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IMPROVING BASIC CADET TRAINING FOR CHANGING ENVIRONMENT
: CASE STUDY AT KOREA AIR FORCE ACADEMY

by

YOOJIN KWON
B.S. Republic of Korea Air Force Academy, 2006
B.A. Hankuk University of Foreign Studies, 2013

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Major Professor: Gene Lee

ABSTRACT

Increasing uncertainty, such as Covid-19 and weather changes, threatens BCT (Basic Cadet Training) at ROKAFA (Republic of Korea Air Force Academy). In preparation for the changing and adverse environment, this study carried out the following steps to propose a system improvement utilizing LVC (Live, Virtual, Constructive) in BCT system at ROKAFA; 1) Researching the examples of BCT and LVC by advanced countries, 2) Analyzing BCT (ROKAFA) through systems approach (document analysis, survey of 140 cadets and officers, written interviews with military experts), 3) Applying LVC to BCT.

BCT is a vital step in the transition from civilian to military status (ROKAFA, 2022), which has significant components such as the environment, its plan, the motivation of trainees, and training instructors. A review of BCT systems of the United States, Japan, the United Kingdom, and Sweden revealed that South Korea and the United States are the most similar. After analyzing BCT through the systems approach, it was identified that BCT has no alternative training despite time constraints (4 weeks). Besides, 87.9% of trainees and instructors experienced changes in BCT plan, and 4.86 (>4: Neutral) agreed with improvement in BCT. There was a significant correlation between negative emotions when changing training plans and the desire to improve BCT; the correlation coefficient (r) is 0.317 (p-value <0.001). Respondents provided positive feedback (> 4: Neutral) on nine of the 14 LVC training cases that would be applied to BCT, with Q25 (formerly Eagle training, not conducted since 2002) being ranked as the most needed training with a score of 4.74. Military experts advised considering the training development needed for Korea Air Force Academy cadets, system development through a long-term plan, and cost-effectiveness when applying LVC to BCT.

The application of LVC in military training is inevitable because it is a proactive alternative training to prepare for the future and guide the way forward, and many advanced countries have already recognized the importance of LVC and are using it for the future military. In addition, LVC enables the accumulation of data to personalize the training data of Korea Air Force cadets even after enrollment. There are limitations of this study that need to be overcome, such as increasing the awareness of LVC among participants, performing Heuristic decision analysis when choosing alternative plans (Blanchard, 2014), and confirming the actual effect of LVC before and after its application.

Keywords: Basic Cadet Training, Changing Environment, Republic of Korea Air Force Academy, LVC (Live, Virtual, Constructive), Systems Approach

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CHAPTER ONE: INTRODUCTION

1.1 Research Motivation

According to the Ministry of the National Defense Republic of Korea (2021), the internal and external security situation of the Republic of Korea (ROK) military has become more complex and severe. The countries surrounding the Korean Peninsula continue to expand their advanced military capabilities, and the scope of the military domain is expanding beyond the existing sea, air, space, and cyber domains. In addition, it is expanding into areas we did not anticipate and increasing uncertainty. For example, Covid-19, terrorism, and catastrophic situations are emerging as threats to national security.

The Republic of Korea Air Force Academy (ROKAFA) aims to nurture not only military experts with broad knowledge and insight but also military leaders with a solid martial spirit to protect their country, according to ROKAFA (2022). To meet this goal, it offers bachelor's degree courses, life education, and military training. Among these courses, Basic Cadet Training (BCT) is the most basic course conducted for four weeks. It cultivates self-restraint through the acquisition of fundamental military spirit and combat skills.

These unexpected circumstances, weather changes, and epidemics also affect BCT at the ROKAFA. (Republic of Korea Air Force Academy, 2019 ~ 2022). It affects not only the planned training schedule and the training itself but also the trainees who are prospective cadets, the upper-class cadets, and the officers who lead training. The motivation for this study starts from the observation that needs to improve BCT when I was a discipline officer at ROKAFA, being in charge of BCT for two years from 2019 to 2020.

1.2 Problem Statement

According to ROKAFA (2022), since the opening of ROKAFA in 1949, the main content of BCT has not changed significantly. Training has been possible to conduct without any significant problems so far, and there has been no problem in the process for civil students to enter ROKAFA. However, as described above, the training environment is changing, and we have faced circumstance that requires improvement of the training system. Although some studies have been conducted on the physical aspects of prospective cadets participating in BCT based on Kim et al. (2014), there is insufficient research on the existing BCT system that can overcome the emerging limitations. Therefore, improving the ability to operate BCT while coping with the restrictions imposed by new and changing surrounding conditions, such as a pandemic, is necessary.

1.3 Research Objective

This study aims to identify the matters that need improvement in the system of BCT at ROKAFA and make suggestions for overcoming them. BCT will be analyzed from the systems approach perspective, and problems will be identified. Additionally, the need for improvement will be placed through the awareness survey of the first-grade cadets who participated in BCT and cadets and training officers in charge of training. Research has been conducted on Live, Virtual, and Constructive (LVC) to improve the identified problems. This research proposes system improvements applicable to BCT at ROKAFA based on LVC cases conducted and applied by the Korean Ministry of National Defense and case studies of other countries.

Ultimately, this study will answer the following question: Can the improvement of BCT system through the application of LVC resolve the problems identified in the system and meet the satisfaction of the prospective cadets, upper-class cadets, and training officers in charge of it?

1.4 Research Contribution

The contribution of this study will lead to an increase in the motivation and satisfaction of those participating in the training, as well as suggest improvements for BCT system at ROKAFA that can handle new training circumstances such as weather and pandemics.

First, this study will conduct the system approach analysis to identify problems in BCT system. The system approach analysis of the training system takes a specific system engineering, and limitations will be determined through objective research of the issues we can overcome or cannot.

In addition, the training system will be supplemented by providing an alternative through applying LVC to BCT that has not been done before. This research will open the possibility of overcoming the discovered limitations and increasing the motivation and satisfaction of training officers, cadets, and trainees.

1.5 Thesis Overview

The thesis consists of 5 chapters, including the introduction of chapter 1, and describes as follows. Chapter 2 explains the theoretical background of each component. The related research is about BCT in other countries, its importance, and its critical element. Also, it defines the definition of LVC, its application in the military field, and examples by countries. In addition, it

emphasizes the need for this study. Chapter 3 demonstrates the research method and recognizes the problems of BCT at ROKAFA through the systems approach. In addition, it conducted a needs assessment for this study via a survey of cadets who participated in BCT, cadets, and instructors who were assigned to BCT. Alternatives were proposed to overcome the identified problems. In the process, focus group interviews (FGI) with experts (military training instructors and officers) were conducted, and the alternatives have been revised based on their advice. Chapter 4 presents the results of this study. It analyzed BCT's plan and performance reports for the past three years. The expected improvement effect was verified through expert review and cadet and instructor survey results analysis. Chapter 5 discusses the conclusion and practical implications of this research. In addition, the limitations of this study and future research are suggested.

CHAPTER TWO: LITERATURE REVIEW

This chapter reviews the related literature on BCT, analysis by country, and its critical components. Second, it explains the origin and development process of LVC, its application in the military field by country, and its pros and cons. Third, it emphasizes why this study is necessary for BCT at ROKAFA.

2.1 Basic Cadet Training (BCT)

The origin of "bas-" of Basic comes from the Greek basis, a step on a stand or pedestal. The meaning of "basic," according to the dictionary (2022), includes not only meaning fundamental basic but also essential.

  All applicants to enlist in the military must undergo basic military training. Therefore, it is the most basic and essential step. (Santtila et al., 2015). BCT is one of the basic military training that applicants who wish to enter the military academy must attend training. According to the selection process of each military academy, those who pass the final step must enter BCT training. The training period varies depending on the military academy, and participating trainees are exposed to intensive physical training as well as adaptation to new knowledge and culture. (AF, 2022).

  Through BCT, the status of high school students or similar civilians will be changed to military soldiers. It has significant meaning for each individual, and those who enter the military academy after completing training enjoy the qualifications and all the rights to live as cadets. At the same

time, they are responsible for following the rules and regulations required by each military academy. (ROKAFA, 2022).

2.1.1 Basic Cadet Training by country

2.1.1.1. BCT at ROKAFA (Republic of Korea Air Force Academy)

ROKAFA (2022) explains that BCT at ROKAFA consists of learning basic combat skills, developing essential physical strength, and learning military discipline. Acquiring basic combat skills consists of close-order drills, shooting, marching, and biological and radiological exercise (CBR-EX), and simultaneously improving physical strength. It can help to develop the knowledge and ability for community life through education such as cadet life regulation education, honor education, and living check. Through mental education, reserved cadets can cultivate the spirit of a soldier. They can realize the meaning of devotion to the country and acquire the most basic knowledge as a soldier through history and security education.

Table 1 BCT at ROKAFA (Republic of Korea Air Force Academy)

Training Overview	
Training Objective	Change of status from civilian to military - Establishing the right values - Establishment of internal and external postures of soldiers - Mastery of basic combat abilities - Early provision of the ability to adapt to cadet life
Training Period	Mid-January ~ Mid-February (4 Weeks) Every year
Training Instructor	Upper-class cadets, Training Officers
Training Plan	
Pre-Adaptation (4 Days)	Adaptation to change as military status - Registration in training, PCR Test, Training introduction - Self-introduction, Organizing supplies, Commander's lecture
Week 1	Establishment of essential military attitude and posture - Military gymnastic / Close-order drill - Learning about BCT guidebook, regulation - Administration required education (Gender issues, security, etc.)
Week 2	Understanding and acquiring military training - Rifle disassembling and assembling, Rifle training - Group running(3km), First Aid education, Emergency training
Week 3	Understanding and acquiring military training (Continued) - Biological and radiological exercise, Gas mask drill, Experience gas - Shooting exercise, Military song education, Group running(4km) - Emergency training, Discussion cadet value
Week 4	Preparing to adapt to life as a cadet - Trek marching training, Group running(5km) - Evaluation of knowledge and physical - Mental education, Practice marching for ceremony, Entrance ceremony

Registration in training / PCR Test	Rifle training
Biological and radiological exercise, Gas mask drill	Group running(5km)

Figure 1 BCT at ROKAFA (Republic of Korea Air Force Academy)

Source: Republic of Korea Air Force Academy. (2022.2). KAFA Basic Cadet Training. https://rokaf.airforce.mil.kr/bmt/index.do
Republic of Korea Air Force Academy. (2022) Republic of Korea Air Force Academy Photobook https://online.fliphtml5.com/nmlnf/erua/#p=1

2.1.1.2. BCT at U.S Air Force Academy

AF (2022) states that BCT at the U.S. Air Force Academy lasts six weeks and consists of two parts. The first part of BCT goes into the administrative procedures and combat skills, and the second covers in-depth combat training and prepares for the entrance ceremony.

Table 2 BCT at U.S Air Force Academy

Training Overview		
Training Objective		Transformation to a new cadet - Change from civilian to military cadet - Preparation for entering the four-year officer program - Readiness to be accepted as a first-year cadet through physical and mental effort
Training Period		Mid-June ~ 1st week of August (6 Weeks) Every year
Training Instructor		Upper-class cadets, Training Officers
Training Plan		
1st BCT	1-2 Days	Proceeding to register - Oath, Supply of essential items (uniforms, etc.)
	3-5 Days	Required Education - Relevant Agency Role Briefing - Physical examination
	6-24 Days	Acquire combat skills - Physical fitness evaluation, Military drill movement - Air Force History and Role Education, Military Culture
2nd BCT	25-34 Days	Field combat training (Jack's Valley Training Courses) - First aid education, Combat skills, Obstacle course, etc.
	35-38 Days	Preparing to adapt to life as a cadet - Trek marching training, Group running(5km) - Evaluation of knowledge and physical - Entrance ceremony

Oath	Jack's Valley Training Courses

Combat skill   Obstacle course
Figure 2 BCT at U.S Air Force Academy

Source: AF (United States Air Force Academy). (2022). Basic Cadet Training
https://www.usafa.edu/military/basic-cadet-training/
https://www.flickr.com/search/?text=BASIC%20CADET%20TRAINING

2.1.1.3. BCT at National Defense Academy of Japan (NDA)

There is no military training before entering the NDA. NDA (2022). Instead, they receive

BCT in their first year after joining the academy. After completing the first year, they are

designated cadets in the Army, Navy, and Air Force based on evaluation and preference.

Table 3 BCT at National Defense Academy of Japan (NDA)

Training Overview	
Education Objective	Training future leaders of Japan's Self-Defense Forces (JSDF) - Program for cadets of the Army, Navy, and Air Force - Develop knowledge, physical and mental aspects - Broaden the horizons of cadets as global leaders
Training Period	Early April ~ Late March (1 year)
Training Instructor	Upper-class cadets, Training Officers
Training Plan	
April - August	Entrance ceremony, Basic physical education, Visit JSDF base Individual combat, Rifle, First aid training (Once a week), Swimming training (Military swimming, 8km) Summer vacation
September - December	Race of Swimming, 1st Semester Exam NDA Anniversary (Pole fight) Training Camp, Winter Vacation
January - March	2nd Semester exam, Cross-country race International cadet conference, Graduation, Spring vacation

| Combat drill | Cross-Country Race |

| Pole Fight | Swimming training |

Figure 3 BCT at National Defense Academy of Japan (NDA)

Source: National Defense Academy of Japan (2022.3) National Defense Academy of Japan pamphlet
National Defense Academy of Japan. (2022). *Military Program. Cadet life.*
https://www.mod.go.jp/nda/english/education/military.html

2.1.1.4. BCT at Royal Air Force College Cranwell (RAFC) in the United Kingdom

There is no BCT for entering RAFC like the NDA. RAF (2022). However, there is IOT

which means Initial Officer Training at RAFC to become an Air Force Officer. It lasts 24 weeks

and is divided into three terms of 8 weeks each. Therefore, IOT can be described as the most

similar to BCT.

Table 4 IOT at Royal Air Force College Cranwell (RAFC) in the United Kingdom

Training Overview	
Education Objective	The first training to become leaders in Royal Air Force - Applicants' steps for challenges and achievements - Completion of the training is a stage that means the beginning, not the end - Courses for those who are physically and mentally ready
Training Period	Throughout the year (24 weeks)
Training Instructor	RAFC staff who have experienced and trained well
Training Plan	
Term 1 (Week 1 – 8)	Change the status from civilian to Service life - Preparation of uniforms, medical checkups, etc. - Education for handling weapons, field craft, and First-aid - Mental and physical challenge, Field Leadership skills
Term 2 (Week 9 – 16)	Practical leadership and studies about - Adventure training, Exercise with advanced tasks and conditions to test one's leadership skills - Academic studies for knowledge of airpower and cyber security - Evaluation for going to Term 3 or not (proper training)
Term 3 (Week 19 – 24)	The transformation from officer cadet to the junior officer - Basic warfare course, Exercise Decisive Edge (High level of Leadership exercise) - Graduation preparation (Parade drill), Sports

2.1.1.5. GU (Grund Utbildning, Basic Education) at the Military Academy Karlberg in Sweden

Sweden has the Military Academy Karlberg (Militärhögskolan Karlberg) instead of a separate army, navy, and air force academy, according to Swedish Armed Forces (2021). After completing GU, which consists of GMU (Grundläggande Militär Utbildning, Basic Military Training) and BU (Befattningsutbildning, Vocational Training), applicants have a choice depending on their preferences. They can become an officer to enter the Military Academy Karlberg, Swedish Defense University, serving as a conscript, a non-commissioned officer, and a civilian service. Therefore, GU can be considered as BCT.

Table 5 GU at the Military Academy Karlberg in Sweden

Training Overview		
Education Objective		The first process to become a member of the Armed forces - Adapt to a new environment and take on new challenges. - Theoretical education and practice are held indoors and outdoors. - Get to know new friends and yourself, and prepare to become a team member through growth.
Training Period		6 -15 months, according to the trainee's specialization
Training Instructor		Training Officers
Training Plan		
GU / Basic Education (6-15 months)	GMU / Military basic training (2-3 months)	Learn about general skills - Daily exercise, Shooting practice (Dark shooting) Practice medical steps, Group shots with a light gun, Group drills, Marching, Weapon maintenance, Inspection, Combat training Theory session - International law, the value of the Armed force
	BU / Occupational training (3-11 months)	Depending on a specific role - Technical systems, How to drive a vehicle, Getting a solution with the group to deal with complicated situations

2.1.1.6. Summary

The analysis of the types of BCT in various countries shows that each country operates BCT according to its military organization and characteristics. Specifically, the Air Force Academy in South Korea and the United States have a similar BCT system. On the other hand, the National Defense Academy of Japan, where students receive BCT after admission and select the military they belong to. Royal Air Force College Cranwell, where they train for more than six months in BCT, and the Swedish armed forces conduct BCT along with education according to their specialties. Although the way to operate BCT in each country is different, recognizing it as a vital step for the transition from civilian to military personnel is the same.

2.1.2 Importance of Basic Cadet Training

Not all trainees participating in BCT will pass the training. The training requires not only intensive physical strength and the acquisition of basic combat skills needed as a soldier but also demands the ability to adapt to community life through group life. (USAF, 2018). BCT requires robust mental health, and some applicants are culled in the middle of training if they do not pass the training or have confirmed that they are not fit for the physical or aptitude. In ROKAFA's case, approximately 10.6% of trainees have failed to pass BCT every year for the past five years. (Republic of Korea Air Force Academy, 2019 ~ 2022). Therefore, BCT is essential for converting to military status and for incoming students to check their aptitude to fit the military academy life.

2.1.3 Critical components in Basic Cadet Training

As Nam (2010) mentions that education and training are carried out to achieve the goals required in each field, and the elements that constitute it are 1) the education and training environment, 2) the contents of the education and training, and 3) the trainees and trainers. Based on this study, it can be explained that BCT consists as follow; First, the education and training environment includes training sites, lodging for trainees, meals, and tools necessary for training, and even encompass weather or infectious diseases. Second, it will be a well-organized BCT plan to meet the objective, and it will also be a vital part of proceeding as planned without any problems. The third is the prospective cadets who will undergo BCT and the training instructors and training cadets in charge of education. Prospective cadets who participate in education and training should be mentally and physically prepared to engage in BCT positively. They should be motivated to overcome them despite exposure to various stressful situations. Moreover, it is also critical for the training instructors who will lead the training to be motivated based on the knowledge and responsibility required for BCT.

In a word, the critical factors in BCT are the environment with a smooth training process, a well-organized plan, and motivated trainees and instructors to achieve the BCT goal.

2.2 LVC (Live, Virtual and Constructive)

The military needs continuous training to preserve and strengthen combat power. However, the training environment is becoming more demanding due to civil complaints around military bases and the cost of developing training sites or equipment. The Live, Virtual, and Constructive (LVC) training system is an alternative to overcome these difficulties. (Kim et al.,

2010) This chapter describes the definition and origin of LVC, application cases by country, and strengths and weaknesses.

2.2.1 Definition and origin of LVC

LVC refers to creating a similar simulated environment in place of an actual battlefield or operational environment and obtaining an effect close to the real operation through virtual simulation. It operates a concept of performing training by actual training using equipment, virtual simulators, and constructive models such as war games. (Ko et al., 2009) It is a representative example of an M&S (Modeling & Simulation) that enables training from soldiers to commanders who must make informed decisions on the battlefield. (Kim et al., 2010) The classification of LVC is based on the simulation of the components: environment, force, and equipment. Specifically, L refers to a system in which real forces attach sensors to their equipment and can train in a real environment. V is the one in which real forces use virtual equipment in a virtual environment, and C system is that virtual troops support training with virtual equipment in a virtual environment. (Choi, 2022) It is a snapshot of LVC, including detailed examples demonstrated in the table below. (Lee, 2021; Hannay et al., 2014)

Table 6 Snapshot of LVC

Index	Forces	Equipment	Environment
Live	Real	Real	Real
	NTC (National Training Center), KCTC (Korea Combat Training Center), MILES (Multiple Integrated Laser Engagement System)		
Virtual	Real	Simulated	Simulated
	Aircraft Simulator, Joint firepower simulator, Airlift dropping simulator The anti-submarine tactical training simulator		
Constructive	Simulated	Simulated	Simulated
	BCTP (Battle Command Training Program)		

Figure 4 Examples of LVC

Source: Lee, K. (2021). A Framework for Verification and Validation of Multi-Resolution Modeling Federation using Live, Virtual, and Constructive Simulations (Publication No. CFE0008693;DP0025424) [Doctoral dissertation, University of Central Florida]. UCF STARS.

As H. Lee (2020) mentions, the origin of the LVC can be traced back to the Second World War. As for Live, Weiss (1966) found that the pilot's shooting down rate in the first battle was 40% based on analyzing the air battle of World War II and the Korean War. However, if pilots participated in combat more than ten times, the probability of being shot down is reduced to 5%. It made the U.S. military aware of the need for hands-on training, so the U.S. Navy created the Top Gun Pilot School, and the U.S. Air Force did Red Flag Training. They dramatically improved the shooting down rate. (H. Lee, 2020)

The U.S. Army had failed in the first battles of all wars of the 20th century, including the Vietnam War, and realized that it could not win wars like it did in the past. (Park, 2015) Concerned about the rapid evolution of modern warfare with sophisticated weapons and high tempo, the first Deputy Chief of Staff for Training (DCST), General Paul F. Gorman, began to modernize training by creating the Army Training and Doctrine Command (TRADOC) and developing an Analysis-Development-Implementation-Evaluation (ADDIE) model. Based on the previously described case in which the shooting down rate of the U.S. Air Force and Navy decreased, he recognized the need for Tactical Engagement Simulation in a similar environment. He developed MILES (Multiple Integrated Laser Engagement System) training systems using a laser developed by the U.S. Navy. Additionally, he established the National Training Center (NTC) to enable brigade-level unit training by combining this equipment with a training control system. (H. Lee, 2020)

Figure 5 Link Trainer (1st Flight simulation) at the University of Central Florida

H. Lee (2020) explains that the origin of V is a paper by Air Force Captain Jack Thorpe of the Defense Advanced Research Projects Agency (DARPA). In a 1987 paper, he presented the concept of a Virtual Environment Distributed Simulation Network and succeeded in the SIMNET project with a startup. It helped the U.S. Army win the Gulf War because of pre-experience of the Middle East terrain through training at SIMNET before sending troops. (Park, 2015) Since then, the U.S. military has built a simulator system, including the first pilot training simulator, Link Trainer, and the NASA space station training system, the Virtual Visual Environment Display (VIVED). (H. Lee, 2020)

With the success of the NTC and SIMNET, the U.S. military recognized the importance of unit training above the division level at the same time. (Park, 2015) Computer Aided Exercise (CAX) emerged as an alternative to the practical problem of all units participating in training simultaneously, and BCTP (Battle Command Training Program) was initiated using the Joint Training Simulation System (JESS), which is a wargame Model. It is where C came from. (H. Lee, 2020)

2.2.2 Development of LVC

The U.S. military recognized the importance of scientific training and systematically developed it since they won the Gulf War based on NTC, SIMNET, and BCTP. (H. Lee, 2020) The development process of the scientific training system is shown in the figure below.

Concept	Year	Foundation	System / Architecture
TES (Tactical Engagement Simulation)	1980s ~ 1991	NTC	
		SIMNET	
		BCTP	CBS (Corps Battle Simulation)
LVC (Live simulation Virtual simulation Constructive simulation) ＋ **STOW** (Synthetic Training Environment)	1992 / DSB (Defense Science Board)	JRTC (Joint Readiness Training Center) JMRC (Joint Multinational Readiness Center, Previous CTMC)	HITS (Home-station Instrumented Training System) I-MILES (Improved MILES)
			CCTT (Close Combat Tactical Trainer) AVCATT (Aviation Combined Arms Tactical Trainer)
			WARSIM (Warfighter Simulation) OneSAF (One Semi-Automated Forces)

The advent of **G (Game)**	The late 1990s	Marine Doom
LVCG PC & HMD (Helmet Mounted Display	2000s	America's Army, DARWA Ambush, Operation Flashpoint, Steel Beast VBS2(virtual battlespace)
LVCG ✚ **LVC-ITE** (LVC-Integrated Training Environment)	The late 2000s ~ 2010s	DIS (Distributed Interactive Simulation) ALSP (Aggregated Level Simulation Protocol) CTIA (Common Training Instrumentation Architecture), HLA (High Level Architecture) RTI (Run-Time Infrastructure) LVC-IA (LVC-Integrating Architecture)

LVCG ➕		TSS (Training Simulation Software)
STE (Synthetic Training Environment) **OWT** (One World Terrain)	The late 2010s ~ Current	TMT (Training Management Tool) DTMS (Digital Training Management System
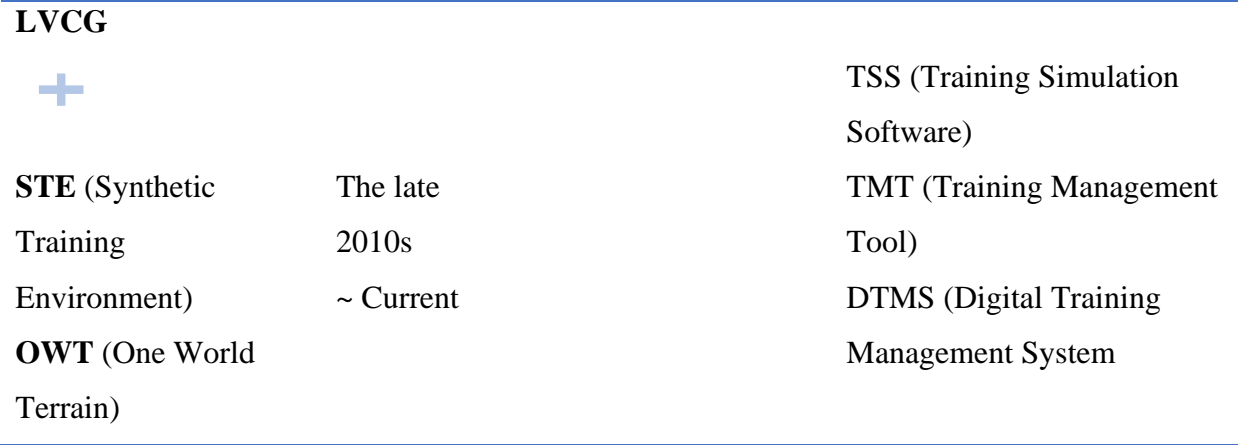
Figure 6 Development process of LVC

Many advanced countries are rapidly transitioning to STE (Synthetic Training Environment) by integrating three-dimensional virtual environments based on LVCG. They promote innovation in education and training with big data and artificial intelligence by creating a low-cost, high-efficiency scientific training environment and secure training data. (Park, 2015) For example, the U.S. Marine Corps converted a concept MCSTE (Marine Cops Synthetic Training Environment) in 2019. The British Army's goal is to achieve SOE (synthetic operating environment), an open architecture based on shared data, topography, and criteria, by 2025 through the development of FCTS (Future Collective Training System) as part of CTTP (Collective Training Transformation Program). In addition, the Australian Army will attain Simulation Core Capability by 2025, and the Canadian Defense Force plans to secure FITE (Future Integrated Training Environment) by 2025. Choi (2022) and H. Lee (2020) suggest an integrated virtual training environment platform based on the metaverse in the Republic of Korea. Countries are focusing on developing STE not only to replace LVC-ITE and find better training methods than in the past, but to fundamentally innovate education and training by

applying advanced science and technology with the emergence of the Fourth Industrial

Revolution. (Choi, 2022)

2.2.3 Application of LVC by country

The US military verified the effectiveness of LVC training system in actual battlefields

such as the Gulf War and the Iraq War. Since then, the US military and advanced countries have

recognized its importance and continue to develop it in various fields. (Kim, 2019) In this

chapter, examples of LVC that can be applied to the BCT at the Korea Air Force Academy are

explained from various cases in the Republic of Korea, the United States, and other developed

countries.

2.2.3.1 LVC in the Republic of Korea

A representative example of the LVC training system in the ROK military is the Korea

Combat Training Center (KCTC), where the 'Brigade-level Bilateral Training' can be conducted

to train as if they are engaged in actual battle. (Ko et al., 2009) It is said that there are only three

countries that can conduct such large-scale brigade-level combat training: the United States,

Israel, and the Republic of Korea. (KCTC, 2022) Also, Korea Military Academy opens Scientific

Tactical Training Center for small units training on 28th April 2022. (The Republic of Korea

Policy Briefing, 2022) Examples of LVC that can be applied to BCT at the Air Force Academy,

among various application cases, are shown in the table below. (Innosimulation, 2023; ROK

Army Headquarters, 2023; OPTIMUS SYSTEM, 2023; An, 2020; Yeom, 2017: Kim, 2018;

Mun, 2011)

Table 7 LVC in the ROK military

ROK Army / KCTC (Korea Combat Training Center)		
L	MILES (Multiple Integrated Laser Engagement System)	·Real-time training information is managed in the control center through the laser launcher mounted on the rifle and the sensor worn by the trainee ·Increase training completeness through analysis of command action results, tactical action results, etc ·Maximize tactical command ability and acquire a practical sense ·Wireless and lightweight
Korea Military Academy / Scientific Tactical Training Center		
V	TAD (Tactical Assault-shooting Drill-simulator)	·Immersive virtual tactical shooting training from HMD-based first-person perspective. ·Network-based squad tactical and combat shooting training ·Practical, tactical training functions in various operational environments ·The repetitive and effective training environment
	MARS (Medium-range Assault Rifles-shooting Simulator)	·Precision shooting training environment in which real and virtual space are synchronized ·Provides a variety of shooting training environments ·Provide network-based shooting training function
C	ARCPX (Augmented Reality Command Post Exercise)	·Command and control training system ·Operational training using AR/VR technology
ROK Airforce		
V	Rifle shooting training	·Shooting training for individual soldiers
	Military police Education	·Military police education for crime prevention
Other Researches		
V	Training Environment for the chemical incident	· A Development of Education and Training Contents for Chemical Incident Response Based on Virtual Reality

MILES

MILES Training

TAD

TAD System

MARS

MARS System

ARCPX	Training Environment for chemical incident
Rifle shooting training	Military police Education

Figure 7 LVC in the ROK military

Source: Innosimulation. (2023). *Training Simulator: MILES System.* Innosimulation. https://innosim.com/en/training-simulator/product/defense/land/miles-system/
ROK Army Headquarters. (2023). *ROK Army policy: Scientific education and training*. The center force for National Defense. https://www.army.mil.kr/webapp/mbshome/mbs/newmobile/subview.do?id=newmobile_030500000000
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2.2.3.2. LVC in the United States

The US Army established CTC (Combat Training Center) based on lessons learned from the Vietnam War. It consists of BCTP (Battle Command Training Program), responsible for Constructive simulation and Live training centers, including JRTC (Joint Readiness Training Center) in Louisiana. In addition, it has CMTC (Combat Maneuver Training Center) in Maryland and NTC (National Training Center) in California. (Kim, 2019). The table and figure below show examples of LVC applications used in each education and training field. (U.S Army, 2023; PEO STRI, 2023; ETC, 2023; Military.com Network, 2023; VirTra, 2023; Dongascience, 2021; TSIS, 2020; Seol, 2020; An, 2020; Yeom, 2017)

Table 8 LVC in the United States Military

US Army / CTC (Combat Training Center)		
L	I-MILES (Instrumentable-Multiple Integrated Laser Engagement System)	·Improve combatant readiness for combat operations ·Evaluate individual and collective missions during forced operations ·Uses eye-safe lasers to replicate the intended "line-of-sight" weapon system's engagement effect ·Provide real-time effects and integrate into training equipment systems to provide high-fidelity mixed arms combat training ·System interdependency: Replace "Basic" MILES that cannot be integrated into training instrumentation systems
	STE (Synthetic Training Environment)	·Bring together the live, virtual, constructive, and gaming training environments ·Fight in this environment and succeed on the modern battlefield with realistic training devices. ·Bringing the transparent battlefield to life at the National Training Center

V	DSTS (Dismounted Soldier Training System)	·The collective combat training program ·Soldiers wearing equipment acts as if it were an actual situation in a battlefield environment, such as shooting or shooting- posture, going up and down stairs, and creeping. ·Possible training in a narrow environment like actual combat (1 ㎡ for individuals, 16 ㎡ for squads) ·Prerequisite: Possession of an advanced combat helmet (ACH) and training in system operation before training.
	Nett Warrior & Enhanced Night Vision Goggle-Binocular (ENVG-B)	·Enhances situational awareness of the battlefield ·Commanders make fast and accurate decisions in tactical engagements to use varied information on a battlefield ·By integrating Nett Warrior with the ITN radios, the commander can judge the combat situation immediately while looking at the smartphone. ·Commercial smartphones provide soldiers with greater situational awareness to achieve a consolidated air, ground, and fire operation
C	JLCCTC (Joint Land Component Constructive Training Capability)	·The foundational constructive simulation toolkit for Army Warfighter Exercises, the active, reserve component, and National Guard units ·Army's Training Support System by providing the proper levels of modeling and simulation resolution and fidelity ·Adjust standard operating procedures for the effective operation of a tactical operations center ·Supported the Key Resolve 18 Exercise at the Korea Battle Simulation Center (KBSC)
U.S. Airforce		
V	V-300® firearms training	·The world's first 300-degree reality-based situational training environment ·Intense and immersive environment considers every detail, from the minor pre-attack indicators to the most cognitive one ·Designed to teach, test, and sustain trainees' and officers' knowledge and skills based on the use of force and decision-making training

Equipment / Game		
V	Bulletproof Helmet with HoloLens 2	·Bulletproof helmet equipped with goggles 'HoloLens 2' 360-degree camera and infrared sensor ·Display is attached to the glasses to provide various information ·Directly access visible information through hand gestures and obtain and share information necessary for combat
	'America Army' Game	·Online first-person shooter game to promote military recruitment and provide an experience like actual military operations
Other Researches		
V	ADMS (Advanced Disaster Management Simulator)	·Emergency disaster management training VR training simulator developed by ETC Simulation ·Command and supervision training of commanders ·Emergency Response Command Academy(ERCA), New Taipei City Fire Department, Taiwan.
C	CALL (Center for Army Lessons Learned)	·A lesson analysis center to provide information to the military by analyzing various training data, including NTC and data from major battlefields ·To deliver appropriate information to align resources based on forward-thinking ·Fostering readiness of the fielded force by informing the future force and modernization

I-MILES   Synthetic Training Environment

DSTS

Nett Warrior

JLCCTC

V-300® firearms training

Bulletproof Helmet with HoloLens 2

America's Army

ADMS

CALL

Figure 8 LVC in the United States Military

Source: PEO STRI. (2023). *Weapon System: PM ST: I-MILES IWS 2*. PEO STRI.
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2.2.3.3 LVC in other countries

Other than the United States, foreign militaries have used LVC much longer than the

ROK military. It is widely utilized in weapons system applications, personal warfare, training,

education, and recruitment. (Yeom, 2017) LVC application examples are investigated, focusing

on countries that have compared BCT in the previous chapter. The Japan Self-Defense Forces

operate the Scientific Combat Training Center called CATC (Combined Arms Training Center).

(Park et al., 2021). The British Army is planning the most critical change in 20 years, called the

Future Soldiers, preparing a modern British Army for the future, not the past. (The British Army,

2023) Three military administrations are carrying out innovative research for the application of

LVC in the Swedish armed forces: FOI - Swedish Defense Research Agency, FMV - Swedish

Defense Materials Administration, SNDC - Swedish National Defense College. (Lele, 2013)

Details are shown in the table below. (The British Army, 2023; U.S. Marines, 2023; NDIA, 2022; Business INSIDER, 2017; U.S. Indo-Pacific Command, 2017; Lele, 2013; Borgvall & Lif, 1994)

Table 9 LVC in other countries

Japan Self-Defense Forces		
L	CATC (Combined Arms Training Center) Camp	·Located at the highest mountain, Fuji ·Provide the premier training facility, support operational plans, and strengthen relationships with Marine Air-Ground Task Force (MAGTF) level training requirements, a command element, ground combat element, aviation combat element, and logistics element. ·34,000 acres of training area to enhance their combat readiness ·Maneuver with cover and concealment and enables high-quality infantry training ·Conduct individual, squad-level training, and much larger scale
British Armed Forces		
L	Immersive Training System	·The British Army's Future Collective Training System is part of the service's long-term campaign to modernize out-of-date training with live, virtual, and constructive systems called the Collective Training Transformation Program. ·A simulator can accommodate 50,000 soldiers at the same time in London ·Provide Dynamic Synthetic Environment that will allow participants to train for army tasks together from different disciplines, using different platforms and equipment
V	Force Mental Health Team	·Help the promotion of mental health & well-being as well as provide a healthcare ·Simulation allows soldiers to maintain physical, cognitive, and social health even though they cannot join on the actual battlefield.

	Recruitment tool	·VR recruitment tool helps a 66% increase in recruitment applications ·Includes four scenarios: tank driving at Salisbury Plain, parachuting at RAF Brize Norton, mountaineering at Crib Goch in Wales, and combat training at Salisbury Plain ·Tested on the Samsung Gear VR headset
	Swedish Armed Forces	
V	CoMap (Cognitive Map)	·Give the commander information to make a cognitive decision ·CoMap has three different parts: 2D, 3D maps, 3D model of an urban area in Norrköping. ·Function to get information about specific objects or to change the field of vision to that specific place by clicking ·View from different angles, such as flying around and seeing everything from above or walking around on ground level. · Overlay function to show certain symbols and/or dispositions
	3D Modeling of Areas of Operations	·Specific environment models of the area of operations are critical for mission planning, execution, and after-action review ·Updated and detailed environment information for complex and rapidly changing area ·Produce specific 3D models of areas and distribute them rapidly

|CATC Camp|Immersive Training System|

CoMap (Cognitive Map)　　　　　3D Modeling of Areas of Operations

Figure 9 LVC in other countries

Source: U.S. Marines. (2023). *Coordinate for action.* The Official Website of the United States Marines Corps. https://www.marines.mil/Photos/igphoto/2002954866/igsearch/CATC/

NDIA (National Defense). (2022, June 6). *Immersive Training System Accommodates 50,000 Players.* NDIA's Business & Technology Magazine. https://www.nationaldefensemagazine.org/articles/2022/6/6/immersive-training-system-accommodates-50000-players

Borgvall, J. & Lif, P. (2005, November). *Swedish Projects. Figure 2&4.* Swedish Defense Research Agency.

2.2.4 Strengths and Weaknesses of LVC

The U.S. military has implemented the LVC training system since the 1980s as a lesson from the last wars' failure. It is continuing to develop the scientific training system centered on STE. (H. Lee, 2020) Also, many countries are recognizing the importance of the LVC and

researching and setting it in various fields. This chapter describes the merits and demerits of LVC. (Choi, 2022; Won et al., 2021; Wee, 2010; Ko et al, 2009)

Table 10 Strengths and Weaknesses of LVC

Strengths	
Live	·Workable training for junior commanders and individual combatants ·Practice on a similar battlefield ·Advancement of small unit combat skill ·Overcoming restrictions such as the production of the training environment and outside training sites ·The applicable method as auxiliary training way with traditional training
Virtual	·Competence and repeated training for operators to master the equipment ·Indirect experience of operations in areas where access is difficult or dangerous ·Prepare for actual battle as an experience of areas which is similar to battlefields ·Save training costs and time
Constructive	·Less expense compared to Live and Virtual simulation ·Practice making decisions for commanders and staff while training combat procedure ·Indirect experience of war crises and scenarios ·Large-scale unit training ·Save training costs and time
Weaknesses	
Live	·Restricted training of large units due to - Civil complaints about noise and danger around the training sites - Lack of training sites and insufficient size - High-priced to construct the training ground ·Lack of opportunities for participants

	·Inappropriate for development and utilization as it is specialized for individual training purposes ·Not providing various training contents, such as situations for advanced and adjacent units ·Restricted training in connection with upper and lower units ·Inconvenience that can be used only with a specific installed space and equipment ·Limitations that many people cannot train at the same time or access and use at any time ·Inability to provide commanders of large units with a variety of battlefield situations at a glance ·High-priced to construct the training sites ·Excessive human resources required to operate the training sites
Virtual	·High-priced to construct the simulation ·Limited tactical training interoperability ·Possibility to occur virtual reality sickness ·Insufficient training effect compared to actual training
Constructive	·Lack of practicality due to the absence of combat friction elements ·Absence of details in battlefields reality

The LVC has been built to achieve their respective training objectives, but they have their pros and cons. Advanced countries are conducting research and development to establish a training system that interlocks each individually operated system To maximize the strengths and overcome the weaknesses of the LVC. (Won et al., 2021) The specific method is to integrate Live-Virtual-Constructive simulation. It is not an integration of Live-Virtual-Constructive Simulation in a superficial sense but to implement education and training more efficiently by using each simulation's strengths and supplementing the weaknesses. (Ko et al., 2009) By linking the three forms of simulation, Live-Virtual-Constructive, they are attempting a conversion to

conduct training under a more scientific and realistic synthetic battlefield environment. (Kim et al., 2010).

(Kwon et al., 2022) analyzed the patent trends of core technologies that have a decisive influence on meeting the goals of the system project among various technologies for establishing the LVC interlocking training system. It conducted a patent analysis of major applicant countries for core technologies from 1990 to 2021, and significant applicant countries have 192 LVC-integrated architectures.

Although LVC has many disadvantages, many countries try to make up for these disadvantages and take advantage of the benefits of integrating LVC. It should be recognized that the direction of education and training is evolving around LVC, and this is an inevitable reality.

2.3 The necessity of this study

Considering the contents of BCT studied in previous chapter 2, it is possible to recognize its importance. In addition, as a result of reviewing the birth of LVC to the present and application cases by country, it is confirmed that each country preparing for the future military accurately recognizes the importance of LVC and develops it. However, research on applying LVC to the BCT of ROKAFA has not been conducted yet, and studies and efforts are needed to overcome the limitations in preparing for the future military. Therefore, this study aims to analyze the problems of BCT at ROKAFA and make suggestions for improvement.

CHAPTER THREE: METHODOLOGY

This study conducted a systems approach to problem-solving and system maintenance. (John & Herman, 2012). This chapter suggests the systems approach and how to analyze the BCT at ROKAFA by applying it. The research design for this study is described in two parts: Part 1 explains the systems approach. Part 2 develops a framework for how to apply to the BCT at ROKAFA for analysis and proposes a system improvement.

3.1 Systems Approach

John and Herman (2012) describe system thinking as resolving complicated situations. It provides the ability to discern order and structure in confusing and chaotic situations. Systems thinking involves a systems approach to conceptualize tangible objects, solve problems, and focus on the big picture to gain the system's objective. The systems approach has the main components described below.

Table 11 The components of the systems approach

The Systems Approach	
The goal and standard of the performance	·What happens while achieving the objective of the system ·What the parts of a system operate by interacting with each other ·Accurate and detailed requirements
The circumstance and obstacles	·Where the system lives, with influences from outside the system ·What manager cannot control ·Include not related environment with the system ·What prevents the system from achieving its goals
The sources	·What the system uses to achieve its purpose
The constituent / the feature / take measurements of the function	·What makes up the system and also can be classified as a subsystem ·The traits of a component or subsystem need to be monitored continuously to manage system performance
The interactivity among the constituent	·Each component works, influencing each other to achieve the goal ·The elements of the system are organized in a hierarchical order
The management	·Understand the workings of the internal components of the system ·Understand how the system interacts with the environment ·Each step of the system evolves through feedback ·Alternative for situations beyond the control of the system using models

3.2 Applying the systems approach to BCT of KAFA

As applying the systems approach to the BCT at ROKAFA, six vital components will be analyzed; 1) the goal and standard of the performance, 2) the circumstance and obstacles, 3) the sources, 4) the constituent, feature and take measurements of function, 5) the interactivity among

the constituent, and 6) the management. Based on the analyzed contents, a research frame will be developed. During this process, the structure includes analysis of the BCT results documents of the past three years received from ROKAFA, surveys, and written interviews with experts.

3.2.1 The goal and standard of the performance

According to the Republic of Korea Air Force Academy (2022), prospective cadets will be changed their status from high school students or similar civilians to cadets as soldiers through BCT. The first goal of BCT is to establish the correct values in them. These values include the nation's vision and the concept of security. The second goal is to enable them to establish a soldier's internal and external posture and acquire basic combat skills. Last but the least, it is to equip them with the ability to adapt to life in the military academy at the early stage.

Only prospective cadets who have successfully passed BCT can enter ROKAFA as cadets. The criteria are as follows; If prospective cadets who meet the following conditions are subject to deliberation, admission is decided through it. (Republic of Korea Air Force Academy, 2022)

1) Those who did not attend more than 21% of training hours

2) Individuals who failed as a result of various re-evaluations

3) Those who did not conduct the evaluation

4) physical incompetence

5) Maladjustment to the military

6) The personality that does not go well with military

3.2.2 The circumstance and obstacles

The system exists in and is affected by the environment, which the manager cannot control. Also, the environment includes not only system-related things but also system-independent things. (John and Herman, 2012) Therefore, the environment directly related to BCT is as follows:

1) The location of ROKAFA and the weather accordingly

2) Infectious diseases and pandemics: Epidemic conjunctivitis, Covid-19 (massive impact on BCT in the last three years)

Additionally, the environment not directly related to BCT is 3) changes in the international situation and war patterns around the Korean Peninsula.

BCT training requires prospective cadets and military instructors to achieve a set goal within the time allocated. There are various limitations according to this as follows.

1) A fixed period (four weeks)

2) Available budget

3) Assigned human resources

3.2.3 The sources

John and Herman (2012) suggest that systems are also described as either natural or human-made. BCT is an example of a human-made organization that is supposed to be conducted by humans. Within the system, resources are available to the human responsible for the operation, which must be used to achieve the system's purpose. As for BCT, it has available assets conducted in ROKAFA; it is as follows.

1) Training field

2) Training equipment

3) Medical facilities

4) Support facilities: cafeteria, military quarters, etc.
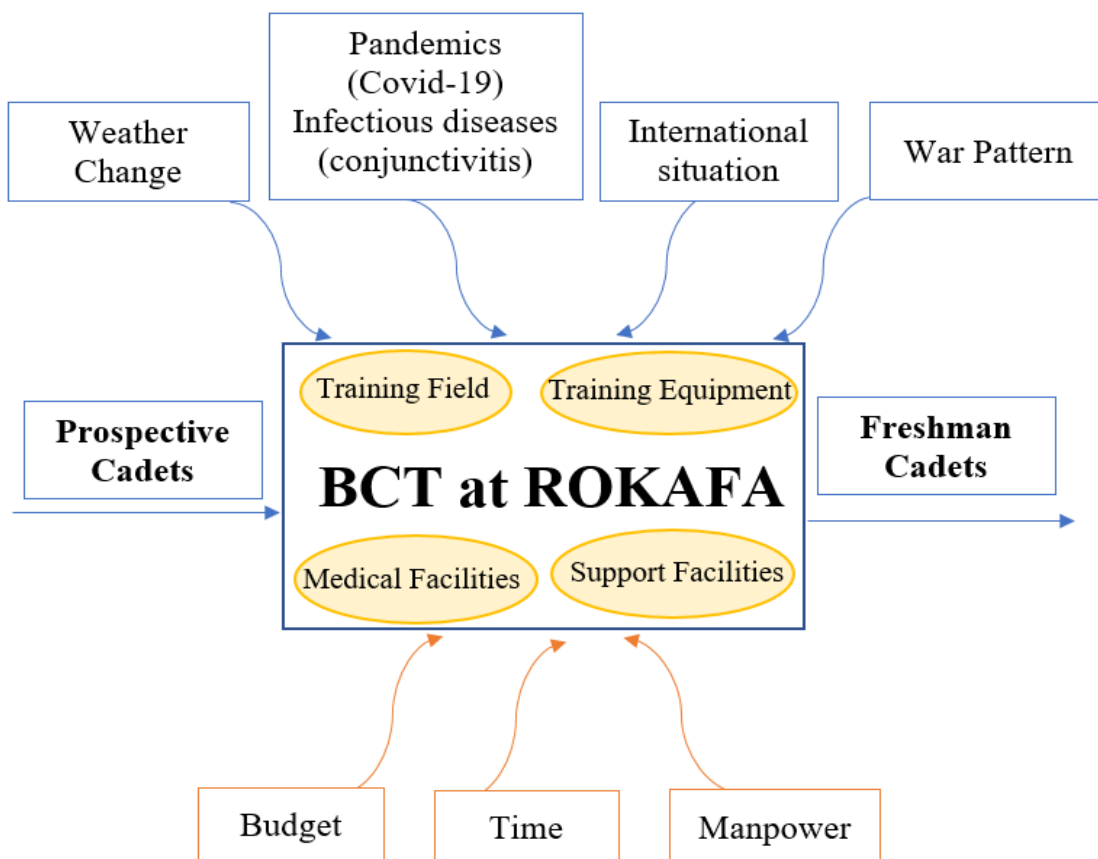
Figure 10 Description of components 1 to 3 of BCT

3.2.4 The constituent/feature /take the measurements of function

A system is a combination of subsystems as functional units and consists of elements that are the smallest unit. (John and Herman, 2012) Although BCT comprises several subsystems, the

operational subsystem will be analyzed in this study. It consists of core components; BCT plan, trainees, and training instructors.

1) BCT plan: Planning BCT starts about three months in advance. Since BCT is one of the primary training of ROKAFA, each subsystem (operation, management, support subsystem, etc.) checks even the most minor components to achieve the purpose of BCT through their respective functions in the planning stage.

2) Trainees (Prospective cadets): Prospective cadets will be notified of various preparations before training. They must prepare physical strength, mental strength, and mind to pass the training successfully. Especially over the last three years, they had to be careful not to get Covid-19 and had to submit the negative results of the Covid-19 test before entering the training. ROKAFA and trainees share information and communicate through the BCT webpage.

3) Training Instructors (Senior cadets and military training officers): Military training officers and senior cadets in charge of BCT prepare prospective cadets to complete the training successfully. They inspect training grounds, and training routes are selected in advance, and check if there are risk factors in advance so that training can be conducted while safety is guaranteed. As much as the trainees undergoing training, they also need physical strength and have been particularly careful not to catch COVID-19 over the past three years. Even if someone gets COVID-19 within BCT, the training should be continued, so they must prepare quarantine facilities for COVID-19 patients and countermeasures to prevent the virus from spreading.

3.2.5 The interactivity among the elements

The components within a system are interrelated and influence each other. They play their role and work together effectively to achieve the system's mission. (Blanchard, 2014). Thus, a system is not a simple sum of components but an extensive combination. (John and Herman, 2012)

The parts of the BCT operation subsystem function are interrelated to achieve the goal of completing training and enrolling prospective cadets at ROKAFA. According to a well-organized BCT plan, drill instructors teach trainees. For training conducted according to the plan, both the instructors and the trainees can prepare in advance and engage in training with motivation and confidence.

3.2.6 The management

Managing each subsystem function and ensuring the components interact is essential to achieving the system's objective. Consequently, the system manager accurately identifies and addresses the risk, environment, constraints, and resources for planning and control. (John and Herman, 2012)

1) In this process, if the environment and constraints are uncontrollable and affecting the system plan, alternatives must also be planned for the system. (Blanchard, 2014) In addition, the system must continuously develop and evolve. 2) For this purpose, it is one of the critical functions of management to identify problems and improve and develop by utilizing the feedback function within the system. (John and Herman, 2012)

To manage BCT at ROKAFA, an alternative to BCT training plan should be provided to prepare for an environment beyond our control, such as Covid-19 or weather changes. In addition, the system should be continuously developed by improving the system through the feedback function of the main components of the system: trainees and training instructors. This study conducted a survey targeting the vital components to operate this function. Furthermore, interviews were conducted to obtain advice and ideas from military training experts. These features will help develop correlations with other features through the data they provide. Thus, the survey and interview data can play a role not only in the meaning itself but also in the interconnection and development of the system. Ultimately, this will also affect the satisfaction of critical elements. The questionnaire and interview designs are as follows.

Table 12 The survey and interview design

The survey design	
Participants	·Trainees: ROKAFA cadet 74th (Freshman) ·Training instructors: ROKAFA Military training officers, ROKAFA cadet 71st (Senior)
Questions	· The questionnaire was reconstructed from a previously verified study to secure the validity of the test tool in the research. (Eu-Jin Nam, 2010) · Two Ph.D. students from the University of Central Florida advised on the reconstruction of the questionnaire. · A professor from the University of Central Florida reviewed the questionnaire. · Twenty-seven main questions and three sub-questions (APPENDIX A: SURVEY AND INTERVIEW FOR IMPROVING THE BASIC CADET TRAINING FOR CHANGING ENVIRONMENT) ·The questionnaires: How they felt when the training schedule unexpectedly changed, what they thought of the ideas for applying LVCG to BCT

Method	·Online: Google survey ·Dates: From 20th to 28th of February 2023 ·Participants decide the place and time of the survey ·Participants decide to take the survey voluntarily
Data	·Demographic information: Age, Gender, Current rank, Period of military service ·No collection of any identifiable data, such as names or IP addresses ·Survey responses will be strictly confidential ·Only used for this study ·Only used in the aggregate
Analysis	·Likert Scale: Scale 1 to 7 according to the questions ·Microsoft Excel and SPSS Statistical software
The interview design	
Participants	·Military training experts: Six Airforce officers ·Experience training instructor in BCT ·Experience related to military training
Questions	· Nine questions (APPENDIX A: SURVEY AND INTERVIEW FOR IMPROVING THE BASIC CADET TRAINING FOR CHANGING ENVIRONMENT) ·The questionnaires: Advice on the suggestion to apply LVCG to BCT
Method	·Online: Google survey ·Dates: From 20th to 28th of February 2023 ·Participants decide the place and time of the survey
Data	·Demographic information: Age, Gender, Current rank, Period of military service, Service period related to military training ·No collection of any identifiable data, such as names or IP addresses ·Survey responses will be strictly confidential ·Only used for this study

Table 13 Group of Experts

Information about the expert group (Republic of Korea Airforce Officers)	
Expert A	·Rank / Gender: Lieutenant Colonel (S) / Male ·Experience BCT instructor ·Branch of the military service: Fighter pilot ·Related to Military training: F-16 Instructor Pilot (5 ~ 10 years)
Expert B	·Rank / Gender: Lieutenant Colonel (S) / Female ·Experience BCT instructor ·Branch of the military service: HR management in education ·Related to Military training: Military drill instructor (5 ~ 10 years) ·Master's degree major in Leadership
Expert C	·Rank / Gender: Lieutenant Colonel (S) / Male ·Experience BCT instructor ·Branch of the military service: Air Defense Artillery (ADA) ·Related to Military training: Military instructor (5 ~ 10 years) ·Master's degree major in MBA (Master of Business Administration)
Expert D	·Rank / Gender: Major / Male ·Experience BCT instructor ·Branch of the military service: HR management in education ·Related to Military training: Military drill instructor (1 ~ 5 years) ·Ph.D. in Business Administration, Human Resources
Expert E	·Rank / Gender: Major / Male ·Experience BCT instructor ·Branch of the military service: Information and Communications ·Related to Military training: Military instructor (5 ~ 10 years) ·Master's degree major in Satellite and Application Systems Engineering
Expert F	·Rank / Gender: Major / Female ·Experience BCT instructor ·Branch of the military service: Fighter pilot ·Related to Military training: F-16 Instructor Pilot (5 ~ 10 years)
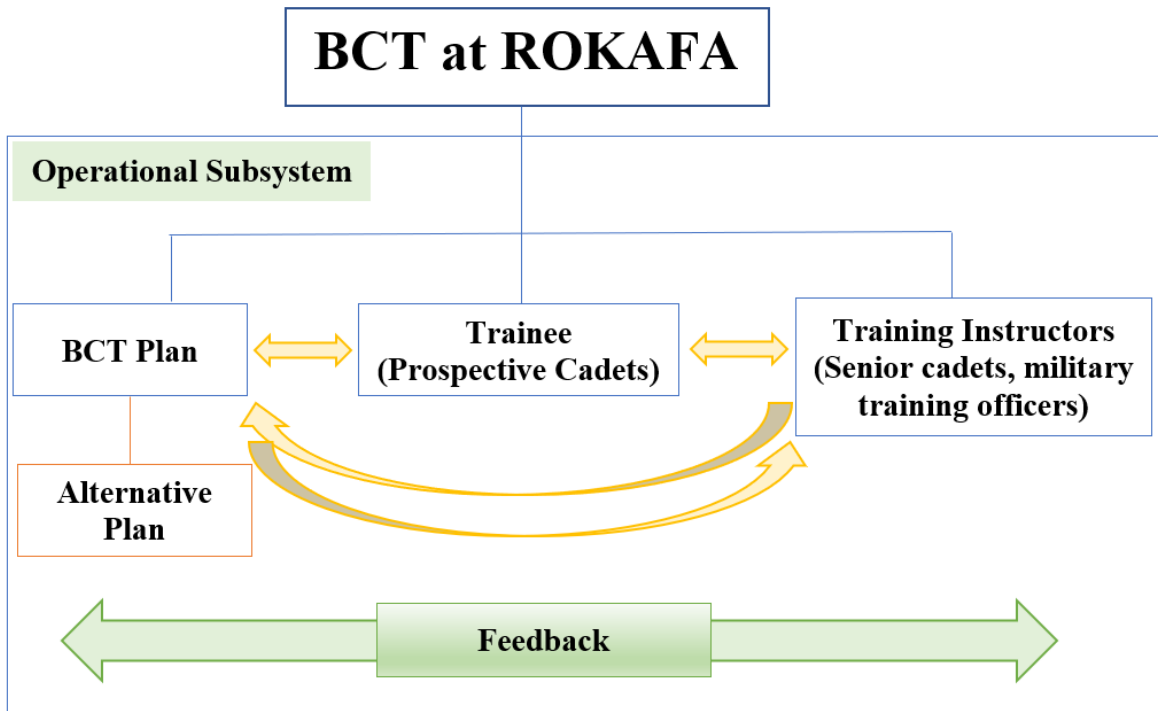
Figure 11 Description of components 4 to 6 of BCT

3.3 Snapshot of the Research Framework

The research design that applied the systems approach to BCT was described through figures and explanations in the previous chapter. The research framework is described in one picture as follows for better understanding.

```
┌─────────────────────────────────────────────────────────────┐
│        BCT at ROKAFA analysis through systems approach        │
└─────────────────────────────────────────────────────────────┘
                              ▼
┌─────────────────────────────────────────────────────────────┐
│        Objective recognition of system improvement requirements │
└─────────────────────────────────────────────────────────────┘
        │                                        │
        ▼                                        ▼
┌──────────────────────────┐    ┌──────────────────────────┐
│  Analysis of the BCT results │    │   Survey to identify the need │
│  documents (the 72nd ~ the   │    │   for improvement of key     │
│  74th BCT) to identify       │    │   components in BCT          │
│  problem                     │    │                              │
└──────────────────────────┘    └──────────────────────────┘
                              ▼
┌─────────────────────────────────────────────────────────────┐
│        Construct BCT improvement plan to overcome obstacles    │
└─────────────────────────────────────────────────────────────┘
                              ▼
┌─────────────────────────────────────────────────────────────┐
│        Satisfaction (expected) analysis of the improvement plan │
└─────────────────────────────────────────────────────────────┘
        │                                        │
        ▼                                        ▼
┌──────────────────────────┐    ┌──────────────────────────┐
│   Survey to collect the      │    │   FGI (Focus Group Interview) │
│   opinions of key components │    │   Written interview with expert │
│   for the improvement plan   │    │   to collect advice & opinion on │
│                              │    │   the improvement plans      │
└──────────────────────────┘    └──────────────────────────┘
                              ▼
┌─────────────────────────────────────────────────────────────┐
│          Proposal to BCT to evolve for the future              │
└─────────────────────────────────────────────────────────────┘
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Figure 12 Snapshot of research framework

CHAPTER FOUR: ANALYSIS OF DOCUMENTS/SURVEY/INTERVIEW

This chapter describes the document analysis of the BCT documents of the plan and results over the past three years. In addition, the study of questionnaire results targets the BCT's main components and the consequences of interviews with military experts.

4.1 Analysis of the BCT plan and results documents

As a result of analyzing BCT plan and results papers through the system approach, two adverse environmental conditions that limit system operation and problems with no alternative methods for primary training were identified.

4.1.1 The first adverse environmental condition: The weather

The outdoor training conducted by the Republic of Korea Air Force is controlled depending on the weather. In the case of BCT held from mid-January to February, the winter season in South Korea, training is conducted according to the control standards for outdoor training in cold weather, as shown in the table below. (Republic of Korea Air Force Academy, 2019 ~ 2022)

Table 14 The control standard for outdoor training in cold weather

Index	Weather Condition	Contents of Control
The sensory temperature	Above -10 °C	Operate planned schedule
	Between -10 °C and -25 °C	Adjust training time (Consider the trainee's physical condition)
	Below -25 °C	Change to indoor education
The strength of the wind	Above 10m/s	Change to indoor education
The amount of snowfall	Above 10cm	Change to indoor education
Visibility	Below 100m (0.063 Statutue mile)	Cease the shooting training
	Below 50m (0.031 Statutue mile)	Cease the outdoor training
Fine dust	Watch or above "Poor" level <Watch> ·PM10: Hourly average concentration exceeds 150 $\mu g/m^3$ for more than 2 hours ·PM2.5: Hourly average concentration exceeds 75 $\mu g/m^3$ for more than 2 hours <Level> ·Good: 0~30 ($\mu g/m^3$·day) ·Normal: 31~81 ($\mu g/m^3$·day) ·Poor: 81~150 ($\mu g/m^3$·day) ·Very poor: 150 + ($\mu g/m^3$·day)	Change to indoor education

The above standards are applied, but the actual training period is adjusted or converted to indoor training by comprehensively considering conditions such as sensible temperature, snow cover, strong wind, and visibility. It is most affected by the commander's decision.

Weather statistics between January to February over the past three years in the Republic of Korea Air Force Academy area are as follows. (Meteorological Observatory at the Republic of Korea Air Force Academy and Airkorea, 2022).

Table 15 Weather statistics in ROKAFA over the past three years

Index		January	February
The highest / lowest temperature (°C)	Week 1	- 9.3 / 2.8	- 8.2 / 4.0
	Week 2	- 9.0 / 2.2	- 6.3 / 7.6
	Week 3	- 7.2 / 5.0	- 6.2 / 5.8
	Week 4	- 5.6 / 6.0	- 3.5 / 10.8
	Average	- 7.7 °C / 4.0 °C	- 6.1 °C / 7.1 °C
The highest / lowest strength of wind (m/s)	Week 1	3.1 / 8.7	5.6 / 12.8
	Week 2	4.1 / 14.9	5.6 / 11.3
	Week 3	3.6 / 11.8	5.6 / 11.3
	Week 4	4.1 / 19.1	5.6 / 12.3
	Average	3.7 m/s / 13.6 m/s	5.6 m/s / 11.9 m/s
The snowfall (Days/cm)	2020	6 / 0	8 / 4.9
	2021	13 / 2.8	6 / 4.8
	2022	11 / 1.3	10 / 1.9
	Average	10 days / 1.4cm	8 days / 3.9cm
Visibility (Statute Mile) BR: Mist	2020	4BR ~ 7	5BR ~ 7
	2021	5BR ~ 7	5BR ~ 7
	2022	6BR ~ 7	5BR ~ 7
	Average	5BR ~ 7	5BR ~ 7
Fine dust(μg/㎥) (PM10/ PM2.5)	2020	50.8 / 32.3	47.2 / 28.6
	2021	49.3 / 21.7	54.4 / 23.9
	2022	51.8 / 28.5	46.3 / 25.4
	Average	50.6 / 27.5	49.3 / 26.0

In comparison with the standards to manage BCT shown in Table 14 and the climate of

ROKAFA shown in Table 15, it is found that the training plan is most likely to be affected by the

temperature. However, the accumulated sensory temperature data could not be obtained since it varies depending on the situation.

4.1.2 The second environmental condition: Epidemic (COVID-19)

As a result of analyzing documents for the past three years, the 72nd BCT plan dealt with measures such as flu, frostbite, and food poisoning (norovirus) as winter disease control measures. However, it was confirmed that steps for the occurrence of COVID-19 patients were added to the 73rd and 74th BCT plans, which were not previously present. In other words, countermeasures were needed from the time of planning the 73rd BCT since COVID-19 was spreading in the Republic of Korea. The countermeasure is as follows.

Table 16 The countermeasure for COVID-19

Period	Procedure
Before the enrollment	·Restriction on visits to multi-dense facilities from two weeks in advance ·Conduct PCR test in case of symptoms ·In the case of a positive test, an admission decision is made through deliberation.
Pre-Adaptation (Day 1 ~ 4)	COVID-19 Test for all participants on the enrollment day 1 1) The positive result: The infected will be transported to the hospital. 2) Close contacts (roommates/users of public facilities): PCR test on day 3 ·Roommate: Move to a quarantine facility. (single room) If negative, maintain quarantine for 14 days, then release quarantine if negative after PCR test of the positive test ·Users of public facilities: If negative, judge after checking symptoms (preventive observation for 14 days)
Under the training	·Move to the quarantine facility in case of fever ·Symptom identification and PCR test If the PCR test is positive, carry out the above procedure 1) and 2)

If a trainee gets the result of COVID-19, it affects not only the trainee but also fellow trainees who have had close contact. In the case of BCT, which lives in a training camp during actual training, a large number of trainees must inevitably be isolated in the event of a COVID-19 patient. As can be seen in the countermeasures, not only the person who tested positive but also the roommates are quarantined for two weeks. The point to note is that the entire training is four weeks; if more than 21% of the training is absent, it will be reviewed through deliberation.

4.1.3 The absence of alternative plans

It is confirmed that there is no substitute plan for significant training. Although the environment (weather and epidemics identified above in 4.1.1 and 4.1.2) significantly impacts critical components within the system, the alternatives are poorly planned.

Firstly, when the weather affects the training plan, it will be changed to indoor training or shooting training suspension.

Second, in case of being affected by the epidemic (COVID-19), measures such as quarantine are planned, but there is no alternative plan for training for trainees who cannot attend the training due to it. Thirdly, the training is to be observed if a patient or an unavoidable situation occurs during exercise. Observation classes are regarded as participating in the activity. However, some subjects are not considered this way because they are essential parts of the training: Live rifle shooting, March training (20km), Gas experience, and Group running with military gear. The reason for setting these subjects is that it is impossible to achieve educational goals during observation and to prevent excessive observation cases.

Hence if trainees do not attend this training, they will be referred to the deliberation to decide whether to enter.

4.1.4 Problems found during document analysis

In summary, it is confirmed that weather can affect training planning. In addition, it is identified that environmental restrictions such as pandemics affect trainees. Finally, in an unavoidable situation where the training plan needs to be changed, it is found that there is a passive change of location rather than a proactive alternative in the procedure itself or no option.

4.2 Analysis of the survey

The questionnaires were distributed online to instructors as Republic of Air Force officers and Republic of Air Force Academy senior cadets with BCT experience, and trainees as Republic of Air Force Academy freshman cadets the most recently trained in BCT. The 140 survey participants responded to the questionnaire, and demographic distribution characteristics were analyzed for the entire sample. In addition, the proper statistical analysis method for each category was applied to the exploring the result of the survey on preparations before BCT, the experience of changing BCT plans, awareness of the need for improvement of BCT, opinions of the application of LVC for improvement methods, and experiences of using VR devices.

4.2.1 Demographic information of subjects

The 140 respondents included 35 Air Force officers (25%) and 58 Air Force cadets from the 71st (41.4%) as instructors and 47 Air Force cadets from the 74th (33.6%) as trainees. Also, they consisted of 120 males (85.7%) and 20 females (14.3%), and detailed demographic characteristics are shown in Table 17. Each category of subjects was a sample of more than 30 participants, so the number was large enough for statistical analysis. (William & Terry, 2016).

Table 17 Detailed demographic information of subjects

Index		Instructor				Trainee (74th)	
		Officer		Senior Cadet (71st)			
		Number	Ratio(%)	Number	Ratio(%)	Number	Ratio(%)
		35	25	58	41.4	47	33.6
Gender	Male	26	18.6	53	37.8	41	29.3
	Female	9	6.4	5	3.6	6	4.3
Age	19~23	-	-	55	39.2	41	29.3
	24~28	4	2.8	3	2.1	-	-
	29~33	12	8.6	-	-	-	-
	34~38	14	10.0	-	-	-	-
	39~43	5	3.6	-	-	-	-
Rank	Cadet	-	-	58	41.4	47	33.6
	First Lieutenant	3	2.1	-	-	-	-
	Captain	13	9.3	-	-	-	-
	Major	16	11.5	-	-	-	-
	Lieutenant Colonel or (S)	3	2.1	-	-	-	-
Service period (Years)	Cadet 1~4	-	-	58	41.4	47	33.6
	Officer 1~5	4	2.9	-	-	-	-
	Officer 6~10	13	9.3	-	-	-	-
	Officer 11~15	12	8.5	-	-	-	-
	Officer 16~	6	4.3	-	-	-	-

4.2.2 Preparation before entering BCT

Q5 was a survey about the most burdensome preparation items before joining BCT. As explained in Chapter Two, trainees experience limitations they have never experienced before, such as physical and mental strength and group life during BCT. In addition, this question contained how much participants feel the pressure of infectious diseases, such as the need to submit a negative result of COVID-19, which recently emerged before entering BCT. The results of the questionnaire analysis that used the Likert scale (7-point: Nothing ~ Very Severe) dealt with depending on training instructor officers, cadets, trainees, and gender.

Table 18 The analysis result of Q5

Index (Number)			Physical Strength	Mental Strength	Group Life	Health/Illness (COVID-19)
Total (140)		Mean	4.11	4.64	4.10	3.76
		Std. Deviation	1.49	1.67	1.84	1.97
Gender	Male (120)	Mean	3.97	4.58	4.10	3.73
		Std. Deviation	1.46	1.67	1.86	1.99
	Female (20)	Mean	4.95	5.00	4.10	4.00
		Std. Deviation	1.49	1.67	1.84	1.97
Status	Officer (35)	Mean	4.57	4.51	4.11	4.54
		Std. Deviation	1.48	1.58	1.64	1.95
	Senior Cadet 71st (58)	Mean	3.81	4.59	3.97	3.66
		Std. Deviation	1.50	1.73	2.03	2.03
	Trainee 74th (47)	Mean	4.15	4.81	4.26	3.32
		Std. Deviation	1.41	1.68	1.74	1.78

According to the analysis results, the highest mean value for all respondent results was mental strength at 4.64 (> 4: Moderate), and the pressure of diseases such as COVID-19 was the lowest at 3.76 (< 4: Moderate). The detailed analysis results are shown in Table 18, where yellow represents the maximum value and orange represents the minimum value.

4.2.3 The experience of changing BCT plans and the need for improvement

Q6 surveyed the occasion of the changed BCT plan during training, the reason, and its effect on the training elements. Q7 asked participants their opinions on the need for training improvement. Both questions used the Likert scale (7-point: Strongly disagree ~ Strongly agree) to ask them.
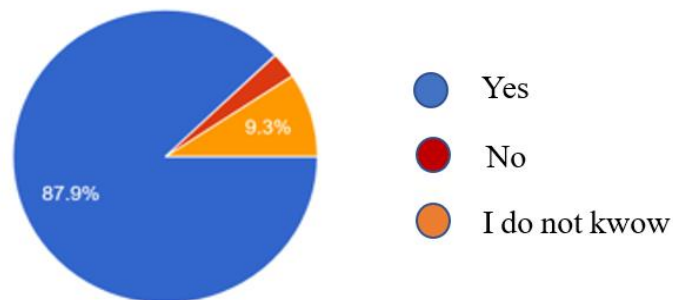
Figure 13 The experience of changing BCT plans

According to the results of Q6, 87.9% (123 / 140) of all respondents responded that they had experienced a change in the BCT plan. 2.9% (4 / 140) answered that they had no experience, and the remaining 9.3% (13 / 140) answered that they did not know.
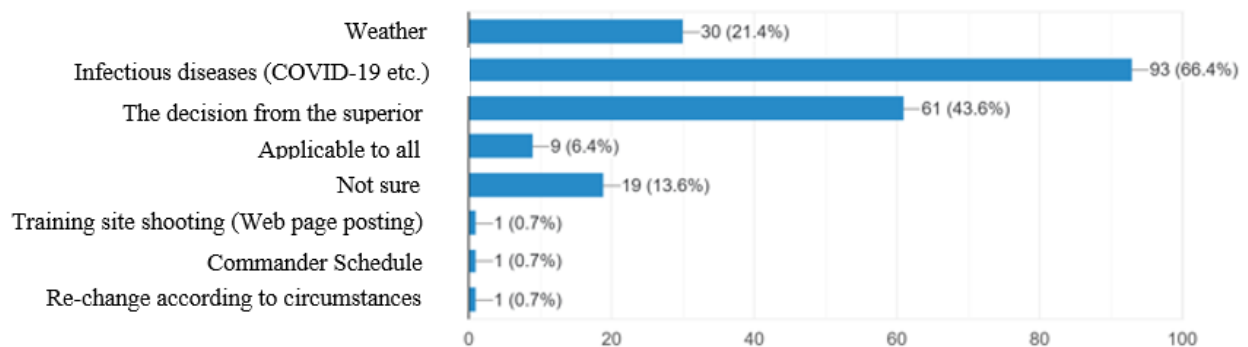
Figure 14 The factors of BCT plan changes

As a result of analyzing the factors of BCT plan changes with Q6-1, 66.4% were caused by infectious diseases such as COVID-19. The second highest factor is 43.6%, answered by the decision from the commander. Technically, the commander's decision determines most plan changes based on Tables 14 to 16 described in Chapter 4.1. It was followed by weather change with 21.4%, and 6.4% of all three factors were applicable. Therefore, it could be described that 84.6% of the factors that affect BCT plan changes so far were related to weather changes and the occurrence of COVID-19 situations.

Through Q 6-2, the effect of changes in the BCT plan on system components was investigated using the Likert scale (7-point: Strongly disagree ~ Strongly agree). The analysis was conducted according to gender, status, and answer to Q 6-1, which indicated an awareness of BCT plan change shown in Table 19 below.

Table 19 The analysis result of Q6-2

Index (Number)		Negative emotions (Decreased motivation or willingness to participate, etc.)	
		Mean	Std. Deviation
Total (140)		3.94	1.73
Answer of Q6	YES	4.09	1.75
	NO	3.50	1.29
	Don't know	2.69	1.18
Gender	Male (120)	3.92	1.77
	Female (20)	4.10	1.59
Status	Officer (35)	4.14	1.68
	Senior Cadet 71st (58)	4.50	1.66
	Trainee 74th (47)	3.11	1.58

As shown in Table 19, the participants who recognized the change in BCT plan experienced negative emotions of 4.09 (> 4: Neutral). In addition, it indicated that females 4.10 (> 4: Neutral) rather than males, drill instructors officers 4.14 (> 4: Neutral), and senior cadets 4.50 (> 4: Neutral) rather than trainees felt negative emotions when training plans were changed.

Q7 asked for opinions on whether BCT plan needed improvement not to be affected by the training environment (weather change, epidemic, etc.) on the Likert scale (7-point: Strongly disagree ~ Strongly agree). This analysis was conducted by status; the results are shown in Table 20.

Table 20 Need for BCT Improvement

Index		Mean	Std. Deviation
Total (140)		4.86	1.67
Status	Officer (35)	4.83	1.92
	Senior Cadet 71st (58)	5.07	1.53
	Trainee 74th (47)	4.62	1.64

The opinion of all participants is 4.86 (> 4: Neutral), representing the need for improvement. The senior cadets in charge of training recognized the need for improvement at the highest level, with 5.07 among the group.

A correlation analysis was conducted to confirm the relationship between negative emotions when changing BCT plan, which resulted from the Q6-2 analysis, and the recognition of the need for BCT improvement in Q7. The result was obtained as shown in Table 21.

Table 21 Analysis of correlation between Q 6-2 and Q 7

Correlations		Q 6-2	Q 7
Q 6-2	Pearson Correlation	1	-
	Sig. (2-Tailed)	-	-
	N	140	-
Q 7	Pearson Correlation	0.317	1
	Sig. (2-Tailed)	< 0 .001	-
	N	140	140

According to the analysis results, the Pearson correlation coefficient value between the two questions was 0.317, a positive correlation. The significance probability two-tailed test *p*-value is less than 0.001, so the two elements were statistically significant.

4.2.4 Awareness of LVC and Satisfaction (Expected)

From Q8 to Q11, awareness of LVC and satisfaction (expected) with applying it to BCT were asked. It also presented why the opinions of participants who objected to this application were suggested. Besides, their impression of it was collected as examples of utilizing specific training fields. Participants were asked if they had heard of LVC through Q 8; the results are shown in Table 22 by the group.

Table 22 Awareness of LVC

Index (Number / Percentage)		Yes	No	I don't know
Total (140 / 100%)		57 / 40.7%	78 / 55.7%	5 / 3.6%
Status	Officer (35 / 100%)	19 / 54.3%	13 / 37.1%	3 / 8.6%
	Senior Cadet 71st (58 / 100%)	10 / 17.2%	47 / 81.3%	1 / 1.5%
	Trainee 74th (47 / 100%)	28 / 59.6%	18 / 38.3%	1 / 2.1%

More than half of the participants (55.7%) and 81.3% of senior cadets answered that they had never heard of it. On the other hand, 54.3% of training instructors and 59.6% of trainee cadets said they had heard of it.

Q9 investigated opinions on the proposal to apply LVC to BCT through the Likert scale (7-point: Not needed at all ~ Extremely necessary), and the results are shown in the following Table 23.

Table 23 Opinion about applying LVC to BCT

Index (Number)		Mean	Std. Deviation
Total (140)		3.53	1.72
Gender	Male (120)	3.46	1.76
	Female (20)	3.95	1.47
Status	Officer (35)	4.43	1.24
	Senior Cadet 71st (58)	3.28	1.59
	Trainee 74th (47)	3.17	1.97

The overall sample average was 3.53 (< 4: Neutral), which was unnecessary for BCT. In particular, the mean of the trainees was 3.17, which was the lowest result. Still, the training instructor officers believed LVC was necessary for BCT application with 4.43 (> 4: Neutral).

The respondents' reasons for opposing the proposal to apply the LVC to the BCT were analyzed by status as follows.

1) Common opinion

· Inconsistent with the purpose of BCT

(The purpose of BCT is to cultivate the military spirit and strong mental strength,

teamwork, and adaptation to group life.)

· What is obtained through actual physical training is more meaningful for candidate cadets.

· LVC application is unnecessary due to low training difficulty.

· Doubts about training effectiveness.

2) Instructor Officer

· Doubts about technical limitations.

· It seems to be helpful for current cadets or officers.

· The cost of building infrastructure

· No relevant training subject.

3) Senior Cadets

· It is necessary for airborne training during 3rd year of cadet life to apply virtual training.

· No battlefield situation experience is required for prospective cadets.

· As soon as the trainees perceive it as virtual reality, the level of immersion and

concentration in training seems to drop.

· It doesn't seem easy to proceed smoothly between training sessions.

· It seems it will take a lot of time, such as many people wearing equipment and

entering training.

· It is necessary to overcome the extremes of weather, environment, pressure, and

psychological stress as part of the training.

· The application of LVC for Air Force training appears less necessary.

· Only some training needs the application of LVC.

4) Trainee Cadets (VR training experiences at Korea Military Academy)

· Doubts about technical limitations.

 - Since there are only about 20 people who can train at one time, it took a lot of time for

   everyone to experience the training.

 - Cannot aim accurately and experience motion sickness.

· Doubts about training effectiveness.

 - The training effect was low and close to playing games rather than training.

 - The dichotomy between the character and the trainee's movements in virtual reality.

· The battlefield experience was good, but some inappropriate trainees perceive war as a

   game and shoot allies, so the cognitive aspect should be considered.

Q10 explored opinions on utilizing LVC for specific training such as close-order drills, shooting training, mental education, CBR (Chemical, Biological, Radiological) training, and patient care among BCT training fields. It was investigated using a Likert scale (7-point: Not needed at all ~ Extremely necessary). The results are shown in Table 24 below.

Table 24 The analysis result of Q10

Index (Number)			Close-order drill	Shooting training	Mental education	CBR (Chemical, Biological, Radiological) training	Patient care
Total (140)		Mean	3.05	4.42	1.77	3.28	4.14
		Std. Deviation	1.76	1.83	1.98	2.08	2.06
Gender	Male (120)	Mean	3.02	4.30	2.63	3.15	4.16
		Std. Deviation	1.78	1.88	1.95	2.07	2.07
	Female (20)	Mean	3.25	5.15	3.90	4.05	4.00
		Std. Deviation	1.71	1.39	1.92	1.99	2.05
Status	Officer (35)	Mean	3.74	5.00	3.09	4.09	4.71
		Std. Deviation	1.90	1.44	1.77	1.90	2.06
	Senior Cadet 71st (58)	Mean	3.12	4.00	2.52	2.86	3.67
		Std. Deviation	1.70	1.88	2.00	1.88	2.01
	Trainee 74th (47)	Mean	2.45	4.51	2.98	3.19	4.28
		Std. Deviation	1.56	1.94	2.10	2.30	2.08

When compared by group, male, instructor officers, and senior cadets had the same results as the overall average. They believed LVC application to shooting training would be necessary, with a score of 4.42 (> 4: Neutral). In contrast, the application of mental education was almost unnecessary, with a score of 1.77 (< 4: Neutral). Yet, the female and trainee groups thought the close-order drill was the most unnecessary training.

Based on the responses to Q11, it was possible to gather opinions on specific training areas where LVC could be applied during BCT. Examples are as follows: first aid, shooting training under battlefield conditions, small-scale combat training, mental education, marching, CBR (chemical, biological, and radiological), action procedures when encountering an enemy, etc.

Besides BCT, subjects were interested in applying LVC to flight experience, airborne training, disaster control, base protection, etc.

4.2.5 Satisfaction (expected) on the application of LVC to BCT

From Q12 to Q25, this study also explored opinions on cases applicable to BCT based on LVC examples by country. It used the Likert scale (7-point: Not needed at all ~ Extremely necessary), and Q12 to Q15 consisted of Live training, Q16 to Q22 Virtual training, and Q23 to Q25 Constructive training. The results are following Tables 25 to 27.

Table 25 Opinion about Live Training (Q12 to Q15)

Index (Number)			Q12 MILES	Q13 STE	Q14 Nett Warrior	Q15 Bulletproof Helmet
Total (140)		Mean	4.54	4.55	4.27	4.01
		Std. Deviation	1.86	1.89	2.00	1.87
Gender	Male (120)	Mean	4.51	4.54	4.31	4.08
		Std. Deviation	1.94	1.96	2.06	1.90
	Female (20)	Mean	4.75	4.60	4.05	3.60
		Std. Deviation	1.33	1.42	1.63	1.66
Status	Officer (35)	Mean	4.43	4.34	4.31	3.83
		Std. Deviation	1.63	1.83	2.05	1.94
	Senior Cadet 71st (58)	Mean	4.34	4.47	4.10	4.02
		Std. Deviation	1.96	1.94	1.98	1.88
	Trainee 74th (47)	Mean	4.87	4.81	4.45	4.15
		Std. Deviation	1.89	1.88	2.02	1.84

All groups agreed with the suggestion of Live training; scores were above 4 (> Neutral) from Q12 to Q15. Looking in detail, all participants, males, and 4th-year cadets answered that STE (Synthetic Training Environment) System was the most necessary. While females, officers, and trainees responded most positively to the MILES (Multiple integrated laser engagement system). However, all subjects responded with a low score for the introduction of bulletproof helmets, and in particular, the female group gave their opinion with the lowest score of 3.60.

Table 26 Opinion about Virtual Training (Q16 to Q22)

Index (Number)			Q16 TAD	Q17 DSTS	Q18 V-300	Q19 MARS	Q20 Mental Edu.	Q21 CBR	Q22 VR Game
Total (140)		Mean	4.32	4.55	4.07	4.58	3.28	3.85	3.74
		Std. Deviation	1.98	1.80	1.86	1.79	1.98	1.96	1.93
Gender	Male (120)	Mean	4.21	4.49	4.09	4.43	3.17	3.73	3.59
		Std. Deviation	2.04	1.87	1.88	1.86	2.01	1.99	1.94
	Female (20)	Mean	5.00	4.90	3.95	5.50	3.95	4.55	4.60
		Std. Deviation	1.48	1.23	1.76	0.82	1.70	1.60	1.63
Status	Officer (35)	Mean	4.51	4.60	4.03	5.17	3.49	4.54	4.40
		Std. Deviation	1.83	1.57	1.88	1.31	1.87	1.73	1.70
	Senior Cadet 71st (58)	Mean	4.28	4.41	4.07	4.41	3.03	3.55	3.53
		Std. Deviation	1.98	1.99	1.99	1.89	1.95	2.07	2.01
	Trainee 74th (47)	Mean	4.23	4.68	4.11	4.34	3.43	3.70	3.49
		Std. Deviation	2.11	1.73	1.71	1.90	2.12	1.89	1.92

From Q16 to Q22, it was possible to confirm the participants' opinions on virtual training. The entire group's average was a favorable opinion of more than 4 points (> Neutral) for Q16, Q17, Q18, and Q19. In comparison, negative views of below 4 points (< Neutral) were presented for Q20, Q21, and Q22. In particular, the officer group offered the most favorable opinion of Q19 with a score of 5.17, and the senior cadets gave the most pessimistic view of Q20 with a score of 3.03.

Table 27 Opinion about Constructive Training (Q23 to Q25)

Index (Number)			Q23 ARCPX/JLCCTC	Q24 CoMap	Q25 ADMS
Total (140)		Mean	3.89	3.89	4.74
		Std. Deviation	1.87	1.89	1.89
Gender	Male (120)	Mean	3.83	3.86	4.68
		Std. Deviation	1.90	1.92	1.96
	Female (20)	Mean	4.20	4.05	5.15
		Std. Deviation	1.70	1.79	1.34
Status	Officer (35)	Mean	3.74	3.66	4.69
		Std. Deviation	1.77	1.87	1.69
	Senior Cadet 71st (58)	Mean	3.76	3.83	4.71
		Std. Deviation	1.92	1.88	1.92
	Trainee 74th (47)	Mean	4.15	4.12	4.83
		Std. Deviation	1.89	1.94	2.05

Table 27 shows the respondents' opinions about Constructive training. The entire group

and the answers by status suggested positive views with more than 4 points (> Neutral) on Q25;

in particular, women scored the highest at 5.15. Q25 was an example of constructive simulation

training, formerly called Eagle Training. It was an exercise that allowed trainees to experience

battlefield teamwork and leadership in a realistic wartime situation, synthesizing all of their

previous training. However, it has not been conducted since the 2001 BCT for various reasons,

including safety and scenario exposure. Notably, among the constructive training examples, only

Q25 received the highest scores in positive comments from all groups. The respondents' opinions about Q23 and Q24 showed below 4 points scores (< Neutral), especially the 4th-year cadets' lowest score of 3.76 in Q23.

The process of analyzing the survey also yielded exciting results. Compared to Q10, which explained only the definition of LVC and asked for opinions, the scores in Q12 to Q25 showed the actual application of LVC in each country with pictures. They were asked for their thoughts, and more positive statements were obtained after the explanation with photographs. It was analyzed through t-Test; the results are shown in the table below.

Table 28 Paired sample t-Test between Q10 and others

Index (N=140)		Mean	Std. Dev.	t-Value	*p*-Value
Close-order drill	Q10-1	3.05	1.76	-8.139	*** <0.001
DSTS	Q17	4.55	1.80		
Shooting training	Q10-2	4.42	1.83	-0.970	One-sided 0.167 Two-sided 0.334
MARS	Q19	4.58	1.79		
Mental Education	Q10-3	2.81	1.98	-2.730	** One-sided 0.004 Two-sided 0.007
	Q20	3.28	1.98		
CBR	Q10-4	3.28	2.07	-3.398	*** <0.001
	Q21	3.85	1.96		
Patient Care	Q10-5	4.14	2.05	2.271	* One-sided 0.012 Two-sided 0.025
VR Game	Q22	3.74	1.93		

* p<0.05, **p<0.01, *** p<0.001

Among the questions, the paired-difference test was conducted by pairing five items that could be connected before and after seeing the photo. Except for Q10-2, the other four paired-sample t-Tests had statistically significant results since *p*-values are less than 0.05. In other

words, it was judged that showing the actual example of the picture and the description affected the answer from negative to positive. However, it could be said that the real example did not affect the answer to Q19 since the p-Value of Q10-2 was higher than 0.05.

4.2.6 Experience using VR devices

Q26 used the Likert scale (7-point: Never ~ Very Frequently) to ask the survey participants whether they often use VR devices such as games and aircraft simulations. The survey results were analyzed by classifying them according to gender and military status.

Table 29 The analysis result of Q26

Index (Number)			Gender		Status		
			Male (120)	Female (20)	Officer (35)	Senior Cadet 71st (58)	Trainee 74th (47)
Total (140)	Mean	2.99	3.01	2.9	2.89	3.05	2.93
	Std. Deviation	1.67	1.69	1.62	1.71	1.55	1.78

The average of the entire sample is 2.99 (< 4: Neutral), and males used it more often, with 3.01, than females, with 2.9. In addition, the senior cadet group had the highest score of 3.05, and the officer group had the lowest score of 2.89.

4.3 Analysis of the Interviews

The analysis of the written interviews in FGI aggregated basic demographic information of experts, their opinions, and advice on the alternatives of applying LVC to BCT, as suggested in the questionnaire.

4.3.1 Demographic information of experts

The expert group comprises six Republic of Korea Airforce officers with experience as BCT instructors who have served in Korea Airforce for over ten years. They were selected in various military branches of the Republic of Korea Air Force in consideration of their final academic background and major to avoid biased opinions.

Table 30 Demographic information of experts

Index	Contents		
Age	Average 37.8		
Gender	Male	Female	-
	66.7% (4/6)	33.3% (2/6)	-
Rank	Major	Lieutenant colonel / Lieutenant colonel (S)	-
	66.7% (4/6)	33.3% (2/6)	-
Service period	10~15 Years	Over 16 Years	-
	33.3% (2/6)	66.7% (4/6)	-
Related to military training	1~5 Years	6~10 Years	11~15 Years
	33.3% (2/6)	50% (3/6)	16.7% (1/6)
The highest education & Major	Bachelor	Master	Doctoral
	33.3% (2/6)	50% (3/6)	16.7% (1/6)
	· Business Administration · Computer Science/Statistics	· Leadership · MBA · Satellite/Application Systems Engineering	· Business Administration, Human Resources
Branch	Fighter pilot	Human Resources/ Education	· Air defense artillery · Information Communications
	33.3% (2/6)	33.3% (2/6)	·16.7% (1/6) ·16.7% (1/6)

4.3.2 Opinions and advice for applying LVC to BCT

The contents of the expert-written interviews were analyzed by dividing them into considerations when constructing a system applying LVC to BCT and operating it, expected advantages, and concerns.

1) Considerations when building a system

   · Need for continuous development of the system (concern about short-term introduction)

   · Needs to consider the space for the establishment, maintenance, human resources,

     budget, etc.

   · Importance of developing a suitable system for the Air Force's operational plan.

   · Need to develop a training system for Air Force Academy cadets

   · Need to verify effectiveness to secure actual cost and feasibility

2) Considerations when operating BCT

   · Need to verify the effectiveness of actual training and virtual training

      (There must be a difference between the two)

   · Keep the actual training required so that war is not mistaken for a game

      (Overcome mental limitations, gas experience, etc.)

   · Need to consider for application in a limited period (4 weeks)

   · Applied, when prospective cadets adapt to some extent and control is possible.

   · Confirmation of whether the effect of training can be obtained through virtual training

      is essential for civilians to become soldiers, which is the purpose of BCT.

3) Advantages

 · Real battlefield experience.

 · Appears to be effective for patients.

 · Alternatives to sudden training plan changes, such as weather, are favorable.

4) Overall concern

 · It is necessary to understand the training of instructors and trainees for the system.

 · The effectiveness is questionable.

 · Except for high-risk training and procedural proficiency, the number of actual uses is

  likely to be low. That is why content development is essential.

 · Concerns about motion sickness when wearing VR devices.

 · Concerns based on the commander's inclinations.

CHAPTER FIVE: CONCLUSIONS

This final chapter summarizes what has been studied and analyzed. Then identify the point to discuss and explain the implications it gives. Finally, the limitations of this study are presented, and follow-up studies to overcome them are suggested.

5.1 Overview

In 2017, South Korea launched the Fourth Industrial Revolution Commission and declared "I-KOREA." In response, the Ministry of National Defense established the Smart Defense Innovation Task Force, headed by the Vice Minister of National Defense. (K. Lee, 2020) In particular, several key challenges were selected to overcome in the education and training sector. One of them was the restrictions on collective training due to the recent COVID-19. (Choi, 2022) Increasing uncertainty, such as Covid-19 and weather changes, threaten various military fields over the Republic of Korea. One is the BCT (Basic Cadet Training) at ROKAFA (Republic of Korea Air Force Academy). This study was conducted as follows to propose an idea to prevail the issues:

1. Research the examples of BCT and LVC by advanced country

2. Analyze the BCT (ROKAFA) through System Approach

3. Apply LVC to the BCT

First, the cases of South Korea, the United States, Japan, the United Kingdom, and Sweden were reviewed regarding BCT operations, and each country considered its own military organization and characteristics to operate it. Among them, South Korea's BCT was found to

perform with a system most similar to that of the United States. It was also recognized that BCT was an essential step in transitioning from civilian to military status. It had critical factors such as a well-organized BCT plan, motivated trainees, and training instructors to achieve the objective of BCT. LVC was reviewed from its appearance to the present as well as application cases by country. Each country has prepared for the future military by recognizing and developing LVC in various fields.

Second, this study analyzed BCT plan and outcome documents and surveyed the system's main components while conducting the systems approach. Document analysis confirmed that there was no alternative training if the training schedule was changed, despite the time constraint that BCT must be completed within four weeks. A total of 140 people responded to the survey, 87.9% of trainees and instructors experienced a change in the training plan, so they agreed with the need to improve BCT training with scores of 4.86 (>4: Neutral). Based on the results in Table 21, negative emotions and demand for improvement in BCT when changing the training plan were significantly correlated, with a correlation coefficient of 0.317 (p-value <0.001) between Q 6-2 and Q 7. In addition, of the pre-training preparations, the training components felt the most pressure about mental strength and the least about health or illness (e.g., COVID-19 infection).

Third, regarding the LVC application proposed through the study, the components in the BCT system were asked for their opinions through a survey, and advice was requested through written interviews with military experts. They considered it necessary for four applications of Live training (Table 25). Four out of seven application cases of Virtual training were answered positively and three negatively (Table 26). For the three application cases of constructive training, one was positive in Q25 (Eagle Training), while two were negative (Table 27). In

addition, there was confirmation that the provision of specific images and explanations positively impacted the responses to the application cases. Military experts advised considering the training development required for Korea Air Force Academy cadets, system development through a long-term plan, and cost-effectiveness when applying LVC to BCT.

5.2 Discussion

The discussion topics based on this study can be described in the following. First, it emphasized that utilizing LVC in military training is an inevitable trend as the flow from the origin of LVC to the present, advantages, disadvantages, and application cases by country were presented in the previous chapters. LVC is a suitable and proactive suggestion as an alternative training in preparation for a changing environment. The Republic of Korea Army aims to launch the Army Synthetic Battlefield Training System (Build-I) by 2026 (Won et al., 2021), and Korea Military Academy is already using the LVC system for military training. However, BCT at ROKAFA, with a time-constrained training schedule, does not consider it. Therefore, this study will contribute to the need for such recognition and lead to practical values.

Second, this study applied a systems approach to BCT analysis, an objective tool that has not been tried before. This method confirmed the training analysis for the corresponding year through BCT plan and result document. In addition, it was also confirmed that there is no alternative training plan for changing environments such as COVID-19, which has been an issue for the past three years. Also, the main components in the system identified the need for improvement in BCT. Respondents provided positive feedback (> 4: Neutral) on nine of the 14 LVC training cases that would be applied to BCT, with Q25 (formerly Eagle training, not

conducted since 2002) being ranked as the most needed training with a score of 4.74. The training, which included real-world battlefield experience, teamwork, and leadership, was what future Air Force leaders required. Hannay et al. (2014) emphasize that the reason for introducing adaptive thinking into decision-making in the defense sector is that decision-makers need to participate in training that explicitly develops thinking skills. Y. Kim (2019) also noted the importance of intangible warfighting capabilities such as mission capability, battlefield leadership, battlefield discipline, and training levels. This exercise allowed the trainee cadets to experience firsthand the fear and anxiety of the battlefield and develop the will to fight to overcome it, in addition to mastering the procedures for each situation. Improvement on this will eventually increase the satisfaction of the components in the system and will guide the direction of training going forward.

Lastly, accumulating data through LVC enables personalized management of Korea Air Force Academy cadets' training data, which can monitor even after enrollment. This feature does not currently exist in the system. As H. Lee (2020) mentions, since the advent of Benjamin Bloom's Two-Sigma Theory, the quest to personalize learning and achieve maximum performance has been ongoing in various fields of education and training. This theory states that the performance of a single teacher teaching a single student is equal to that of the top 2% of a class of 30 students. It also has been applied and studied in the military fields of many countries, including the United States. It has recently been radicalized by the technological development of the Fourth Revolution worldwide. Therefore, the Air Force Academy should also recognize the personalized learning trend using advanced technology. The advanced training system can recruit more suitable prospective cadets, eventually contributing to the training of customized leaders

who lead the Korea Air Force. It will ultimately affect the goal of the Korea Air Force Academy system.

The introduction of LVC and the recognition of its necessity through this study will help to provide a practical and proactive blueprint for future training development plans for trainees and training instructors in BCT as well as increase their satisfaction. It will also contribute to commanders' awareness of improving training direction and making policy decisions for the future ROK Air Force, which has not fought a real war since the Korean War in the 1950s.

5.3 Limitation and Future Research

Even though adopting LVC is an appropriate suggestion for advancing BCT, some limitations of this study must be overcome. First, there is a limitation of the study population. Of the BCT participants in this study, 59.3% of them had never heard of or did not know about LVC. Therefore, they likely do not have an accurate understanding of LVC utilization. The survey results showed different responses before and after seeing photos and descriptions of actual LVC examples currently being used in advanced countries. In four out of five cases, we saw a positive change in response after seeing a real-world application. To solve this problem, it is necessary to select subjects with a precise awareness and knowledge of LVC and, at the same time, an accurate recognition of the difficulties with BCT.

The second is a limitation of the research methodology. Heuristic decision analysis should be performed at the system development stage when developing alternatives using a systems approach. Despite this, the alternative procedure development module was not applied to the selection of alternative training but only based on the literature review. Since the purpose of

this study was not to develop a BCT system from the initial stage, there was a limitation in applying the analysis method item by item for each stage of system development. Thus, to overcome this limitation, it would be possible to derive an optimized application of LVC for a BCT system by starting the development from the first stage of system engineering and applying the appropriate analysis method for each step, such as considering perceived usefulness and perceived ease of use when it comes to developing LVC application. Customers' willingness to continue using information technology applications can be predicted by their perceived usefulness and perceived ease of use. (Hamid et al., 2016; Davis, 1989)

Third, there are limitations to the research contents. 1) The survey was conducted online to investigate the expected satisfaction with the LVC application. Online surveys are limited because the participants do not allow immediate resolution of questions when they understand each question poorly. 2) Equally important, it needs to verify the effectiveness of the training by comparing it before and after the application of LVC among BCT participants in order to make an accurate comparative analysis. This study could only obtain the participants' opinions because there is no application of LVC in the current BCT system. Therefore, it is necessary to check the actual effect of LVC before and after its application to overcome this problem.

According to the Air National Guard (2016), "Free from the constraints of the physical realm, we can develop virtual environments-airspace, ranges, etc. - that deliver robust, realistic training against existing threats as well as those we anticipate in the future" (p.9). Continued research to overcome these limitations can positively impact the informed decision-making required to improve BCT for the changing environment as a proactive preparation.

APPENDIX A

: SURVEY AND INTERVIEW FOR IMPROVING THE BASIC CADET TRAINING

FOR CHANGING ENVIRONMENT

Survey for improving the basic cadet training for changing environment

: For candidate cadets, senior cadets, and training instructors participating in basic military training

  at the Republic of Korea Air Force Academy

- HRP-254 Explanation of Research) will be shown after clicking "Continue."

- Participation in the survey is voluntary and will not affect your relationship with your career.

- On average, it takes 10 -15 minutes to complete the survey.

- Questionnaire consists of 27 main questions and 3 sub-questions. The expert interview survey contains 9 main

  questions.

- All the data you submit are confidential, and results will not be disclosed in any identifiable form.

Click the "Continue" button below to start the survey.

You can close the browser window or tab if you wish to stop the survey anytime.

If you have questions or concerns, please get in touch with me using the contact information below.

Yoojin Kwon

Industrial Engineering and Management Systems, College of Engineering and Computer Science, University of Central Florida, by phone at   or by email at kyoojin23@knights.ucf.edu

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[Demographic information]

The questions in this section will help us better understand the survey participants. They will not ask for any identifiable information.

1. Age:

2. Gender

☐   Female

☐   Male

☐   Prefer not to answer

3. Status

☐   Airforce Cadet (71st)

☐   Airforce Cadet (74th)

☐   First lieutenant (Current or previous military instructor officer)

☐   Captain (Current or previous military instructor officer)

☐   Major (Current or previous military instructor officer)

☐   Lieutenant colonel or Lieutenant colonel (S) (Current or previous military instructor officer)

4. Years served at the Republic of Korea Airforce

☐   Airforce Cadets 1 ~ 4 years

☐   Officers 1 ~ 5 years

☐   Officers 6 ~ 10 years

☐   Officers 11 ~ 15 years

☐   Officers over 16 years

[Before the basic cadet training] Questions about preparation

5. How would you express the stress level about the elements you need to prepare before entering the basic cadet training?

Elements	Nothing	Less mild	Mild	Moderate	Slightly Severe	Severe	Very Severe
	1	2	3	4	5	6	7
Physical strength							
Mentality							
Group life							
Health/Illness (Covid-test, etc.)							

[During the basic cadet training] Question about the effect of training plan change on training satisfaction

6. During the basic military training, were there any cases where the training plan was changed?

☐ Yes
☐ No
☐ I do not know

6-a. If the training plan was changed, in what cases? (Duplicate check possible)

☐ Weather
☐ Infectious diseases (COVID-19, conjunctivitis, etc.)
☐ The decision from the Superior
☐ Applicable to all
☐ Other :(Short Answer):
☐ Not sure

6-b. When the training plan was changed, did you feel negative emotions (decreased motivation, decreased willingness to participate, etc.)?

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
1	2	3	4	5	6	7

7. Do you think the basic cadet training plan needs to be amended to avoid being affected by the environment (weather, pandemic, etc.)?

Strongly disagree	Disagree	Somewhat disagree	Neutral	Somewhat agree	Agree	Strongly agree
1	2	3	4	5	6	7

[Satisfaction (expected) question on the application of LVCG to the basic cadet training]

LVCG (Live, Virtual, Constructive, and Game) generates a simulated environment in place of an actual battlefield or operational environment to indirectly experience real situations through virtual simulation. Military training with VR and aircraft operating simulation are representative examples.

8. Have you ever heard of LVCG?

☐   Yes
☐   No
☐   I do not know

9. What are your thoughts on the application of LVCG to basic cadet training?

Not needed at all	Not necessary	Generally not necessary	Neutral	Generally necessary	Necessary	Extremely necessary
1	2	3	4	5	6	7

9-a. If you are negative about the application of LVCG to basic military training, what is the reason? (Descriptive)

10. What are your thoughts on applying LVCG to the training below:

Content	Not needed at all	Not necessary	Generally not necessary	Neutral	Generally necessary	Necessary	Extremely necessary
	1	2	3	4	5	6	7
Close-order drill (Bayonets drill, etc.)							
Shooting training							
Mental education							
CBR (Chemical, Biological, Radiological) training							
Patient care							

11. What kind of training would you like to apply LVCG to? (Short answer)

The followings are training improvement contents (suggestions) based on examples (or under development) of LVCG applications in the Republic of Korea and other countries.

Live training: Training conducted by combatants in a real combat field (e.x. Korea Combat Training Center)

12. Do you think that the application of **MILES (Multiple integrated laser engagement system)** is helpful for basic cadet training?

	Description of MILES
	·Real-time training information is managed in the control center through the laser launcher mounted on the rifle and the sensor worn by the trainee ·Increase training completeness through analysis of command action results, tactical action results, etc. ·Maximize tactical command ability and acquire a practical sense ·Wireless and lightweight

Not needed at all	Not necessary	Generally not necessary	Neutral	Generally necessary	Necessary	Extremely necessary
1	2	3	4	5	6	7

13. Do you think that the application of **STE (Synthetic Training Environment) System** is helpful for basic cadet training?

	Description of STE System
	·Bring together the live, virtual, constructive, and gaming training environments ·The realistic training devices to fight in that environment and to succeed on the modern battlefield ·The transparent battlefield to life at the National Training Center

Not needed at all	Not necessary	Generally not necessary	Neutral	Generally necessary	Necessary	Extremely necessary
1	2	3	4	5	6	7

14. Do you think that the application of **Nett Warrior** is helpful for basic cadet training?

	Description of Nett Warrior
	·Enhances situational awareness of the battlefield ·Commanders make fast and accurate decisions in tactical engagements to use varied information on a battlefield ·Commercial smartphones provide soldiers with greater situational awareness to achieve a consolidated air, ground, and fire operation

Not needed at all	Not necessary	Generally not necessary	Neutral	Generally necessary	Necessary	Extremely necessary
1	2	3	4	5	6	7

15. Do you think the application of **Bulletproof Helmet with HoloLens2** is helpful for basic cadet training?

Description of Bulletproof Helmet with HoloLens2

·Bulletproof helmet equipped with goggles' HoloLens 2' 360-degree camera and infrared sensor
·Directly access visible information through hand gestures and obtain and share information necessary for combat

Not needed at all	Not necessary	Generally not necessary	Neutral	Generally necessary	Necessary	Extremely necessary
1	2	3	4	5	6	7

Virtual training: Training of real troops in a virtual environment (e.x. aircraft simulator)

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16. Do you think that the application of **TAD (Tactical Assault-shooting Drill-simulator)** is helpful for basic cadet training?

Description of TAD

·Immersive virtual tactical shooting training from HMD-based first-person perspective.
·Network-based squad tactical and combat shooting training
·Practical and tactical training functions in various operational environments
·The repetitive and effective training environment

Not needed at all	Not necessary	Generally not necessary	Neutral	Generally necessary	Necessary	Extremely necessary
1	2	3	4	5	6	7

---

17. Do you think that the application of **DSTS (Dismounted Soldier Training System)** is helpful for basic cadet training?

Description of DSTS

·The collective combat training program
·Soldiers replicate the motion with combat gears in a real battlefield environment, such as shooting or shooting- posture, stairs, and creeping.
·Enable training in a confined environment like real combat

Not needed at all	Not necessary	Generally not necessary	Neutral	Generally necessary	Necessary	Extremely necessary
1	2	3	4	5	6	7

18. Do you think that the application of **V-300® firearms training** is helpful for basic cadet training?

	V-300® firearms training description
	·The world's first 300-degree reality-based situational training environment ·Intense and immersive environment considers every detail, from the smallest pre-attack indicators to the most cognitive one ·Designed to teach, test, and sustain trainees' and officers' knowledge and skills based on the use of force and decision-making training

Not needed at all	Not necessary	Generally not necessary	Neutral	Generally necessary	Necessary	Extremely necessary
1	2	3	4	5	6	7

19. Do you think that the application of **MARS (Medium-range Assault Rifles-shooting Simulator), Rifle shooting training** is helpful for basic cadet training?

	Description of MARS
	·Precision shooting training environment in which real and virtual space are synchronized ·Provides a variety of shooting training environments ·Provide network-based shooting training function
	Description of Rifle shooting training ·Shooting training for individual soldiers

Not needed at all	Not necessary	Generally not necessary	Neutral	Generally necessary	Necessary	Extremely necessary
1	2	3	4	5	6	7

20. Do you think the application of **VR-based mental education** is helpful for basic cadet training?

	Example of VR-based mental education
	·Military police education for crime prevention

Not needed at all	Not necessary	Generally not necessary	Neutral	Generally necessary	Necessary	Extremely necessary
1	2	3	4	5	6	7

21. Do you think the application of **VR-based CBR(chemical, biological, radiological) training** is helpful for basic cadet training?

	Description of VR-based CBR
	· A Development of Education and Training Contents for Chemical Incident Response Based on Virtual Reality

Not needed at all	Not necessary	Generally not necessary	Neutral	Generally necessary	Necessary	Extremely necessary
1	2	3	4	5	6	7

22. Do you think the application of **VR Game training** is helpful for basic cadet training?

Description of VR Game Training
·Online first-person shooter game to promote military recruitment and provide an experience like actual military operations
·Help the promotion of mental health & well-being as well as provide a healthcare ·Simulation allows soldiers to maintain physical, cognitive, and social health even though they cannot join on the actual battlefield.

Not needed at all	Not necessary	Generally not necessary	Neutral	Generally necessary	Necessary	Extremely necessary
1	2	3	4	5	6	7

Constructive training: Training by virtual troops in a virtual environment (e.x. wargames)

23. Do you think the application of **ARCPX (Augmented Reality Command Post Exercise) and JLCCTC (Joint Land Component Constructive Training Capability)** is helpful for basic cadet training?

Description of ARCPX
·Command and control training system ·Operational training using AR/VR technology

			Description of JLCCTC

·The foundational constructive simulation toolkit for Army Warfighter Exercises, the active, reserve component, and National Guard units
· Army's Training Support System by providing the right levels of modeling and simulation resolution and fidelity

Not needed at all	Not necessary	Generally not necessary	Neutral	Generally necessary	Necessary	Extremely necessary
1	2	3	4	5	6	7

24. Do you think the application of **CoMap (Cognitive Map)** is helpful for basic cadet training?

Description of CoMap

·Give the commander information to make a cognitive decision
·CoMap has three different parts; 2D, 3D maps, 3D model of an urban area in Norrköping.
·Function to get information about specific objects or to change the field of vision to that specific place by clicking
·View from different angles, such as flying around and seeing everything from above or walking around on ground level.

Not needed at all	Not necessary	Generally not necessary	Neutral	Generally necessary	Necessary	Extremely necessary
1	2	3	4	5	6	7

25. Do you think the application of **scenario training (the former eagle training)** is helpful for basic cadet training?

Eagle Training: Conducting evacuation and combat drills assuming a real war situation

Description of scenarios training

·Emergency disaster management training VR training simulator developed by ETC Simulation Company
·Command and supervision training of commanders

Not needed at all	Not necessary	Generally not necessary	Neutral	Generally necessary	Necessary	Extremely necessary
1	2	3	4	5	6	7

26. Do you often use VR devices in games and/or aircraft simulations?

Never	Very Rarely	Rarely	Neutral	Occasionally	Frequently	Very Frequently
1	2	3	4	5	6	7

27. Describe opinions on the development direction of basic cadet training based on the application of LVCG.

<Expert Interview>
Demographic information

The questions in this section will help us better understand the survey participants. They will not ask for any identifiable information.

1. Age:

2. Gender

☐　　　Female

☐　　　Male

☐　　　Not to answer

3. Status

☐　　　Captain

☐　　　Major

☐　　　Lieutenant colonel or Lieutenant colonel (S)

4. Years served at the Republic of Korea Airforce

☐　　　Officers 1 ~ 5 years

☐　　　Officers 6 ~ 10 years

☐　　　Officers 11 ~ 15 years

☐　　　Officers over 16 years

5. Service period related to military training (flight instructor, basic cadet training, disciplinary officer, etc.)

☐　　　1 ~ 5 years

☐　　　6 ~ 10 years

☐　　　11 ~ 15 years

☐　　　over 16 years

6. The highest level of education

☐   University graduate

       Major:

☐   Graduate School (Masters)

       Major:

☐   Doctoral Degree

       Major:

7. Please give us any concerns or advice when applying LVCG training system to the basic cadet training at the Korea Air Force Academy.

> **LVCG (Live, Virtual, Constructive, and Game) generates a simulated environment in place of an actual battlefield or operational environment to indirectly experience real situations through virtual simulation. Military training with VR and aircraft operating simulation are representative examples.**

8. Your concerns and advice regarding the improvements (suggestions) of the LVCG presented in the previous questionnaire.

9. Do you often use VR devices in games and/or aircraft simulations?

Never	Very Rarely	Rarely	Neutral	Occasionally	Frequently	Very Frequently
1	2	3	4	5	6	7

APPENDIX B

: INSTITUTIONAL REVIEW BOARD APPROVAL

UNIVERSITY OF CENTRAL FLORIDA

NOT HUMAN RESEARCH DETERMINATION

February 16, 2023

Dear Yoojin Kwon:

On 2/16/2023, the IRB reviewed the following protocol:

Type of Review:	Initial Study
Title of Study:	Survey for improving the basic cadet training for changing environment: For candidate cadets, senior cadets, and training instructors participating in basic military training at the Republic of Korea Air Force Academy
Investigator:	Yoojin Kwon
IRB ID:	STUDY00005078
Funding:	None
Grant ID:	None
Documents Reviewed:	• HRP-250 - FORM - Request for NHSR.docx, Category: IRB Protocol; • Introduction of Survey(ENG).docx, Category: Other;

The IRB determined that the proposed activity is not research involving human subjects as defined by DHHS and FDA regulations.

IRB review and approval by this organization is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these activities are research involving human in which the organization is engaged, please submit a new request to the IRB for a determination. You can create a modification by clicking **Create Modification / CR** within the study.

If you have any questions, please contact the UCF IRB at 407-823-2901 or irb@ucf.edu. Please include your project title and IRB number in all correspondence with this office.

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UNIVERSITY OF CENTRAL FLORIDA

Sincerely,

Harry Wingfield
Designated Reviewer

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