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Decision Analysis Using Value-focused Thinking for Retention of Long-term Officers in the Korean Army

Jaebum Kim

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THESIS

Jaebum Kim, Captain, ROKA

AFIT-OR-MS-ENS-12-15

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

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Jaebum Kim, BS

Captain, ROKA

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Jaebum Kim, BS

Captain, ROKA

Approved:

// signed //	9 March 12
Dr. Weir, Jeffery D (Advisor)	Date
// signed //	9 March 12
Dr. Johnson, Alan W (Reader)	Date

Abstract

The attacks of Navy ship, Cheonan and Yeonpyeong Island, have deteriorated the relationship between North and South Korea. The death of Kim Jong Il resulted in unstable political situation in North Korea. South Korea has continued Military Reform to develop the retention and management of military personnel as one of the agendas. However, South Korea needs better methods and measures for evaluating personnel to distinguish qualified officers.

The purpose of this research is to improve the method of assessing long-term officers through the use of Decision Analysis principles, especially a Value-Focused Thinking approach. The value model was created based on the instructions of selecting long-term officers in the Korean Army. Individuals are evaluated by the model to retain qualified officers in the organization. The result of the model provides insight to the decision makers who are the best officers for the Korean Army and how officers are retained depending on their abilities.

To my family

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First and foremost, I would like to thank God, provided everlasting shelter and great joy every moment when I needed. I also appreciated my country to support me educationally and economically. Without Maj. Youngchul, Kim, I could not finish this long race.

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Jaebum Kim

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Chapter 1. Introduction

1.1 Background

North Korean Central News Agency announced Kim Jong Il's death on December 19, 2011 (M. o. Defense, Ministry of National Defense 2011). He dictated North Korea over eighteen years but North Korea remains one of the poorest countries in the world, with a per capita gross domestic product (GDP) of $1,900 (CIA 2009). His son Kim Jong-un is now expected to take over the key of the nuclear-armed Communist country, one of the most closed societies in the world. This raised serious concerns over the future of the country and stability in the Korean Peninsula.

North Korea has threatened South Korea for over half of a century. On November 22, 2010, North Korea fired dozens of shells at the South Korean island Yeonpyeong, killing two South Korean soldiers and setting off an exchange of fire in one of the most serious clashes between the two sides in decades(defense 2010). In March 2010, a South Korean naval vessel, the Cheonan, was sunk killing 46 sailors in the same area. Furthermore, an American nuclear scientist who visited the North said he had been shown a secret and modern nuclear enrichment facility. This provides evidence that there is the potential threat of nuclear weapons in the North Korea (Bruce E. Bechtol 2010). Overall, the many threats posed by North Korea's maritime demarcation line, nuclear weapons, and territorial disputes in Northeast Asia demonstrate that

the Korean Peninsula is one of the troubled areas in the world (M. o. Defense, Defense White Paper chapter 1 2011, 9).

On the other hand, Korean Ministry of Defense (MND) has continued Military Reform Basic Plan since 2009. The purpose of this reform is for the Korean Military to build the most elite troops in the future. There are many fields that Korean MND emphasizes for this goal. For example, R&D investment will be expanded from 5.6 to 7.4 percent of national defense expenditure, inventing the military system for network centric warfare (NCW), and procurement of military strength against North Korea's threat; Nuclear weapon and missile (M. o. Defense 2009). In military structure reform area, MND will improve the recruitment system to ensure expert personnel are secured and establish a customized personnel expertise resource system.

However, the Korean Army is experiencing a decline in military manpower caused by decreasing birthrate. It also confronts a growing demand for improved living conditions for officers and enlisted. Accomplishing the goal of military reform with current issues, an efficient recruit system and method is necessary to the Korean Army. Nevertheless, there is not specific mathematical model to estimate the quality of each officer.

1.2 Problem Statement

The purpose of this research is to improve the method that decision makers utilize to retain qualified long-term officers in the Korean Army. Currently, officials make decisions based upon subjective criteria when evaluating and selecting long-term Army officers. Therefore, it is necessary to develop a model to aid decision makers in their selection of qualified officers.

The evaluating of personnel has characteristics such as multi-objective, entangled, and highly biased if there is no precise method to assess. The multi criteria decision analysis method helps to determine each officer's qualification. Especially, Value Focused Thinking in Decision Analysis offers a way to analyze overall strategic values and to search and evaluate alternatives on the basis of these values. It is devised to find the value structure of decision makers by analyzing their objectives and to use those values in the search of creative alternatives and their evaluation (Keeney 1992, 4-44). In the South Korean Army, herein are many values that are emphasized. Based on these values, decision makers would like to obtain qualified long-term officers to fulfill the Korean Army objectives. Therefore, the use of the VFT for the retention of qualified long-term officers in the Korean Army is appropriate.

1.3 Thesis Overview

This research has four overall chapters. Chapter 2 explains the general retention issues in the world and the background of the Korean Army's retention issues. It also identifies the methodology applied to this thesis. In Chapter 3, 10-step VFT process is provided for improving a model to retain qualified long-term officers in the Korean Army. Deterministic and Sensitivity analysis are exercised in order to analyze the results and determine how robust the model is. At last, a recommendation related to retention problems and future researches are discussed in chapter 5.

1.4 Definition of Terms

Applicants – short-term officers who have worked in the Korean Army between lieutenant and captain.

Decision makers – this contains general officers in the Personnel Department of the Korean Army or interviewers who select long-term officers.

Long-term officers – officers who work at least 15years in the Korean Army. By a rank, this accounts for approximate half of officers over Lieutenant Col in the South Korean Army

Chapter 2. Literature Review

2.1 Chapter Overview

This chapter introduces the importance of retention in military forces over the world and provides the background of retention issues in the South Korea Army. Next, this research explains Decision Analysis as the primary method. The definition and advantage of Value Focused Thinking is proposed, then it illustrates the 10-step VFT Process to approach South Korea's retention problem of long-term officers.

2.2 Background

Militaries worldwide have tried to obtain qualified personnel to construct powerful forces. However, it is not easy to recruit and retain qualified people. Retention is not only one country's problem but every country's concern. On top of that, retention of qualified military personnel is a constant problem.

There were many problems in the North Atlantic Treaty Organization (NATO) countries. At the end of the Cold War, Belgian forces faced many challenging issues. Conscripted personnel in the military were decreasing, and the military hardly retained attributed personnel. Belgian forces had to downsize their organization in order to make it more efficient. Furthermore, keeping a single job is common in Belgium, and people disliked being part of combat units. Therefore, these reasons prevented the Belgian military from achieving its retention goals, and Belgian forces were unable to acquire and retain superb personnel in their military forces (LtCol Psych Francois Lescreve, Bert Schreurs 2007).

After the Berlin Wall fell, the Dutch armed forces also confronted some difficulties in retention. During the Cold War, they didn't have to be concerned about military retention. There were enough conscripts and volunteer military personnel. However, as the economy was developing quickly, people were not interested in selecting a military as their career. On top of that, armed forces had not established any measure or method to retain military personnel. Consequently, the proportion of military personnel returning to civilian society exceeded 30%. Many preventive measures were performed to decrease losses. Nevertheless, losses were still over 20% until 2002 (Mr. Cyril van de Ven, LCol Rik Bergman 2007).

Germany Federal Armed Forces (GFAF) had downsized after the two Germanys united. Their organization was suitable to be in charge of tasks of UN, NATO, and European defense policy. However, they also had problems retaining qualified officers. One incentive to being officers, the military gives officers the opportunity to study at one of the two GFAF academies. When these officers finished their duty, they were valuable human resources in civilian society. Even though they were offered a high education in the military, after their obligatory service was finished they did not want to volunteer for the military anymore. So retaining of these officers was a critical issue for GFAF personnel (E. Gerhard StormPh.D 2007).

In the United Kingdom, the Armed Forces also had a problem retaining qualified aircrews. They preferred civilian life and a higher salary to the stresses of military life and lower income. This results in an unstable readiness condition in the U.K. military forces (Dawn JohansenPh.D 2007).

United States are having a trouble to retain junior officers in the Army. Even though the Army made the largest investment for retaining junior officers, the retention of them is lowest. In FY

2009 cumulative continuation rates (CCRs)[1] for Army officers, about 30 percent of junior officers left the Army within five years. To make things worse, only 30 percent of them are expected to serve the Army after 20 years (Michael L. Hansen, Shanthi Nataraj 2011).

After the Korean War, the South Korea Army worked to recover from the ruins of warfare. They fortified the military forces and obtained foreign aid from the UN and the United States. The ROK-U.S. Mutual Defense Agreement was created to restrain another war and establish forces. As economic development is essential to constructing military forces, Korea had focused on economic advancing during 1960s. The 5 year plan for economic development was one of the measures used to progress the economy. However, there had been lots of North Korean's threats. For example, the raid of Blue House (The Korean Presidential Residence), seizure of USS Pueblo, and EC-121 shoot down incidents (SongCongressman 2011). In this situation, the South Korean Army could not create any personnel strategy or model to recruit and retain.

Nevertheless, there was not a critical problem to recruit and retain at that time, since South Korea has required service for all men. Moreover, there were military coups on April 16th, 1961 and Dec 12th, 1979. Because of these, many qualified personnel chose the military as their career until late 1980s. In 1988, the military government transferred authority to a democratic one. Many people at this time disliked the idea of a military career. Consequently, the South Korea Army began to have trouble recruiting and retaining qualified personnel. To make matters worse, research on retention methods of personnel had not been developed.

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[1] " Continuation rates reflect the proportion of officers on active duty at the beginning of FY 2009 who are still on active duty at the end of FY 2009."

In the 2010, the South Korea Army had developed quantitatively and qualitatively. For instance, approximately the South Korean Army is made up of 520,000 troops, 2,400 tanks, 5,200 pieces of field artillery, and 2,600 armored vehicles. Additionally, there are 200 multiple rocket launchers, 30 missiles, and 680 helicopters. Organized into the ROK Army Headquarters, three field army commands, the Aviation Operations Command, the Special Warfare Command, and units to support these commands, the ROK Army consists of 10 corps (Special Warfare Command included), 46 divisions and 14 brigades(Included Marine Corps) (M. o. Defense, 2010 White Paper Appendix 2010).

In spite of this quantitative and qualitative progress, it is still necessary to develop specific personnel strategy for retention of qualified people. As an example, chapter 3 of Military Reform Plan 2020 proposes a development of retention and management of military personnel as one of the agendas. President Lee announced the Ministry of Defense should be innovated throughout the military personnel strategy and management in the meeting of the Committee of National Security (departmentBlue 2010). Cyber warfare headquarters has encountered a similar personnel problem in the absence of appropriate computer programmer (ChoiHyeonsu 2011). Therefore, the South Korean Army should invent a creative screening model for retention of qualified personnel and the advance of the organization.

2.3 Decision Analysis

Decision Analysis (DA) is the method for helping decision makers considering not only the whole problem but their particular objective. Most DA problems are complex and hard to decide by hand, many devices have been made to assist making decision. Hence, DA suggests efficient measure to make complicated problems manageable and analyzed. Sometimes DA also

denotes important uncertainty as an objective to decision maker throughout a processing. Figure 1 shows a flowchart for the decision analysis process (Robert T. Clemen, Terence Reilly 2000, 1-11).

The first step is for the decision makers to figure out decision circumstances and to identify their objective in the situation. This level prevents people from having trouble distinguishing decisions or problems, and thus they treat the problem differently. Identifying a decision maker's objective in decision situation is an important first step and includes some speculation. Many scholars denote that figuring out the problem is the first step and then proper objectives to be used must be understood. However, Keeney argues the opposite (KeeneyRalph 1992, 4-9). He insists that allocating lots of time to identify the decision maker's values and objectives is much more appropriate.

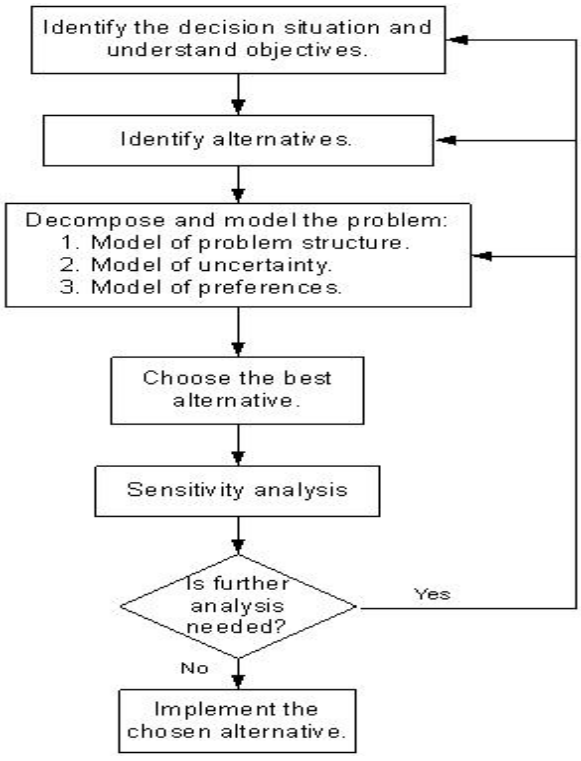


Figure 1 Decision Analysis Process Flowchart

In the next step, discovering and creating alternatives are performed. When decision makers analyze and examine precise objectives, they could find alternatives that were not obvious at first.

The next two steps concentrate on dissecting the problems to appreciate their structures and determining the uncertainty and value. These steps are often called “modeling and solution”. In first level of decomposition, it calls for organizing the problem in smaller and controllable pieces. Next the decision maker must give careful thought to the component of uncertainty in different parts of the problem or deliberate consideration about different aspects of the objectives (Robert T. Clemen, Terence Reilly 2000, 1-11).

The modeling in decision analysis is quantitative or analytical accesses to the problems. These models are mathematical and graphical in nature, making one to find discernment that may not be obvious on the exterior. Through the modeling, decision maker can figure out which alternative is superior to others. After a model has been established, sensitivity analysis is executed. “If we make a slight change in one or more aspects of the model, does the optimal decision change?” If so, decision would be sensitive to these little changes, and probably decision maker wish to reexamine more carefully those aspects to which decision is sensitive. The term “decision analysis cycle” is the best description of this overall iteration (Robert T. Clemen, Terence Reilly 2000, 6).

2.3.1 Multi-objective Value Analysis

Most decision problems do not have a single objective but need to help decision makers decide trade-offs between objectives. Multi-objective value analysis evaluates alternatives and

decides the most preferred alternative. This method is proper when there are multiple and conflicting objectives and no uncertainty about the consequence of each alternative.

To perform a multi-objective value analysis, it is necessary to determine a value function, which combines the multiple evaluation values into a single measure of the overall value of each evaluation alternative. Therefore, determining a value function requires that single dimensional value functions are specified for each evaluation measure and weights be specified for each single dimensional value function (KirkwoodCraig 1997, 53).

2.4 Value Focused Thinking

When people decide a particular problem, they usually focus on alternatives that are readily proposed or suggested. Hence, it is common that the decision problem is defined by its alternatives. Keeney refers to this method as Alternatives Focused Thinking (AFT). However, there are many problems with this process. First of all, it concentrates only on a selection of alternatives. Secondly, it's not proactive but reactive. And this method produces incorrect outcomes that do not satisfy the decision makers' objectives.

Values are important issues or objectives that an individual or organization cares about. For instance, they guide direction for decision making and the fundamental standard for the money and energy people expend thinking about decision. Value Focused Thinking (VFT) first specifies values that are important to decision makers and then, figures out how to achieve those values. It addressed the process from constraint-free creative thinking to structured approaches with quantitative and qualitative skill. Keeney discusses the value focused thinking in detail (KeeneyRalph 1992, 3-23).

In Figure 2, there are illustrated advantages of VFT. At first, VFT provides many ways to clarify subconscious values. This is essential to identifying the decision maker's hidden objectives. Once important values are specified, worthy information on alternatives is collected so that people can judge in terms of attainment of those values. So, this could eliminate unnecessary spending on time and effort. In VFT, the decision maker's objective drives the overall decision and prevents people from derailed direction which can arrive at incorrect output. There is a more detailed study of advantages in VFT (KeeneyRalph 1992, 24).

Figure 2 Advantage of Value Focused Thinking

Figure 3 shows the ten-step approach for executing VFT. This helps people learn techniques to build value hierarchies and understand mathematical blueprint. The following section figures out concise process of each step (ShoviakMark 2001).

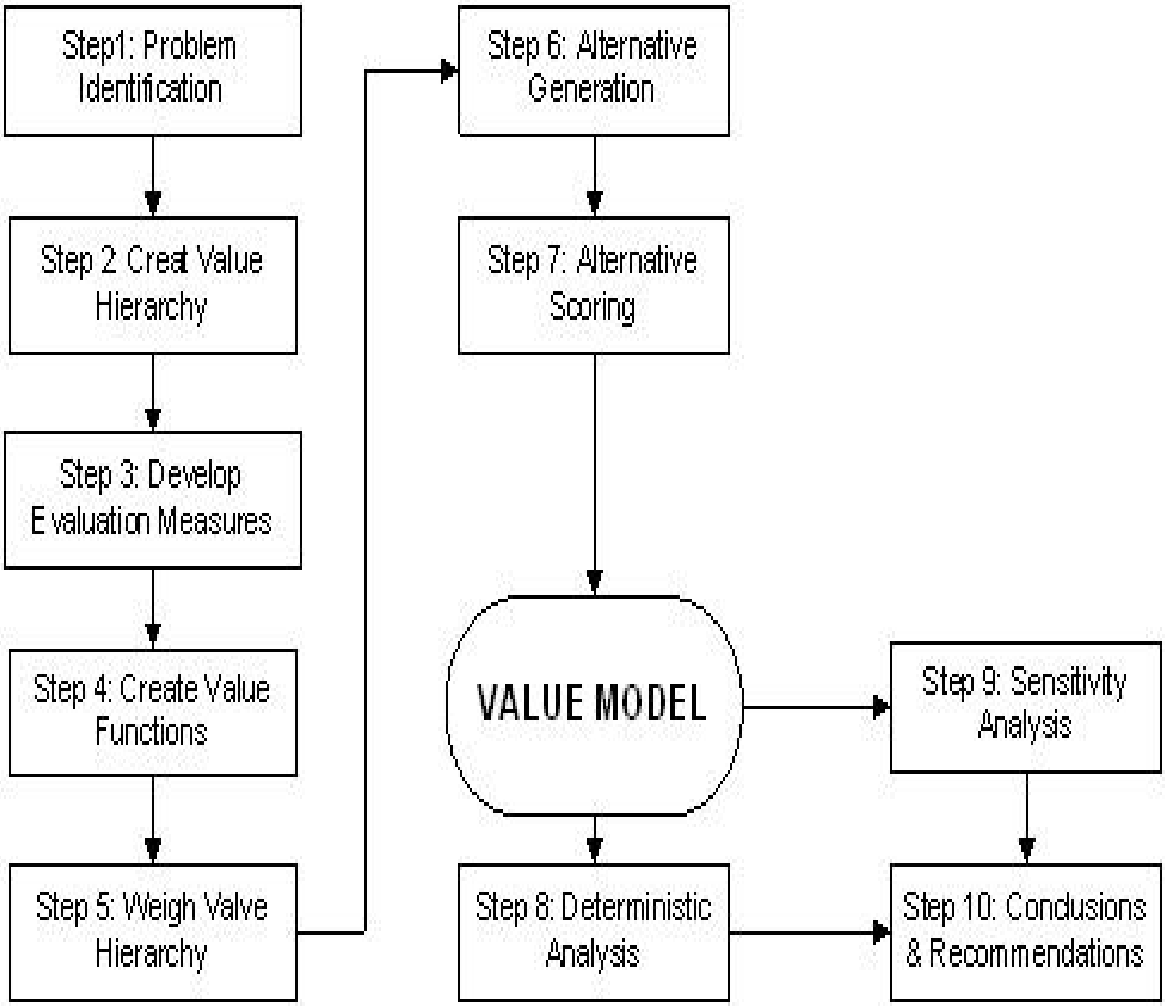


Figure 3 10-step approach VFT

2.4.1 Step-1 Problem Identification

This step is the fundamental part of decision making process to guide how people approach a decision problem. “What is the problem that we confront right now?” is the best description of this step. For example, the Environment Protection Agency is concerned about the recent figures of sulfur dioxide. In this case, people wish to identify how to manage sulfur dioxide (KirkwoodCraig 1997, 30).

2.4.2 Step-2 Create Value Hierarchy

When the decision problem is defined, the value that an individual or organization cares about are proposed. Value hierarchy is a "tree-like" structure of these suggested values (KirkwoodCraig 1997, 69).

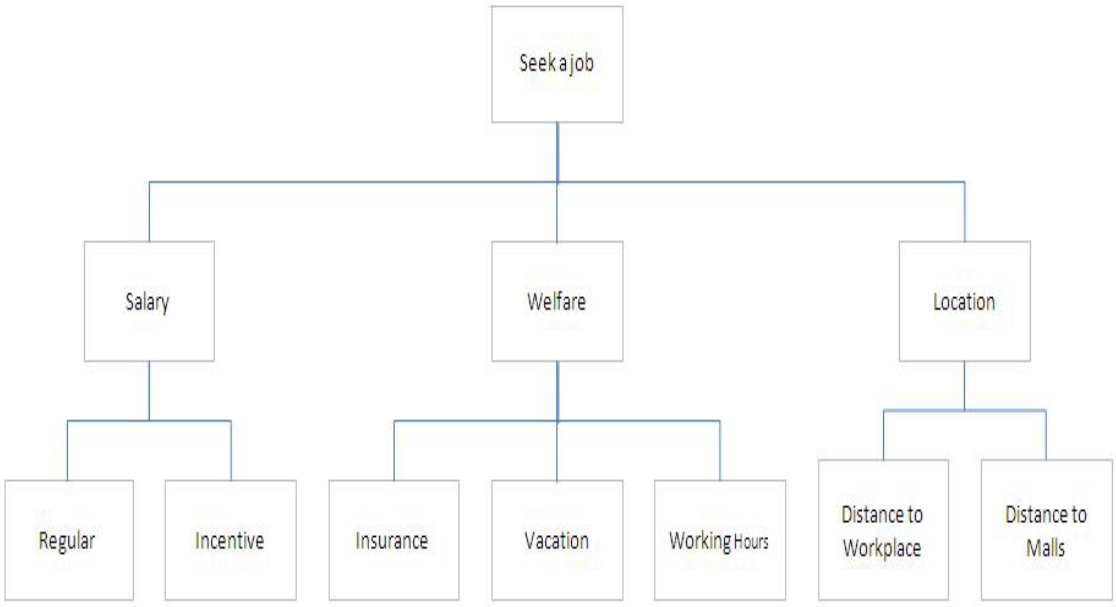


Figure 4 Value Hierarchy Example

However, some values are relatively more important to the decision maker. So, there is a need to figure out how to measure each value. To address this issue, it is necessary to suggest some terminology.

Evaluation consideration - This element is to evaluate importance of alternatives. For instance, when a graduate student wants to find a job, he compares each job's salary, welfare, and location. These criteria would be evaluation consideration for each job.

Evaluation measure - A measuring method for the level of achievement of an objective is an evaluation measure. “10 minutes commuting time” might be the evaluation measure for the above graduate student of obtaining a close location for a job.

Layer or tier - there are identical evaluation considerations from the top value in the value hierarchy. In Figure 4, for example salary, location, and welfare are positioned at the same layer.

Desirable Properties of Value Hierarchy – There are five properties which are desirable in value hierarchy. First, the evaluation considerations at each layer include all concerns to assess objective of decision (Completeness). Second, the evaluation consideration in the same tier should not be overlapped not to be misunderstood (Non-redundancy). Third, evaluation measures in the same tier should be comparable with each other to calculate the value (Decomposable). Fourth, Value Hierarchy should be understandable to users including decision makers and staffs (Operability). Last, when other conditions are same, smaller value hierarchy is better for the benefit of communication and evaluating (Small size). These properties are discussed more detail by Kirkwood (KirkwoodCraig 1997, 12-19).

2.4.3 Step-3 Develop Evaluation measures

Once value hierarchy is structured, evaluation measures should be quantified to evaluate achievement of objective. In this step, we develop value focused thinking from a subjective view to an objective point. Evaluation measure is classified into four different types of scale shown in Table 1. A natural scale can be recognized by people in general use. On the other hand, constructed scale is devised to measure alternatives in a particular decision problem. A direct scale can be used to evaluate achievement of objective, whereas a proxy scale represents

approximate method to measure attainment of the objective. In business area, lots of companies utilize Profit in dollars as natural direct scale which can be understood to everyone. Higher profit in dollars reflects more achievement in business. Gross National Product (GNP) was developed to represent how countries are economically well-being. Higher GNP indicates well-being country in economic view. It is well known concept to everybody. However, it does not represent directly how well country is economically. So, it is natural proxy scale.

Among winter Olympic Games, the players in figure skating are evaluated by examiners using constructed direct scale. They evaluate player scoring with adding all points of various level of movement. When some players played higher level motion, they obtain the good total score. The others have the poor total score, it represents that they did not achieve difficult motion, stable landing, or have mistakes during a competition. Letter grade in school exams is constructed proxy scale because some schools use 0.0-4.0 grade scale and the other schools utilize 0.0-4.3. On top of that, letter grade does not reflect a student's knowledge about the subject because he could obtain low grade if he has healthy issues such as flu (KirkwoodCraig 1997, 24).

Table 1 Types of Evaluation Measure Scale

	Direct	**Proxy**
Natural	Profit in dollars	Gross national product
Constructed	Points in Figure skating	Letter Grade in School

2.4.4 Step-4 Create Value Function

It is useful that modifying evaluation measures scale to grade with a value between 0 and 1, because people can compare each alternative with application of this value. In short, an alternative that has the most preferred scores have one value, otherwise decision maker does not prefer an alternative that has an overall value of one. However, when people convert scores of each evaluation measure, there is a problem caused by the number of units or scaling method. Kirkwood explains this in detail (KirkwoodCraig 1997, 56-60).

Single Dimensional Value Function (SDVF) is used to convert the score of the evaluation measure. There are three different types of SDVF. The first one is piecewise SDVF in Figure 5 and exponential SDVF is displayed in Figure 6. Lastly, categorical SDVF is shown in Figure 7. To determine the SDVF over the number of product evaluation measure in Figure 5, it needs to figure out the value gap between two evaluation measures. The lowest level $X_p = -4$ has zero value and the highest level $X_p = 5$ has one and the sum of all increment should be one. Then, the increment x between $X_p = 0$ and $X_p = 1$ is the smallest among evaluation measures. The increment from $X_p = -4$ to $X_p = 0$ is 5x, and the increment from $X_p = 1$ to $X_p = 5$ is 3x. Therefore, 5x+x+3x = 1, hence x = 0.11. Likewise this, decreasing piecewise SDVF can be calculated.

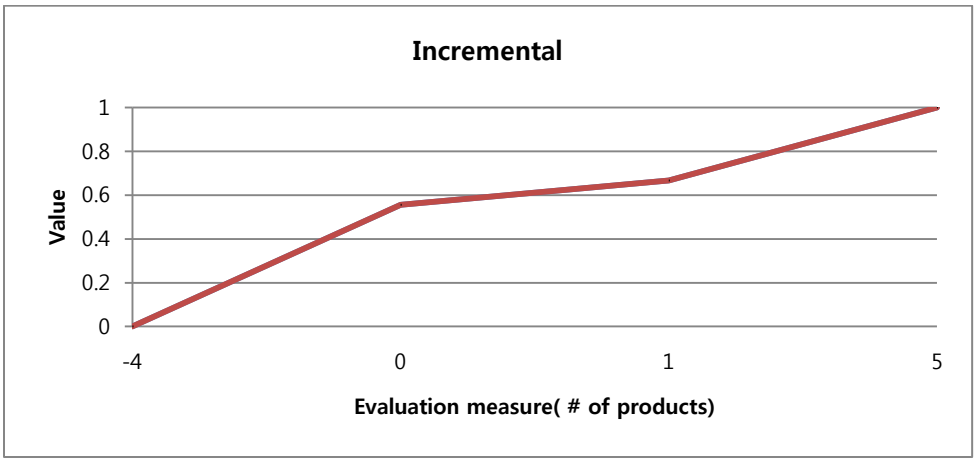
$V_p(-4) =$ 0.00 (The least preferred level) **(1)**

$V_p(0) = 0.00 + 5x = 0.00 + 5 * 0.11 = 0.55$ **(2)**

$V_p(1) = 0.00 + 5x + x = 0.00 + 5 * 0.11 + 0.11 = 0.66$ **(3)**

$V_p(5) =$ 1.00(The most preferred level) **(4)**

Exponential SDVF, otherwise, can be useful when it needs to determine the small amount of value increments between evaluation measures or infinite number of different levels among evaluation measures. Exponential SDVF is concluded upon the range of evaluation measures and a constant, the exponential constant ρ(rho). As Figure 6 shows that for the higher value of ρ, the SDVF is more curved and positive constant ρ makes SDVF bow upward, negative ρ has SDVF bow downward. The Equations (5) and (6) explain the exponential SDVFs in Figure 6 when the highest score is 11 and the lowest score is 1



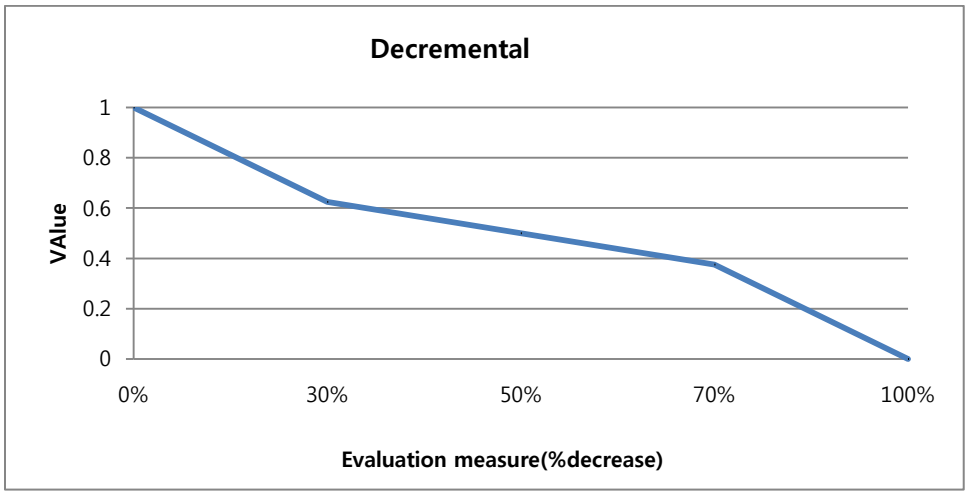
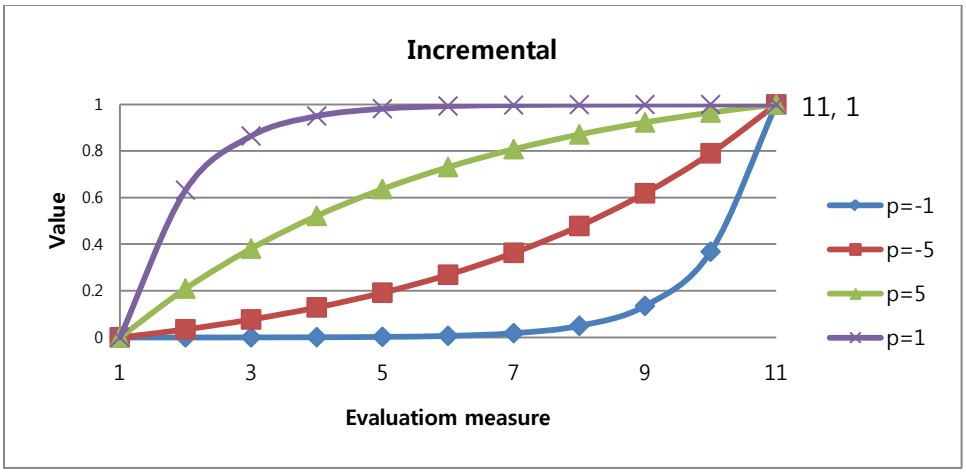


Figure 5 Piecewise SDVF



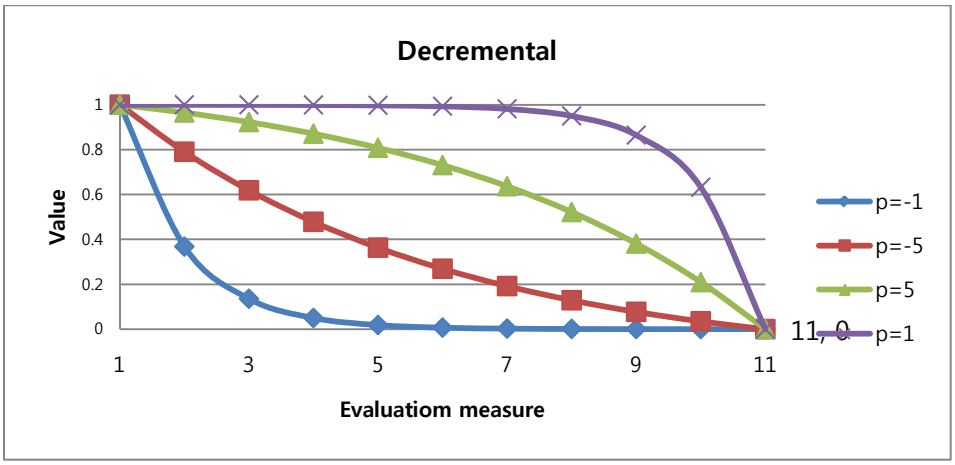


Figure 6 Exponential SDVF

Monotonically Increasing

$$V_i(X_i) = \begin{cases} \dfrac{1 - e^{\left[-\frac{X_i - X_i^L}{\rho i}\right]}}{1 - e^{\left[-\frac{X_i^H - X_i^L}{\rho i}\right]}} & , \rho_i \neq \infty \\ \dfrac{X_i - X_i^L}{X_i^H - X_i^L} & , \text{otherwise} \end{cases} \quad \textbf{(5)}$$

Monotonically Decreasing

$$V_i(X_i) = \begin{cases} \dfrac{1 - e^{\left[-\frac{X_i^H - X_i}{\rho i}\right]}}{1 - e^{\left[-\frac{X_i^H - X_i^L}{\rho i}\right]}} & , \rho_i \neq \infty \\ \dfrac{X_i^H - X_i}{X_i^H - X_i^L} & , \text{otherwise} \end{cases} \quad \textbf{(6)}$$

Where,

- X_i : Score of Alternative i
- ρ : exponential constant
- X_i^H: Highest Score
- X_i^L: Lowest Score

Categorical SDVF is appropriate when there is a distinct value increment between evaluation measures. For example, when a price of SUV varies from $20,000 to $50,000, customers who want to buy a new SUV can give each value as Figure 7 shown depending on the price. The applicants for long-term officer in the Korean Army can be distributed into different group upon their points, thus categorical SDVF is more proper for this research.

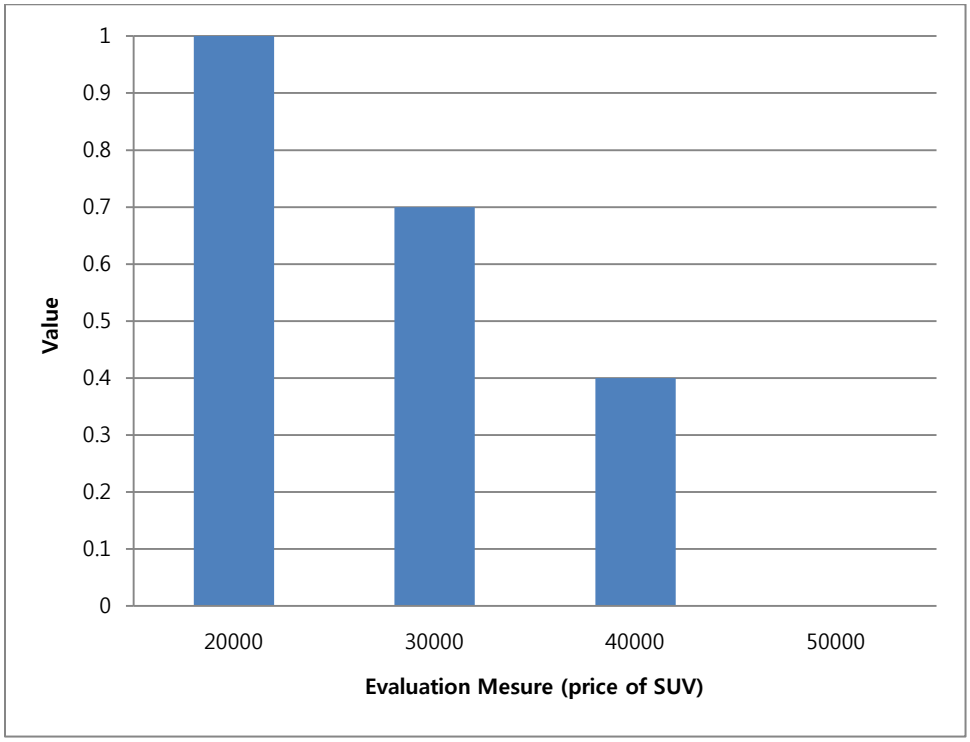


Figure 7 Categorical SDVF

2.4.5 Step-5 Weigh Value Hierarchy

The decision maker's preference is determined by the weighting of each evaluation measure. In value hierarchy, there are two weights; global and local weight. Global weights will sum to at the lowest tier of value hierarchy, while local weight measures sum to 1 at the particular branch/tier. Figure 8 shows an example of Local weight and Global weights are shown in Figure 9 (KirkwoodCraig 1997, 68-73). In Hierarchy Builder which is used as a main program in this research, there are three ways to determine weights, Direct Assessment, AHP pairwise comparison, and Swing weight matrix (WeirJefferey 2011). The Korean Army sets the weight for each value in instructions, so the Direct Assessment method is the proper weighting technique.

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Figure 8 Value Hierarchy with Local weights

Figure 9 Value Hierarchy with Global weight

2.4.6 Step-6 Alternative Generation

The alternatives are determined by the decision makers involved, but many people do not account for all of the alternatives available. Natural cognitive process prevents people from exploring creative alternatives. The initial alternatives that are derived for a certain situation are a production of the last alternatives. Sometimes people can find out an appropriate alternative: however it is difficult to discover this on their own. Thus, Value Focused Thinking helps people to choose the alternative which best fit the preferences of the decision maker. Keeney expands further on this issue (KeeneyRalph 1992, 198-225).

2.4.7 Step-7 Alternative Scoring

The scores of the alternatives with respect to values are a critical scale to identify the best alternative. In a mathematical view, this step focuses on the x-axis with value between 0 and 1 to examine alternatives. This step also requires collected data to compare the alternatives. It takes a

vast amount of time and money to accumulate valuable data. These data often turns out to be worthless for aiding the choice of alternatives. One reason for this is biased data that will result in bad criteria. So this step is a tedious and time-consuming process to explore the appropriate data. After acquiring reasonable data, each alternative is assessed by an evaluation measure.

Creating SDVF and weighting in the value hierarchy, and then value scores for each alternative can be calculated. The additive value function shown in Equation (7), assess the overall value including all evaluation measures in the hierarchy (KirkwoodCraig 1997, 230).

$$V_j(x) = \sum_{i=1}^{n} \lambda_i v_i(x_{ij}) \qquad (7)$$

Where,

- i : the evaluation measure
- j : the number of alternative
- λ_i : global weight for the evaluation measure i, $\sum_{i=1}^{n} \lambda_i = 1$
- $v_i(x_{ij})$: The single dimensional value function i of alternatives j
- $V_j(x) =$ the overall value score of alternative j

2.4.8 Step-8 Deterministic Analysis

By deterministic analysis, people can determine non-inferior alternatives among the generated alternatives. Mathematical methods can be used to find out dominant alternative with the combined score of evaluation measures and weight of alternatives (ShoviakMark 2001).

2.4.9 Step-9 Sensitivity Analysis

Sensitivity Analysis is a study about the consequences of altering the input upon the outcome of model. This step in VFT analyzes the effect on the ranking of alternatives of changes in different model assumption. There are two different components in sensitivity analysis; SDVF and weight. It is sometimes difficult to figure out a noticeable difference among alternatives when sensitivity analysis is applied in a single dimensional value function. On the other hand, weight varies depending upon different groups or decision makers. Hence it is used to accomplish sensitivity analysis in a value hierarchy. Customizable One-way Sensitivity Analysis (COSA) is employed to perform sensitivity analysis in this research (Chambal, S., Weir, J. D., Kahraman, Y., and Gutman, A. 2011).

$$W_s = W_s^o + \alpha_s \Delta x\,,\ W_i = W_i^o - \alpha_i \Delta x\,, W_u = W_u^o + \alpha_u \Delta x\ \ (s \in S, i \in I, u \in U) \quad \textbf{(8)}$$

$$\alpha_i = \frac{W_i^o}{\sum_{i \in I} W_i^o} \quad \textbf{(9)}$$

$$-W_s^o \ \leq \Delta x \leq \min\{\Delta x_i, \Delta x_i = \frac{W_i^o}{\alpha_i}\} \quad \textbf{(10)}$$

$$\sum_{s \in S}(W_s^o + \alpha_s \Delta x) + \sum_{i \in I}(W_i^o + \alpha_i \Delta x) + \sum_{u \in U}(W_u^o + \alpha_u \Delta x) = 1 \quad \textbf{(11)}$$

Where,

- W_s^o : The original value of the weight analyzed sensitivity analysis
- W_i^o : The original value of changing weights for sensitivity analysis
- W_u^o : The original value of the unchanging weights for sensitivity analysis
- Δx : The limit that sensitivity weight can be changed without affecting the relation among all weights.

2.4.10 Step-10 Conclusion & Recommendation

Once deterministic and sensitivity analysis are completed, the outcomes are suggested to the decision makers to identify the most preferred alternative. Even though value focused thinking is a useful method to present better alternatives to the decision maker, it still has some risk to produce biased results. Therefore, it is very important to suggest unbiased results to the decision maker to aid them in selecting the right decision. Furthermore, the tendency of decision makers could change the best alternative about uncertainty or risk.

2.5 Summary

The review of literature in this chapter provides an important basis for understanding Value Focused Thinking. In the research presented herein, Value Focused Thinking is applied to the South Korean Army Long-term officers' retention problem in answering the question of how to obtain and retain valuable personnel to improve the organization. The techniques discussed in chapter 2 are used to determine scores for each of the evaluation measures and weights. The next chapter presents a methodology that demonstrates intensified VFT as a tool for acquiring value of each of the alternatives.

Chapter 3. Methodology

This chapter describes the methodology that is used to solve the Korean Army long-term officers' retention problem. First of all, it explains the background of this research about retaining qualified officers in South Korea. Then, it builds a value hierarchy that belongs to this problem. In the next step, it concludes the evaluation measures and value functions applied. Finally, it determines a method to generate each alternative and analyzes the score of each alternative.

3.1 Background

There are four important values that South Korean Army focuses on when they retain long-term officers. Their value weights and score measures are different according to the rank of applicants. These values have evaluation measures to calculate each applicant's overall score. There is also a minimum guideline in criteria because the Korean Army requests qualified officers for their organization. This decision situation indicates that multi-criteria decision analysis with VFT is an appropriate methodology to apply to this research. This research categorizes applicants into two groups depending on their rank; Lieutenant and Captain. Then it uses personal data that each applicant has obtained in the Korean Army. Finally, it calculates each applicant's score and determines who the qualified officers are for the Korean Army. A 10 step process is used for elicitation of a big picture to understand mathematical underpinnings and study techniques to build value hierarchy (ShoviakMark 2001).

3.2 Step 1 - Problem Identification

This research explains “who are the qualified officers in the Korean Army?” Secondly it concentrates “which evaluation measure is more important to retain long-term officers?” There are two different groups divided by rank - Lieutenant and Captain. These groups each have alternatives which represent applicants for long-term officer in the Korean Army. Each applicant has a value of Working Evaluation, Commanders’ Opinion, Military Course Result, Evaluation of Other Quality. The total score is based on these values which show how this officer has worked in his base.

3.3 Step 2- Create Value Hierarchy

When VFT is used as the methodology, the first step in structuring the value hierarchy is figuring out DM’s values. This research builds the value hierarchy according to the Korean Army instructions and guidelines which are noted. The value hierarchy is developed utilizing Hierarchy Builder software invented by Dr. Jeffery Weir (WeirJefferey 2011) and is illustrated in Figure 10. Obviously Retention of Long-term officers was chosen as the overall value for the hierarchy. The first tier values are Working Evaluation, Commanders’ Opinion, Military Course Result, Evaluation of Other Quality. The second tier has 8 values which are evaluation measures to score each alternative. Each value in the hierarchy is explained in the following section.

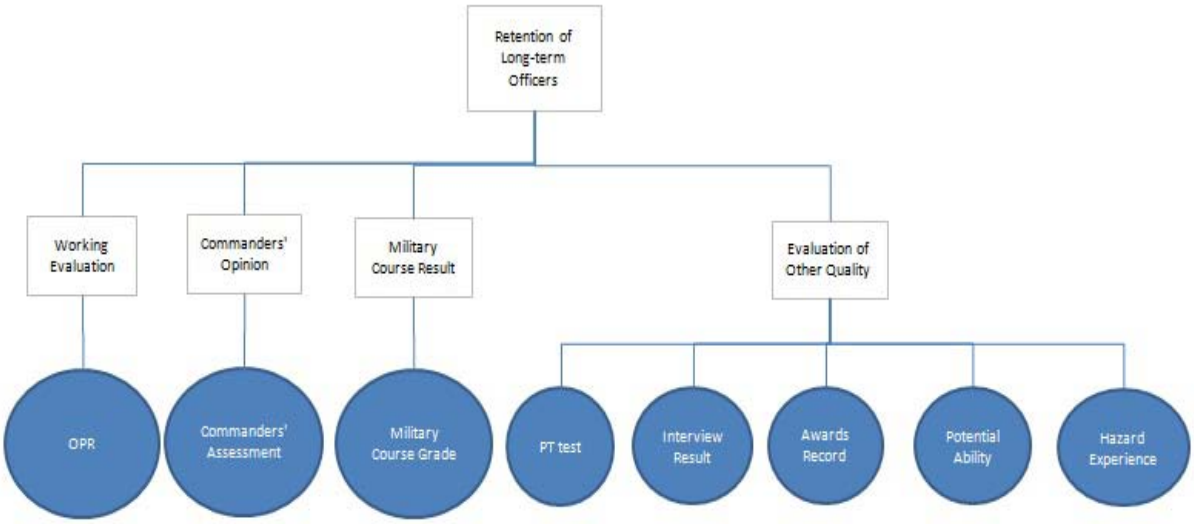


Figure 10 Retention of Long-term Officer Value Hierarchy

3.3.1 Working Evaluation

Working Evaluation is one of the most important values for retention of qualified long-term officers. It shows how each officer has worked in the Korean Army. So Working Evaluation is the criterion which determines one applicant's integrity while he works on a base. Working Evaluation is evaluated by superior officers and each applicant is assessed annually. Superior officers evaluate subordinate officers with a letter grade. This research assumed working evaluations performed differently depending on applicant's rank: lieutenants have three evaluations and captains have four. Appendix A : Description of Three major values explains how each applicant can be evaluated by the superior officer.

3.3.2 Commanders' Opinion

The Korean Army emphasizes commanders' opinion as equal in importance to working evaluation when they select long-term officers. However, the value of commanders is focused on one applicant comparison with other officers. For example, a company commander evaluates three platoon leaders and a battalion commander assesses nine platoon leaders. Likewise this,

applicant, who is a captain, is evaluated by a battalion commander with two other captains and assessed by regiment commanders with eight other captains. Herein commanders indicate company, battalion commanders for lieutenant applicants and battalion, regiment commanders for captain. Higher echelon commanders are more important since the Korean Army regards high ranker as more reliable and trustworthy when they evaluate subordinates. Commanders' Opinion is executed once when applicants apply for long-term officers in the Korean Army.

3.3.3 Military Course Result

Military Course Result is the third value in the value hierarchy for retaining long-term officers. Military course is important because all applicants have to finish regular military course and obtain a class score when they finish the course. There are three factors in the military course which consists of Military Course for Commission (MCC), Officer Basic Course (OBC), and Officer Advanced Course (OAC). MCC is a course that transfers a civilian man into a military officer. It consists of a firing exercise, close-order drill, bayonet drill, and individual battle drill and so on. OBC is a military course for qualified platoon leaders. There are combat drills for small units, tactical knowledge tests, and so on. OAC is a requirement for being a company commander. The purpose of this course is to discipline officers to be a company commander and staff of regiment troops. It has particular courses such as battalion and regiment combat, simulation exercises, operational discussion, proposal for combat development. As shown in Table 2, lieutenants can finish two courses; MCC and OBC, on the other hand, captains have to finish three courses before applying to be long-term officers. Every officer is given a military course result when they graduate from these military courses.

Table 2 Military Courses in the Korean Army

Lieutenant	Military Course for Commission (MCC)	Officer Basic Course (OBC)	
Captain	Military Course for Commission (MCC)	Officer Basic Course(OBC)	Officer Advanced Course(OAC)

3.3.4 Evaluation of Other Quality

Evaluation of Other Quality is the fourth important value in long-term officer value hierarchy. It represents the desires of the Korean Army for long-term officers' physical, logical and potential abilities. There are 5 evaluation measures in Evaluation of Other Quality value: a PT test, Interview Result, Awards Record, Potential Ability, and Hazard Experience. PT tests are fulfilled semiannually with push-ups, sit-ups and three-kilometer run. Interview results are qualification of the applicant's logical ability and power of eloquence. For awards record, every officer has an opportunity to receive awards from superior officers. Usually they are given once a year. There are a lot of components in Potential ability. For example, language skill, advance computer ability, or community service can be potential ability. Appendix B : Description of Evaluation of Other Quality value shows detail criteria of potential ability. Lastly, there are some regions which are very dangerous and far away. For example, the D.M.Z. (Demilitarized Zone) is one of the most hazardous areas in South Korea. When Korean officers work there, they cannot take enough TDY or vacation. So the Korean Army Headquarters have given an advantage to these officers when they apply for long-term officers. Officers in the Korean Army are in charge of their troops so they should be eligible to lead others where they pursue. For that reason, the Korean Army values Evaluation of Other Quality to each applicant.

3.4 Step 3 - Develop Evaluation Measures

In Step 3 of the VFT model building process, evaluation measures are developed to insure the evaluation achieves an objective. There are 8 evaluation measures in this model. Each measure is mutually exclusive and collectively exhaustive so that they are not affected by one and another and they should be contained every case of alternatives' score. Table 3 shows values, evaluation measures, scale type, lower bound, and upper bound of each measure in the value hierarchy. Lower bound is identified as the minimum standard for long-term officers in each evaluation measure. Likewise, higher bound is the highest score in that evaluation measure. The detailed definition of each measure is explained in Appendix A : Description of Three major values and Appendix B : Description of Evaluation of Other Quality value.

Table 3 Evaluation measures for VFT model

1st Tier Value	2nd Tier Value	Measure	Scale Type	Lower Bound	Upper Bound
Working Evaluation	OPR	Working Evaluation Score	Constructed Direct	30 % of Score	90% of Score
Commanders' Opinion	Commanders' Assessment	Commanders' Assessment Score	Constructed Direct	30 % of Score	90% of Score
Military Course Result	Military Course Grade	Total Score of Every Course	Constructed Direct	30 % of Score	90% of Score
Evaluation of Other Quality	PT test	Result of Tests	Constructed Direct	80% of every test	90% of every test
	Interview Result	% of group	Constructed Proxy	Top 70% of group	Top 5% of group
	Awards Record	# of Awards from superior officers	Constructed Direct	0.2(Lieutenant) 0.5(Captain)	2.4(Lieutenant) 3.0(Captain)
	Potential Ability	# of License, Record, or Score of Test/	Constructed Direct	0	1.7
	Hazard Experience	Existence of Hazard Area	Natural Direct	Non-Experienced	Experienced

3.5 Step 4 - Create Value Function

The next step in building the value hierarchy is creating value functions. Evaluation measures were changed into a single dimensional value function (SDVF). The SDVF, also called single attribute value function, is a standardized score of each evaluation measure into a unit-less value between 0 and 1 (KirkwoodCraig 1997, 61). The Hierarchy builder (WeirJefferey 2011) was utilized to create value functions in this research. Categorical type of SDVFs was used to make value function in this model, and SDVFs have increasing preferences or decreasing preferences depending on values. The objective of this research is to suggest the range of qualified long-term officers by score, therefore a categorical value function involves a group of people that belong in categories can be more reasonable than continuous value function. The example of Interview Result SDVF is displayed in Figure 11. The minimum acceptable measure score is within the top 70% of the group and the target one is the top 5% of the group in Interview Results. In accordance with this evaluation measure bound, category 1 is the most preferred Interview Result and category 5 is the least preferred of that. The rest of SDVFs for evaluation measures in the model are shown Appendix C : Total Value Score of Lieutenant Alternatives.

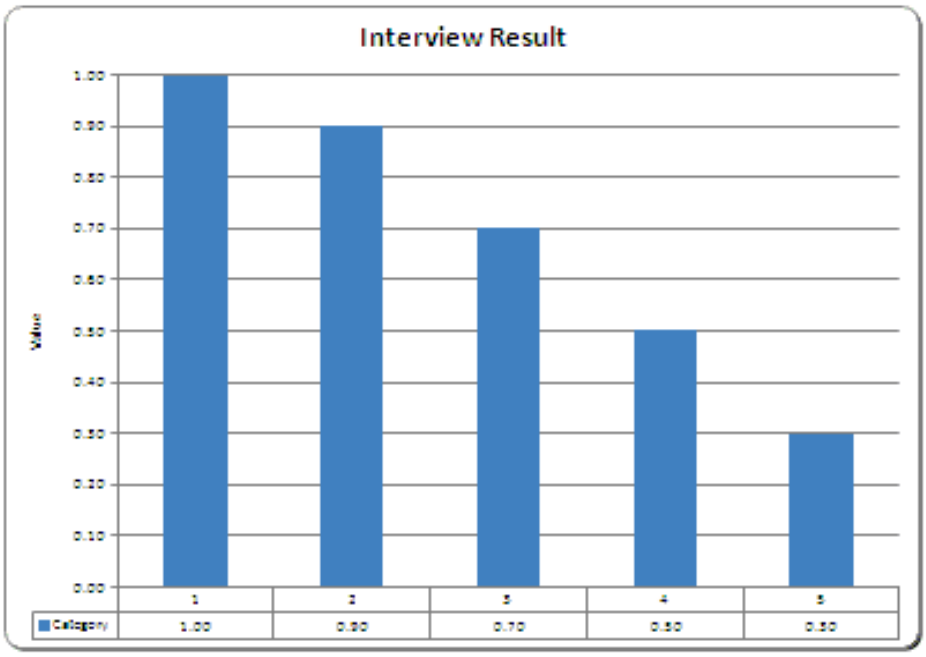


Figure 11 SDVF of Interview Result

3.6 Step 5 - Weigh Value Hierarchy

The allocation of weights to the evaluation measures is a very important phase that determines which measure is more critical to select a long-term officer. This research follows the Korean Army instructions about weight of each evaluation measure. This analysis uses Bottom to Top approach to figure out the global weight of each evaluation measures and values. Figure 12 and Figure 13show the weight of each value. However, the Korean Army instructions indicate the weight of value can be different depending on the alternatives' rank. For instance, in the highest portion of total value, captains are examined by Working Evaluation while Lieutenants are examined using the Commanders' Opinion. The fact is shown that captains can be evaluated more on what they achieve than lieutenants. The major three values in the value hierarchy such as Working Evaluation, Commanders' Opinion, and Military Course Result contain over 80% of global weight regardless of rank. The Evaluation of Other Quality is weighted 14%.

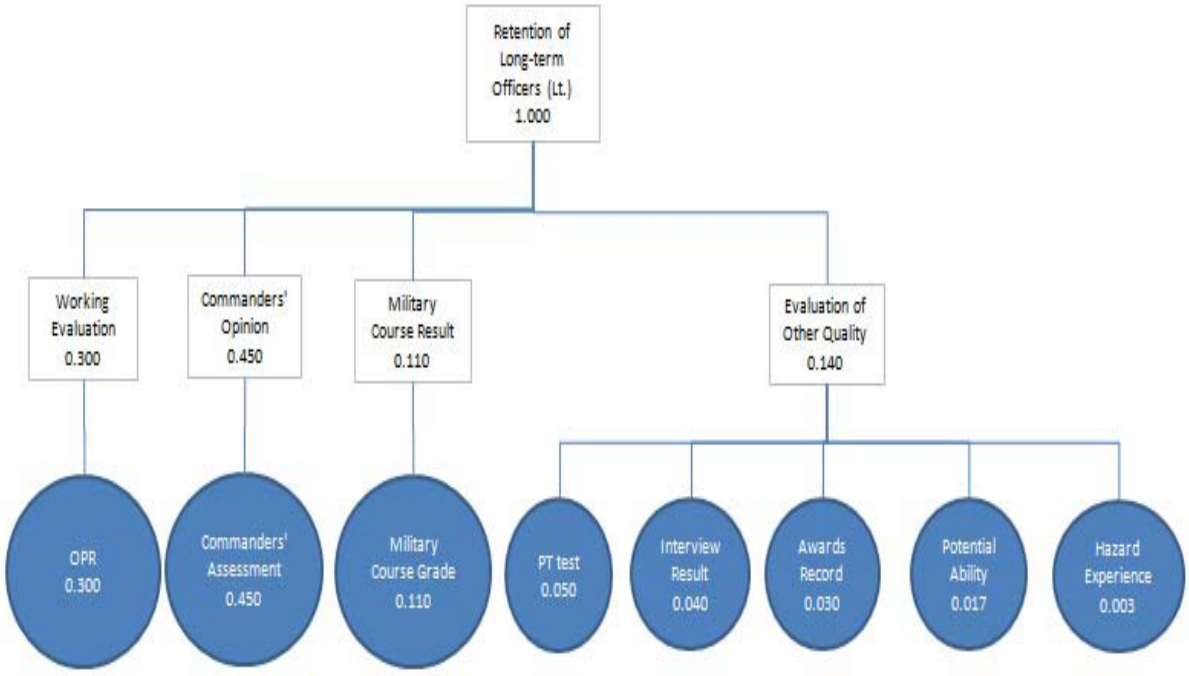


Figure 12 Global Weight for Value Hierarchy (Lieutenant)

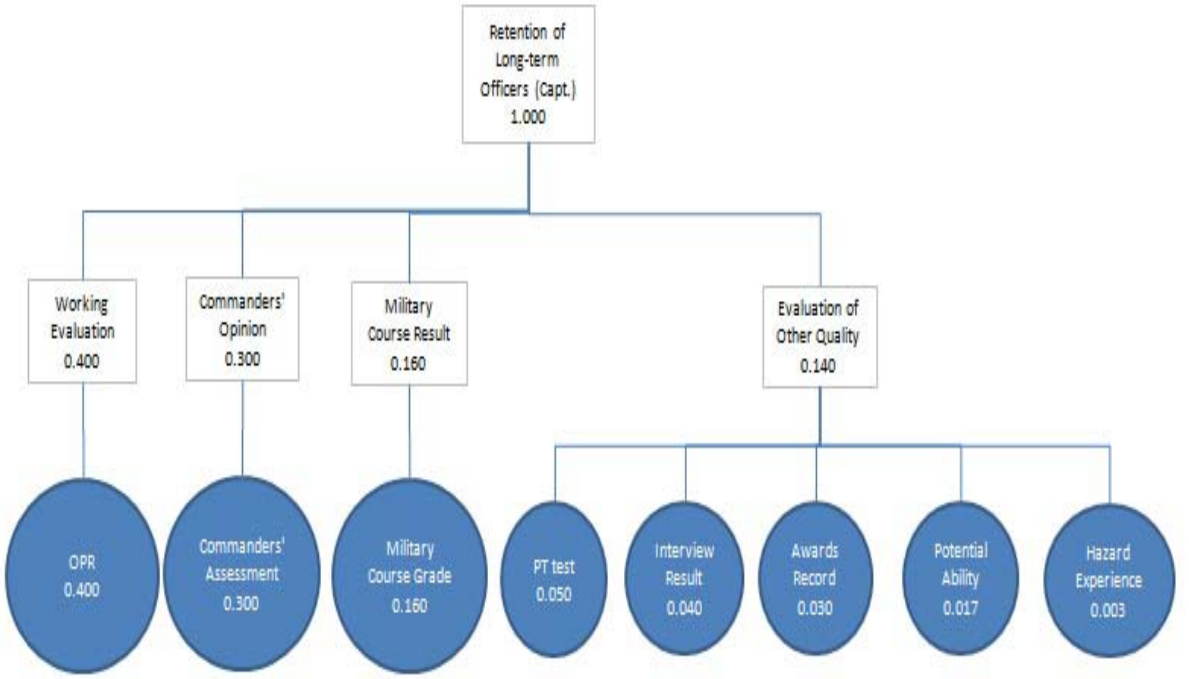


Figure 13 Global Weight for Value Hierarchy (Captain)

3.7 Step 6 - Alternative Generation

After weighting the value hierarchy, each alternative can be generated to obtain valuable data. Because personnel records are confidential in the Korean Army, this research generates alternatives considering a number of cases as shown in Figure 14. For example, each alternative has 4 categories of OPR evaluation measure and each category has 4 categories of Commanders' Assessment. All cases of alternatives can be calculated by multiplying all categories in Appendix A : Description of Three major values and Appendix B : Description of Evaluation of Other Quality value which are 62720 cases. However, this research does not need all combinations of each category which would have redundant data, thus herein are 40 alternatives selected to represent the whole data set.

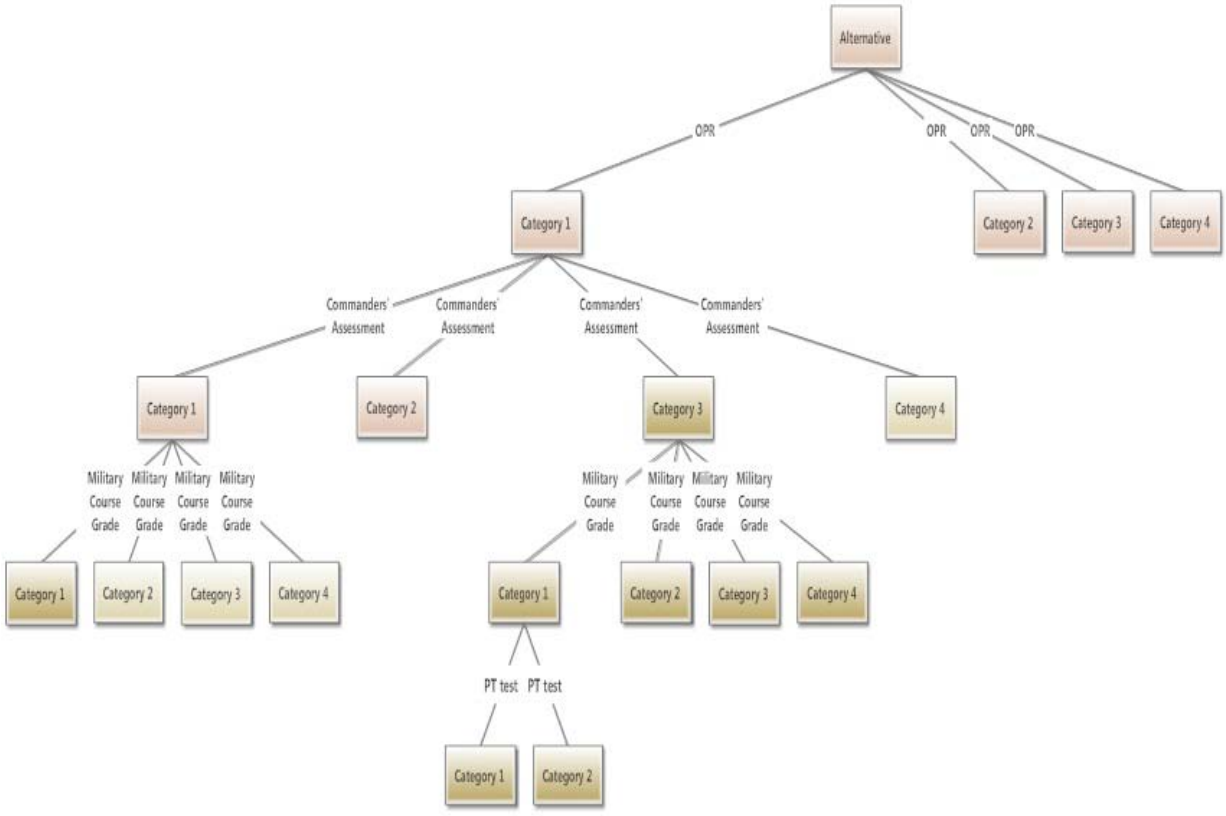


Figure 14 Alternative Generation Method

3.8 Step 7 - Alternative Scoring

Scoring the alternatives is Step 7 in the VFT process (ShoviakMark 2001). After each value SDVF determined and weighted, the following additive value function can be implemented to calculate overall score of each alternative:

$$V_j(X) = \sum_{i=1}^{n} \lambda_i v_i(x_{ij})$$

$$\text{Lieutenant } V_j(X) = 0.3v_1(x_{1j}) + 0.45v_2(x_{2j}) + 0.11v_3(x_{3j}) + 0.05v_4(x_{4j}) + 0.04v_5(x_{5j}) + 0.03v_6(x_{6j}) + 0.017v_7(x_{7j}) + 0.003v_8(x_{8j}) \quad \textbf{(12)}$$

$$\text{Captain } V_j(X) = 0.4v_1(x_{1j}) + 0.3v_2(x_{2j}) + 0.16v_3(x_{3j}) + 0.05v_4(x_{4j}) + 0.04v_5(x_{5j}) + 0.03v_6(x_{6j}) + 0.017v_7(x_{7j}) + 0.003v_8(x_{8j}) \quad \textbf{(13)}$$

Where,

- i : the evaluation measures $(1 = \text{OPR}, \ldots, 8 = \text{Hazard Experience})$
- j : the number of alternatives ($j = 1 \sim 125$ of Lieutenant, $j = 1 \sim 625$ of Captain)
- $v_i(x_{ij})$: The single dimensional value function i of alternatives j
- $V_j(X) =$ the overall value score of alternative j

These scores are input to the Hierarchy Builder software (WeirJefferey 2011) to create visual graph of each alternative. Each alternative is shown in order of overall value score in Appendix C : Total Value Score of Lieutenant Alternatives.

3.9 Summary

This chapter explained the implementation of Value Focused Thinking in this research to build a decision analysis tool for the retention of qualified long-term officers in the Korean Army. The detailed iteration performed in this thesis followed the AFIT 10-Step VFT process to figure out the outline. The current decision problem was identified; the value hierarchy built, developed evaluation measures, graphed SDVFs, weighted the value, generated and scored the alternatives. The deterministic and sensitivity analysis of the model are discussed in Chapter 4.

Chapter 4. Result and Analysis

4.1 Chapter Overview

This chapter describes the deterministic and sensitivity analysis for the forty alternatives to retain Korean Army long-term officers. Step 8 Deterministic Analysis in the Value Focused Thinking (VFT) process, is performed by calculating and examining the total score for each alternative to suggest insight to decision makers as to which values are more important in retaining long-term officers. Furthermore, this research analyzes evaluation measures which determine qualified and unqualified officers. In Step 9 of the VFT process, the sensitivity analysis is presented how each alternative's rank can be changed depending on DMs' variation of weights about values Sensitivity breakeven charts illustrate how the alternatives total value score change when DMs focus on different evaluation values and measures.

4.2 Step 8 – Deterministic Analysis

Each deterministic analysis is performed relying on the rank of the alternative: Lieutenant and Captain. Total scores are obtained by an additive value function in the value hierarchy model and displayed in chart to distinguish which value determines the ranking of alternatives. The comparison between selected and unselected officer are performed based on which value is significant.

4.2.1 Lieutenant Deterministic Analysis

Total value scores of Lieutenant's calculated by the model are shown and ranked in Appendix C : Total Value Score of Lieutenant Alternatives. Forty officers were selected among 125 officers to be representative. Table 4 is extracted from the total score of Lieutenant to

compare each alternative. The criterion of selected officers is greater than 0.7 in total value score. Blue and green cells indicate officers who obtain the same value in three major values but officers are divided into different ranks. This phenomenon happens in both lower score (blue cells) and higher score (green cells). Red cells identify that the average score of three major values is 0.7, but it is not retained since Evaluation of Other Quality score is not as high as other selected officers.

Table 4 Total Value Score of Lieutenant

Alternatives	Commanders' Assessment	OPR	Military Course Grade	PT test	Interview Result	Awards Record	Potential Ability	Hazard Experience	Total	Sum*	Normalization*
officer41	0.225	0.09	0.033	0.045	0.012	0.015	0	0	0.42	0.348	0.404651
officer7	0.225	0.09	0.033	0.05	0.012	0.003	0.0119	0	0.4249	0.348	0.404651
officer32	0.225	0.09	0.033	0.045	0.012	0.009	0.017	0.003	0.434	0.348	0.404651
officer52	0.225	0.09	0.033	0.05	0.02	0.009	0.0119	0.003	0.4419	0.348	0.404651
officer16	0.225	0.09	0.033	0.05	0.028	0.015	0.017	0.003	0.461	0.348	0.404651
officer61	0.225	0.09	0.033	0.05	0.04	0.015	0.0119	0	0.4649	0.348	0.404651
officer2	0.315	0.21	0.077	0.045	0.02	0.003	0.0017	0.003	0.6747	0.602	0.7
officer13	0.45	0.15	0.033	0.05	0.012	0.015	0.017	0	0.727	0.633	0.736047
officer22	0.45	0.15	0.033	0.05	0.02	0.021	0.0051	0.003	0.7321	0.633	0.736047
officer49	0.45	0.15	0.033	0.05	0.012	0.03	0.017	0	0.742	0.633	0.736047

*This represents three major values' summation and normalization

The diagram in Figure 15 shows the difference between unselected Officer 2(yellow bar) and selected Officer 22(orange bar). Officer 2 does not obtain the score 0.031 in three major values compare with Officer 22. However, if Officer 2 has as a good value as Officer 22 in Evaluation of Other Quality (0.00991), he can be retained as long-term officer (0.7011).

Consequently, he did not do well in PT Test, Awards, and Potential Ability so, he cannot be selected.

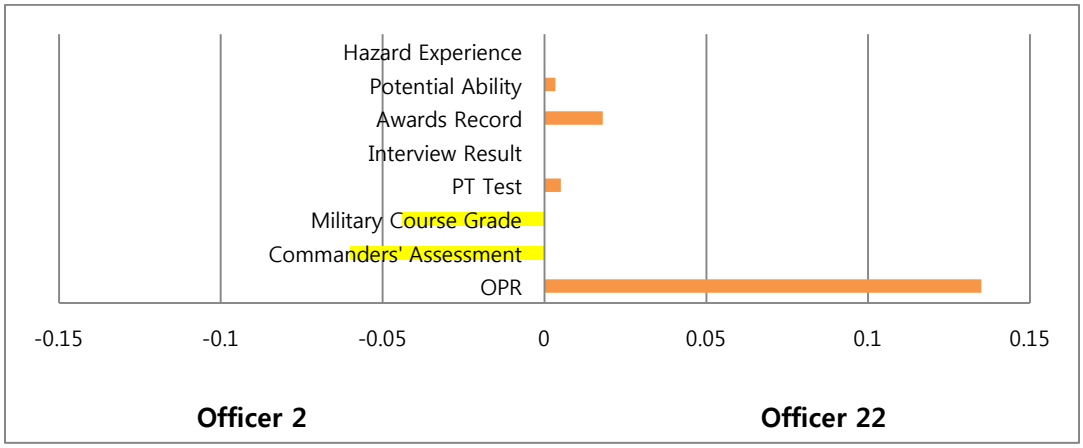


Figure 15 Comparison between Lieutenant Officers 2 and 22

Total value score differences among officers in green cells are shown in Table 4. Three officers have the same score of three major values as 0.633. Nevertheless they have a different rank in total score. This indicates how the value model can distribute each officer into different group with precise measure. In green cells, which evaluation measures determine the rank is displayed in Figure 16 and Figure 17. Officer 13 is blue bar and Officer 49 is green bar in the chart. Only the difference in Awards Record determines the ranking of two officers.

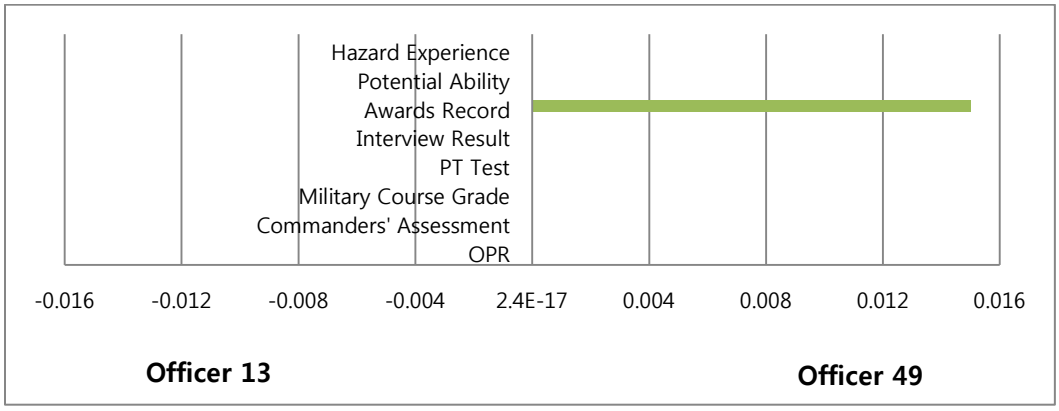


Figure 16 Comparison between Lieutenant Officers 13 and 49

On the other hand, when Officer 22(purple bar) and 49(Green bar) are compared in Figure 17, Officer 22 obtained more value in Interview Result and Hazard Experience, while Officer 49 has a higher quality in Potential Ability and Awards Record. These differences determine the rank of two officers.

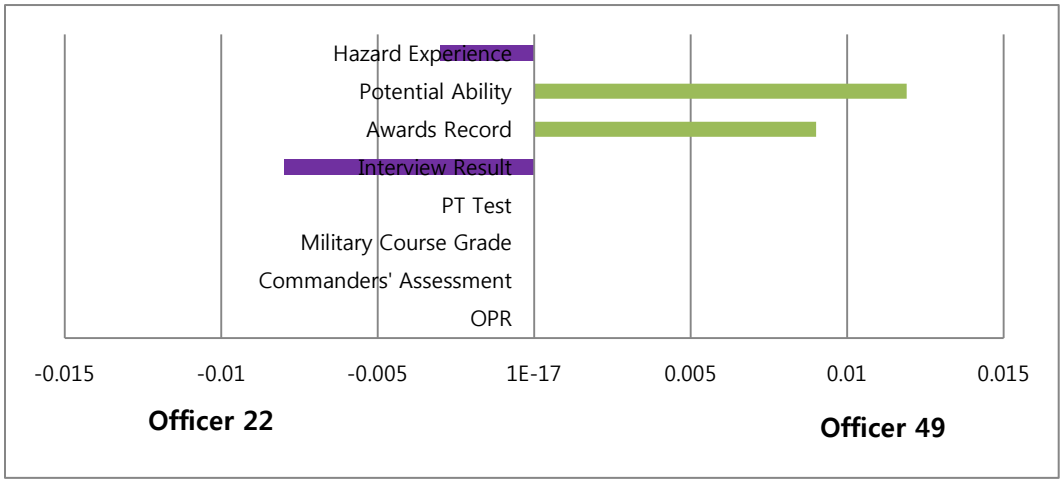


Figure 17 Comparison between Lieutenant Officers 22 and 49

Figure 18 displays the total score of all alternatives in Lieutenant. Most of the selected officers have higher three major values equally and obtain qualified subjective value in Evaluation of Other Quality. However, Evaluation of Other Quality can be a more important value than Military Course Grade in the chart. This indicates applicants who want to be selected officers should retain both three major values score and Evaluation of Other Quality value score in the model.

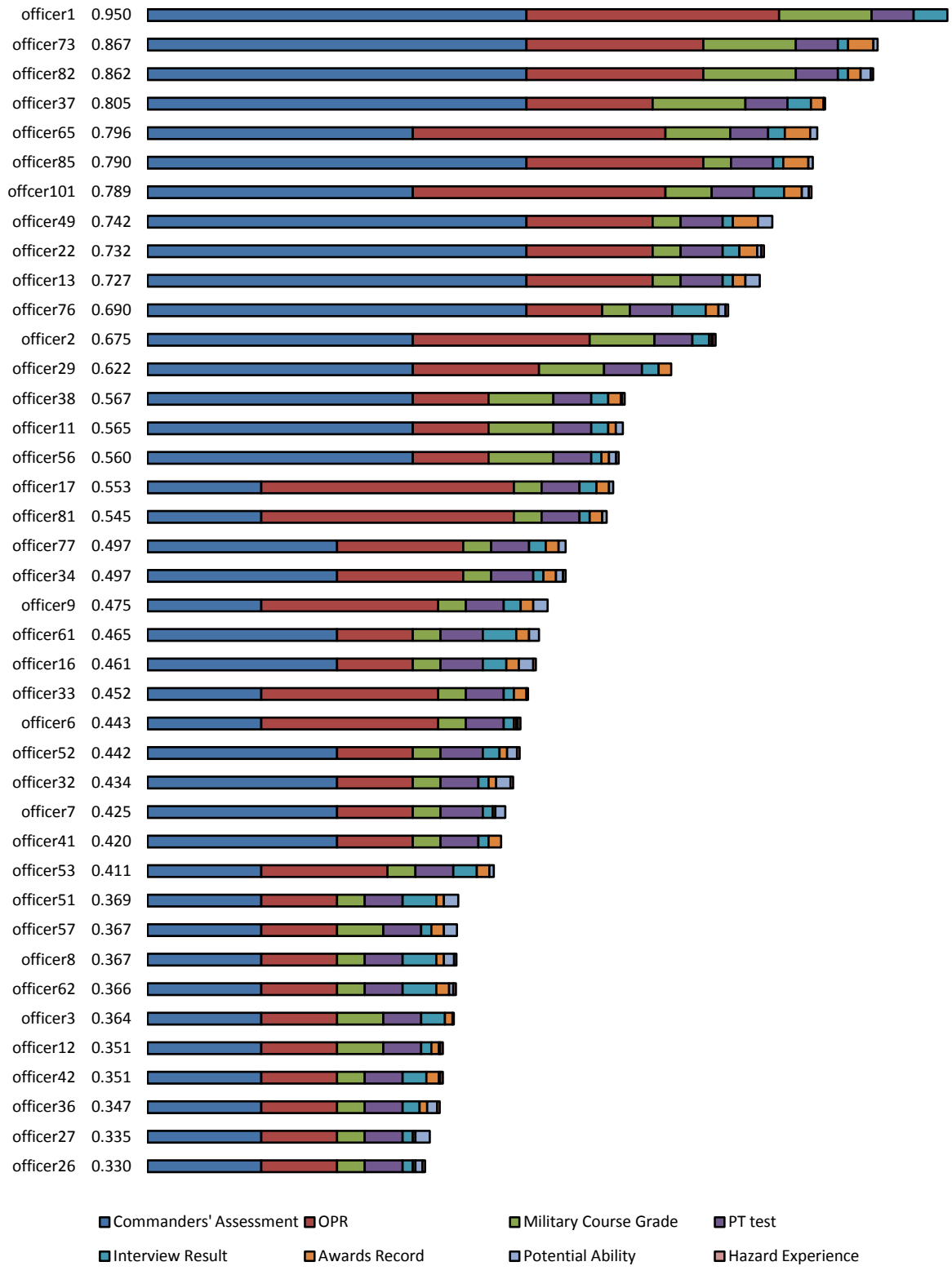


Figure 18 Lieutenant Applicants of Long-term officers in value order

4.2.2 Captain Deterministic Analysis

Total value scores of Captain calculated by the model are shown and ranked in Appendix D : Total Value Score of Captain Alternatives. The forty officers were selected among 625 officers to represent a specific case. Blue and green cells have the same definition of Lieutenant's. Yellow cells show the comparison officers who are lower than the other officer in three major values but they have the better values of total score in Table 5.

Table 5 Total Value Score of Captain

Alternatives	OPR	Commanders' Assessment	Military Course Grade	PT test	Interview Result	Awards Record	Potential Ability	Hazard Experience	Total	Sum*	Normalization*
officer53	0.2	0.09	0.048	0.045	0.02	0.009	0.0051	0	0.4171	0.338	0.393023256
officer297	0.2	0.09	0.048	0.045	0.028	0.021	0	0	0.432	0.338	0.393023256
officer386	0.2	0.09	0.048	0.045	0.04	0.015	0.0051	0.003	0.4461	0.338	0.393023256
officer93	0.2	0.09	0.048	0.045	0.036	0.027	0.0119	0	0.4579	0.338	0.393023256
officer496	0.12	0.3	0.112	0.05	0.012	0.03	0.0017	0.003	0.6287	0.532	0.618604651
officer100	0.12	0.3	0.08	0.05	0.036	0.03	0.0153	0.003	0.6343	0.5	0.581395349
officer389	0.28	0.21	0.048	0.045	0.02	0.027	0.0119	0	0.6419	0.538	0.625581395
officer513	0.4	0.09	0.048	0.045	0.036	0.027	0	0	0.646	0.538	0.625581395
officer31	0.12	0.3	0.16	0.05	0.028	0	0	0	0.658	0.58	0.674418605
officer442	0.12	0.3	0.112	0.05	0.04	0.027	0.017	0.003	0.669	0.532	0.618604651

*This represents three major values' summation and normalization

The diagram in Figure 19 shows Officer 496(red bar) and Officer 100(blue bar). Even though Officer 100 has a lower Military Course Grade in three major values than Officer 496, he has better Interview Result and Potential Ability in objective point. So, Officer 100 is a higher ranker in Total Score. This result happens between Officer 31(Purple bar) and Officer 442(Green bar) is given in Figure 20

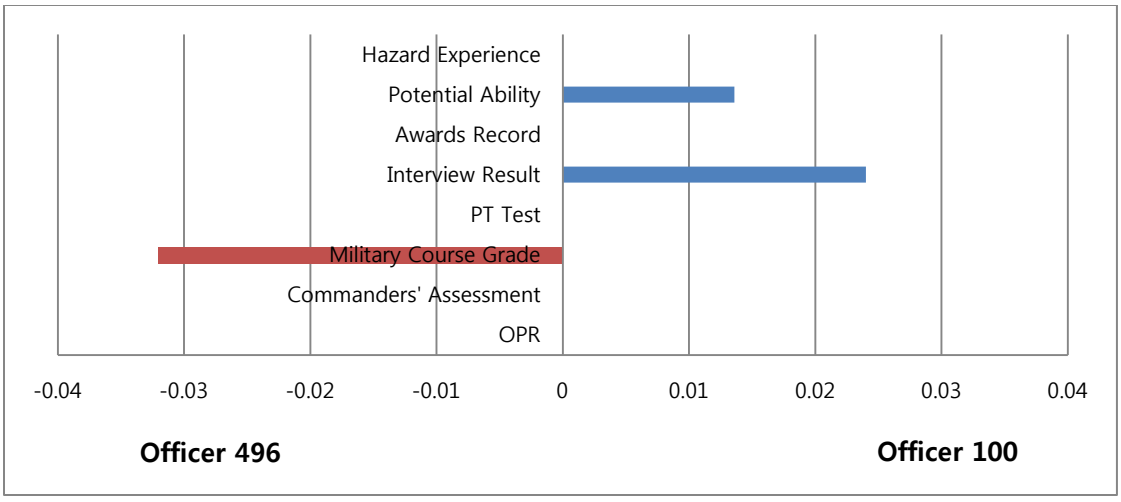


Figure 19 Comparison between Captain Officers 496 and 100

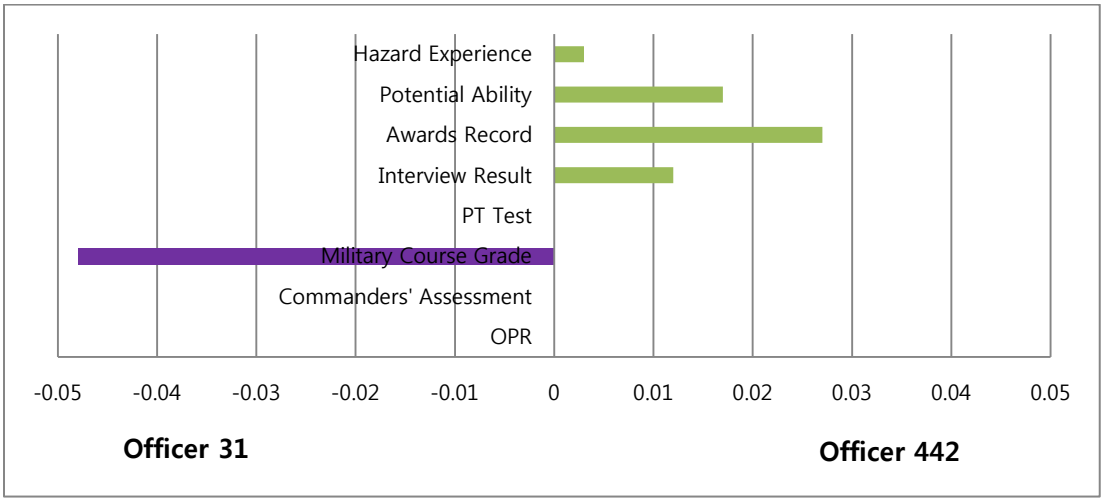


Figure 20 Comparison between Captain Officers 31 and 442

Similar to the comparison of Lieutenant Officers 2 and 22, Officer 581 and 10 are the example of which values are important between selected and unselected officers. Table 6 shows the total score of each alternative. The comparison between Officer 581(Aqua bar) and 10(Black bar) is displayed in Figure 21. This bar chart represents the example of which evaluation measures are significant to determine qualified officers in Captain. Officer 10 has only a 50% OPR value compared with Officer 581. This would be critical disadvantage to applicants who

want to be long-term officer in the Korean Army. However, Officer 10 compensates this defect with equally higher score of other values. This result indicates officers who do not obtain specific values, they can still be selected if they keep working hard to acquire qualified values.

Table 6 Total Value Score Officer 581 and 10

Alternatives	OPR	Commanders' Assessment	Military Course Grade	PT test	Interview Result	Awards Record	Potential Ability	Hazard Experience	Total	Sum*	Normalization
officer581	0.4	0.15	0.048	0.045	0.012	0.027	0.0051	0	0.6871	0.598	0.695348837
officer10	0.2	0.3	0.112	0.05	0.028	0.015	0.017	0.003	0.725	0.612	0.711627907

*This represents three major values' summation and normalization

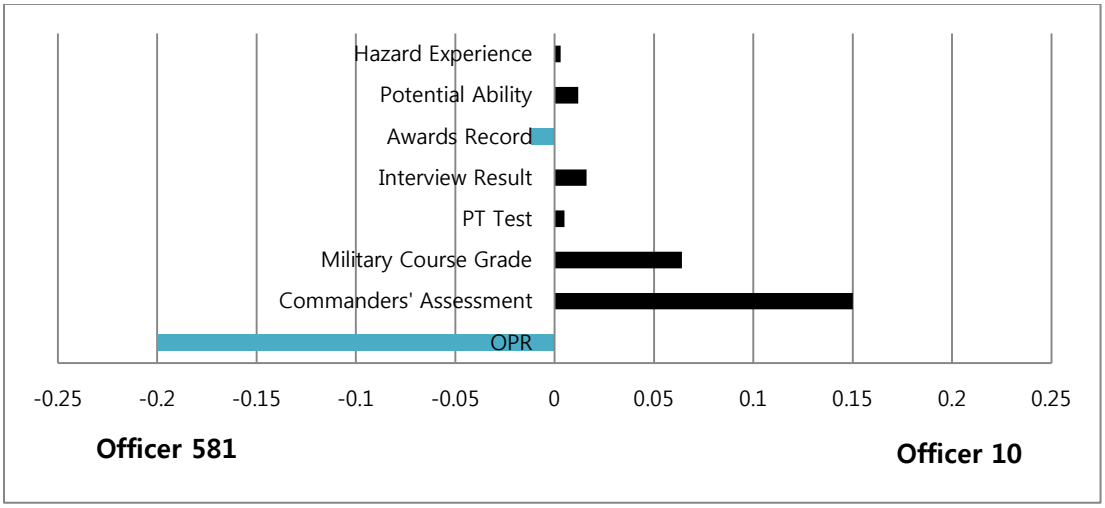


Figure 21 Comparison between Captain Officers 581 and 10

Figure 22 shows how each alternative can be retained and which evaluation values and measures are important in selection of long-term officers. As in the Lieutenant case, the important thing is in retention of Korean Army long-term officers that three major values should be obtained equally, furthermore Evaluation of Other Quality which is still significant as the fourth highest value in the model.

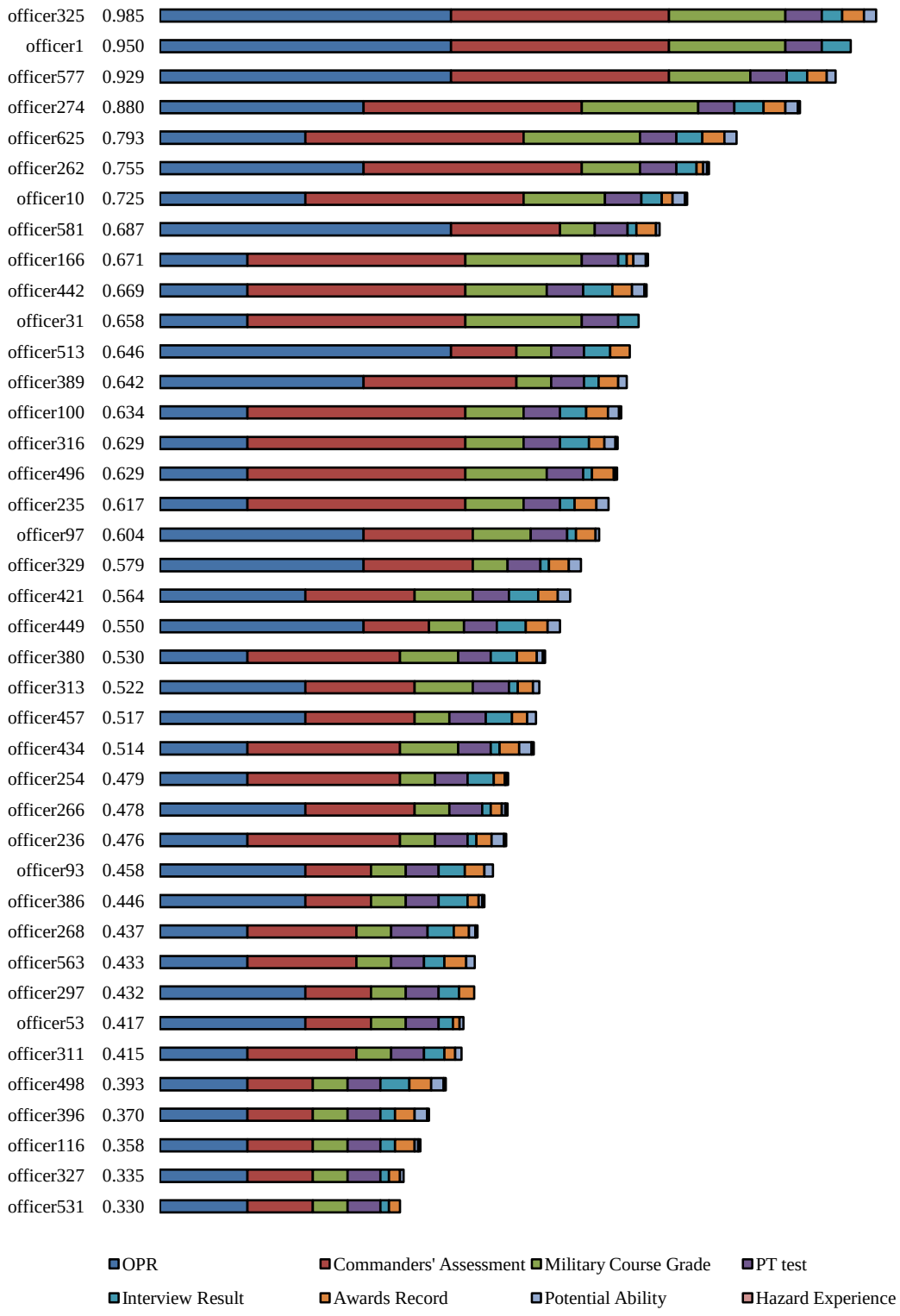


Figure 22 Captain Applicants of Long-term officers in value order

4.3 Step 9 – Sensitivity Analysis

In sensitivity analysis, DMs can change the weight of values or measures in the value hierarchy to understand the impact on total score of the alternatives. On the contrast, the criterion of selected long-term officer is 0.7 in deterministic analysis, top thirty percentage of group (twelve officers) is selected to determine the robust of the model in sensitivity analysis. The weight of a value is varied from zero to one to demonstrate how much effect it has on the ranking of the officers while other weights are stationed proportionally. Three major values have the same weight as their evaluation measures and Evaluation of Other Quality consists of five evaluation measures. The variation of weight is ±0.1 for three major values, ±0.001 for Hazard Experience, and the rest of evaluation measures are varied by ±0.01. Customizable One-way Sensitivity Analysis (COSA) is applied to display the impact of a changing weight in total score on breakeven charts (Chambal, S., Weir, J. D., Kahraman, Y., and Gutman, A. 2011).

4.3.1 Sensitivity Analysis of OPR

OPR is the second highest weighted evaluation measure in the model for Lieutenant's model (30%) and the highest weighted in Captain's (40%). Sensitivity analysis is performed varying the weight ±0.1. In Figure 23 and Figure 24 are the breakeven charts for the sensitivity analysis of the OPR measure. There is no significant change when the weight is varied in the breakeven chart of Lieutenant. However, when the weight given OPR was changed to 0.5, Officer 17 and 81 were selected officers and Officer 22 and 76 are restricted for long-term officers. In the case of captains, the baseline weight is 0.4 which has Officer 325, 1, 577, 274, 625, 262, 10, 581, 166, 442, 31, and 513 were retained as long-term officers and Officer 389, 100, 496, and 97 were not selected. Officers 513 and 581 were not selected, Officer 100 and 496

were selected officers when the weight is 0.3. Officers 31 and 442 were not selected, Officer 97 and 389 were selected when changing the weight to 0.5.

From this analysis, the model for Lieutenant is robust depending on sensitivity analysis about OPR. On the other hand, when DMs select long-term officers for Captain, there is a 16% change of retention officers, so OPR evaluation measure was considered sensitive to both increasing and decreasing weight. Sensitivity analysis for Lieutenant does not give a significant suggestion to DMs because there is no change of selected long-term officers regardless of changing of evaluation measures. So, the rest of the breakeven charts for Lieutenant are displayed in Appendix F : Lieutenant Sensitivity Analysis Graph and the following section in detail about sensitivity analysis on Captain's Commanders' Assessment.

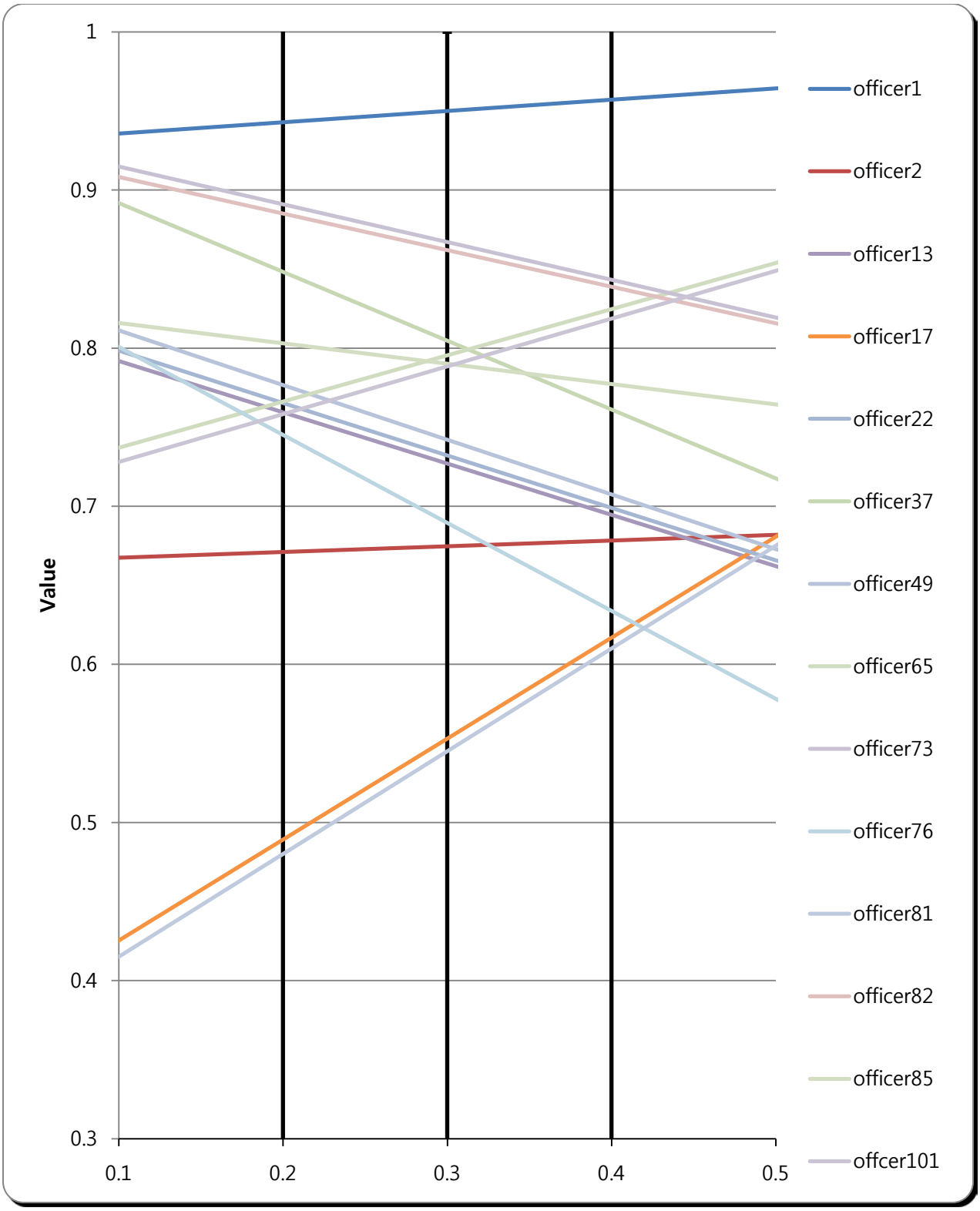


Figure 23 Lieutenant Sensitivity Analysis of OPR

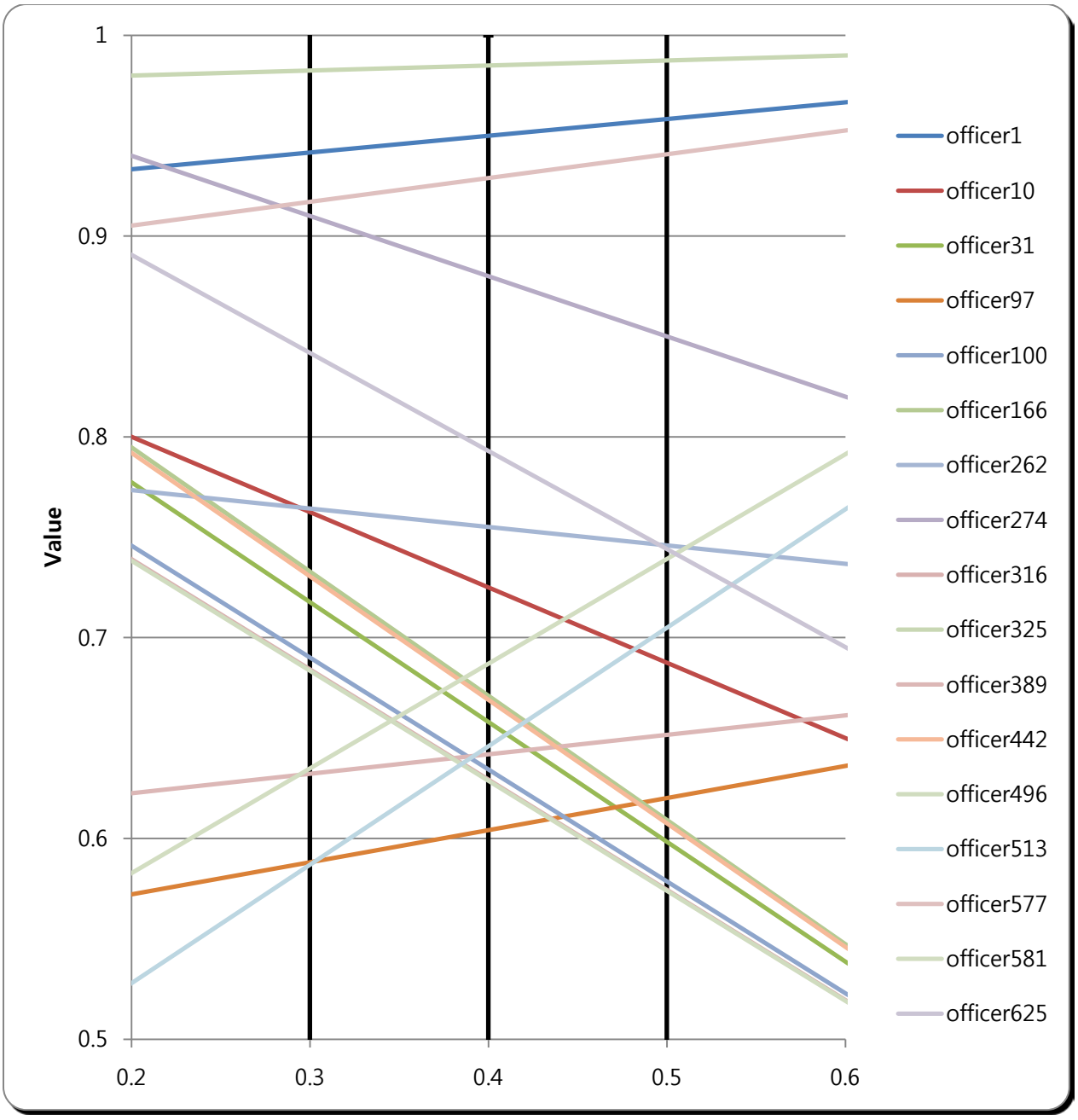


Figure 24 Captain Sensitivity Analysis of OPR

4.3.2 Sensitivity Analysis of Commanders' Assessment

Commanders' Assessment is the second highest measure for Captain Figure 25 illustrates the breakeven charts for Commanders' Assessment. Likewise OPR case, the weight is varied

±0.1. In the weight of 0.3, Officer 325, 1, 577, 274, 625, 262, 10, 581, 166, 442, 31, and 513 were selected, Officer 389, 100, and 496 were not chosen. When the weight of Commanders' Assessment was changed to 0.2, Officer 31 was not selected and Officer 389 selected long-term officer. On the other hand, Officer 513 and 581 were not retained and Officer 100 and 496 were chosen as new long-term officers when the weight is 0.4. This result indicates Commanders' Assessment is sensitive, and will have large effects on selection for long-term officers when DMs change their emphasis upon other environment such as economy, military, and social issues.

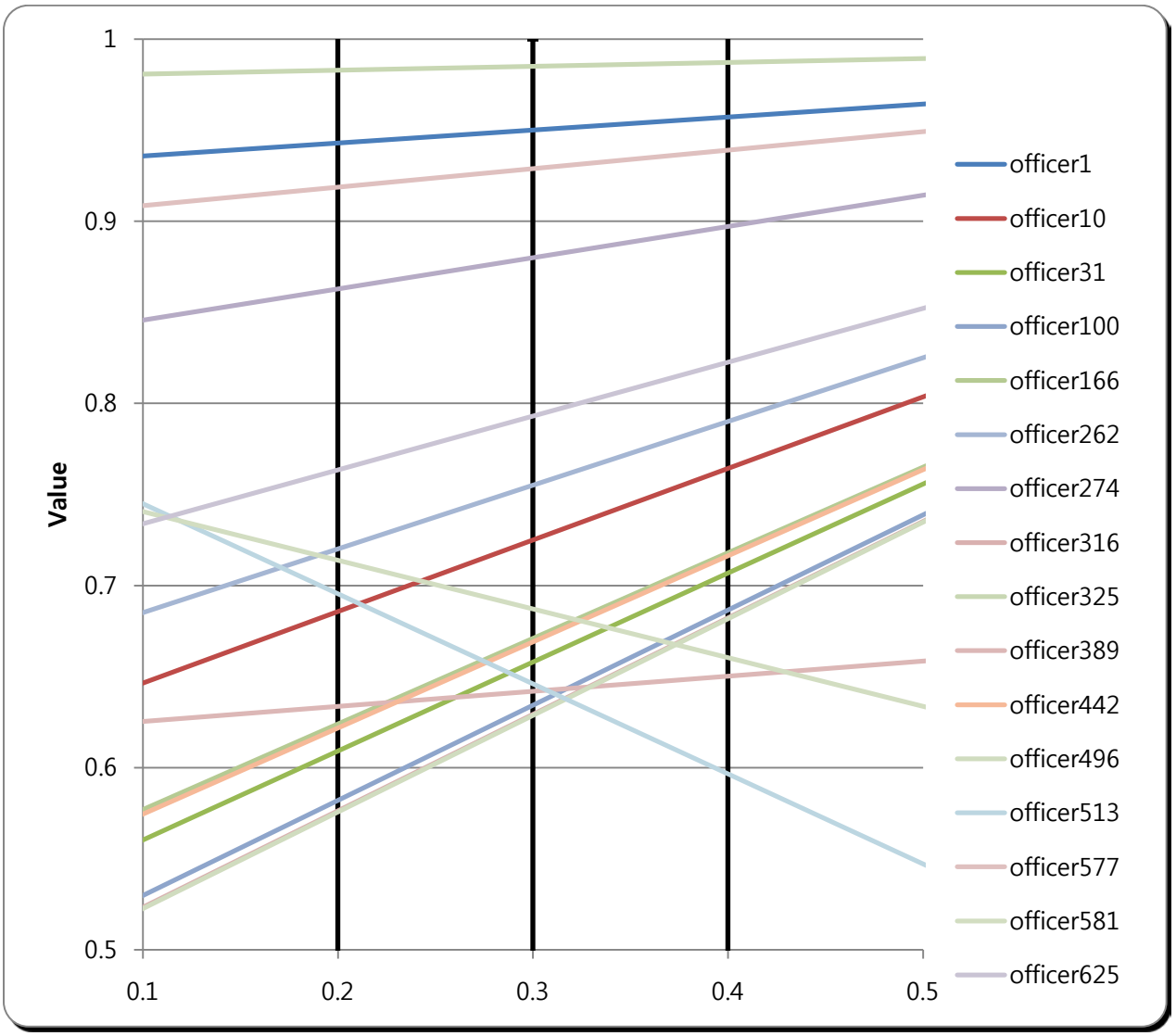


Figure 25 Captain Sensitivity Analysis for Commanders' Assessment

4.3.3 Sensitivity Analysis of Military Course Grade

When sensitivity analysis is executed on Military Course Grade measure, there is a change on the ranking of long-term officers. The weight is varied ±0.1. Officer 325, 1, 577, 274, 625, 262, 10, 581, 166, 442, 31, and 513 were long-term officers, but Officer 389, 100, and 496 were not qualified officers in the weight 0.16. When the weight is decreased to 0.06, Officer 31 and 166 were not selected, Officer 100 and 389 are selected the new long-term officers. When the weight was increased to 0.26, Officer 513 was deselected and Officer 496 was selected as seen in Figure 26. Military Course Grade is also a sensitive evaluation measure in the model that can change the selected qualified long-term officers. If there is budget limit in the Korean Army, DMs might choose officer 325, 577, 1, 274, 262, 625, and 10. These officers are robust whether the weight on Military Course Grade is changed or not. On the other hand, if there are many quotas for the following year, officers 31, 100, 166, 389, 496, and 513 could be retained regarding their potential possibility of success in the Army.

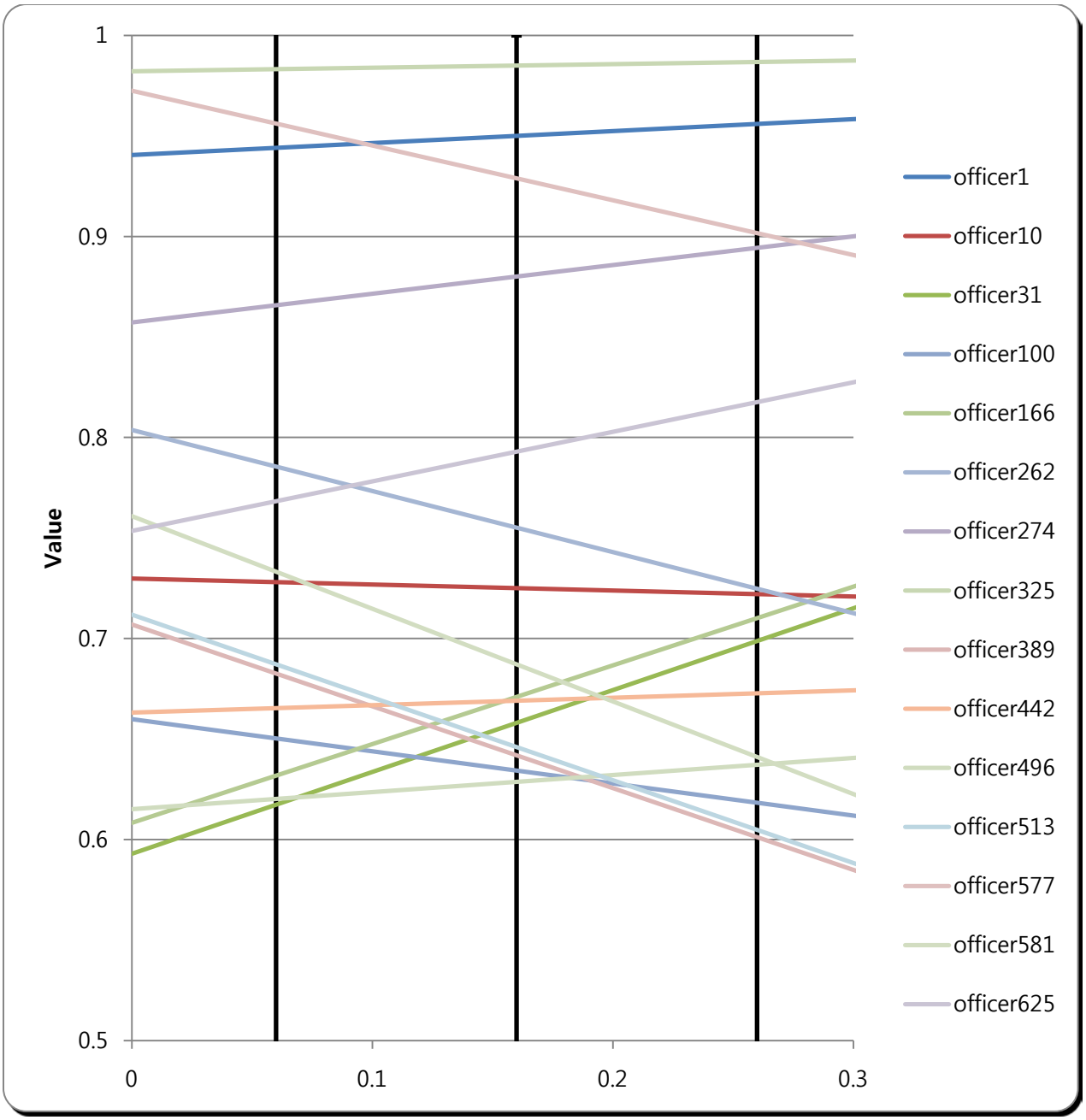


Figure 26 Captain Sensitivity Analysis for Military Course Grade

4.3.4 Sensitivity Analysis of Evaluation of Other Quality

Evaluation of Other Quality is composed of five evaluation measures and it is the fourth highest value in the value hierarchy model. Sensitivity analysis was performed varying the weight ±0.1. Figure 27 illustrates the breakeven chart for Evaluation of Other Quality. In the

weight of 0.14, Officer 325, 1, 577, 274, 625, 262, 10, 581, 166, 31, 442, and 513 were retained as long-term officers, but Officer 100 and 316 were not retained. There are no changes about long-term officers if the weight is 0.04, however Officers 100 and 316 are selected as new long-term officers, Officer 31 and 513 were eliminated when the weight of Evaluation of Other Quality was increased to 0.24. Evaluation of Other Quality is not sensitive to a decreasing weight but is sensitive to increasing weight. DMs, therefore should consider increasing the weight of Evaluation of Other Quality while they retain long-term officers whether alternatives are accepted or not.

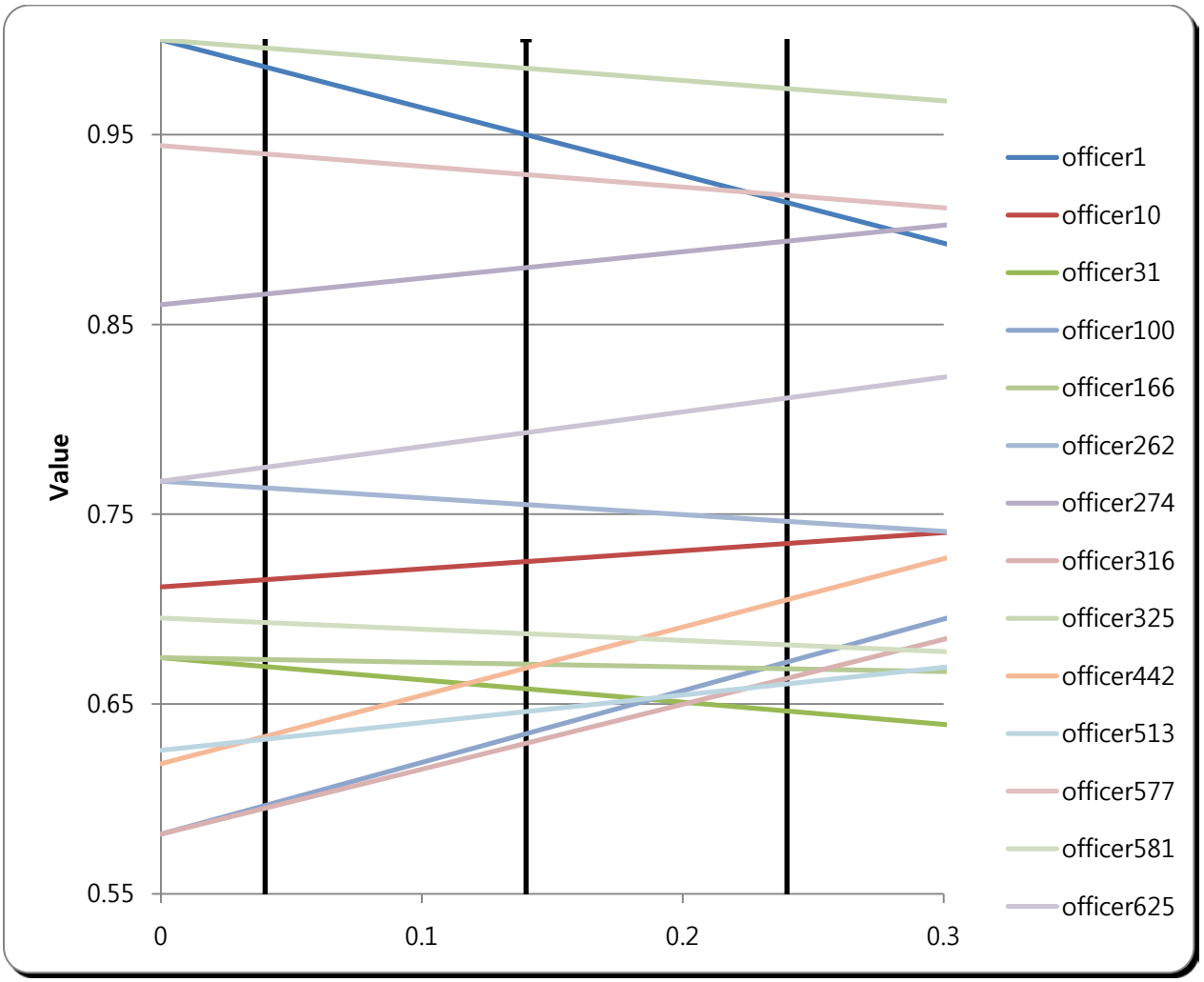


Figure 27 Captain Sensitivity Analysis for Evaluation of Other Quality

4.3.5 Sensitivity Analysis of PT test

PT test is the highest weighted measure in Evaluation of Other Quality value. Figure 28 illustrate the breakeven chart for PT test. The weight of PT test is varied by ±0.01. In the contrast to the sensitivity of previous evaluation values, there is no change in selected long-term officers. This indicates this model is robust depending on changes of weight within ±0.01 in PT test.

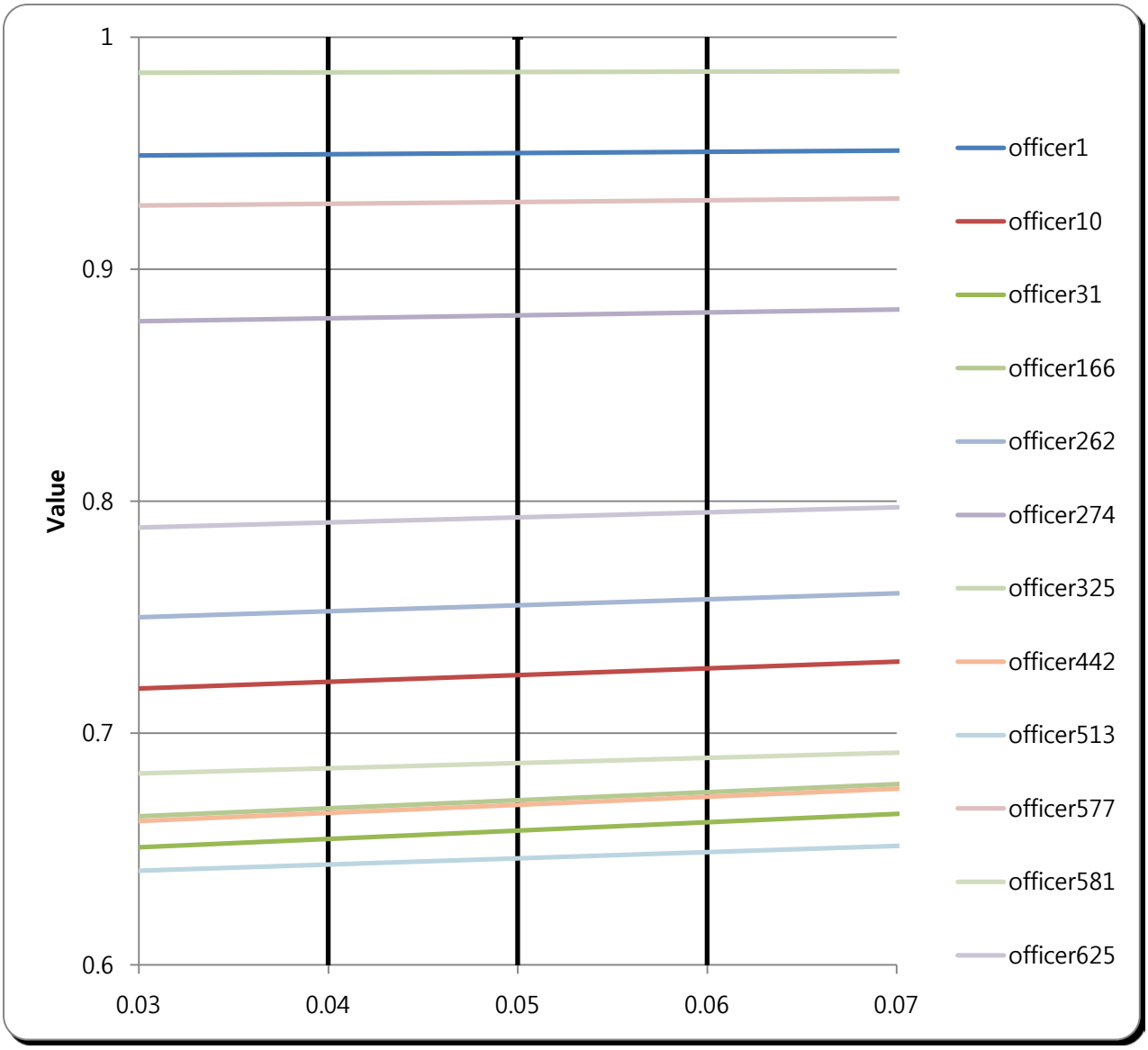


Figure 28 Captain Sensitivity Analysis for PT test

4.3.6 Sensitivity Analysis of Interview Result

Interview Result is the second highest measure in Evaluation of Other Quality value. Figure 29 illustrates the breakeven charts for Interview Result. The weight of Interview Result test is varied by ±0.01. Long-term officers were Officer 325, 1, 577, 274, 625, 262, 10, 581, 166, 442, 31, and 513, however Officer 389 was not selected in the weight 0.04. In the contrast to sensitivity analysis of Evaluation of Other Quality, there is no change when the weight was increased to 0.05, but Officer 389 was selected, Officer 513 was deselected when the weight was decreased to 0.03. This result indicates that qualified long-term officers can be changed when the weight of Interview Result is decreased by DMs.

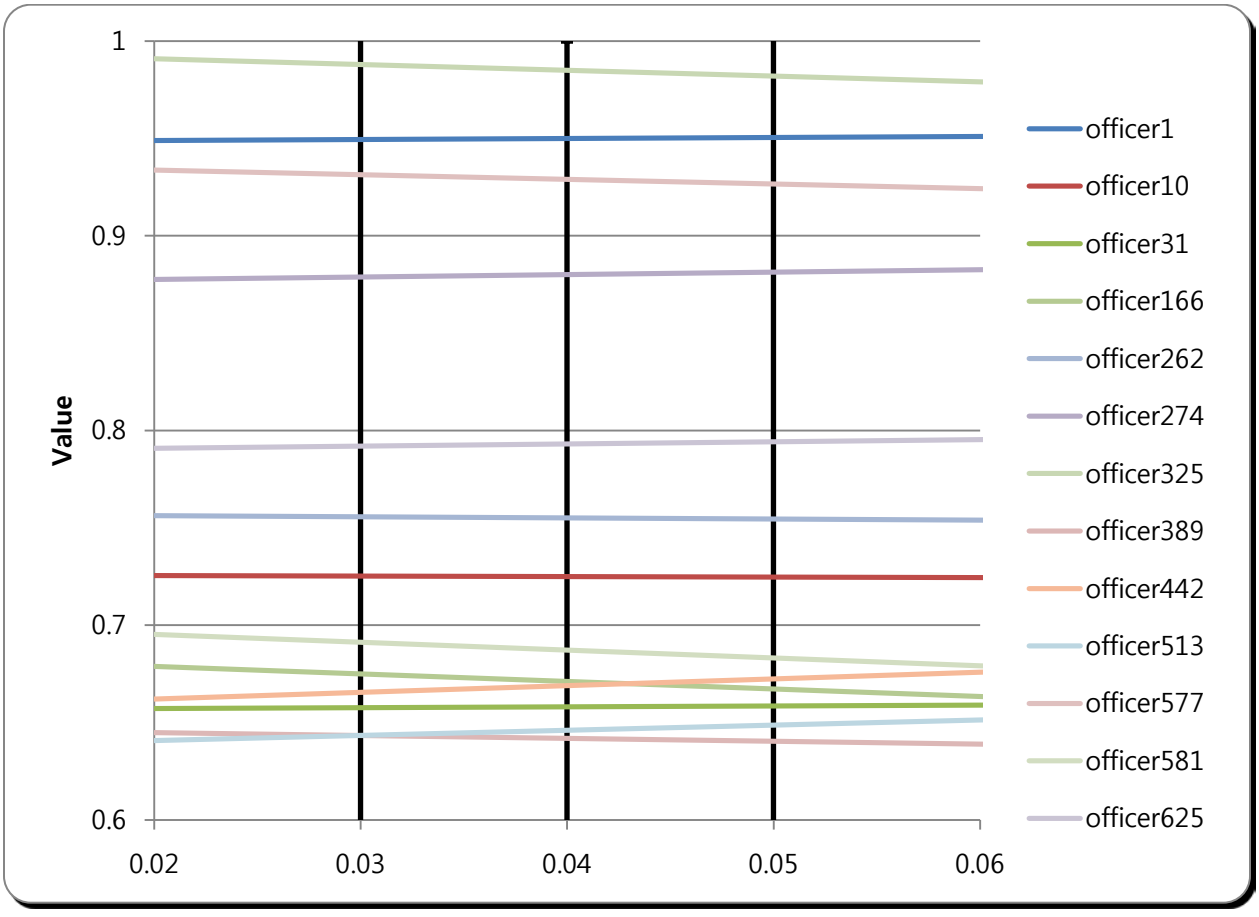


Figure 29 Captain Sensitivity Analysis for Interview Result

4.3.7 Sensitivity Analysis of Awards Record

Awards Record is the third highest evaluation measure in Evaluation of Other Quality value. Figure 30 illustrates the breakeven charts for Awards Record. Sensitivity analysis was performed by changing the weight of ±0.01. Although the weight of evaluation measure was changed, there are no changes in the selected officers.

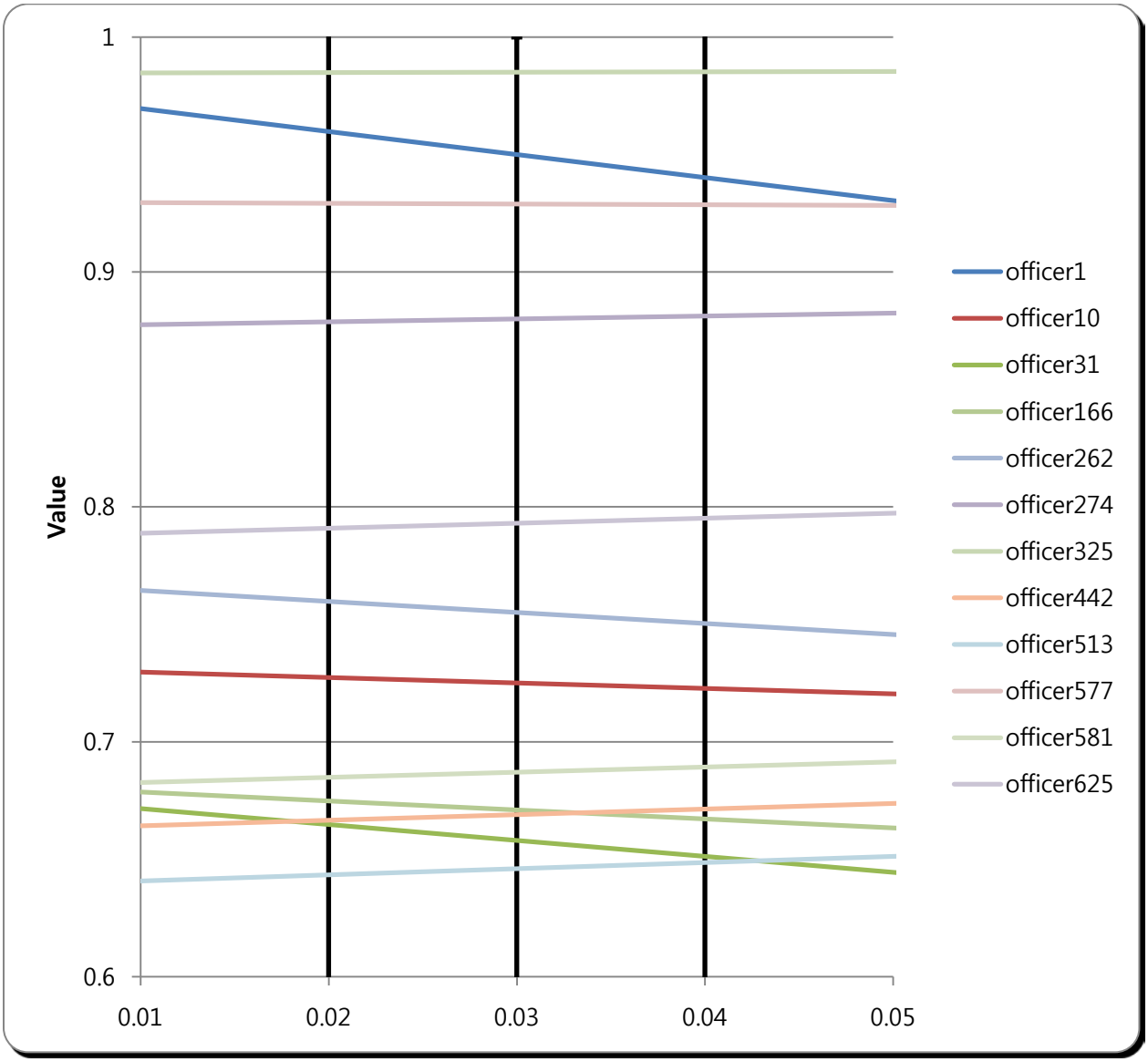


Figure 30 Captain Sensitivity Analysis for Awards Record

4.3.8 Sensitivity Analysis of Potential Ability

Potential Ability the second lowest evaluation measures in Evaluation of Other Quality. Sensitivity analysis is performed varying the weight ±0.01. Figure 31 displays the breakeven chart for Potential Ability. There is no change about long-term officers on decreasing weight to 0.007, however Officer 513 was deselected, Officer 389 was selected as a new long-term officer when the weight of Potential Ability was increased to 0.027. It is the opposite result of Interview Result. Potential Ability is not sensitive to a decreasing weight but is sensitive to increasing weight. Likewise Evaluation of Other Quality sensitivity analysis, Potential Ability is an important evaluation measure when DMs consider increasing the weight.

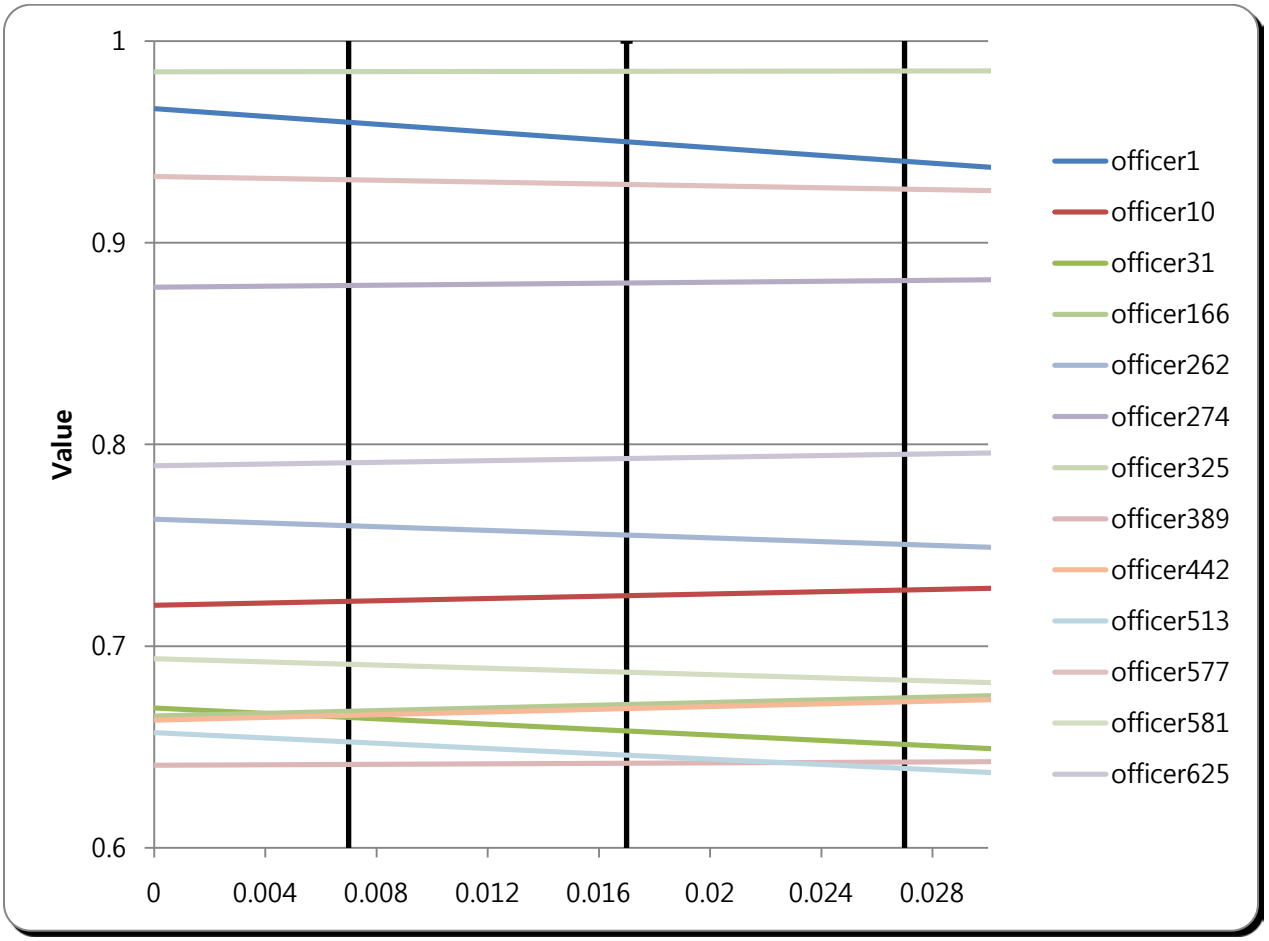


Figure 31 Captain Sensitivity Analysis for Potential Ability

4.3.9 Sensitivity Analysis of Hazard Experience

Hazard Experience is the least evaluation measure in Evaluation of Other Quality. Sensitivity analysis was performed varying the weight ±0.001. Figure 32 displayed the breakeven chart for Hazard Experience. In Hazard Experience, since the variation of the weight was small compared with other evaluation measures, there were not any changes in retained officers.

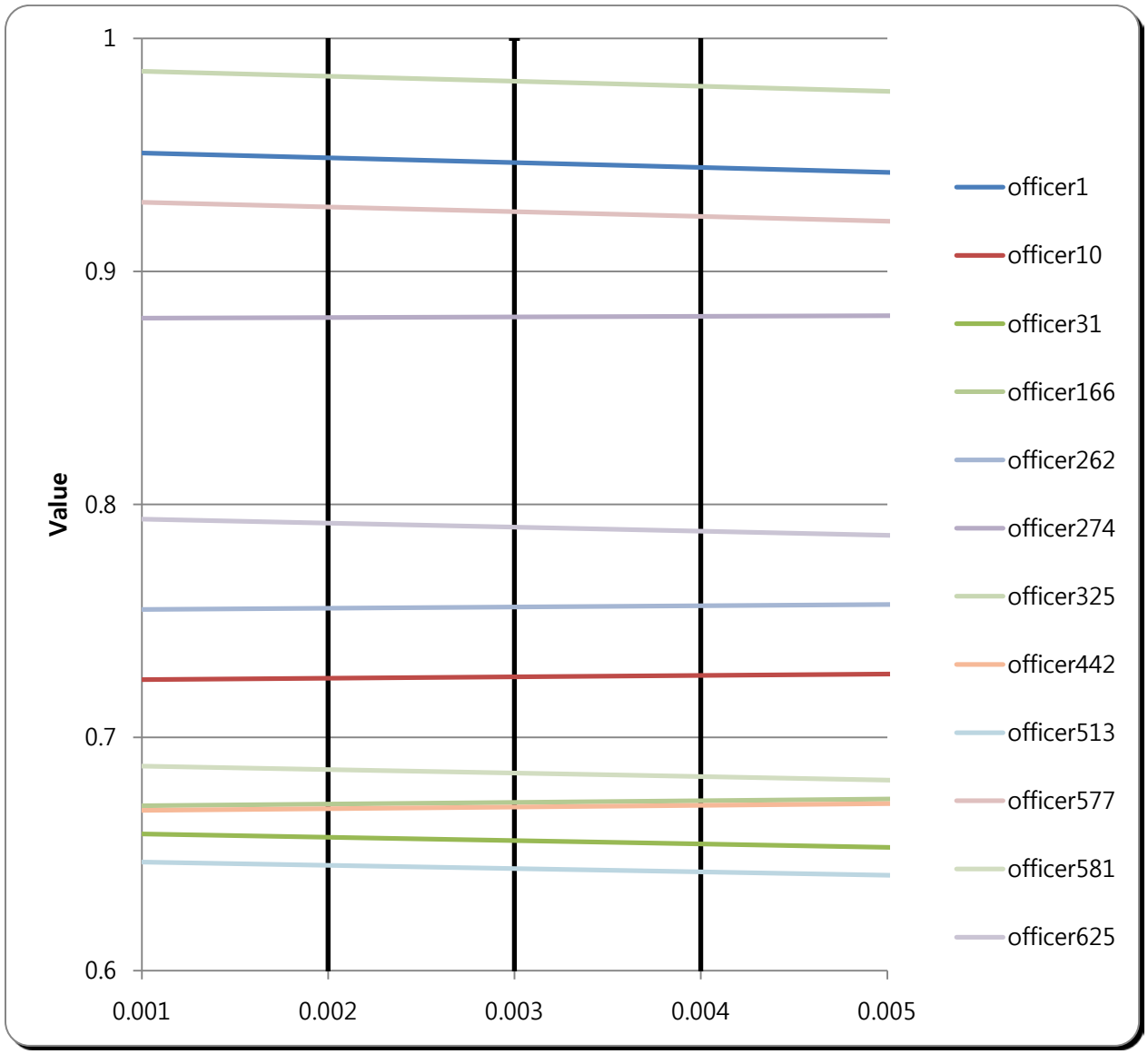


Figure 32 Captain Sensitivity Analysis for Hazard Experience

4.4 Summary

Deterministic and Sensitivity analysis are performed to applicants of long-term officers in chapter 4. The ranking of officers was displayed in stacked bar charts to distinguish which values and evaluation measures are important to retain long-term officers. While the weight of each value and evaluation measure is varying, the change of total score and ranking can be presented in sensitivity analysis. This is meaningful to DMs who want to change the weight of values or have some issues (i.e. budget, needed quota, recruiting policy) with how to retain long-term officers for the next year. The following chapter explains the conclusion and recommendation of this research.

Chapter 5. Conclusions

5.1 Chapter Overview

This chapter provides a summary of the research and recommendations for the future research. At first, the research effort and results of the model are summarized. Strengths and limitations of the model are discussed and finally, recommendations for future research are introduced.

5.2 Research Summary

The primary objective of this research is to determine more qualified long-term officers for the retention in the Korean Army. There are several values which were suggested by the Korean Army when long-term officers are retained. The Value Focused Thinking (VFT) approach can evolve out these values into a mathematical score to clarify value of officers and discern the ranking of officers. The result of deterministic and sensitivity analysis introduced and discussed in chapter 4 demonstrate that this model can change the current subjective retention system into an adjusted objective method for the retention of long-term officers in the Korean Army. The research results show how the ranking of the officers changed when the major three values are varied in comparison with Lieutenant and Captain. Even though there are officers who obtain the qualified score in three major values, they may not be retained as long-term officers. On the other hand, officers who do not have enough scores in three major values, they can be selected attributed to the quality of Evaluation of Other Quality.

In chapter 3, the 10-step VFT iteration for this research explained the process of creating values by DMs concerns to develop top-down model. The Hierarchy Builder developed

evaluation measures and built SDVFs to identify how values and measures are divided into different group. The weight by Korean Army instruction suggests the desire of DMs to retain qualified long-term officers. After the value hierarchy model is made, the alternatives are generated which have their total score. Consequently, the officer group, which has equally higher three major values and evenly obtains Evaluation of Other Quality, are relatively higher ranker in the value hierarchy model.

5.3 Benefits of Model

This VFT model has several strengths to further Korean Army personnel retention. First of all, the process of retention is more objective and impartial than existing method. Therefore, there is less possibility of raising objections about personnel retention. It can also make a selection process simpler and easier as maintaining the effectiveness and accuracy.

Secondly, this model is applicable to other situations. There are lots of retention processes in the Korean Military; Army, Navy, Air Force, and Marine Corp. This methodology can be applied to any retention situation when the values and evaluation measures are changed depending on DMs' desire. And the model can be repeated to confirm the result or score of alternatives for decreasing the shortcomings when the process is performed. Furthermore, the total score of each alternative can compare current applicants with former applicants. This will result in the development of a retention process in the Korean Military.

Lastly, the VFT model is communicable and understandable. The results of the model can be understood although DMs do not have any mathematical knowledge. The process of retention can be more transparent and clearer with this model. Therefore, this can promote

communication between staffs and DMs, even politicians. This lessens a lot of labor and time typically spent on preparation for the discussion or inspection.

5.4 Limitations of Model

The Korean Army personnel information is confidential and cannot be disclosed to the public. The data of this research is based on the assumption that each alternative obtain score depending on the model which was invented in this research. Thus, the credibility of the result is limited to theoretical data. For the more trustworthy results, 10-step process of VFT should be performed with real data.

There is the possibility that each alternative has a different scoring method (i.e. the weight of evaluation measures is different) from the model. Values and evaluation measures are classified into different groups where the weight of values can be adjustable. The solution of this problem is while the iterative process of VFT performed, the detailed SDVFs or weights should be changed according to real values.

5.5 Recommendations for Future Research

This researcher recommends Value Focused Thinking to the Korean Army decision situations. The VFT method can be a superb methodology to the Korean Army which needs swift and precise decision-making process. There are many decision situations, for example, how to supply ammunition safely and correctly, how to arrange the personnel's station to optimize the benefit of organization, and what is the best combination of weapons for the defense of islands in the Korean Military. These decision problems can be solved with value focused thinking method.

On top of that, this research focused on how to retain qualified long-term officers among alternatives. Other research can be investigated by this outcome. If the limit of qualified officers changed into 40% or 50% relying on the decision situation, how qualified officers are varied or when the criteria is changed about values, weight, and quota, how current retained officers distributed could be developed.

Appendix A : Description of Three major values

- **OPR** Officer Performance Report is a common method to evaluate officers when they serve for the country in all nations. The Korean Army also utilizes this method to assess each officer within a same squadron. OPR score can be calculated depending on a score what a superior officer evaluates.

Table 7 Criterion of OPR evaluation measure

Grade	Description
A	He is an excellent officer in the group. He volunteers every activity to make his troops to be ready to fight. He has a superb leadership to lead his soldiers (90% of score).
B	He is a good officer in the group. He participates in activity to build the military force of his troops. (70% of score).
C	He is a normal officer in the group. He follows superior officer when he is ordered to do. (50% of score).
D	He is an unqualified officer in the group. He usually does not obey the superior officer. (30% of score).

- **Commanders' Assessment** From Company Commanders to Regiment Commanders assess Lieutenants and Captains to determine who qualified officers are in a troop. On the contrary OPR, Commanders' Assessment is evaluated by a written report. Each commander assesses

Table 8 Criterion of Commanders' Assessment evaluation measure

Grade	Description
A	He is creative, intelligent, and diligent officer. He has integrity to the country and good relationship with comrades. He works good overall task (90% of score).
B	He is good officer who can execute tasks. He is friendly with others (70% of score).
C	He usually finishes his mission. He is unfriendly with others (50% of score).
D	He does not finish his tasks. He has a social problem with others (30% of score).

- **Military Course Grade** Lieutenants have to finish two military course and Captains have to finish three to apply for long-term officers in the Korean Army. Below description shows the criteria of each grade.

Table 9 Criterion of Military Course Grade evaluation measure

Grade	Description
A	Overall score over 90% including physical, extra activity, and peer evaluation (90% of score).
B	Overall score over 80% including physical, extra activity, and peer evaluation (70% of score).
C	Overall score below 80% including physical, extra activity, and peer evaluation (50% of score).
D	Failed (30% of score).

Appendix B : Description of Evaluation of Other Quality value

- **PT test** The Korean Army evaluates officers' physical ability with PT test chart table which shows what score is passed in their ages. Each officer has the criteria of PT test relying on ages.

Table 10 Criterion of PT test evaluation measure

Grade	Description
Special	Every test of push-ups, sit-ups and three-kilometer run is higher than 90%.
Pass	Every test of push-ups, sit-ups and three-kilometer run is higher than 80%.

- **Interview Result** There are two interviews when applicants apply for long-term officers in the Korean Army. First one is processed by Interviewers and the other one is evaluated by peers.

Table 11 Criterion of Interview Result evaluation measure

Grade	Description
A	He remembers every moral code of Army. He has a vision in the Army. He is collaborate officer (Top 5% of group).
B	He knows the moral code of Army well. He is ambitious to do task in the Army. He can communicate with others to do activity (Top 15% of group).
C	He knows the moral code of Army. He is interested in serving for the country. He understands what he should when he is ordered (Top 30% of group).
D	He does not know the moral code of Army. He is not interested in service. He does not contribute adequately to a unit (Top 50% of group).
E	He does not answer any of moral code questions. He does not want to serve the country. He is unsociable officer in a group (Top 70% of group).

- **Awards Record** 0.2 point for Lieutenant Colonel award, 0.5 for Colonel award, 1.0 point for General award, and 1.5 points for Four star General award. Lieutenant has four times and Captain has five times to obtain awards before applying for long-term officers. The score is sum of all award points.

Table 12 Criterion of Awards Record evaluation measure

Grade	Description	Lieutenant	Captain
1	Excellent(U-value : 1)	≥ 2.4	≥ 3.0
2	Good(U-value : 0.9)	$2.0 \leq X < 2.4$	$2.5 \leq X < 3.0$
3	Above average(U-value : 0.7)	$1.5 \leq X < 2.0$	$2.0 \leq X < 2.5$
4	Average(U-value : 0.5)	$0.9 \leq X < 1.5$	$1.5 \leq X < 2.0$
5	Below average(U-value : 0.3)	$0.5 \leq X < 0.9$	$0.9 \leq X < 1.5$
6	Poor(U-value : 0.1)	$0.2 \leq X < 0.5$	$0.5 \leq X < 0.9$
7	None(U-value : 0)	$0 \leq X < 0.2$	$0 \leq X < 0.5$

- **Potential Ability** There are many licenses and skills depending on languages, computer, and military knowledge. 0.1 point for regular ability and 0.2 point for advanced skills of officers. Both Lieutenant and Captain can register their licenses or certificates to the Korean Army regularly. The score is sum of all licenses and certificate points.

Table 13 Criterion of Potential Ability evaluation measure

Grade	Description	Officer
1	Excellent(U-value : 1)	$X \geq 1.7$
2	Good(U-value : 0.9)	$1.5 \leq X < 1.7$
3	Above average(U-value : 0.7)	$1.2 \leq X < 1.5$
4	Average(U-value : 0.5)	$0.9 \leq X < 1.2$
5	Below average(U-value : 0.3)	$0.5 \leq X < 0.9$
6	Poor(U-value : 0.1)	$0.2 \leq X < 0.5$
7	None(U-value : 0)	$0 \leq X < 0.2$

- **Hazard Experience** General Outpost or Guard Post can be hazard region in the Korea Army. The Korea Army also grants credit for officers who work for Special Forces because of dangerous missions of units.

Table 14 Criterion of Hazard Experience evaluation measure

Grade	Description
O	He experienced or is working in hazard region in the Army.
X	He has not experience a hazard region in the Army.

Appendix C : Total Value Score of Lieutenant Alternatives

Table 15 Total Value Score of Lieutenant

Alternatives	Commanders' Assessment	OPR	Military Course Grade	PT test	Interview Result	Awards Record	Potential Ability	Hazard Experience	Total	Sum*	Normalization*
officer26	0.135	0.09	0.033	0.045	0.012	0.003	0.0085	0.003	0.3295	0.258	0.3
officer27	0.135	0.09	0.033	0.045	0.012	0.003	0.017	0	0.335	0.258	0.3
officer36	0.135	0.09	0.033	0.045	0.02	0.009	0.0119	0.003	0.3469	0.258	0.3
officer42	0.135	0.09	0.033	0.045	0.028	0.015	0.0017	0.003	0.3507	0.258	0.3
officer12	0.135	0.09	0.055	0.045	0.012	0.009	0.0017	0.003	0.3507	0.28	0.325581
officer3	0.135	0.09	0.055	0.045	0.028	0.009	0.0017	0	0.3637	0.28	0.325581
officer62	0.135	0.09	0.033	0.045	0.04	0.015	0.0051	0.003	0.3661	0.258	0.3
officer8	0.135	0.09	0.033	0.045	0.04	0.009	0.0119	0.003	0.3669	0.258	0.3
officer57	0.135	0.09	0.055	0.045	0.012	0.015	0.0153	0	0.3673	0.28	0.325581
officer51	0.135	0.09	0.033	0.045	0.04	0.009	0.017	0	0.369	0.258	0.3
officer53	0.135	0.15	0.033	0.045	0.028	0.015	0.0051	0	0.4111	0.318	0.369767
officer41	0.225	0.09	0.033	0.045	0.012	0.015	0	0	0.42	0.348	0.404651
officer7	0.225	0.09	0.033	0.05	0.012	0.003	0.0119	0	0.4249	0.348	0.404651
officer32	0.225	0.09	0.033	0.045	0.012	0.009	0.017	0.003	0.434	0.348	0.404651
officer52	0.225	0.09	0.033	0.05	0.02	0.009	0.0119	0.003	0.4419	0.348	0.404651
officer6	0.135	0.21	0.033	0.045	0.012	0.003	0.0017	0.003	0.4427	0.378	0.439535
officer33	0.135	0.21	0.033	0.045	0.012	0.015	0.0017	0	0.4517	0.378	0.439535
officer16	0.225	0.09	0.033	0.05	0.028	0.015	0.017	0.003	0.461	0.348	0.404651
officer61	0.225	0.09	0.033	0.05	0.04	0.015	0.0119	0	0.4649	0.348	0.404651
officer9	0.135	0.21	0.033	0.045	0.02	0.015	0.017	0	0.475	0.378	0.439535
officer34	0.225	0.15	0.033	0.05	0.012	0.015	0.0085	0.003	0.4965	0.408	0.474419
officer77	0.225	0.15	0.033	0.045	0.02	0.015	0.0085	0	0.4965	0.408	0.474419
officer81	0.135	0.3	0.033	0.045	0.012	0.015	0.0051	0	0.5451	0.468	0.544186
officer17	0.135	0.3	0.033	0.045	0.02	0.015	0.0051	0	0.5531	0.468	0.544186
officer56	0.315	0.09	0.077	0.045	0.012	0.009	0.0085	0.003	0.5595	0.482	0.560465
officer11	0.315	0.09	0.077	0.045	0.02	0.009	0.0085	0	0.5645	0.482	0.560465

officer38	0.315	0.09	0.077	0.045	0.02	0.015	0.0017	0.003	0.5667	0.482	0.560465
officer29	0.315	0.15	0.077	0.045	0.02	0.015	0	0	0.622	0.542	0.630233
officer2	0.315	0.21	0.077	0.045	0.02	0.003	0.0017	0.003	0.6747	0.602	0.7
officer76	0.45	0.09	0.033	0.05	0.04	0.015	0.0085	0.003	0.6895	0.573	0.666279
officer13	0.45	0.15	0.033	0.05	0.012	0.015	0.017	0	0.727	0.633	0.736047
officer22	0.45	0.15	0.033	0.05	0.02	0.021	0.0051	0.003	0.7321	0.633	0.736047
officer49	0.45	0.15	0.033	0.05	0.012	0.03	0.017	0	0.742	0.633	0.736047
offcer101	0.315	0.3	0.055	0.05	0.036	0.021	0.0085	0.003	0.7885	0.67	0.77907
officer85	0.45	0.21	0.033	0.05	0.012	0.03	0.0051	0	0.7901	0.693	0.805814
officer65	0.315	0.3	0.077	0.045	0.02	0.03	0.0085	0	0.7955	0.692	0.804651
officer37	0.45	0.15	0.11	0.05	0.028	0.015	0.0017	0	0.8047	0.71	0.825581
officer82	0.45	0.21	0.11	0.05	0.012	0.015	0.0119	0.003	0.8619	0.77	0.895349
officer73	0.45	0.21	0.11	0.05	0.012	0.03	0.0051	0	0.8671	0.77	0.895349
officer1	0.45	0.3	0.11	0.05	0.04	0	0	0	0.95	0.86	1

*This represents three major values' summation and normalization

Appendix D : Total Value Score of Captain Alternatives

Table 16 Total Value Score of Captain

Alternatives	OPR	Commanders' Assessment	Military Course Grade	PT test	Interview Result	Awards Record	Potential Ability	Hazard Experience	Total	Sum*	Normalization*
officer531	0.12	0.09	0.048	0.045	0.012	0.015	0	0	0.33	0.258	0.3
officer327	0.12	0.09	0.048	0.045	0.012	0.015	0.0051	0	0.3351	0.258	0.3
officer116	0.12	0.09	0.048	0.045	0.02	0.027	0.0051	0.003	0.3581	0.258	0.3
officer396	0.12	0.09	0.048	0.045	0.02	0.027	0.017	0.003	0.37	0.258	0.3
officer498	0.12	0.09	0.048	0.045	0.04	0.03	0.017	0.003	0.393	0.258	0.3
officer311	0.12	0.15	0.048	0.045	0.028	0.015	0.0085	0	0.4145	0.318	0.369767442
officer53	0.2	0.09	0.048	0.045	0.02	0.009	0.0051	0	0.4171	0.338	0.393023256
officer297	0.2	0.09	0.048	0.045	0.028	0.021	0	0	0.432	0.338	0.393023256
officer563	0.12	0.15	0.048	0.045	0.028	0.03	0.0119	0	0.4329	0.318	0.369767442
officer268	0.12	0.15	0.048	0.05	0.036	0.021	0.0085	0.003	0.4365	0.318	0.369767442
officer386	0.2	0.09	0.048	0.045	0.04	0.015	0.0051	0.003	0.4461	0.338	0.393023256
officer93	0.2	0.09	0.048	0.045	0.036	0.027	0.0119	0	0.4579	0.338	0.393023256
officer236	0.12	0.21	0.048	0.045	0.012	0.021	0.017	0.003	0.476	0.378	0.439534884
officer266	0.2	0.15	0.048	0.045	0.012	0.015	0.0051	0.003	0.4781	0.398	0.462790698
officer254	0.12	0.21	0.048	0.045	0.036	0.015	0.0017	0.003	0.4787	0.378	0.439534884
officer434	0.12	0.21	0.08	0.045	0.012	0.027	0.017	0.003	0.514	0.41	0.476744186
officer457	0.2	0.15	0.048	0.05	0.036	0.021	0.0119	0	0.5169	0.398	0.462790698
officer313	0.2	0.15	0.08	0.05	0.012	0.021	0.0085	0	0.5215	0.43	0.5
officer380	0.12	0.21	0.08	0.045	0.036	0.027	0.0085	0.003	0.5295	0.41	0.476744186
officer449	0.28	0.09	0.048	0.045	0.04	0.03	0.017	0	0.55	0.418	0.486046512
officer421	0.2	0.15	0.08	0.05	0.04	0.027	0.017	0	0.564	0.43	0.5
officer329	0.28	0.15	0.048	0.045	0.012	0.027	0.017	0	0.579	0.478	0.555813953
officer97	0.28	0.15	0.08	0.05	0.012	0.027	0.0051	0	0.6041	0.51	0.593023256
officer235	0.12	0.3	0.08	0.05	0.02	0.03	0.017	0	0.617	0.5	0.581395349
officer496	0.12	0.3	0.112	0.05	0.012	0.03	0.0017	0.003	0.6287	0.532	0.618604651
officer316	0.12	0.3	0.08	0.05	0.04	0.021	0.0153	0.003	0.6293	0.5	0.581395349

officer100	0.12	0.3	0.08	0.05	0.036	0.03	0.0153	0.003	0.6343	0.5	0.581395349
officer389	0.28	0.21	0.048	0.045	0.02	0.027	0.0119	0	0.6419	0.538	0.625581395
officer513	0.4	0.09	0.048	0.045	0.036	0.027	0	0	0.646	0.538	0.625581395
officer31	0.12	0.3	0.16	0.05	0.028	0	0	0	0.658	0.58	0.674418605
officer442	0.12	0.3	0.112	0.05	0.04	0.027	0.017	0.003	0.669	0.532	0.618604651
officer166	0.12	0.3	0.16	0.05	0.012	0.009	0.017	0.003	0.671	0.58	0.674418605
officer581	0.4	0.15	0.048	0.045	0.012	0.027	0.0051	0	0.6871	0.598	0.695348837
officer10	0.2	0.3	0.112	0.05	0.028	0.015	0.017	0.003	0.725	0.612	0.711627907
officer262	0.28	0.3	0.08	0.05	0.028	0.009	0.0051	0.003	0.7551	0.66	0.76744186
officer625	0.2	0.3	0.16	0.05	0.036	0.03	0.017	0	0.793	0.66	0.76744186
officer274	0.28	0.3	0.16	0.05	0.04	0.03	0.017	0.003	0.88	0.74	0.860465116
officer577	0.4	0.3	0.112	0.05	0.028	0.027	0.0119	0	0.9289	0.812	0.944186047
officer1	0.4	0.3	0.16	0.05	0.04	0	0	0	0.95	0.86	1
officer325	0.4	0.3	0.16	0.05	0.028	0.03	0.017	0	0.985	0.86	1

*This represents three major values' summation and normalization

Appendix E : SDVFs

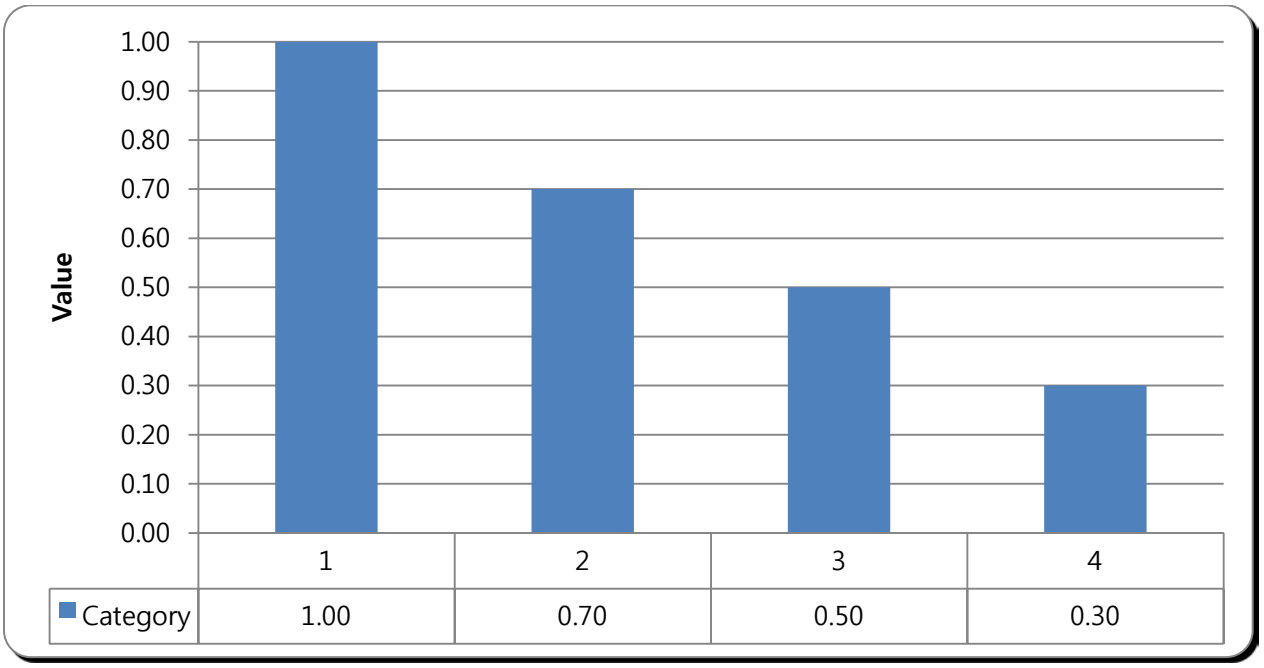


Figure 33 OPR SDVF

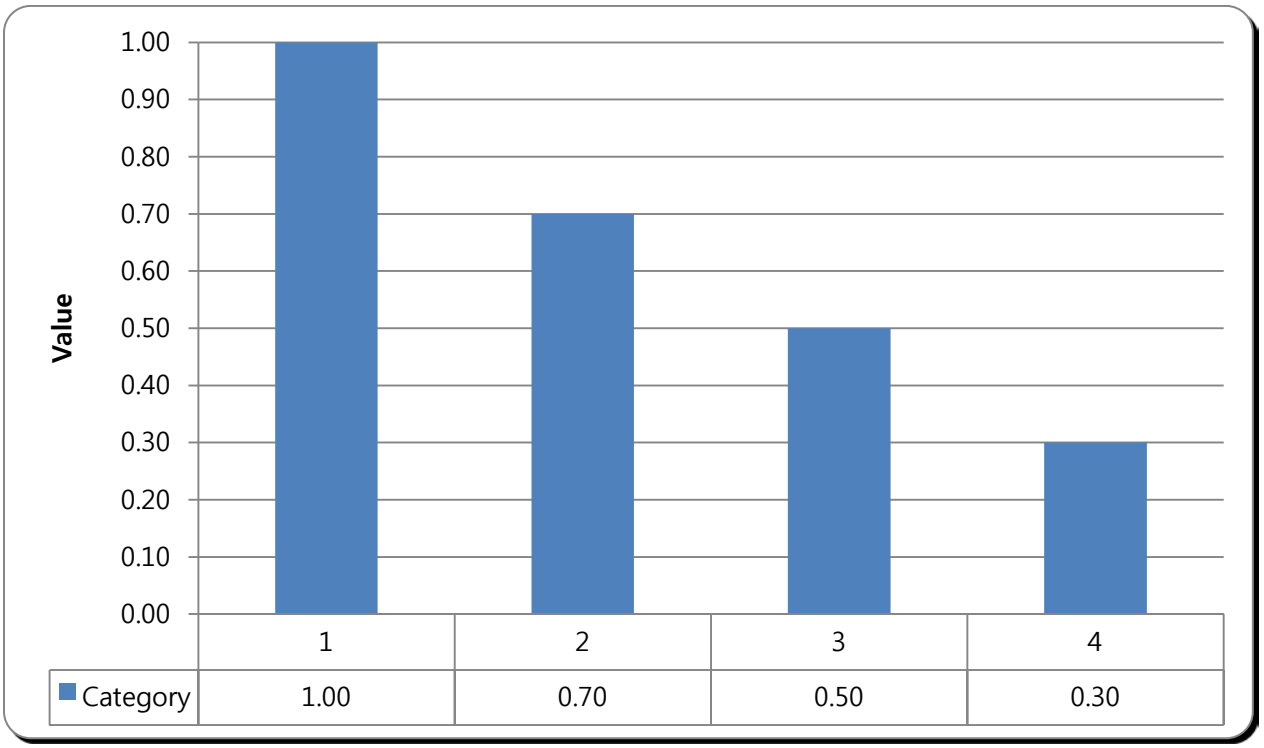


Figure 34 Commanders' Assessment

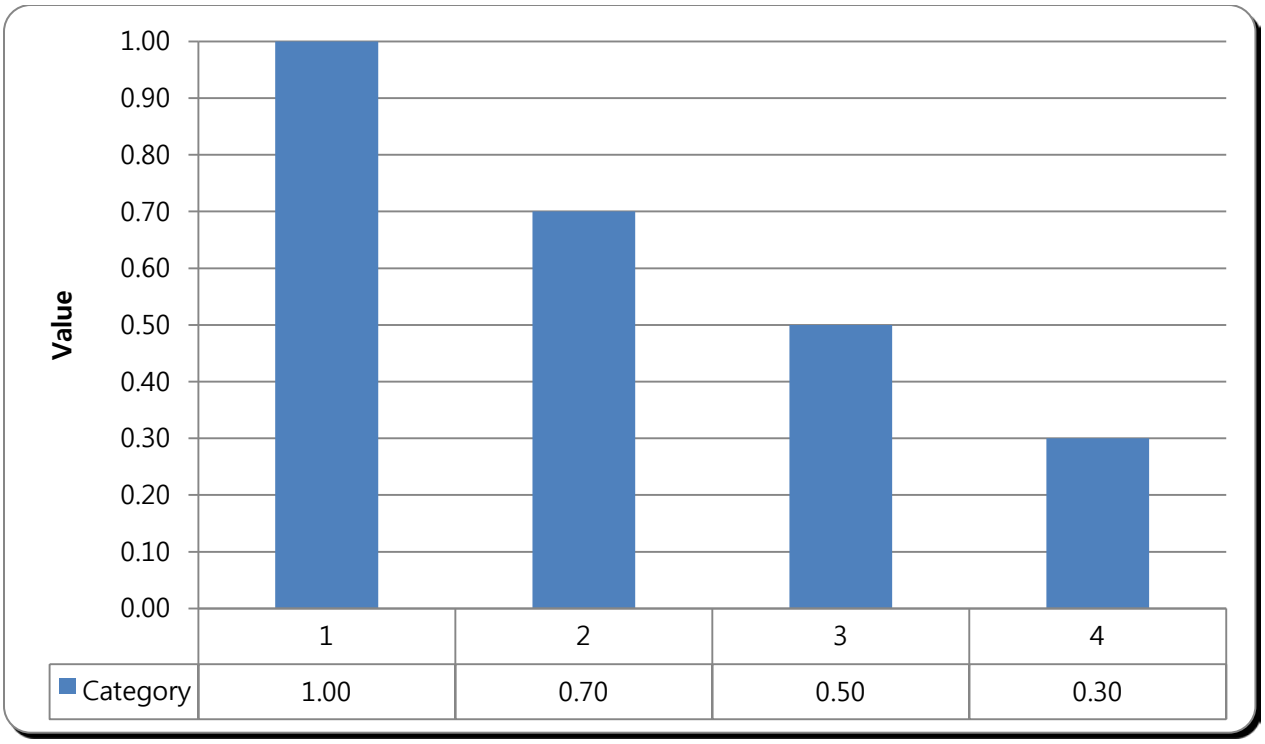


Figure 35 Military Course Grade SDVF

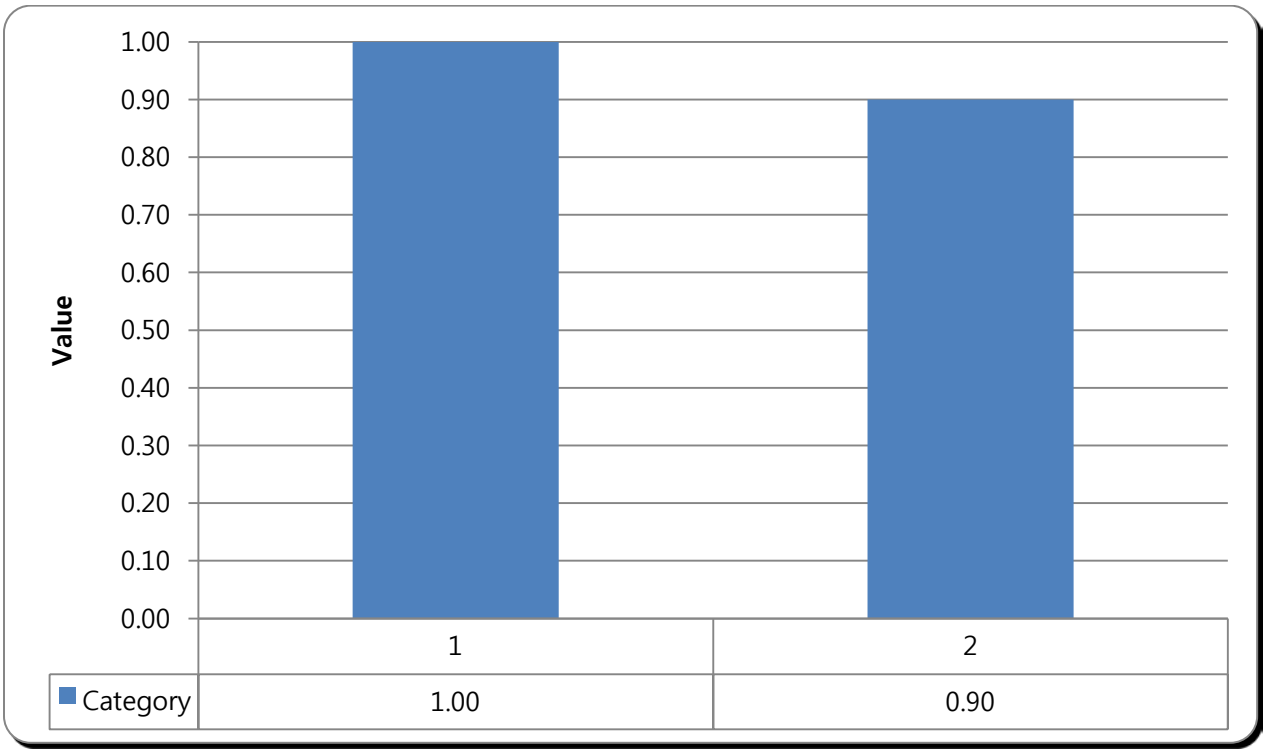


Figure 36 PT test SDVF

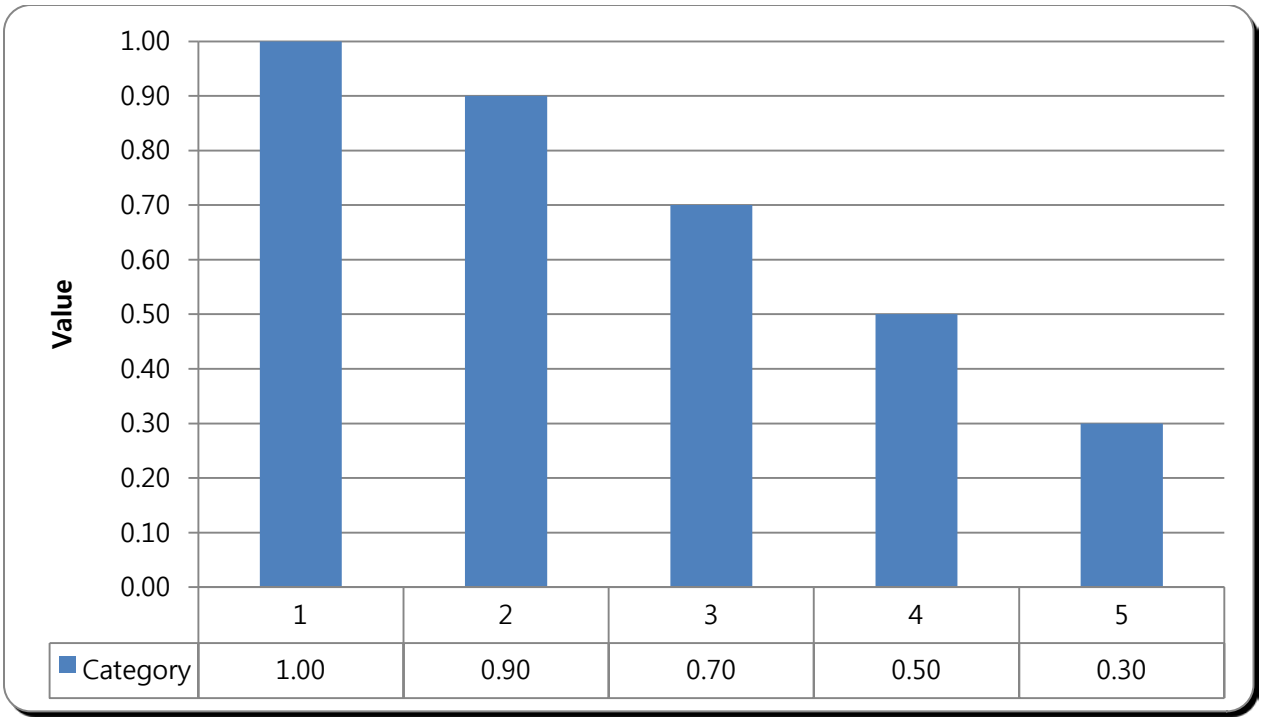


Figure 37 Interview Result SDVF

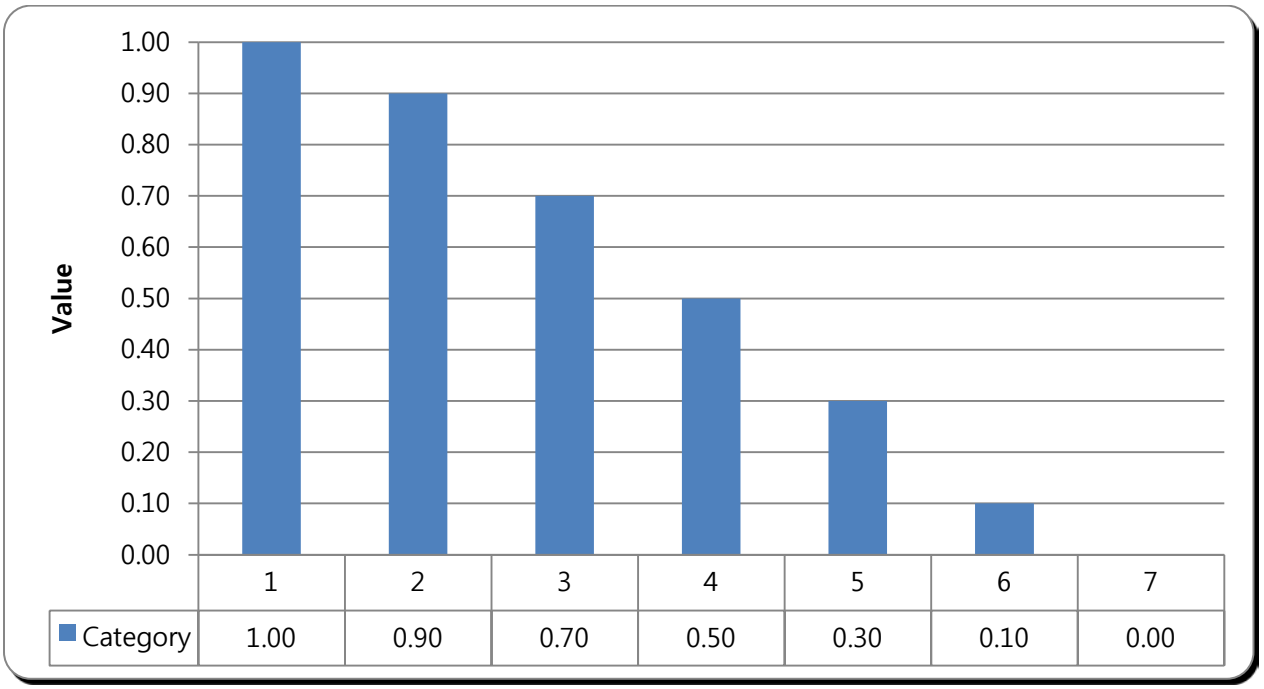


Figure 38 Awards Record SDVF

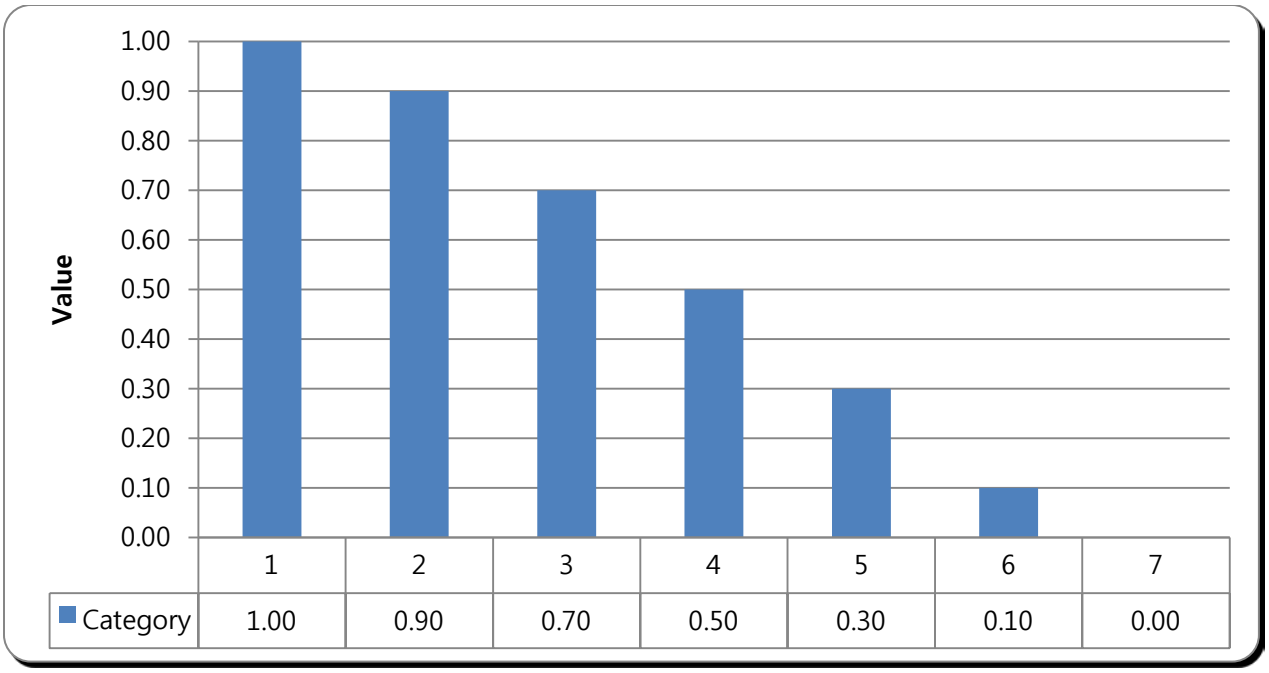


Figure 39 Potential Ability SDVF

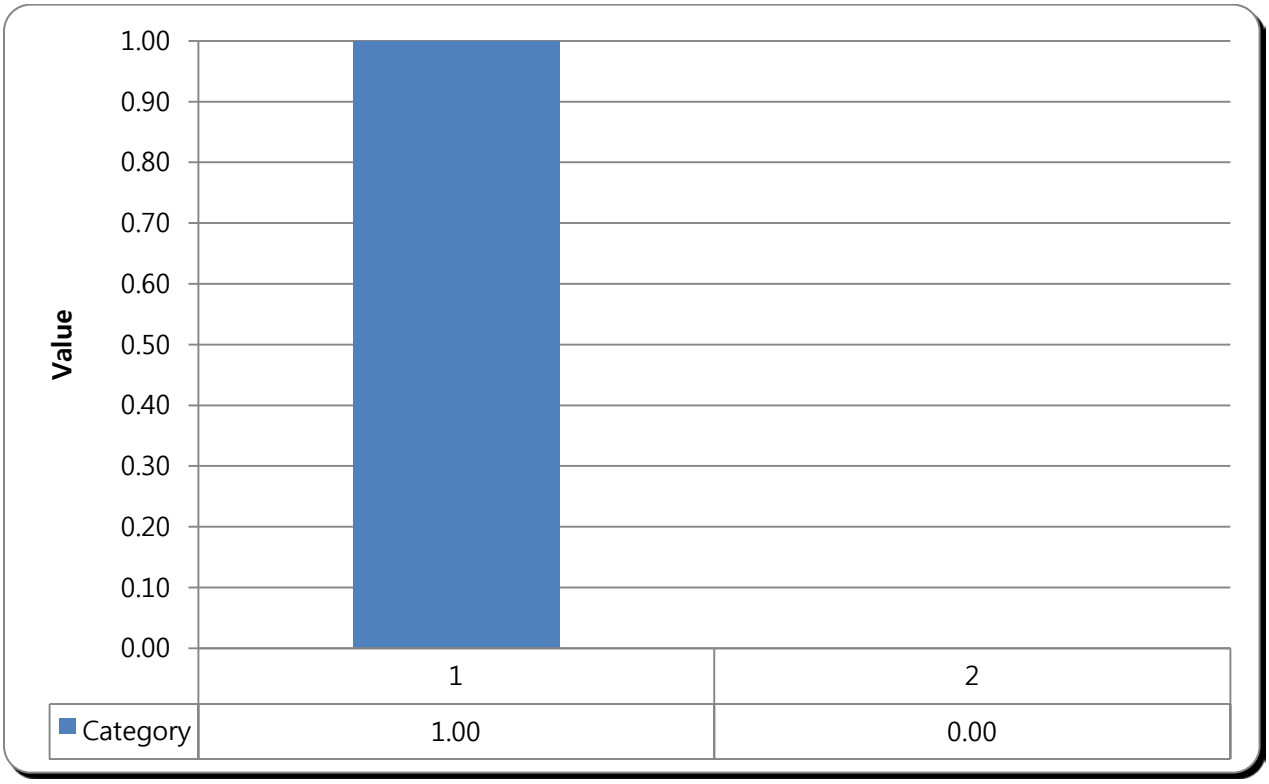


Figure 40 Hazard Experience SDVF

Appendix F : Lieutenant Sensitivity Analysis Graph

In long-term officers in lieutenant, there are not any changes because the model is robust to lieutenant case. Officer 1, 2, 13, 22, 37, 49, 65, 73, 76, 82, 85, and 101 are selected as qualified officers regardless of evaluation measures. However, this result is not general since qualified officers are sensitive to the model in Captain's case.

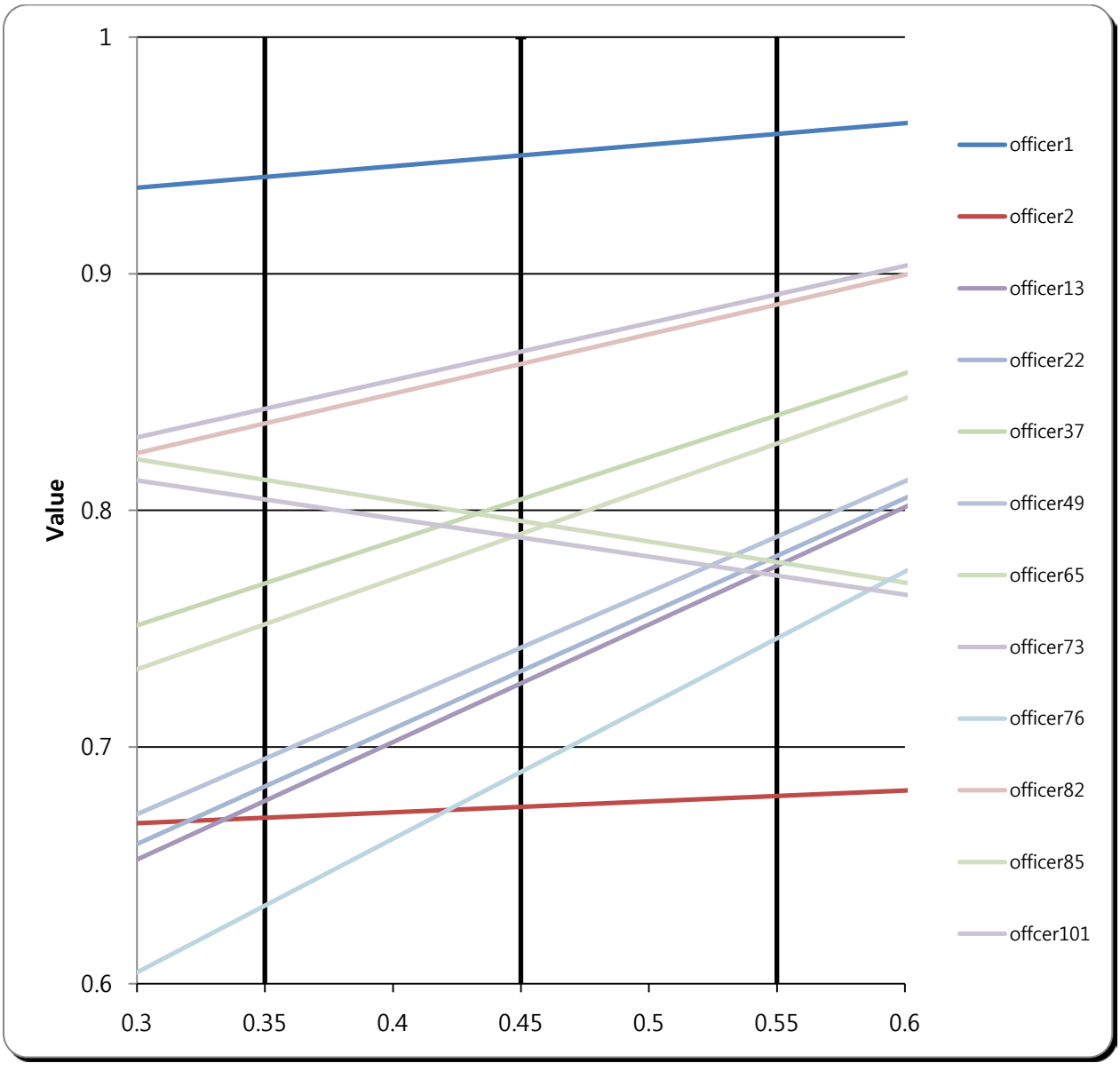


Figure 41 Sensitivity Analysis for Commanders' Assessment

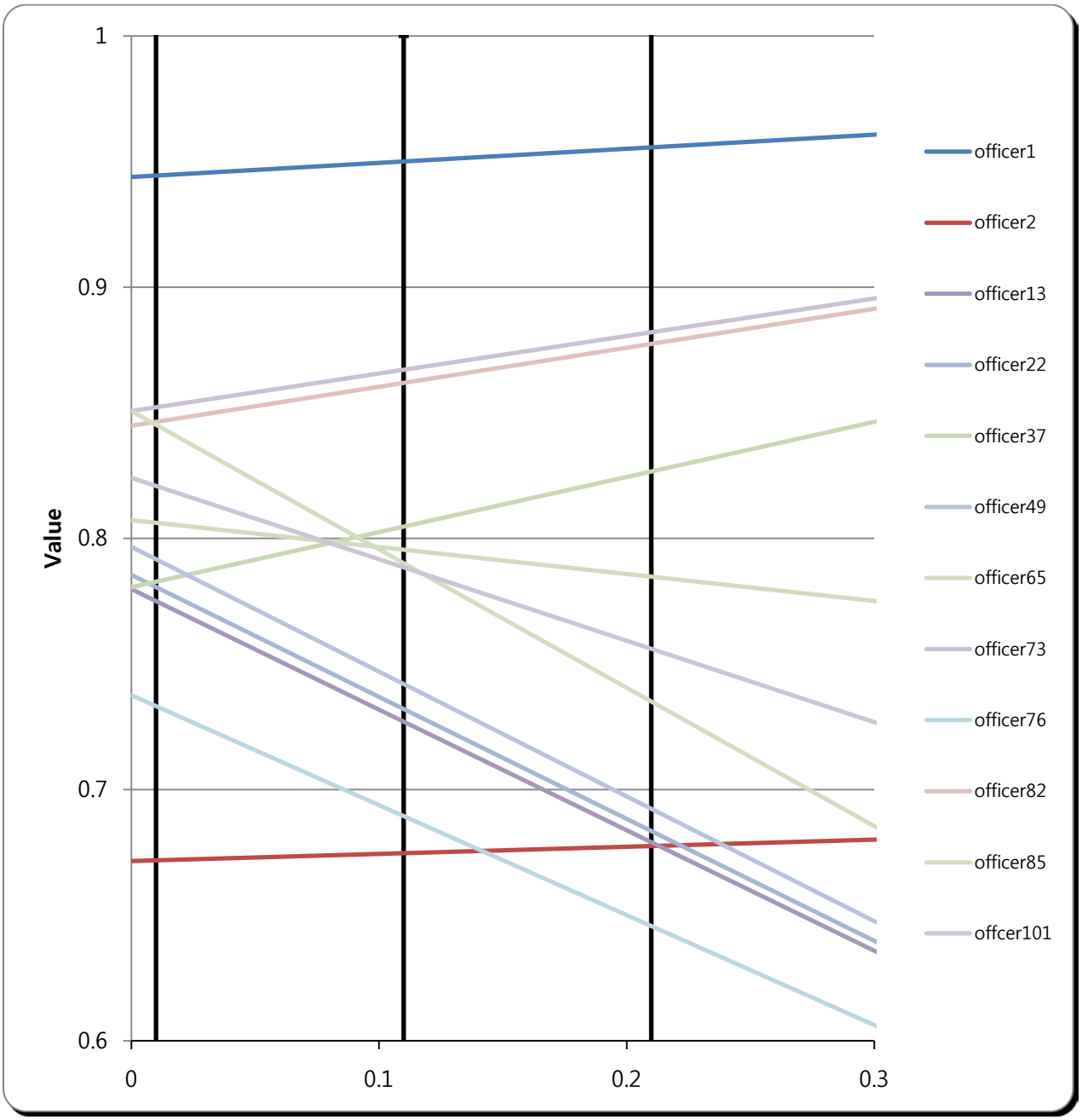


Figure 42 Sensitivity Analysis for Military Course Grade

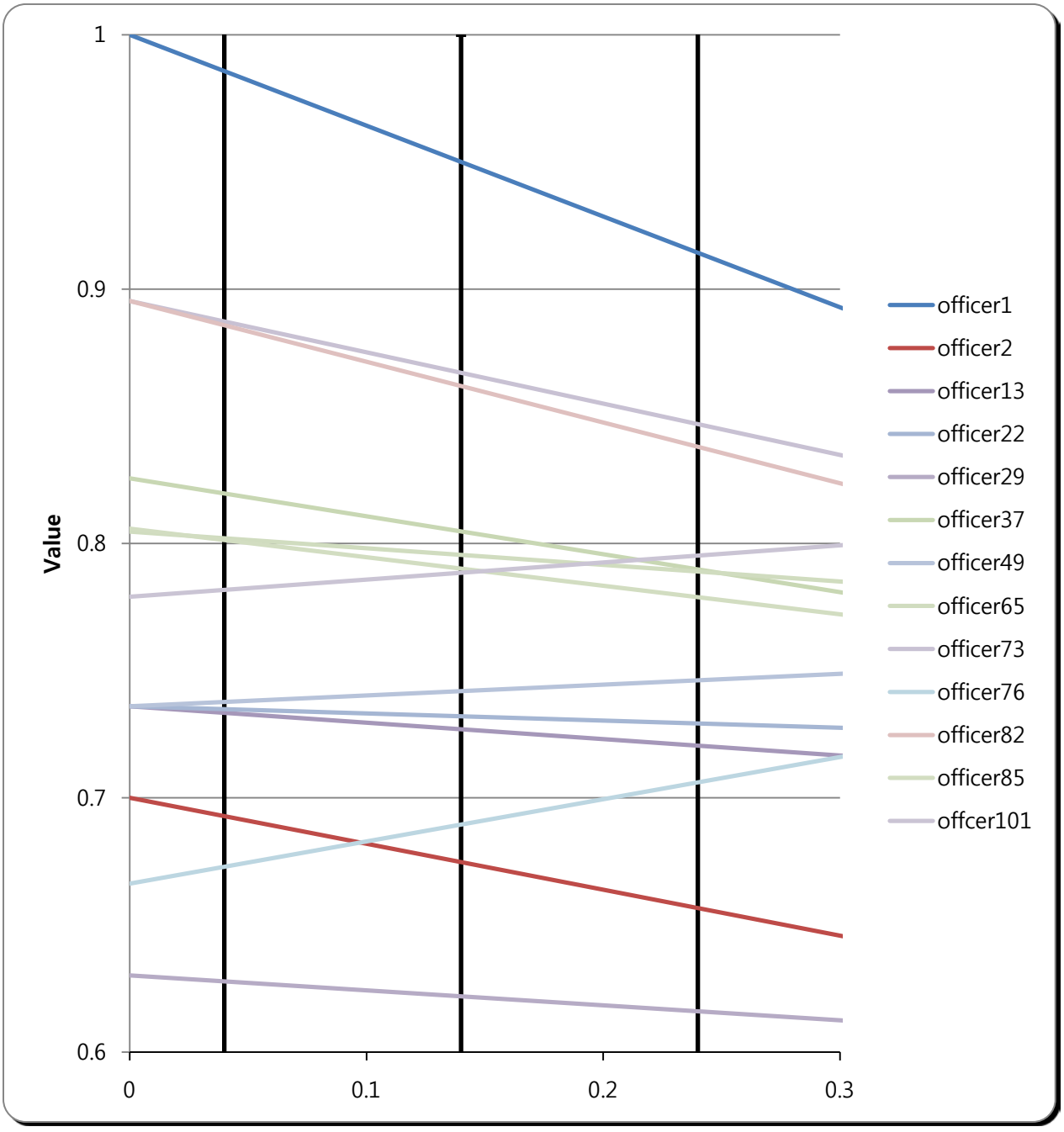


Figure 43 Sensitivity Analysis for Evaluation of Other Quality

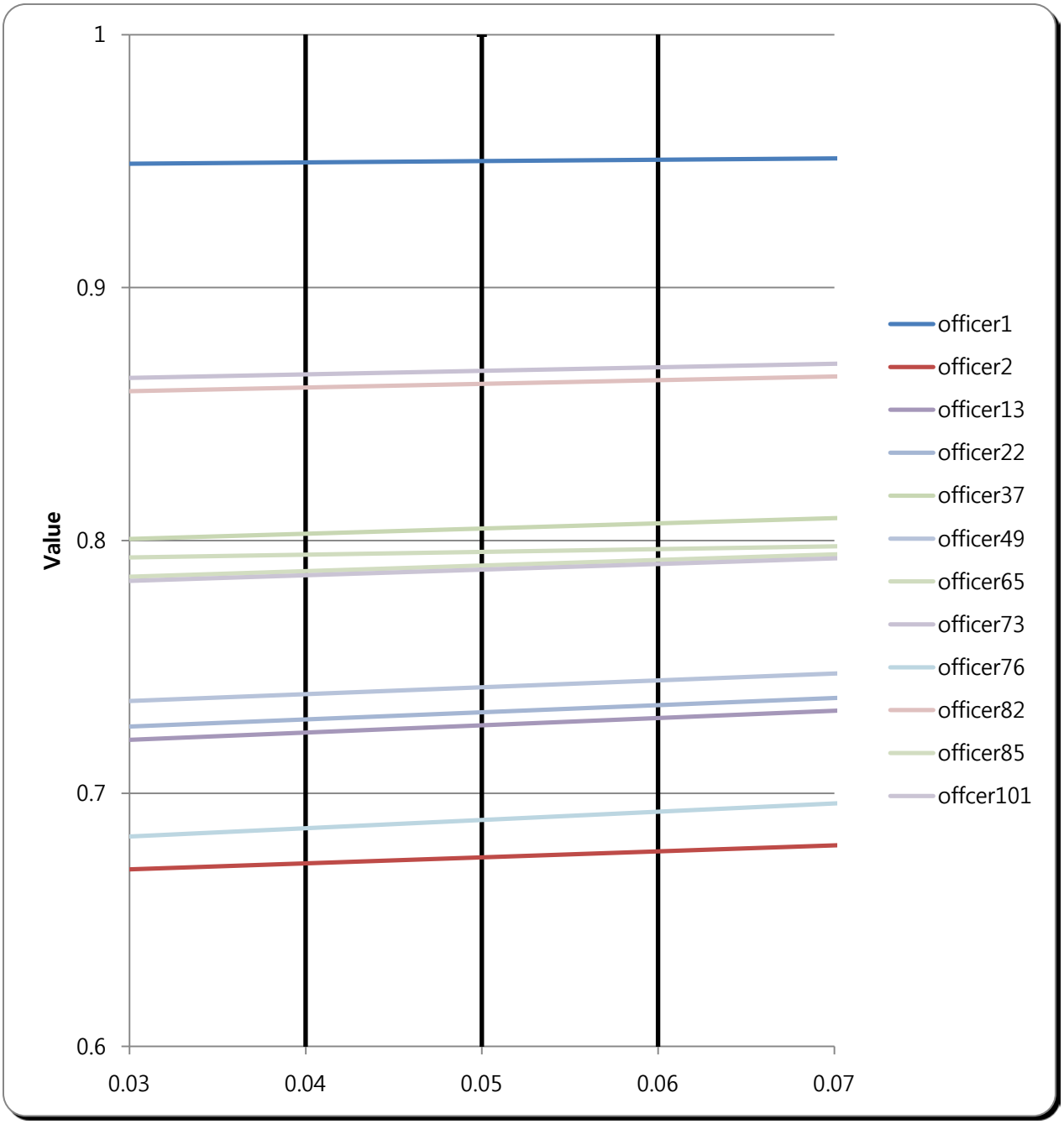


Figure 44 Sensitivity Analysis for PT test

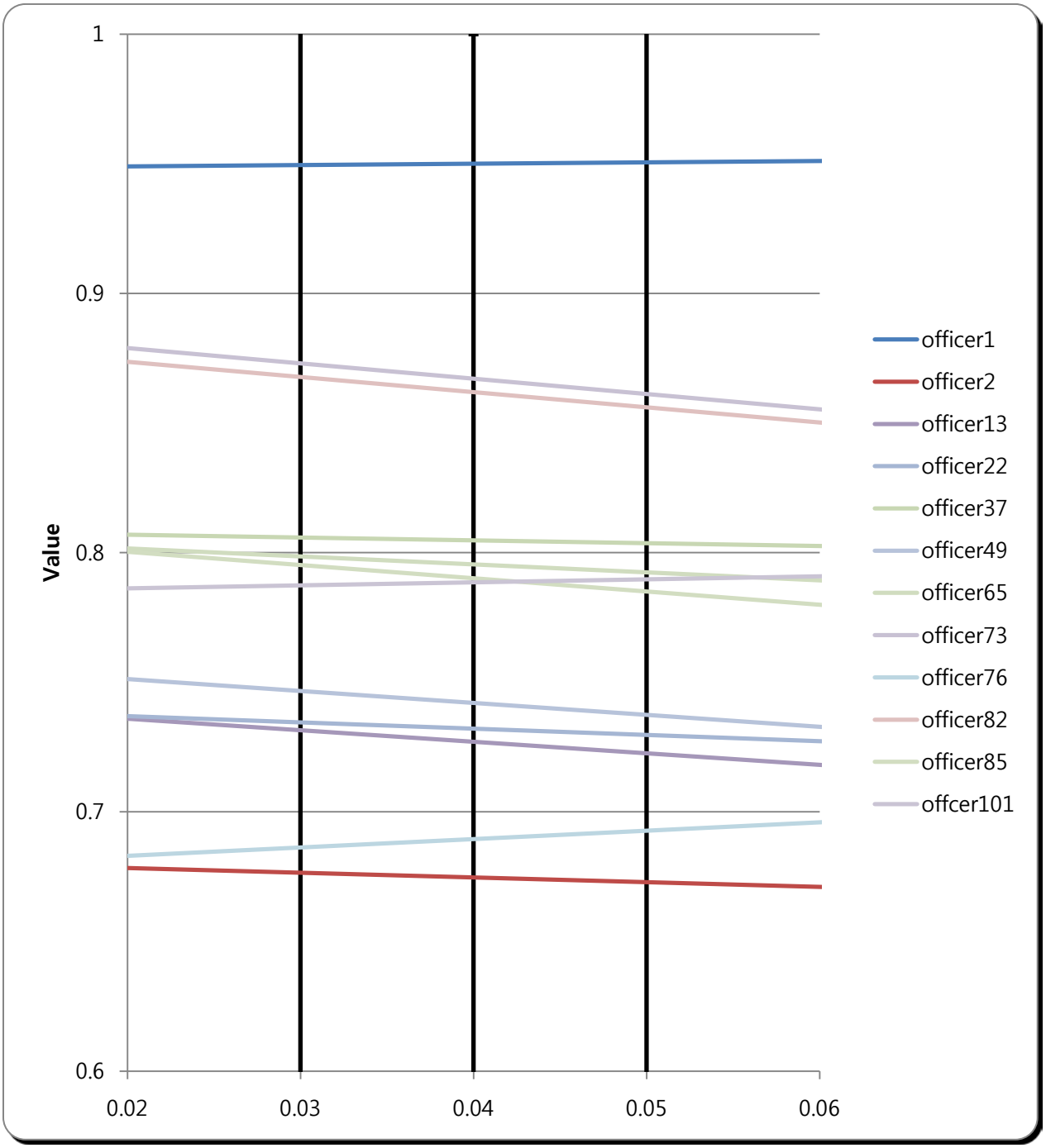


Figure 45 Sensitivity Analysis for Interview Result

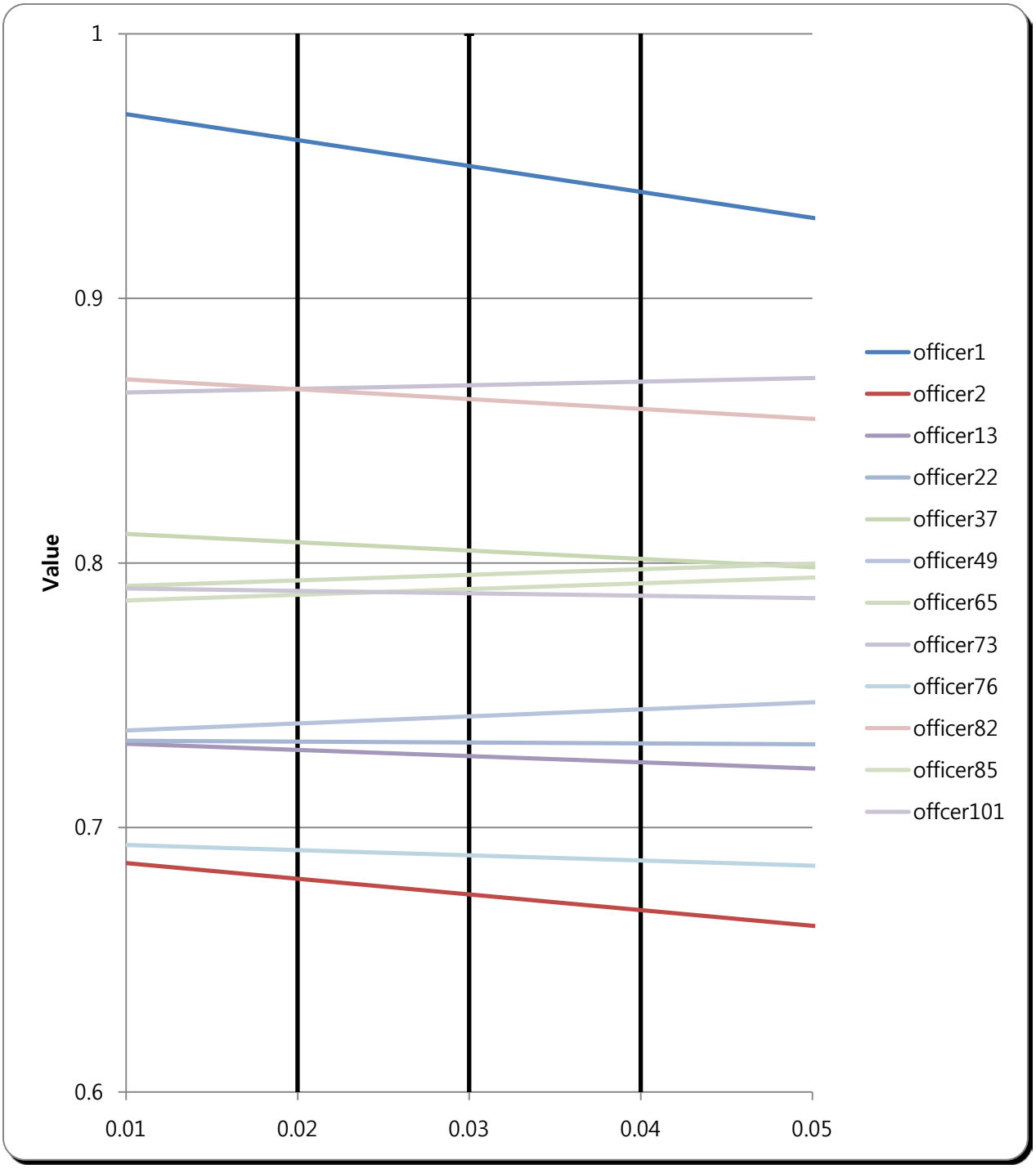


Figure 46 Sensitivity Analysis for Awards Record

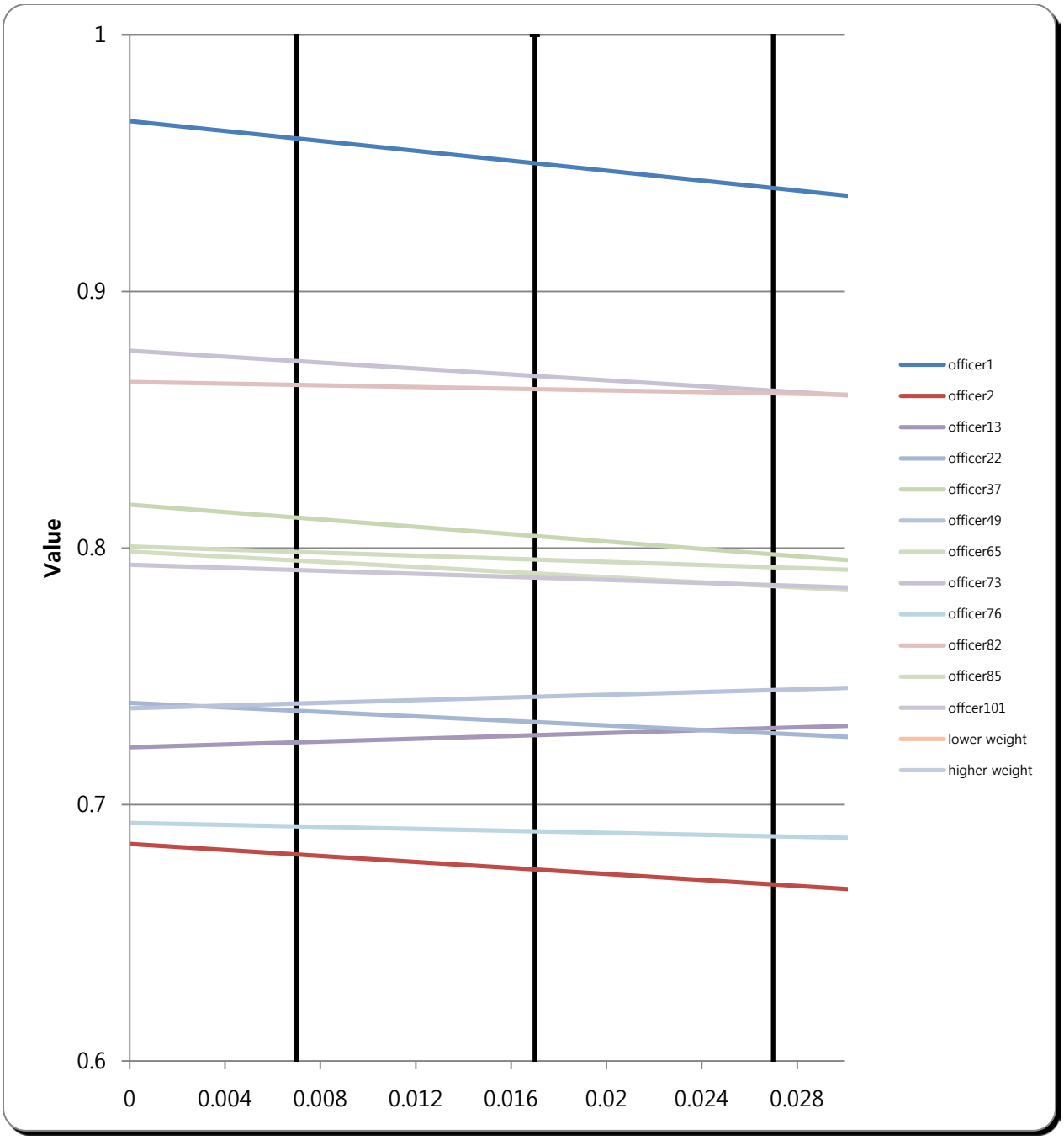


Figure 47 Sensitivity Analysis for Potential Ability

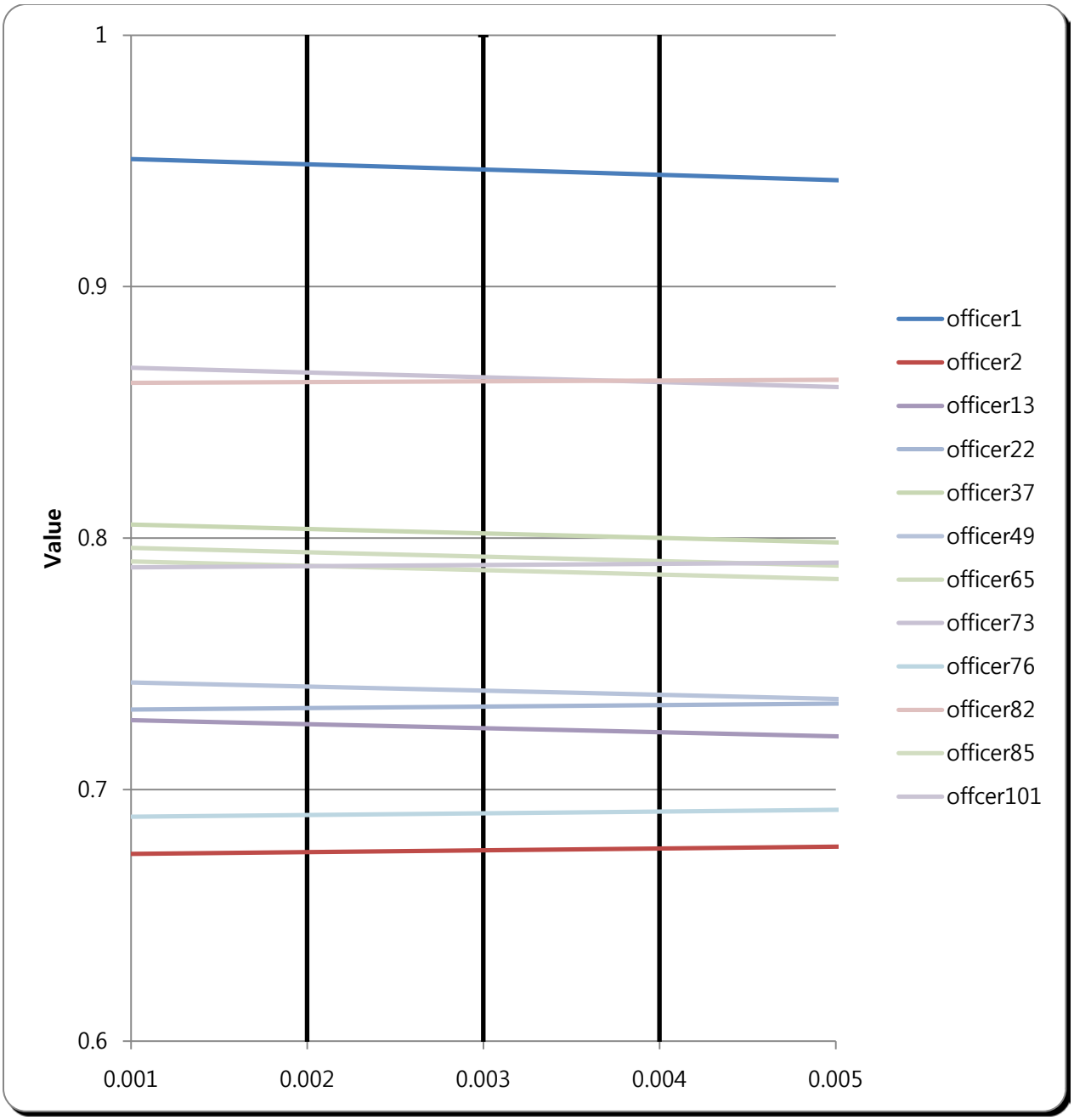


Figure 48 Sensitivity Analysis for Hazard Experience

Decision Analysis Using Value-Focused Thinking For Retention Of Long-Term Officers In the KOREAN ARMY

Captain Jaebum Kim
Advisor : Dr. Jeffery, D. Weir
Reader : Dr. Alan, W. Johnson
AFIT/ENS

Motivation and Objectives

Progress is needed toward a improved method for decisionmakers to evaluate officers for retaining qualified long-term officers in Korean Army

This model will provide the insight for
- Introducing VFT methodology to Korean Army
- Evaluating officers with objective criteria
- Identifying who are the qualified officers
- Changing the pool of qualified officers through sensitivity analysis

Introduction

North Korea has threatened South Korea since the Korean War. The South Korean Army has been performing military reform to build elite troops. Restructuring is one of the agendas. Therefore, it is necessary to study an efficient method for evaluating personnel. This research develops a model of evaluating alternatives who apply for long-term officers in the Korean Army. There are eight values that the Korean Army emphasizes when they select long-term officers. With these, the trade-off between values are determined to identify qualified long-term officers for the organization. Furthermore, this research considered the impact of changing the weight of values.

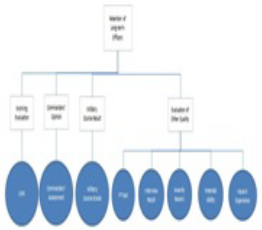
AIR FORCE INSTITUTE OF TECHNOLOGY

Threat of North Korea

Naval Ship Cheonan

Yeonpyeong Island

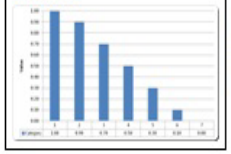
Value Hierarchy



Develop Evaluation Measures

1st Tier Value	2nd Tier Value	Measure	Scale Type	Lower Bound	Upper Bound
Working Evaluation	OER	Working Evaluation Score	Command Direct	10 % of Score	35% of Score
Commanders' Opinion	Commanders' Assessment	Commanders' Assessment Score	Command Direct	10 % of Score	35% of Score
Military Course Result	Military Course Grade	Test Score of Every Course	Command Direct	10 % of Score	35% of Score
Evaluation of Other Quality	PT test	Result of Test	Command Direct	15% of every test	35% of every test
	Marksmanship	Result of Test	Command Direct	5[illegible] (2MM)	5[illegible] (2MM)
	Awards Earned	Number of Awards from superior officers	Command Direct	1.5(Ea) 0.5(Day)	3.5(Ea) 1.5(Day)
	Essential Ability	Evaluation Score or Score of Test	Command Direct	1	1.7
	Unusual Experience	Evaluation Score or Score of Test	Vacant Direct	Major Experienced	Experienced

Categorical Single Dimensional Value Function

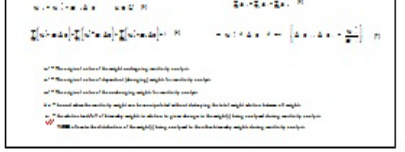


Additive Value Function

$$v_j(x_{ij}) = \sum_{i=1}^{n} \lambda_{ij} v_{ij}(x_{ij})$$

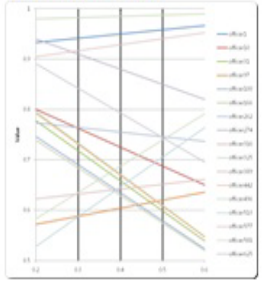
- Lieutenant $V_j(X) = 0.2v_1(x_{1j}) + 0.45v_2(x_{2j}) + 0.11v_3(x_{3j}) + 0.05v_4(x_{4j}) + 0.04v_5(x_{5j}) + 0.03v_6(x_{6j}) + 0.017v_7(x_{7j}) + 0.002v_8(x_{8j})$
- Captain $V_j(X) = 0.4v_1(x_{1j}) + 0.2v_2(x_{2j}) + 0.16v_3(x_{3j}) + 0.05v_4(x_{4j}) + 0.04v_5(x_{5j}) + 0.03v_6(x_{6j}) + 0.017v_7(x_{7j}) + 0.002v_8(x_{8j})$

Customizable One-way Sensitivity Analysis



Deterministic Analysis

Sensitivity Analysis



Methodology

Results

Contributions

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Vita

Captain Jaebum Kim was born in Kimcheon, Korea. He graduated from Cheong-suk High School in Cheong-ju, Korea. He entered undergraduate studies at the Korea Military Academy where he graduated with a bachelor degree of Literature Degree in Business Management and received a regular commission in March 2006.

He successfully performed three years assignment as a platoon leader. He graduated from Company Commander Course in Jang-sung, Korea in 2009. He entered the Graduate School of Engineering and Management, Air Force Institute of Technology. After graduation, he will be given the mission as a company commander.

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Air Force Institute of Technology
Graduate School of Engineering and Management (AFIT/EN)
2950 Hobson Street, Building 642
WPAFB OH 45433-7765

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9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

Major, Young-cheol Kim
Republic of Korea Army Headquarters
Bunamri, Sindoan Myeon, Kyeryong City, Chungnam Province,
South Korea 321-929
Office : 82) 042-550-0114 e-mail: rok7156@army.mil.kr

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14. ABSTRACT

The attacks of Navy ship, Cheonan and Yeonpyeong Island, have deteriorated the relationship between North and South Korea. The death of Kim Jong Il resulted in unstable political situation in North Korea. South Korea has continued Military Reform to develop the retention and management of military personnel as one of the agendas. However, South Korea needs better methods and measures for evaluating personnel to distinguish qualified officers.

The purpose of this research is to improve the method of assessing long-term officers through the use of Decision Analysis principles, especially a Value-Focused Thinking approach. The value model was created based on the instructions of selecting long-term officers in the Korean Army. Individuals are evaluated by the model to retain qualified officers in the organization. The result of the model provides insight to the decision makers who are the best officers for the Korean Army and how officers are retained depending on their abilities.

15. SUBJECT TERMS

Decision Analysis, Value Focused Thinking, Korean Army Long-term Officers Retention, Value Hierarchy, Deterministic Analysis, Sensitivity Analysis

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a. REPORT	b. ABSTRACT	c. THIS PAGE			Jeffery D. Weir, Ph. D.(ENS)
U	U	U	UU	103	19b. TELEPHONE NUMBER *(Include area code)* (937) 255-3636, ext 4523; e-mail: Jeffery. Weir@afit.edu

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