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An Expert Based Multi Attribute Group Decision Making (MAGDM) Model for Portfolio Evaluation: Application on Ground Force Units

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AN EXPERT BASED MULTI ATTRIBUTE GROUP DECISION MAKING (MAGDM) MODEL FOR PORTFOLIO EVALUATION: APPLICATION ON GROUND FORCE UNITS

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ABSTRACT

AN EXPERT BASED MULTI ATTRIBUTE GROUP DECISION MAKING (MAGDM) MODEL FOR PORTFOLIO EVALUATION: APPLICATION ON GROUND FORCE UNITS

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Old Dominion University, 2013
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This main objective of this dissertation is to propose an expert based multi attribute group decision making model (MAGDM) for portfolio evaluation and demonstrate it by applying it to evaluate brigade types under different military missions. Specifically, currently used Heavy, Mechanized Infantry, Airborne Infantry, and Stryker brigades are evaluated under a set of possible future military missions. The purpose of the study is to provide a model for decision makers, engaged in a force development process.

This study combined MAGDM and simulation by using expert judgments to create distributions rather than aggregating them into point values. Excel and Monte Carlo simulation software are exploited to create the model.

This dissertation will primarily be of interest to force planners and high-level decision makers in the land forces and broader Department of Defense and other parts of the government concerned with defense planning. It should also be of interest to researchers focusing on decision making, specifically Multi Attribute Decision Making (MADM), and Multi Attribute Group Decision Making (MAGDM) under imprecise information, and engineers dealing with portfolio selection.

This dissertation is dedicated to my wife, Nesrin Gültekin.

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I would especially like to thank my lovely wife, Nesrin, who has passionately supported and encouraged me without ever complaining. I felt her everlasting support during my 3 year Ph.D. endeavor. Without her, it would not have been possible to complete my chapters on time.

Nurten and Eren, my daughter and son, sorry for not having played with you as much as I wanted. I hope I can compensate for this someday, and I also hope my perseverance in my studies encourages you in your long school life in the future; "There is no pain without gain!"

Special thanks to the SME team, who supported me during the analysis, for their time, contribution and efforts. Their discussions and suggestions during workshops were vital to supporting my analysis.

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Last but absolutely not least, I thank the Turkish Armed Forces for granting me this opportunity to pursue a Ph.D. degree so that I can better serve my country.

LIST OF ACRONYMS AND ABBREVIATIONS

AC	Active component
ARCIC	Army Capabilities Integration Center
ARFORGEN	Army Force Generation
ARSTRUC	Army structure
BCT	Brigade combat team
CNN	Cable News Network
COCOM	Combatant command
CS	Combat support
CSA	U.S. Army Chief of Staff
CSS	Combat Service Support
DISCOM	Division Support Command
DM	Decision Making
DMs	Decision Makers
DoD	Department of Defense
DOTMLPFI	Doctrine Organization Training
DSS	Decision Support Systems
FM	Field Manuel
FY	Fiscal Year
GDSS	Group Decision Support Systems
GF	Generating Force
GPD	Gross domestic product
HA	Humanitarian Aid

HMMWV	High Mobility Multipurpose Wheeled Vehicle
HADR	Humanitarian Aid & Disaster Relieve
HQDA	Headquarters, U.S. Department of the Army
HQ	Headquarter
JP	Joint Publication
JTF	Joint task force
MADM	Multi Attribute Decision Making
MADA	Multi Attribute Decision Analysis
MAGDM	Multi Attribute Group Decision Making
MCC	Major Combat Campaign
MCDM	Multi Criteria Decision Making
MDCA	Multi Criteria Decision Analysis
MP	Military Police
MTO&E	Modified Table of Organization and Equipment
NATO	North Atlantic Treaty Organization
NCO	Non-commissioned Officer
OEF	Operation Enduring Freedom
OF	Operating Force
OS	Opposed Stabilization
SFUF	Support to Foreign Unconventional Forces
SD	Sanctuary Denial
SIPRI	Stockholm International Peace Research Institute
TRADOC	Training and Doctrine Command

WS	Weapon systems

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CHAPTER 1

INTRODUCTION

"Uncertainty is necessarily the lot of the planner, since he deals with the future. Uncertainty can never be completely removed. However, it can be compensated for, and to do so is a continuing responsibility of those who plan military forces. Primarily this can be done by insuring, in so far as we can, that future weapons and forces will be adaptable to the right range of defense needs or, as defense planners often put it, by insuring flexibility."

Harold Brown, 1967

U.S. Secretary of Defense (1977-1981)

1.1 Background of the Study

Countries are devoting dwindling resources to large ground forces to keep them in position for today and tomorrow's war spectrum. This diverse spectrum ranges from the least severe peacetime missions like domestic disaster relief or security assistance to the most severe ones like international war or nuclear warfare.

According to the Stockholm International Peace Research Institute (SIPRI) Yearbook (2011) the U.S. is the top military spender in the world with $687 b. (4.7% GDP). Similar nations spend an average of 2.5% of their GDP to keep their armed forces ready for any future conflict. Analyses of the future security environment, in which NATO member countries and Coalition forces may engage, have concluded that two of the major characteristics will be: complexity and uncertainty. This conclusion is also supported bluntly by the Former US Secretary of Defense, Robert Gates:

> When it comes to predicting the nature and location of our next military engagements, since Vietnam, our record has been perfect. We have never once gotten it right, from the Mayaguez to Grenada, Panama, Somalia, the

> Balkans, Haiti, Kuwait, Iraq and more -- we had no idea a year before any of these missions that we would be so engaged. (CNN, 2011)

Although this expression may exaggerate the situation, an army has to be prepared for the unpredictable nature of the future security environment. This requires force planning with a high level of uncertainty.

Given war history, nations have been instinctively keeping their forces ready for contingent conventional major combats since WWII, but over the last two decades stability operations have become an inescapable reality of the security environment. U.S. and allied military expeditions to Afghanistan, Iraq and other unstable regions are likely to be continued. Success requires complete accomplishment of conventional and non-conventional operations. Therefore, both types of operations should be planned for, and the capability to do both should be developed. (Kelly, Jones, Barnett II, Crane, Davis, Jensen, 2009)

1.1.1 Uncertainty of Combat Environment: Missions, Adversaries, Terrain

Owing to a decade of persistent irregular conflicts, with its emphasis on ground centric operations, U.S. Army units are highly expected to play a central role in future conflicts. Figure 1 displays whole range of this conflict spectrum which includes 26 types of operations that land forces may or may not be tasked to conduct. At the diagram severity of operations increases from left to right, and there is a gray area between peace and combat environment. Army forces need to build on well-known cold war era expertise in conducting operations at the lower end of the conflict spectrum like stability operations, foreign internal defense, transition and reconstruction, and counterinsurgency (Krepinevich, 2009).

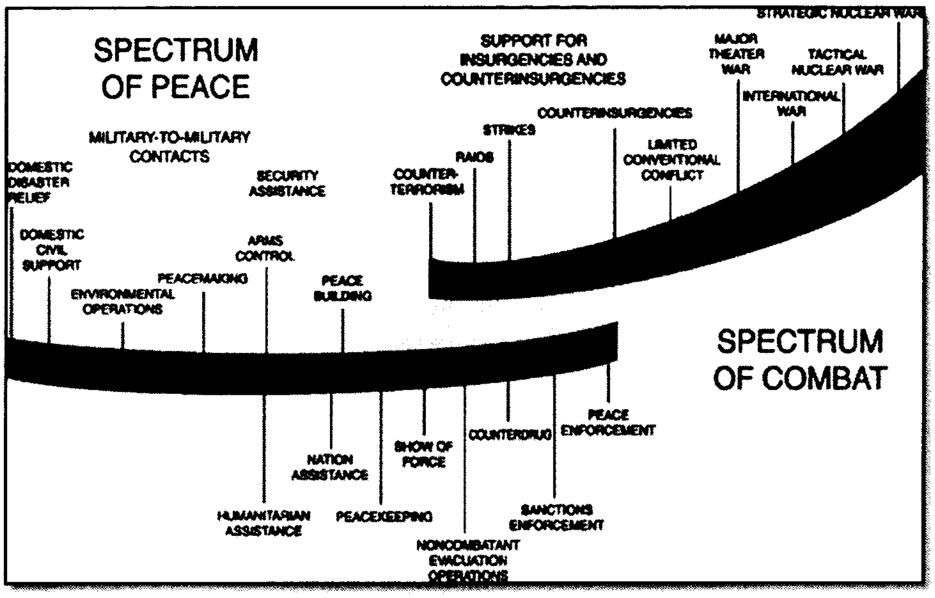

Figure 1 Conflict Spectrum (Adapted from Army Vision 2010 (Washington, D.C.: Headquarters, Department of the Army, nd.)

Diversity is not limited to operation types; new adversaries-besides the state actors-are added to the spectrum during the last two decades of war in Bosnia, Kosovo, Iraq and Afghanistan. The Army is expected to be prepared and conduct operations against non-state actors like terrorists, insurgents, militias, and criminal organizations.

Environment or more specifically terrain is another important dimension affecting the composition and capability requirements of the Army units. Although historically U.S. Army units are deployed to various distinct regions, from the jungles of Vietnam to desserts in Iraq and mountains in Afghanistan, recent studies suggest that every single operational type could reasonably be anticipated in every region of the world (Freier, 2011).

These disparate missions, adversary types, and environments argue for specialized and properly equipped army units and troops that are able to operate effectively around the globe and across the entire conflict spectrum.

1.2 Statement of the Problem

Owing to the broadness of the scenario range, the Army requires capabilities and skill sets that are sufficiently different from each other. In practical terms, capabilities are mostly achieved through weapon systems. Weapon systems (WS) requirements of a peace building mission in an urban environment are completely different from a strike or conventional conflict mission in a steppe or rural area. The first mission is about monitoring and policing the cease-fire and requires lightly equipped mobile infantry troops, but the latter one requires heavy armored troops with a high level of lethality. Figure 2 provides more visualization to understand diverse weapon requirements for different combat missions.

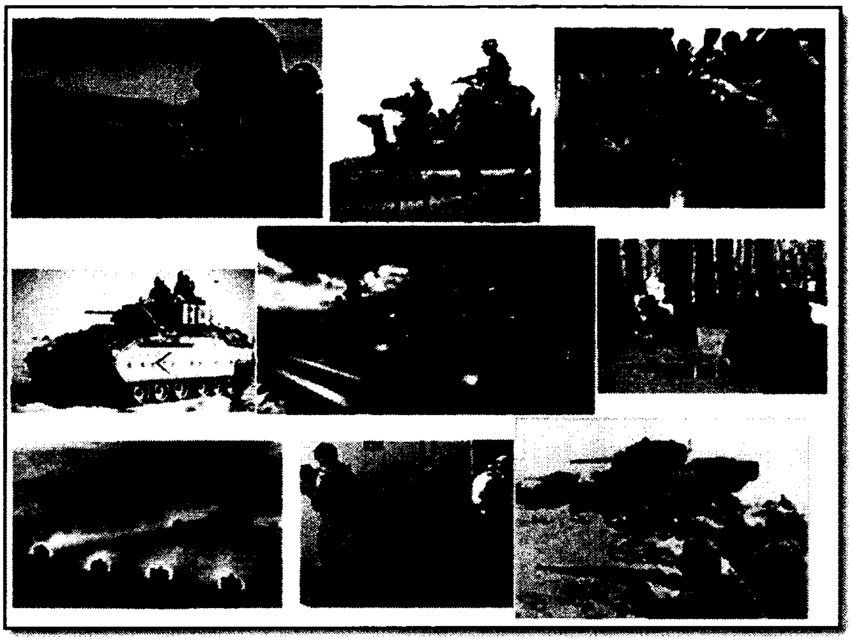

Figure 2 Snapshots from Different Missions and Environments

Currently, nations possess armies that maintain this specialization by different unit types. Light forces (airborne, air assault, and light infantry divisions) are tailored for forcible-entry operations and for operations on restricted terrain, like urban areas, mountains, and jungles. Heavy forces (mechanized and armored divisions equipped with armored fighting vehicles and main battle tanks) are trained and equipped for operations against state armies employing modern tanks and armored fighting vehicles (FM 3-92, 2010).

Currently these unit types and their percentage within the Army is under great scrutiny:

- Does the Army still need armored divisions?
- What should be the percentage of the unit types within the Army?

- How do newly emerged combat types affect the force mix in the Army?
- If equipped with proper weapon systems, can a unique force type be more effective than all the other unit types?
- Should the Army dissolve the current units and go for a multi- purpose unit type that can effectively be used in whole combat spectrum?

Debate on the future of the Army has not ended yet, and currently there is no clear answer; the answer differs among decision makers and researchers. Krepinevich and others argue that although some heavy forces are necessary insurance against the unlikely event of a major ground war, the Army could cut its armored and mechanized battalions. On the other hand, the Army cites its experiences since WWII and insists that armored and mechanized units are necessary for deterrence and any future combat (Freedberg, 2012).

In order to enable high level decision makers to answer these complex questions, detailed analysis needs to be done, and decision makers should be backed up with proper models and associated decision support systems. Although many analyses have been done on ground force evaluation, those are either focused to specific weapon systems or they are high level strategic assessments of specific combat types. Review of the literature shows that numerous assessment studies have been done on specific weapon systems like tanks, helicopters and rifles, but these studies are not able to link the lower level weapon systems to higher level force skills and capabilities and capabilities to the conflict spectrum as shown in Figure 1.

Therefore, one of the questions researchers need to answer is: what is the best mix of forces within the army and the mix of weapon systems within the army units at a given mission composition?

1.3 Purpose of the Study

The overarching purpose of this study is to investigate important factors that influence operational effectiveness of land forces and propose a methodology to assess ground forces by considering the weapon systems that they contain. To reach that goal this study has four subsequent objectives.

First, current and future security and combat environments need to be assessed since scarce resources are devoted to prepare and keep land forces in position for diverse missions.

Next, it is necessary to analyze and define elements and factors that determine or influence the effectiveness of ground forces within different security and combat environments. These factors include, but are not limited to, doctrine, training, leadership personnel, and equipment

After that, literature needs to be reviewed to understand what tools, techniques, and methodologies have been used to aid decision makers in defense planning, force development, and weapon system procurement. Similar to the previous step, emphasis is on studies of weapon systems.

Lastly, Multi Criteria Decision Making (MCDM) methods are investigated, and a model is developed by exploiting MDCM techniques. This model would be able to evaluate multiple force alternatives composed of multiple weapon systems under different types of operations and terrain/environment and allow users to make sensitivity analysis to have a deeper understanding of the variables that affect the performance of ground forces.

The methodology aims to fill the gap between studies conducted to evaluate individual weapon systems and high level reports by linking bottom level weapon systems with high level force level capabilities.

1.4 Research Questions

The main questions for this research are stated below. The questions are further refined through sub-questions.

- What are the characteristics of current/future military missions?
- What are the factors that determine or influence the ground force effectiveness?
- What are the techniques and methodologies in the literature that have been used to aid decision makers in defense planning?
- How can MDCM techniques be exploited to design a methodology for ground force assessment?

The following Investigative Questions (IQ) are necessary in order to answer the above listed research questions:

IQ-1 How are capability requirements varied between operation types?

IQ-2 What are the major criteria sets and hierarchy to evaluate weapon systems and force options?

IQ-3 How do weapon systems contribute to these attributes?

IQ-4 How can subject matter expert opinion be used in the model?

IQ-5 What are the major attributes for evaluation of ground forces?

IQ5 What are the analytical requirements to evaluate ground force options?

1.5 Significance of the Study

Besides reviewing the literature regarding ground force assessment and analysis of factors that affect the success of ground forces in different combat tasks, this dissertation proposes a model that provides detailed analytical results to inform decision makers on force modernization and planning issues.

This study exploits MDCM techniques to evaluate a bigger system composed of weapon systems while previous studies focused on evaluating individual weapon systems. This study therefore tries to fill the gap between low level weapon system evaluations (e.g. tanks, artillery, rifles, vessels, etc.) and strategic level assessments on specific mission or force types (e.g. heavy brigades, counterinsurgency deployability studies).

Another important aspect of the study is the way of representing uncertainty. The model combines MCDM methods with simulation to represent the uncertainty linked with the force evaluation by converting expert ratings to probability distributions. Thus, final ratings are the results of the simulation iterations where expert ratings are used as inputs. This approach provides a larger ground for making additional analysis compared to many previous studies.

Finally, the generic model proposed in this study would be applicable to the evaluation of other systems composed of sub/individual systems. This might include, for example, vehicle fleet evaluation for transportation services or team evaluation for different rivals and environments.

1.6 Limitations

Evaluation of ground force options across multiple combat tasks and terrain types requires analysis of other aspects like personnel readiness, training, force structure, facilities besides analysis of weapon systems. The proposed model focuses on weapon systems composed of land units (e.g. tanks, infantry carriers, howitzers, mortars).

Due to security restrictions, all the data related to the weapon system specifications and force structures are obtained from related and reliable open sources (including unclassified military publications).

The methodology is not intended to find a complete solution to complex defense planning problem; rather, it is designed to serve as a decision aid tool for decision makers.

During the analysis five personnel from NATO Allied Command Transformation (ACT) Headquarters are used as Subject Matter Experts (SME). Although they have sufficient background and expertise on the topic, for more detailed real life studies the proposed model should be used with relevant decision makers in the Force Development Process.

1.7 Organization of the Remainder of the Study

This dissertation includes a total of 5 chapters. The research starts with an introductory chapter in which brief information and objectives of the research are presented. This chapter also identifies the research questions, limitations, and problem statement.

Chapter 2, "Literature Review, provides the necessary background about the specific area of interest for the research. In this part, past studies and research are revisited and will be introduced with a brief explanation. The literature review is intended to point to possible deficiencies or gaps and areas for future research. This chapter sets a baseline for Chapter 3 ("Methodology") by exploring the fundamentals of MADM and its applications to military force planning and weapon system evaluations.

Chapter 3 describes the eight phases of the proposed MAGDM model. Chapter 3 also includes examples of methods and techniques to better explain the process and links to the literature.

Chapter 4 demonstrates the proposed model and its application by applying it to evaluation of current U.S. ground forces.

Chapter 5 presents a brief reflection on the main conclusions and recommendations as well as limitations and some suggestions for future research.

Finally, for the sake of simplicity, rather than providing all the literature consulted, only studies that are directly related to the research have been selected and put in the references.

1.8 Definitions of Key Terms

The following are significant terms that frequently appear in the study. Several of them are unique to the environment in which this research was conducted, while others have multiple meanings, depending on the context in which they are used. An understanding of the intended meaning in the context of this study and of the environment that provides the context will greatly assist in understanding specific portions of the study and the study as a whole. In some cases, expanded definitions are discussed in the literature review.

Military Operation: It is the harmonized military actions of a state in response to an emerging situation. These actions are designed as a military plan to resolve the situation in the State's favor. Operations may be of combat or non-combat types (JP 1-02, 2011).

Spectrum of Conflict: Spectrum of conflict is the backdrop for Army operations. The spectrum of conflict uses violence as a discriminator on an ascending scale that ranges from stable peace to general war. On the left hand of the spectrum, stable peace represents an operational environment characterized by the absence of militarily significant violence. On the right hand of the spectrum, general war describes an environment dominated by interstate and intrastate violence (Figure 1) (FM0-3 p. 2-1).

Joint. This term refers to "activities, operations, organizations, etc., in which elements of two or more Military Departments (e.g. army, navy, air force) participate" (JP 1-02, 2004, p.25).

Multi Criteria Decision Making (MCDM): These are decision making methods that exist to help people making decisions according to their preferences, in cases where there is more than one conflicting criterion (Bogetoft and Pruzan, 1997). For a decision to be classified as an MCDM, more than one criterion must be present (basic requirement), and these criteria must be conflicting (sufficiency requirement) with each other. In other words, if a problem involves at least two conflicting criteria and at least two alternative solutions to choose from, it can be classified as an MCDM problem (Tabucanon, 1988). Multi-Attribute Decision Analysis/Aid (MCDA) is another term often used interchangeably with MCDM. It emphasizes that the methods should aid DMs in making better decisions.

Multi Attribute Decision Making (MADM): This is a branch of MCDM and concentrates on problems with distinct decision spaces. In these problems the set of alternatives are finite and have been predetermined. Car and house selection problems are well-known examples of this branch.

Multi Objective Decision Making (MODM): This is the second branch of MCDM and deals with multi criteria decision problems which have a continuous decision space with infinite alternatives. The difference between MADM and MODM is that MADM is associated with problems of which a number of alternatives have been predetermined. The decision maker (DM) selects/ranks a finite number of courses of action. On the other hand, MODM is not associated with the problems in which alternatives have been predetermined. In other words, MODM techniques present optimization of an alternative or alternatives on the basis of prioritized objectives while MADM techniques present selection of an alternative from a set of alternatives based on prioritized attributes of the alternatives.

CHAPTER 2

MULTI CRITERIA DECISION MAKING AND ITS APPLICATIN IN MILITARY

2.1. Introduction

Reviewing previous studies and investigating the collective knowledge related to a topic is an important stage of the research (Neuman, 2003). The literature review, which is part of chapter 2, brings clarity, helps researchers to build a foundation, and shows theoretical evolution of the topic at hand (Neuman, 2003).

Traditional and electronic sources supported the research in the literature. The search incorporated and used refereed journal articles, scholarly books, and research documents through electronic library search engines, ProQuest, EBSCOhost, etc. Bibliographic and reference listings were used from appropriate titles for further literature searches through Old Dominion University Perry Library's interlibrary loan services.

The purpose of this chapter is to address the MCDM and its relationship to military applications in order to set a baseline for Chapter 3 by exploring the fundamentals of MADM and its applications to military force planning and weapon system evaluations.

This chapter starts with a brief description of decision making and an explanation of where MCDM stands under this broad field. Then the main futures and steps in MADM are explained, and a detailed list of MCDM techniques with good reference are provided. The literature review concludes with discussion of the use of MCDM in weapon system evaluation and gaps in military applications of MCDM. Figure 3 displays the outline of the literature review.

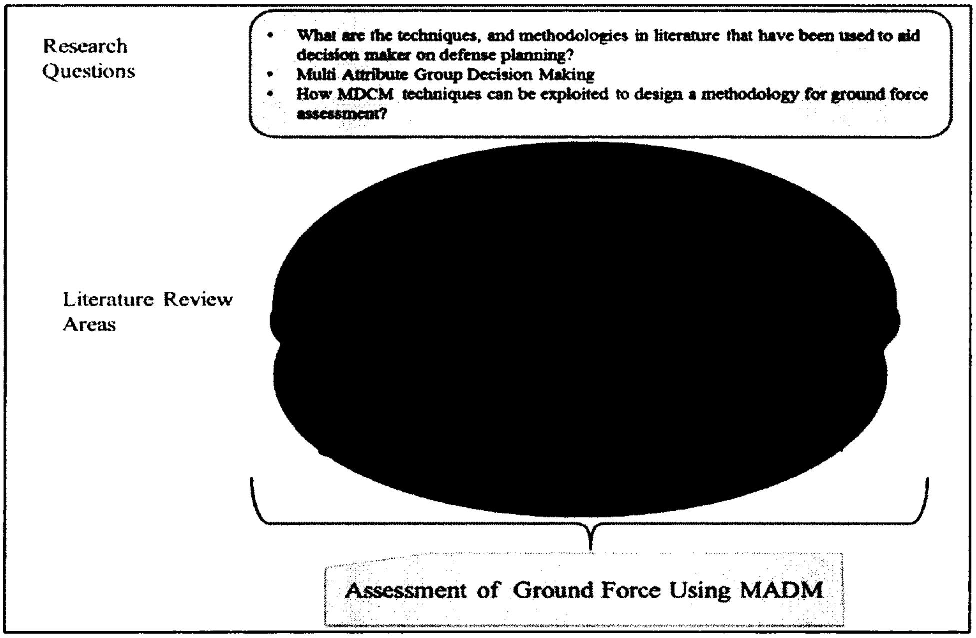

Figure 3 Literature Review Outline

2.2. Decision Making (DM)

Making the right decision directly affects the success of both individuals and organizations. No matter how complex or simple, all decisions follow the same basic process. Although sometimes it might not be recognised by decision makers (DMs), the process should be supported by a model that guides the DMs through all appropriate steps (Ababutain, 2002). Regardless of the amount of alternatives and objectives, the decision making process is defined as an interactive process that encompasses a complete search of information, full of by-passes, enriched with feedback, and collecting and evaluating information. It is an indispensable organic process where pre and post decision activities overlap. Many researchers described the decision process, but Zeleny (1982) provides one of the most detailed explanations for decision making. He stresses the process quality of human decision making, the inter-relation of its stages, and the evolutionary nature of its main outcomes.

Real life decision problems are usually too complex and multidimensional to be considered through a single point of view or criterion to reach an answer. To reach an optimum solution all pertinent factors that are related to the problem should be considered simultaneously. Otherwise, oversimplification of the problem by uni-dimensional approaches might lead to impractical decisions (Hall and Nauda, 1990).

The Army is a massive organization, and reaching a clear resolution in force planning decisions is always tough as it concerns national security and protection of national interests. Other important aspects that make force planning difficult are that it consists of multiple and conflicting criteria, there are multiple objectives, there is an uncertain future security environment, several stakeholders are involved in the decision process, and imprecise and incomplete assessments exist since the decision outcomes are all related to the future. MCDM offers a sound framework, as well as a wide range of methodological tools that are oriented to support the decision makers in facing complex decision problems (Zopounidis and Psarras, 2006).

2.3. Multiple Criteria Decision Making (MCDM)

MCDM is a well-recognized branch of decision making, a general class of Operations Research (OR). It studies decision problems under the presence of multiple decision criteria. Many authors including Zimmermann (1991), Pohekar & Ramachandran (2004), and Climaco (1997), divided MCDM into two main branches:

- Multi-Objective Decision Making (MODM)
- Multi-Attribute Decision Making (MADM).

MODM deals with decision problems that have a continuous decision space with infinite alternatives. A typical example is problems that can be solved with multiple objective functions in mathematical programming. The first reference to this problem is attributed to Kuhn and Tucker, (1951) as the "vector-maximum" problem. On the other hand, MADM concentrates on problems with distinct decision spaces. The difference between MADM and MODM is that MADM is related to problems of which a number of alternatives have been predetermined. The decision maker selects/ranks a finite number of courses of action (selecting a weapon system among ten alternatives). On the other hand, MODM is not related to the problems in which alternatives have been predetermined. In other words, MODM techniques present optimization of an alternative or alternatives on the basis of prioritized objectives.

2.4. Evolution of MCDM

Although today the application of MCDM techniques is widespread, it only has a fairly short 40 year history as a separate discipline. Similar to other disciplines, improvements in computer science serve as a catalyst for the developments in MCDM. On one hand, the widespread use of computers and information technology has generated a huge amount of information, which makes MCDM increasingly important and useful in supporting decision making. On the other hand, the rapid development of computer science has made it possible to conduct systematic analysis of complex MCDM problems (Xu and Yang, 2001).

The number of academic publications on MCDC techniques and applications have also grown dramatically. Figure 4 shows the number of MCDM publications have grown exponentially over the years from the 1970s to 2006. This significant increase indicates the utility and usability of MCDM techniques among decision makers.

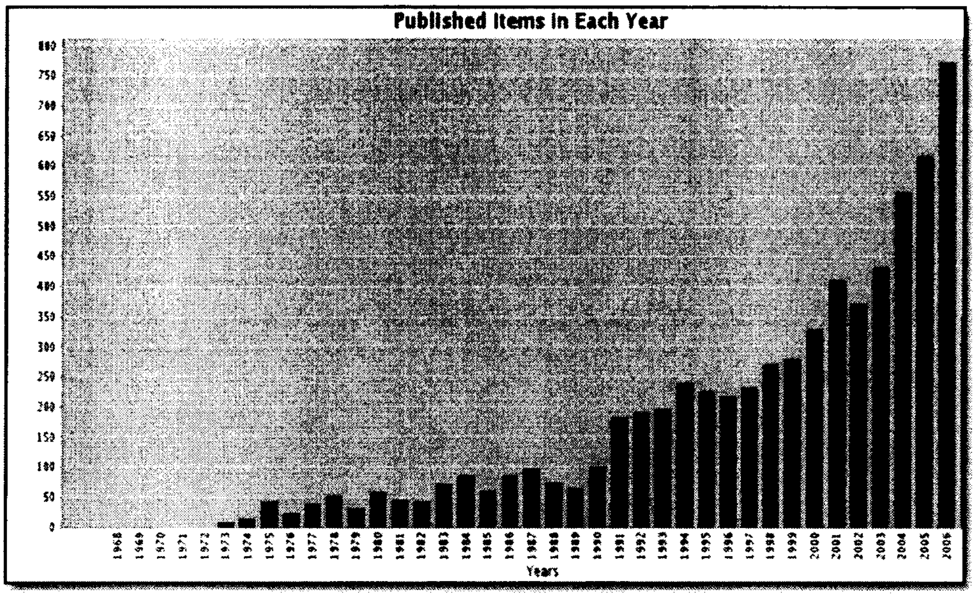

Figure 4 Number of MCDM Related Publications Retrieved from (Wallenius, et al., 2008)

Since the aim of this dissertation is to propose a model that exploits a MADM method, the following section provides detailed information on MADM and methods in the literature. More information on MCDM and MODM can be found in the works of Szidarovszky, Gershon & Duckstein (1986); Yager (1977); Fonseca & Fleming (1993); and Figueira, Greco, and Ehrgott (2005).

2.5. Main Futures of Multi Attribute Decision Making (MADM)

Although MADM problems could be very diverse in context and can be structured and solved via different methods, they share some common features that differentiate them from other decision problems. A discussion of these features follows.

Multiple Attribute: As the name suggests, in a MADM problem there should be more than one attribute. The number of attributes depends on the nature of the problem. While there would be hundreds of factors to be considered for reaching a decision, DMs may use the most important among them to simplify the process. Selection of the criteria demands a special effort since this phase builds the framework of the process. A perfect process that started with a faulty criteria selection phase will result in an incorrect decision.

For an attribute to be useful for the decision maker, it should be both comprehensive and measurable. If the level of a criterion is known in a certain situation and with this knowledge the decision maker can clearly estimate the level of achievement for the objective related to that criterion, the criteria at stake is considered to be comprehensive. A criterion is measurable when a probability distribution for every alternative can be determined or point values for special situations can be calculated (Keeney, 1993).

Conflict among Criteria: Multiple criteria usually conflict with one another. For example, in tank design; protection, lethality, and mobility are conflicting with one other. Although it is not the only improvement, protection requires thicker armor and that lowers mobility due to additional armor weight. In the case of a land unit (ie. brigade) if DM wants to have a more protected and lethal unit, deployability needs to be sacrificed due increased transportation requirements.

Amount of Alternatives: A finite number of alternatives – out of maybe hundreds of alternatives – are evaluated, selected, or ranked in a MADM problem. Selecting some personnel among hundreds, selecting a car or vehicle among many are examples of selection within a finite alternative pool. In the literature, the terms "choice," "policy," and "candidate" are also used instead of alternative.

Hybrid Nature and Different Scales/Units: Every attribute/criterion may require a different measurement scale. In a weapon selection problem, fuel consumption may be measured with liters/km, armor thickness with cm, rate of fire with rounds/minute, and price with dollars. In many decision problems, attributes may even be non-quantitative, such as the style or ergonomic performance (Valls and Torra, 2000).

Attributes of Qualitative and Quantitative Nature: It is possible that some attributes can be measured quantitatively while some others can only be described subjectively. For instance, command and communication of a weapon system, or safety features of a vehicle may only be indicated in linguistic terms. The price of a car can be defined by a quantitative scale (dollars), but the scale of comfort has to be qualitative. This requires MADM methods that aggregate both subjective and objective assessments, made for multiple decision criteria, in a meaningful and robust way.

Deterministic and Probabilistic Attributes: Some or all of the attributes of a decision problem may be probabilistic due to the nature of attributes, or lack of data (Kim and Ahn 1999). For example, in the weapon selection problem, cost might be deterministic while firepower might be probabilistic because hitting a target is measured by a probability distribution.

Weights of Criteria: In almost all MADM problems criteria/attributes have different importance/weights. These weights can be determined by the DMs, and many different methods have been proposed for assessing criteria weights. Detailed information can be found in the works of Pekelman and Sen (1974); Choo and Wedley (1985); Darmon and Rouzies (1991).

Decision Matrix: MADM problems can be restated in a simple matrix format. In this matrix, the columns represent the criteria of the decision problem while the rows represent the alternatives. Each criterion has a weight that shows its importance. Table 1 represents a sample matrix for a tank selection decision problem. The problem has four attributes and three alternatives, and a matrix shows the weights of criteria and scores each alternative received for each criteria.

Table 1 Decision Matrix

Alt./Criteria	**Mobility**	**Logistic Cost**	**Protection**	**Firepower**
	Benefit	Cost	Benefit	Benefit
Criteria Weight	0,15	0,29	0,07	0,49
M1A2 Abrams	0,8081	0,9129	0,5657	0,3293
Leopard-2	0,5051	0,3651	0,4243	0,5488
Challenger	0,3030	0,1826	0,7071	0,7683

Attribute/Criteria Hierarchy: A hierarchy in MADM is composed of multiple levels of attributes. The top-level attribute of the hierarchy is generally an overall qualitative attribute like best desktop computer, best candidate for a job, best program, aircraft, armored vehicle, etc. This high level attribute should be decomposed into more specific sub-attributes or criteria. The sub-criteria can be further decomposed until the bottom level criteria can be evaluated directly or qualitatively (Xu & Yang, 2001). A hierarchy example for Main Battle Tank is shown in Figure 5, where the overall attribute "main battle tank" is decomposed into "attack", "mobility", "defense", "communication & control" sub-criteria. Then, to better evaluate alternatives against these attributes they are decomposed into sub criteria. For example, mobility is decomposed into "general" and "over obstacle" mobility, and these are decomposed again into sub-criteria.

Inconclusive Assessment: Due to lack of information, the conflict among criteria, the uncertainties in subjective judgment and different preferences among multiple decision makers, the final result of assessments may not be conclusive (Hwang and Yoon, 1981).

2.6. Major Steps in MADM Process

In every MADM problem four main steps need to be completed to reach a final decision and prioritize alternatives. First, attributes and alternatives needs to be defined. Then, importance (weight) of each criterion needs to be set. At the third step, alternatives are rated against each criterion. Lastly, weights of criteria and ratings of alternatives are aggregated, and alternatives are prioritized. Important aspects of these steps are highlighted in the following sections. The proposed model uses these steps but adds another step where imprecise expert judgments are defined as probability distributions and feed into the Monte Carlo simulation.

- **Selection of Attributes/Criteria and Alternatives**

The decision criteria must be clearly specified at the initial stage of the process. This helps DMs to focus on the right problem. Determining criteria is usually done by expert judgment supported by relevant literature review and surveys. Criteria set should *encompass* all fundamental aspects of the decision problem and should be *meaningful* and *transparent* enough to be easily used by experts. It should also be *decomposable* so that the problem can be break into manageable pieces. A criteria set should be *non-redundant* to avoid double-counting. Lastly, but importantly, it should be as minimal as possible while satisfying the above highlighted properties (Keeney and Raiffa, 1993).

- **Assigning Weights to Criteria**

To evaluate the alternatives and represent the preferences of DMs, criteria should be differentiated among each other in terms of importance. DMs express their preferences by assigning weights to each criterion. By nature; preferences add subjectivity to the MADM. Also, sometimes it becomes quite difficult for the decision maker to make preferences on criteria (Karsak and Ahiska, 2008). Various methods have been proposed by researchers to make criteria weighting easier (Heerkens, 2006). In the literature there are many variations of weighting methodologies. The most common methods are: algebraic procedures, statistical procedures where statistical procedures such as regression analysis are used to get weights, decomposed methods look at criteria pairs at a time, while direct methods require the DMs to compare the ranges of two attributes in terms of ratio judgments whereas indirect procedures infer weights from preferred expert judgments using means (Weber and Borcherding, 1993).

Many researchers use a pair wise comparison method to calculate the weights of criteria. (Georgiadis, Mazzuchi, and Sarkani, 2012) The pair-wise comparison method was popularized by Saaty (1980), the developer of the Analytic Hierarchy Process. This process is used in the proposed method to determine criteria weights. Details of the AHP process are explained in Appendix-A.

- **Aggregating Numerical Values to Prioritize Alternatives**

Criteria weights and the ratings that each alternative receives against each criteria are usually normalized to remove computational difficulties caused by multiple measurement units (e.g. tons, mile, $) in a decision matrix. The procedure of normalization aims to obtain equivalent scales, which allows comparisons among criteria. Consequently, normalized ratings have equal units, and the larger the rating becomes, the more preference it has. Linear and Vector Normalization are the two main normalization approaches, and MADM methods use variations of these approaches. Details of these methods can also be found in Appendix-A.

2.7. Overview of MCDM Methods

In recent years, the number of MDAM methods has increased dramatically, and today it is hard to have a certain record of it. Recent compilation and survey studies suggest between 30-60 MCDM methods in the literature. Georgiadis, Mazzuchi and Sarkani (2012) identified and listed 33 methods, among them are well known AHP and its variants, ER, PROMETHEE, TOPSIS, ELECTRE, Fuzzy models and more specialized ones like nTOMIC, Robust Portfolio Modeling (RPM), Geometrical Analysis for Interactive Aid (GAIA). Georgiadis (2013) expanded previous work by researching 59 MCDM methods excluding the Fuzzy method and its variants, but his list incorporates some MCDM methods that do not fulfill the main futures of MCDM like Bayesian Analysis, Game Theory & Neuroscience, Value Analysis (VA) and Value Engineering (VE). Fuzzy models are researched in detail and well covered by the studies of Kahraman (2008) and Zhang, Ruan and Wu (2007). In their extensive book, Tzeng &

Huang (2011) examine and give very detailed application examples of most common methods including Fuzzy sets, Rough Sets and the Gray Relationship Model.

Although not exhaustive, Appendix-B provides a list of 41 MCDM methods researched within the literature review. It can be considered as a summary of MCDM techniques in the literature capturing good samples of each method with references. Four well documented MADM methods, AHP, the Simple Additive Weighting (SAW) model, the Weighted Product Model (WPM), are exploited within the proposed model, and details of these methods are provided in Appendix-A.

2.8. Use of Multiple Decision Makers in MADM

Due to the complexity of real-world problems, a single DM often cannot comprehensively consider all aspects of the decision problem. Thus, complex decisions usually have to be made by integrating the knowledge of multiple DMs (Chuu, 2009; Ma, Lu, and, Zhang, 2010). The problem that this dissertation tries to address, the land force unit mix and option evaluation, is a complex and multi-dimensional problem, and it requires multiple experts. Therefore, the proposed model uses multiple DMs. This is called Multi Attribute Group Decision Making (MAGDM) in the literature (Pang and Liang, 2011). In MAGDM, multiple DMs make judgments or evaluations by virtue of their respective knowledge, experience and preference for a decision space (i.e., a finite set of alternatives) under multiple attributes to rank all the alternatives or give evaluation information of each alternative. Then, decision results from each DM are aggregated to form an overall ranking result for all the alternatives.

With group decision-making, the group's final decision may be reached through consensus (a solution that satisfies everyone), unanimity (all members of the group agree), majority (the alternative that receives the most votes wins), or a mathematical mean of all judgments (Walker, 1995).

MADM methods such as, TOPSIS and AHP (and their variants) are often used in group settings (Srdjevic and Srdjevic 2012; Shih, Shyur, and Lee, 2006). The main issue in MAGDM is the aggregation of multiple DMs' preferences and judgments. Concerning AHP, there are two primary ways to aggregate individual preferences into a final preference depending on whether the group wants to act as separate individuals or together as a unit (Forman and Peniwati, 1998).

- **Aggregation of Individual Judgments (AIJ):** When DMs are ready to relinquish their own judgment ratings and they act in concert and pool their evaluations into the group decision. Discrete DMs are lost with every stage of aggregation, and a synthesis of the hierarchy produces the group's priorities. Since DMs may not even make any individual judgments, there is no synthesis required for each individual. Thus, MAGDM turns into normal MADM (Forman and Peniwati, 1998).

- **Aggregation of Individual Priorities (AIP):** When DMs are acting in their own right, researchers are concerned about each individual's resulting alternative priorities. An aggregation of each individual's resulting priorities can be computed using either a geometric or arithmetic mean proposed by Saaty (Pang and Liang, 2011).

Although both of these methods are applied in multiple cases and their results showed consistency, the final results of this method are point values and don't represent the uncertainty in the decision problem.

2.9. Use of MCDM In Weapon System Evaluation/Assessment

Since the characteristics of the problems are very similar to military decision making, especially in strategic defense/force planning, weapon system development and procurement, use of MADM is also common in military decision making. The literature review shows that most of the applications are on single weapon system evaluation. The rest of this section analyzes some of the significant MADM applications in weapon systems selection and defense planning.

An example of MCDM application for single weapon system selection is provided by Jiang, Li, Zhou, Xu, and Chen (2011). They considered weapon system assessment as MCDM under uncertain environments and proposed a model named Weapon System Capability Assessment (WSCA), which uses the Evidential Reasoning (ER) method. To demonstrate the WSCA model they evaluated four well known Main Battle Tanks (MBT), Type 98, M1A2 Abrams, Challenger 2E, and Leopard 2. For the evaluations they used a total of 32 criteria within 3 hierarchical sets as shown in Figure 5. Although the study demonstrates the appropriateness of the ER method in combining qualitative and quantitative information into a belief structure (BS), the final results do not represent the imprecise evaluations and "uncertainty" properly. MBTs are used in different combat environments for different missions. Each mission requires some characteristics more than others. Consequently, weights of criteria change from mission to mission and that affects the ranking of MBTs. However, the study does not cover this part of the problem and limit itself to a higher capability set.

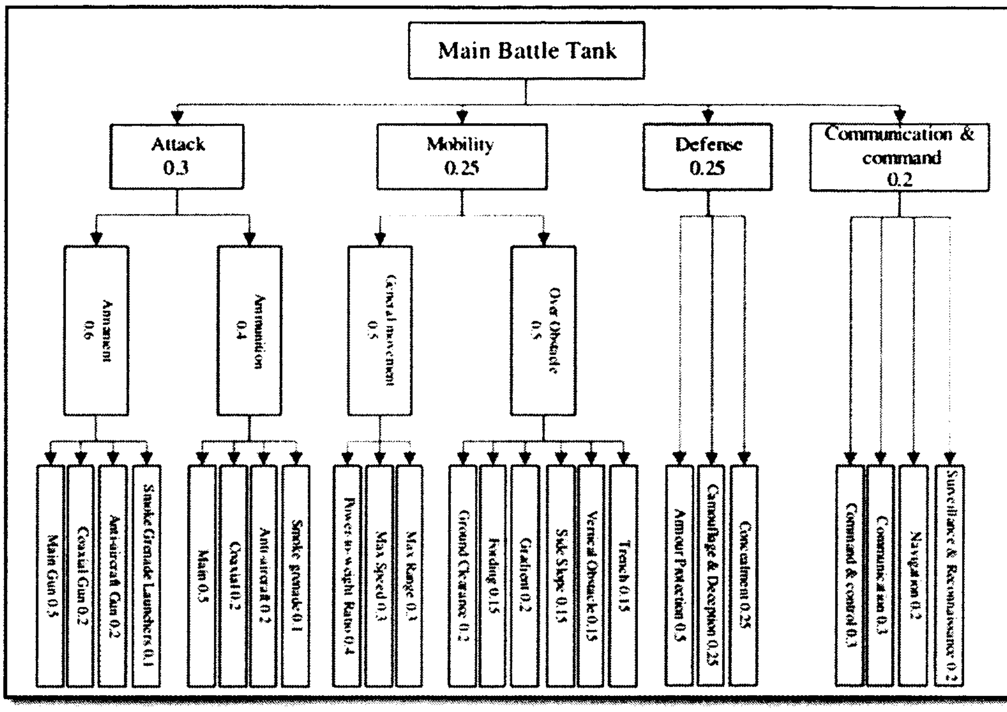

Figure 5 MBT Assessment Hierarchy Jiang, Li, Zhou, Xu, and Chen (2011).

A naval researcher, Kocaman (2009), used MCDm to assess the operational readiness of warships. The primary focus of his study is to establish a suitable and feasible assessment methodology based on MCDM methods to derive Operational Readiness Level (ORL) through Material Readiness Level (MRL). In this structure, every single warship periodically undergoes a thorough routine check of the reliability and the operability of its material systems. During that process a score is given for each main system and subsystem according to the relevant technical documents. Researchers used seven different evaluation models including pairwise comparisons (AHP), Linear Normalization, Borda Count and analyzed them to find the most suitable model. As a result of analysis it is concluded that the most suitable combination would be the Borda Count Method via Ideal Values. He used a total of 81 criteria to evaluate 20 different warships and in some methods 10 DMs were requested to complete 15200 pairwise comparisons for assessments. This study shows that AHP can be used to evaluate alternatives within a large number of criteria sets.

In a strategic level study, Meyez (2008) analyzed a current defense planning process and proposed that MADM methods can be used within long-range defense planning. He suggests that the model can be used in the formal defense planning process and allows decision makers to link top level qualitative National Military Objectives to R&D and accusation programs. The proposed model exploits AHP with multi-level group decision making. Criteria sets used in Meyez's study have similarities to the ones used in this dissertation like mission types, military tasks, force requirements, etc. Figure 6 illustrates how Qualitative National Military Objectives are linked to low level acquisition and R&D programs. He limits his study with high level R&D contributions to higher level objectives.

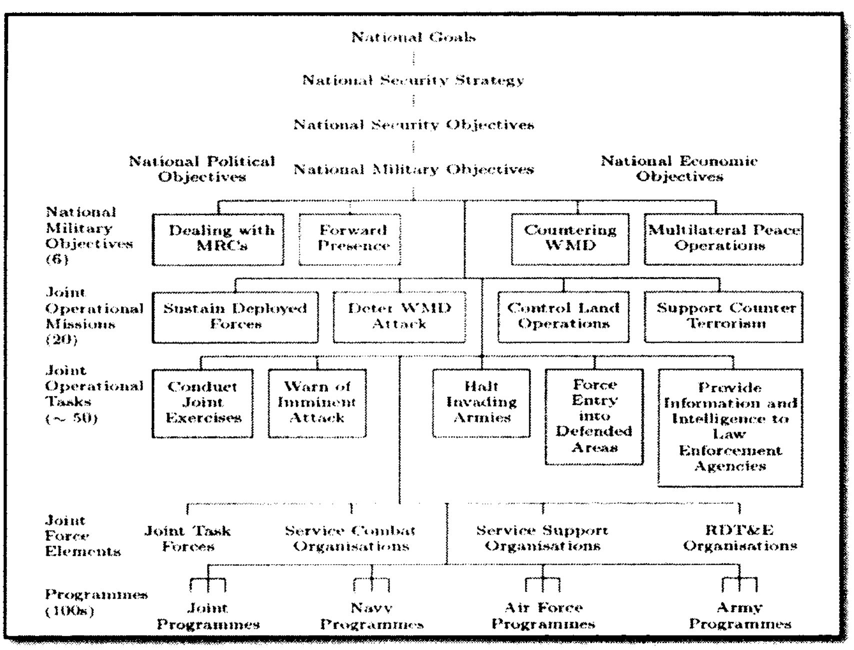

Figure 6 Hierarchy From National Security Strategy To Resources.

Fuzzy numbers/theory have been widely used MADM and models developed for evaluation and ranking of weapon systems. For these models, preferences and weights of attributes are characterized by fuzzy assessments. Zhang, Ma, Xu (2005) have argued that most criteria that have been used for weapon system evaluations have interdependent or interactive characteristics; consequently, weapon systems cannot be evaluated by conventional evaluation methods. To overcome this issue they proposed a method based on Trapezoidal Fuzzy AHP and hierarchical fuzzy integrals to evaluate individual weapon systems. The ratings of criteria performances are described by linguistic terms expressed in trapezoidal fuzzy numbers. Main battle tanks are used to demonstrate the model. This study is another example of individual weapon systems evaluation, but, similar to Jiang, et al. (2011), the final results are point values and do not represent imprecise evaluations and uncertainty.

Lee, Kang, Rosenberger & Kim (2010) proposed a hybrid approach for weapon systems selection that combines principal component analysis (PCA) with AHP and to determine the weights to assign the factors that go into selection decisions. These weights are fed into a goal programming (GP) model to evaluate and prioritize weapon systems. They argue that proposed hybrid approach balances the shortcomings posed by AHP and can therefore provide DMs with more reasonable and realistic decision support than AHP alone. They used 3 attributes and 19 criteria to evaluate 6 missile alternatives in the case study. Although there are not crisp clear results, this demonstrates the usefulness and effectiveness of the proposed hybrid AHP–PCA–GP approach.

Some researchers utilized multiple methods to create models for weapon system evaluation. Dağdeviren, Yavuz, & Kılınç (2009) described weapon selection as a problem containing subjectivity, uncertainty and ambiguity in the assessment process. They developed an evaluation model based on the AHP and the TOPSIS. The more simple AHP method is used to assign weights to the evaluation criteria, while fuzzy TOPSIS is employed to cope with ambiguity of the assessments while determining the priorities of the alternatives. Although they utilized two methods in their model, they used a single decision maker to evaluate a single weapon system (rifle) independent from the mission environment.

Multiple decision makers/stake holders are also an important aspect of MADM. Cheng and Lin (2002) utilized fuzzy numbers with the Delphi Group Decision Making method, developed by RAND (Ababutain, 2001) to adjust the fuzzy ratings of multiple experts to achieve a consensus condition. They have constructed a general and easy fuzzy group decision-making model to evaluate main battle tanks with multiple decision makers. This study is an example of using MADM with multiple decision makers. They used basically the same attribute – Attack, Mobility, Self Defense, and Command & Communication – that Jiang, et al. (2011) used in their model.

2.10. Studies on Force Development and Defense Planning

Review of the literature on defense planning and force development showed that most of the studies are strategic level and generally conducted on the request of government. The number of studies increased between 1993 and 2000 as the U.S. Army made its biggest transformation to adapt the post-cold war environment. Another main future of these studies is that they focus on single attribute (i.e. deployability) and single combat mission or scenario. This section provides major studies done in defense planning.

In an earlier study, Gordon & Wilson (1998) analyzed the ratio of different types of army units and described the Army as a "Barbell" (p.3) since at that time the Army only had 101st Air Assault division as a medium weight force between light and heavy. As a solution they proposed "aero-motorized divisions" (p.7), and they argued that there is a mix of existing and near-term combat systems and technologies that will allow the Army to create a number of these "aero-motorized divisions". As a future concept they proposed that aero-motorized forces can be used either as part of a leading edge of a large and inherently slower to deploy expeditionary force or as a central combat component of future lesser contingencies including operations other than war. Having forces equipped with light armored vehicles, next generation combat aviation, and enhanced indirect fire support will provide the Army with a strategic fist (Gordon & Wilson, 1998).

Johnson, Grissom & Oliker (2008) aimed to draw insights about the use of medium-armored forces from previous operations to help inform decisions about the design of the Future Force. Doing this qualitative study they assessed the employment of medium-armored forces in the operations between 1936-2005 including Operation Iraqi Freedom. They analyzed how medium forces performed across the range of military operations in complex terrain shown in Figure 8 and against different types of opponents. Results suggest that medium-weight armor enjoys only four clear advantages over heavy armor: rapid deployability (particularly with air-droppable vehicles), speed over roads, trafficability in infrastructure not suited to heavy armor, and lower logistical demands. Since the U.S. Army cannot expect all future operations to occur in circumstances analyzed in the study, they advocated that it would be prudent to maintain a mix of heavy, medium-armored, and light forces. Although results of the study seem reasonable it lacks quantitative analysis, thus, they couldn't suggest any ratio of medium, heavy and light force mix.

Case	Complex Terrain					
	Urban	Mountainous	Jungle	Forests	Hedgerows	Undeveloped Infrastructure
Armored warfare in the Spanish Civil War (1936–1939)	X	X				
U S armored divisions in France and Germany during World War II (1944–1945)	X	X		X	X	
Armored cavalry and mechanized infantry in Vietnam (1965–1972)		X	X			X
Soviet airborne operations in Prague, Czechoslovakia (1968)	X					
South Africa in Angola (1975–1988)				X		X
Soviet Union in Afghanistan (1979–1989)		X				X
Operation Just Cause, Panama (1989)	X					
1st Marine Division light armored infantry in Operation Desert Shield and Operation Desert Storm, Southwest Asia (1990–1991)						X
Task Force Ranger in Mogadishu, Somalia (1993)	X					X
Russia in Chechnya I (1994–1996)	X	X				X
Australia and New Zealand in East Timor (1999–2000)			X			X
Russia in Chechnya II (1999–2001)	X	X				X
Stryker Brigade Combat Teams in Operation Iraqi Freedom (2003–2005)	X					X

Figure 7 Use of medium forces in complex Terrain. Adapted from Johnson, D. E.,Grissom, A., &Oliker, O. (2008), p. 170.

Their key findings are presented below.

Medium-armored forces can make serious contributions, particularly when extending light forces or in cases where quick response can prevent an effective enemy counter.

Although medium armor has clear advantages over heavy armor in many circumstances, opponents operating in mixed complex terrain with heavy armor and/or highly lethal weaponry can refute these advantages.

Future Army forces need to maintain an appropriate mix of heavy, medium-armored, and light forces tailored to the battlefield conditions that best match their attributes. Johnson (2011) categorises future adversaries in Irregular, State-Sponsored, Hybrid, and States and examines organizational skills, and command and control capabilities of these adversaries, using recent experiences across the range of military operations in Iraq, Afghanistan, Gaza, and Lebanon. He identifies the contributions of heavy armored forces throughout these operations and proposes a scalable approach to force structure that would ensure that the army has the required capabilities to deal with each potential adversary without maintaining specialized forces for every type of contingency. Contrary to Johnson, Grissom &Oliker (2008) and Gordon & Wilson (1998), he argues that light forces optimized for a lower spectrum of warfare cannot scale up to the high-lethality standoff threats that state opponents will present. Some other researchers focused on the transformation aspect of the force development and investigated alternatives for future force options.

Petty (2001) investigated the employment of heavy armored forces in near history and expressed his concerns about the future of heavy armor units. He argues that current and future security environment requires more deployable, agile and sustainable forces. To have this type of force he suggests that lighter vehicles -with very high end technology- should be developed and doctrine and training should be changed accordingly. He also suggests the use of many emerging technologies like Electromagnetic Guns electric motors, communication and radar technologies, etc. in vehicles.

Overland's (2009) study is an example of evaluation of a land unit type in a specific operation type. He assessed the effectiveness of Heavy Brigade Combat Team-HBCT in COIN operations using Iraq war as a case study with three case events. To evaluate the effectiveness of HBCTs in COIN, he used a three part analysis which included a tactical war-game, a cross walk of HBTC capabilities against doctrinal COIN lines of effort, and a DOTMLPF capabilities assessment. Results suggested that from the beginning of war to 2007 HBCTs have made improvements over time in terms of capabilities, as well as enablers that improved their effectiveness in the COIN environment. In regard to results he argues that HBCTs are adaptable to complex environments and diverse missions; hence, they should be an important part of the future army.

In a single capacity focus study Davis (2000) examines a security environment in terms of army's deployability using Desert Storm as a case. The study lists actual transportation durations of certain amount of troops with the available air and sea lift capabilities which includes Fast Sealift Ships (FSS), roll-on/roll-off (RORO) ships, Fast Sealift Ships (FSS), C-5, C-17 and C-141 aircraft fleets, heavy equipment transporter trucks (HETs), etc. He also examines force concepts such as middle weight brigades, mobile combat teams and future warfare divisions and applies realistic global deployability constraints (by comparing them with future transportation capabilities) to determine possible solutions to meet strategic maneuver goals for a relevant transformed Army, but he didn't address the effects of having lighter and more transportable units on the battlefield or operation environment.

Cost-efficiency analysis of weapon systems involves several challenges: considering the possible interactions between various weapon systems, the relevance of multiple criteria, and the different combat missions where these systems may be used. Kangaspunta, Liesi & Salo (2012) developed a portfolio methodology where these challenges are addressed by evaluating the cost-efficiencies of portfolios consisting of individual weapon systems. Their methodology exploits combat simulation models and expert opinion to address some interactions between systems by synthesizing impact assessment results. They argue that that their hybrid methodology aids decision makers in identifying which combinations of weapon systems are efficient with respect to multiple evaluation criteria in different combat situations at different cost levels, but they limit their case study for indirect fire support weapon systems.

Don's (2002) work is an example of simulation application in force planning analysis. He examined the change in operation environment since the Cold War and addressed the ground commander's current and possible future needs for close fire support. His study employed a series of high-resolution models, like JANUS (a ground combat model) and CAGIS (a cartographic system), and applied them in a variety of combat scenarios. He used four diverse operational vignettes to cover different operational tasks that a troop may encounter. His study draws implications about the amount, category, responsiveness, and desirable features of close fire support.

Steeb, Matsumura, Covington, Herbert & Eisenhard (1996) used simulation as a tool in force planning. They mainly assessed how specific technological advances can help to have more transferable forces without sacrificing combat effectiveness. By exploiting JANUS force-on-force combat simulation they examined, compared, and contrasted new technologies and systems that would allow light forces to better resist and stop attacks from larger and more heavily armed forces in varying terrain. Effects of air-deliverable acoustic sensors (ADAS), studied in multiple combat scenarios against North Korea. Their study results suggest that a lighter but technologically advanced division ready brigade (DRB) can be improved to fight and survive against a current and future heavy force. The "hunter/standoff killer" concept, made possible by a number of emerging technologies, proved to be major contributor to the success of a DRB against a larger, more maneuverable heavy force.

Strategic management and resource allocation of defense forces are carried out using the DoD's framework of the Planning, Programming and Budgeting System (PPBS). High level decision makers involved in this process and debates among them are very common during the process. Results of this bureaucratic but well-established process affect the size, mix, structure, and, shortly, the future of services. Lewis, Roll & Mayer (1992) examined PPBS process in the "Base Force Decision" case took place between 1989 and 1991. Their study is different from others in the literature since they focused on the effectiveness of the PPBS process rather than the individual outputs of this process. They evaluated the quality of information and options presented to key DoD DMs during the preparations, and analyzed the interactions among these players during the force structure debates. They used notes and documentation provided to DM before key meetings. As a result of their qualitative work they assert that, despite the many challenges of DoD's dynamic environment, the decision-making framework functioned successfully in that options were raised and debated by all participants.

Another example of single capability focus study is done on rapid employment of ground forces by Gritton, Davis, Steeb & Matsumura (2000). Their main criterion was deployability of forces within a given time frame (a week). They studied alternatives for rapidly deployable future ground forces that would be used in time-urgent joint-task-force missions. They first outlined the operational requirements, define forces responsive to those requirements, and then discussed the feasibility of achieving such forces. Their analysis suggests that such forces would potentially be quite valuable, while also indicating likely limitations and the many uncertainties of the assessments. Organizational structure is another dimension that affects an army's success in combat.

During the period of the main transition of the U.S. Army Johnsen (1998) conducted a qualitative analysis and discussed the 21st century Army in a broad strategic context. He examined the expected security environment and the roles the Army will be called upon to fill. After analyzing the future tasks he assessed general factors that will influence capabilities necessary to carry out these anticipated roles, including general and specific criteria used to determine the appropriate size of U.S. Army XXI. After the examining future security environment and factors like Power Projection, Interoperability, Overseas Engagement, that affect the force structures he concludes:

- The Army should expect to perform new noncombatant roles in addition to its long-standing conventional roles as described in Figure 8;
- To accomplish its varied missions, the Army's force structure and design must provide the capabilities necessary to operate across a broad spectrum of conflict in peacetime, crisis, and war;
- The Army should be able to perform effectively throughout the full range of military operations;
- A varied force structure is preferable against a single type of all-purpose brigade solution;
- Balance is necessary between technology and interoperability with less modernized allied forces and host nations.

	Military Operations	General U.S. Goal	Examples
COMBAT	*War*	Fight & Win	Large-scale Combat Operations: Attack / Defend / Blockades
NONCOMBAT	*Operations Other Than War*	Deter War & Resolve Conflict	Peace Enforcement / Noncombatant Evacuation Operations (NEO) / Strikes / Raids / Show of Force / Counterterrorism / Peacekeeping / Counterinsurgency
		Promote Peace	Antiterrorism / Disaster Relief / Peacebuilding / Nation Assistance / Civil Support / Counterdrug / NEO

Figure 8 Range of Military Operations Retrived from :Johnsen (1998). Force planning considerations for Army XXI.

Many of the studies on force development are mission focus or limited to one force type such as motorized infantry, heavy force options, but Johnson, Peters, Kitchens & Martin's (2011) work differs from others in terms of focus. They recently conducted a study on the Army's new modular force structure.

First they examined the transformation history from 2003 to 2008 by reviewing the official military messages and orders and interviewing personnel involved in the process. After getting the necessary data they were able compare two force structures and their performances in different combat situations.

They concluded that the new modular force structure is more cost efficient compared to the division focus structure. Although some other researchers disagree they argued that modular forces (Heavy, Stryker and Light brigades) can deliver the same operational effectiveness with pre-modular force structure in the full spectrum of mission as depicted in Figure 9.

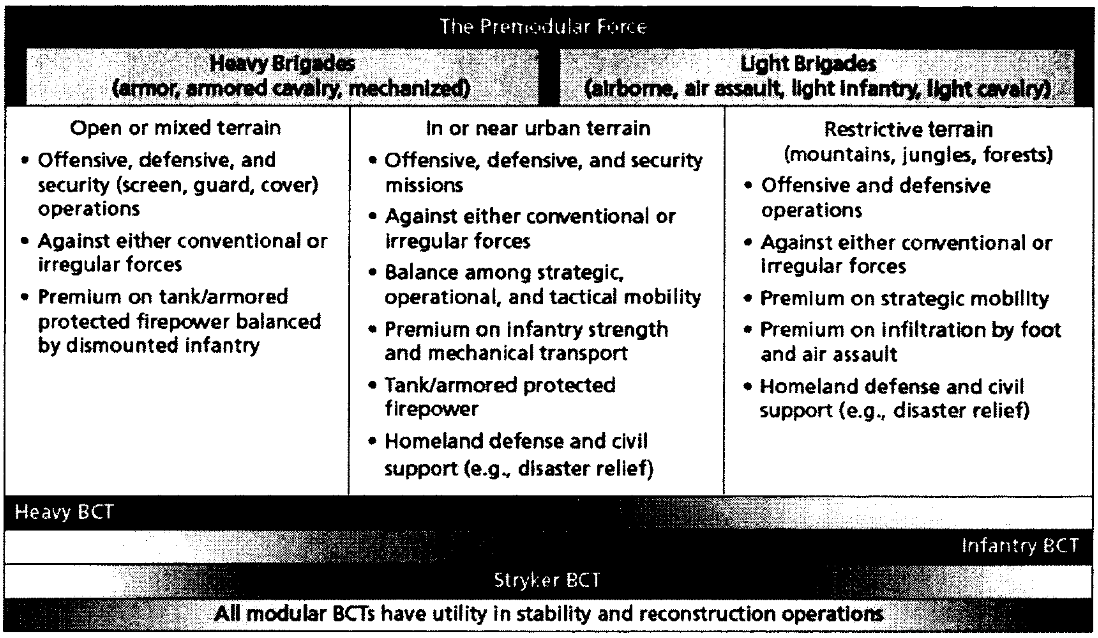

Figure 9 Comparative Expectations for the Utility of Army Forces Adapted from Johnson, Peters, Kitchens & Martin (2011)

2.11. Gaps in Military applications of MCDC Literature

Most of the MCDM studies are done on individual weapon systems evaluation, but army units as a system that composed of weapon systems haven't been evaluated using MCDM.

The literature review on defense planning and force development showed that numerous studies done on force development are at strategic level and do not link the tactical level weapon systems to strategic level military missions. Table 2 summarizes the studies and the knowledge gap in the literature.

Table 2 Gap Analysis of the Literature on MCDC Applications on Force Evaluation

Topic/Application Name	Area	Type	Reference	GAP
Optimal decision-making of weapon system based on effectiveness evaluation. In Seventh Wuhan International Conference on E-business (Vol. I–III, pp. 1080–1084).	Individual Weapon System	Model Proposal	Gao, X. J., Shi, Y. B., & Zhang, A. (2008).	Study on portfolios that comprise multiple weapon systems Use of simulation to aggregate multiple DMs views into analysis
Analytic gray hierarchy process of safety evaluation for missile nuclear weapon system. Progress in Safety Science and Technology, 4, 2297–2300.	Nuclear Weapon System	Case Study	Gao, G. Q., Wen, F. L., & Liu, G. (2004).	
Study on tradeoffs between weapon system cost and performance based on support vector machine. In 2007 International conference on wireless communications, networking and mobile computing (Vol. 1–15, pp. 5232–5235).	Individual Weapon System	Cost/Effectiveness analysis	Jiang, T. J., Wang, S. Z., & Wei, R. X. (2007).	
Study on effectiveness evaluation of missile weapon system based on rough set theory and neural network. In Proceedings of the fifth international conference on information and management sciences (Vol. 5, pp. 212–215).	Missile Systems	Effectiveness analysis	Gu, H., & Song, B. F. (2006).	
Technology and tank maintenance: An AI-based diagnostic system for the Abrams tank. Expert Systems with Applications, 11, 99–107.	Tank	Logistic Study	Edmond, Dumer, Hanratty, Helfman & Ingham (1996).	
Evaluating the main battle tank using fuzzy number arithmetic operations. Defense Science Journal, 56, 251–257.	Tank	Model Proposal	Deng, Y., & Shen, C. (2006).	
Situational ME-LOWA aggregation model for evaluating the best main battle tank. In Proceedings of the sixth international conference on machine learning and cybernetics, (pp. 19–22).	Tank		Chang, J. R., Liao, S. Y., & Cheng, C. H. (2007).	
A multi-objective risk-based framework for mission capability planning. The artificial life and adaptive robotics laboratory technical report. (Assessment of capabilities)	Strategic Planning	Model Proposal	Bui, L. T., Barlow M., &Abbass, H. A. (2007).	
Cost-efficiency analysis of weapon system portfolios. European Journal of Operational Research, 223(1), 264-275. doi: 10.1016/j.ejor.2012.05.042	Simulation	Cost/Effectiveness analysis	Kangaspunta, J., Liesiö, J., &Salo, A. (2012).	
Weapon System Capability Assessment under uncertainty based on the evidential reasoning approach.	Individual Weapon System	Model Proposal	Jiang, J., Li, X., Zhou, Z.-j., Xu, D.-l., & Chen, Y.(2011).	

CHAPTER 3
3. METHODOLOGY

This chapter is dedicated to describing the proposed MAGDM model, the core of the dissertation. It also provides the structure for the rest of the dissertation.

3.1. Introduction

Methodology involves 8 separate phases: *defining criteria set and hierarchy*, *weight assignment to criteria*, *alternative generation*, *evaluation of weapon system weights*, *evaluation of force level attribute and capability values*, *evaluation of mission effectiveness*, *prioritization*, and *perturbation.*

Figure 10 shows the order of these 8 phases, which are described in detail through the rest of this chapter. It is worthwhile to mention that in the first four phases the model uses AHP wise structure to create criteria sets, hierarchy, weights of criteria, and alternatives than, feeds these ratings to Monte Carlo simulation to represent imprecise assessments and uncertainty in the last four phases.

These phases reflect the common steps of MCDM problem. First the decision model is structured by determining and defining criteria hierarchy. Then alternatives are selected and characterized. Then options are evaluated and compared. It is important to note that the proposed method is not necessarily the only or best way to apply MADM for force evaluation.

Although this model is applied to army brigades similar to current U.S. ones, it is generic and can be used for the assessment and evaluations of other countries' army forces without any significant modification. It can also be used to evaluate portfolios or vehicle fleets composed of multiple vehicles, airplanes, etc.

Force development is a complex issue and requires the involvement of multiple stakeholders (Chuu, 2009; Ma, Lu, and, Zhang, 2010). The model is designed in a way to reflect this aspect of the force development and allows integrating multiple decision makers' opinions into the evaluations.

Force evaluations also involve future uncertainties due to the range of probable combat and non-combat missions that force units may involve. Adding uncertainty on the use of multiple DMs makes the MADM problems even more complex (Chen, Yang (2011). Predicting the future is hard, and using deterministic methods to identify the probabilities of these missions may not give feasible results. To avoid that, the proposed method uses multiple DMs evaluations to create a probabilistic evaluation process rather than aggregating their assessments into a single value.

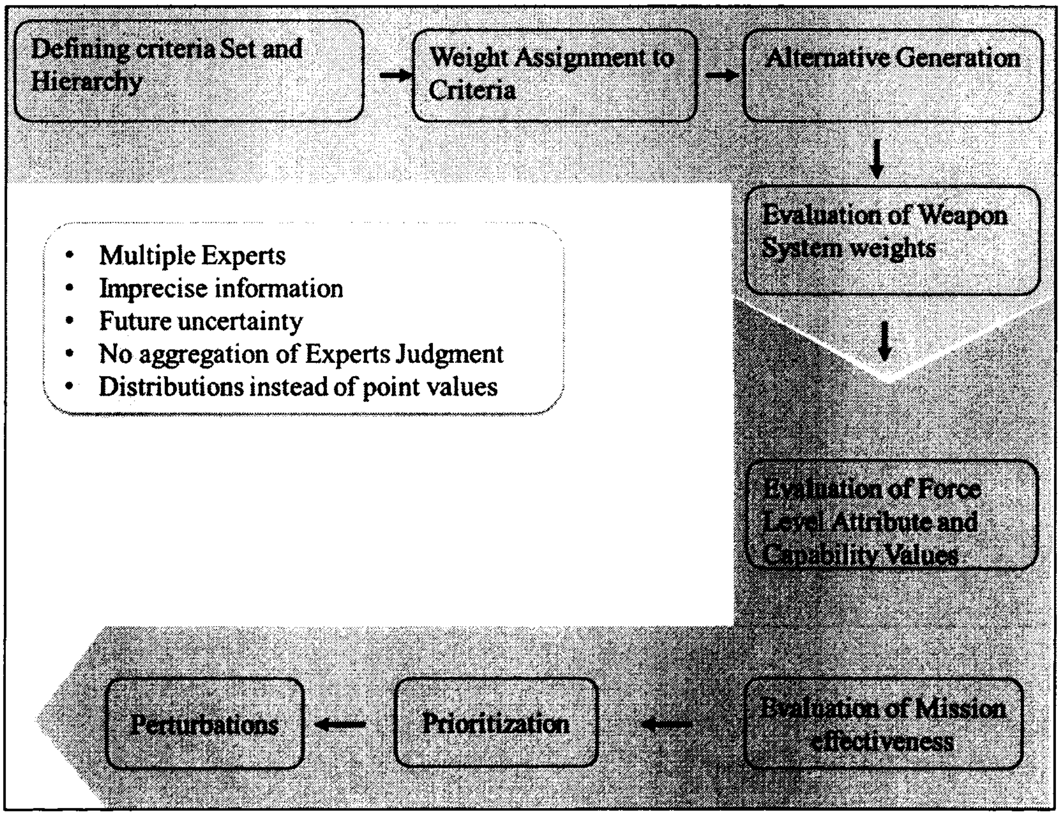

Figure 10 Phases of MAGDM Model

3.2. Defining Criteria Set and Hierarchy

At the beginning of the process decision criteria must be clearly specified. This helps DMs to focus on the right problem. Determining criteria is usually done by expert judgment supported by a relevant literature review and surveys. The criteria set should encompass all fundamental aspects of the decision problem and should be meaningful and transparent enough to be easily used by experts. It should also be decomposable so that the problem can be broken into manageable pieces. A criteria set should be non-redundant to avoid double-counting. Lastly, but importantly, it should be as minimal as possible while satisfying the other properties (Keeney and Raiffa, 1993).

The initial step of the model includes defining four sub sets: *missions*, *capabilities*, *attributes*, and *system roles*.

3.2.1. Combat Mission Selection

The first step of the process is choosing and defining the missions. They represent the diverse situations or conditions in which an alternative might be used. The effectiveness of each option is evaluated for multiple missions. As described in Chapter 1 there are more than 15 missions that land forces may be called upon to accomplish. The priority and importance of these missions dramatically differ among countries and change decade to decade. Although not inclusive, Table 6 lists the spectrum of operations that army forces may conduct in war and military operations other than war (FM-3.0).

Table 3 Full Spectrum Operations

Mission Types (m)	
Show of force	Seize and Secure
Humanitarian assistant & Consequence Management	Human security operation
Foreign Internal Defense	Opposed Stabilization
Support to Foreign Unconventional Forces	Sanctuary Denial
Enabling operation	Raid
Non-combatant evacuation	Counter-network campaign
Halt	Defend
Peacekeeping	Major combat campaign
Peace Building	Peace Enforcement

The missions set, indexed by "*m*", should cover all the missions that are likely to occur or are significantly important to the decision maker (in this case the Army). It is worthwhile to mention that listed missions are just a snapshot in time and represent the current situation, but in the future new mission types may emerge or some missions may become redundant. Also, a decision maker may decide to create her/his own specific mission set to evaluate alternative force options. Subject Matter Experts may chose a number of missions to evaluate alternatives and each mission's importance may differ.

3.2.2. Defining Force Level Capabilities

Capabilities represent the different dimensions from which the alternatives can be viewed (Chen and Hwang, 1992). At this step, essential capabilities of a ground force are defined. Land forces should have some capabilities to accomplish missions that are important to DMs. A set of capabilities is indexed by "*c*". Capability is the quality of being capable, to have the capacity or ability to do something, achieve specific effects or declared goals (JP 1-02). Lethality Mobility and Survivability are well-known examples of capabilities in military literature (Krepinevich, 2002). Those capabilities are related to a hierarchy of objectives that links them to bottom level weapon system characteristics and to the top overarching goal (Saaty, 1980). Capability levels of alternatives are too broad to be evaluated directly. Thus, they are calculated based on each force options composition and components' attribute levels. Therefore, they can be represented as a function of weapon system characteristics.

3.2.3. Defining Weapon System Attributes

Weapon systems, the components of the force options, have essential *attributes* that are different from the *capabilities* that a force should have. Attributes, indexed by "*a*", represent the bottom level of the evaluation hierarchy. Attributes should represent the crucial properties of a WS. Fire power, mobility, transportability, and protection are some of the attributes that are used to evaluate weapon systems by Cheng & Mon (1994), Deng &Shen (2006), Gao, Wen & Liu (2004), Dağdeviren, Yavuz & Kılınç (2009) and many other researchers. To better explain each attribute, a number of contributing factors such as scale proxies are defined and a nine grade scale created to rate WSs under each attribute.

3.2.4. Defining System Roles

Alternative force options, that the model tries to evaluate, are composed of weapon systems. WSs perform many different roles, depending on their functions and abilities. System roles are indexed by "*r*". Different roles require some attributes more than others. For instance, WSs may provide indirect fires where fire power has higher importance while others conduct a reconnaissance role where concealment, detecting the enemy and properly providing information to relevant friendly forces have higher importance. Thus, allocating a system role to each WS allows it to contribute force option accordingly.

At the end of the first step, criteria sets should be defined and the hierarchy should be set. Figure 11 represents the criteria sets and their hierarchy System Roles will be added to the hierarchy at further steps.

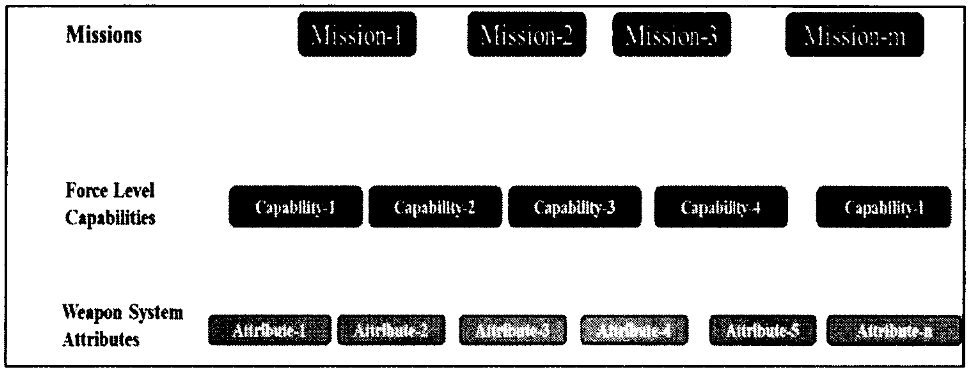

Figure 11 Criteria Sets and Their Hierarchy

3.3. Weight Assignment to Criteria

After defining the criteria sets each criteria group should be weighted; thus, the evaluation structure is properly defined before the evaluation of alternatives. At this step the importance of each force capability is rated for each mission, and importance (contribution) of each WS attribute is weighted for each force capability. Lastly, the importance of each WS attribute is calculated for each system role.

3.3.1. Assessments of Multiple Experts and Their Usage in The Model

It is important to mention that the model uses multiple experts. Experts do not interact and do not behave as a group during the assessment of criteria weights. The model uses these assessments to create distributions instead of aggregating them into point values[1]. Assessments of experts can be seen in two ways. First they can be described as viewpoints to a problem (Keating, Kauffmann, Dryer, 2001). Secondly difference among their assessments represents the uncertainty in the problem, and aggregating them into single point values will result in ignoring a different perspective and uncertainty. Therefore, to incorporate each of the experts' judgment into the final results they are turned into the distributions and they feed into Monte Carlo simulations. At each iteration (of 10000) of the simulation one of the experts' views will be used randomly to calculate the mission effectiveness of alternatives.

3.3.2. Weighting Force Capabilities Under Each Mission

Each mission in the spectrum of operations requires a capability more than the others. Capability needs of a peacekeeping mission are completely different from a raid or major combat campaign or show of force mission. The first mission is about monitoring and policing the cease-fire and requires less survivability and lethality while needs more mobility. The latter ones require more lethality and survivability. To reflect this the importance of each capability is defined.

The capability weights are obtained using the pairwise comparison method developed by Saaty (1980) and used by many others. This scale is within the psychological limit of 7±2 defined by (Miller, 1956). Detailed information about pairwise comparison and AHP can be found in Appendix-A. Using this method experts rate the importance of each capability (c_i) as compared to each of the other capabilities (c_l) under

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[1] Detailed information on the use of multiple experts/decision maker and aggregation of expert assessments can be found in Chapter 2.

each particular mission (m). The scale, a modification of Saaty's (1980) original scale, shown in Table 4 is used for the pairwise comparisons.

Eigenvector normalization process, explained in Annex-A, is used for aggregation of pairwise comparisons into capability weights. First each element in the matrix is divided by its column total to generate a normalized pairwise matrix using equation (5-1) where (c_{im}) is the importanc of i^{th} capability for m^{th} mission, ($r_{i,l,m}$) is the expert rating of i^{th} capability against l^{th} capability for m^{th} mission, (n) is the total number of capabilities.

Table 4 Scale to Assess the Relative Importance of Capabilities

Capacity (i) (c_i) is _____important than Capability (l) under mission (m)	**Rating**
Equally as	1
Moderately	3
Strongly	5
Very strongly	7
Extremely strongly	9
Moderately less	1/3
Strongly less	1/5
Very strongly less	1/7
Extremely less	1/9
Intermediate values between the two adjacent judgments	2,4,6,8,1/2,1/4,1/6,1/8

$$c_{im} = \frac{r_{il,m}}{\sum_{i=1}^{n} r_{i,l,m}} \qquad (3.1)$$

To have the final weights for each capability ($C_{i,m}$) aggregated by normalizing the geometric means across all capabilities using equation (5.2) where "L" represents total number of capabilities. As the equation suggests each capability may have different importance weight across missions; therefore, each force alternative archives different effectiveness levels across missions.

$$C_{im} = \frac{\sum_{i=1}^{L} c_{im}}{L} \tag{3.2}$$

3.3.3. Weighting WS Attributes for Each Force Capability

WS attributes represent the bottom level of the hierarchy. Force capabilities are assessed by the contribution of WS attributes. Model weights each attribute to indicate how much each of them contributes to each Capability. The weights of attribute "l" for each capability "j" (aw (j,l)) are obtained using the same method explained above for Force Capabilities. It is important to mention that the sum of the each criteria sets is equal to 1. Some of the capabilities or attributes can be more important than others while some of them can be equal.

3.3.4. Weighting WS Attributes for Each System Role

WS attribute set is the bridge between weapon systems that compose alternative force options and Force Capabilities. Thus, the importance of each attribute is also evaluated for each System Role that a WS may perform. Experts used the scale in Table 8 for the ratings.

Table 5 Rating Scale to Asses WS Attributes' Importance for System Roles

Degree of Importance	Rating
Very low	1
.	2
Moderate	3
.	4
High	5
.	6
Very high	7
.	8
Extremely High	9

Up to this point of the model characteristic sets that alternatives are to be evaluated upon are created and their weights are assigned. Figure 12 depicts the weighted criteria where thickness of arrows represents the weight of a characteristic to determine the value of a characteristic in the higher level of hierarchy. One example is the weight of capability-1 in determining the value of Mission-1 is higher than Capability-3.

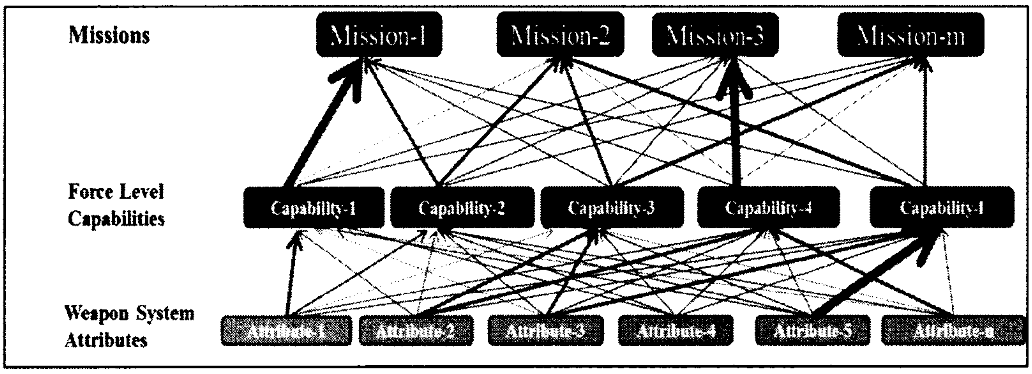

Figure 12 Weighted Criteria Set

The next step is the alternative generation where this model differs from the other studies.

3.4. Alternative Generation

Alternatives that the model tries to evaluate are mainly portfolios consisting of multiple weapon systems. Multiple options can be compared by using the model on the condition that they are distinct from each other. Alternatives should also be similar in terms of hierarchical level and the amount of ground they influence (e.g., battalion, brigade, and fleet).

It should be noted that options represent specific points in the option space. Arithmetically the number of alternatives that can be generated from a portfolio of "N" different types of weapon system is equal to N*(N-1), but most of these options may not be sufficiently distinct from each other and plausible to evaluate. Thus, decision makers (or experts) eliminate irrational options and select plausible ones from the option space.

A force option indexed by (f) is defined by: all weapon systems (s), like M1A2 Tank, Bradley APC, Mortar, etc. that comprise that option, the number of each weapon system (AWS) in the option, and the role of each weapon system (r) like fire support, reconnaissance, etc. An example of alternatives is shown in Table 9. At the next step system roles and the number of weapon systems are used to get the options force level attribute values.

Table 6 Composition of an Alternative

Weapon System (s)	System Role (r)	Option-1 (f_1)	Option-2 (f_2)	Option-3 (f_3)
s_1	r_2	$5x(s_1, r_2)$	$7x(s_1, r_2)$	$13\ x(s_1, r_2)$
s_2	r_3	$12x(s_2, r_3)$	$2\ x(s_2, r_3)$	$10\ x(s_2, r_3)$
s_3	r_1	0	$8x(s_3, r_1)$	$6\ x(s_3, r_1)$
s_4	r_3	$5\ x(s_4, r_3)$	0	$3\ x(s_4, r_3)$
s_5	r_4	$8\ x(s_5, r_4)$	$9\ x(s_5, r_4)$	0
Total AWS		30	26	32

3.5. Evaluation of Weapon System weights

At this step weapon system attribute levels of each option are calculated using three values: attribute values of each system av (j,s), quantity (q [s,f]) values of each system, and importance of each attribute for the system roles ($r_l\,(a_j)$) .

The step starts with defining of 1-9 rating scale for each attribute. These scales should be specific enough to allow experts to rate component weapon systems. Using these scales attribute values of each WS is determined. Then for each attribute system quantity weights of each system (q [s,f]) are calculated using equation (3.3) where *AWS* [s,f] is the amount of each system in an alternative, "n" is the total number of weapon systems in the option.

$$q[s,f] = \frac{AWS\,[s,f]}{\sum_{s=1}^{n} AWS\,[s,f]} \qquad (3.3)$$

For example if we calculate the quantity weight of the first system (s_1) for each option (f_1, f_2, f_3) by using the values on the Table-9 it would be as follows:

q [s_1,f_1]= 5/30

q [s_1,f_2]= 7/26

q [s_1,f_3]= 13/32.

Then system role importance ratings SRI [r,a] are assigned for each system so each system has its own role importance (SRI (j,s)). For example if importance of the mobility attribute is rated as moderate (3) for "indirect fire support role" than SRI (indirect fire support, mobility)= 3. Consequently a weapon system with an indirect fire support role will have the same SRI such as SRI (howitzer, mobility) =3.

SRI values are then combined with system quantity weights to have system importance weights (SIW [j,s,f]) for each attribute (j) in each force option (f) by using equation (3-4) where.

$$SIW\,[j,s,f] = \frac{SRI\,[j,s].q[s,f]}{\sum_{s=1}^{S}(SRI\,[j,s].q[s,f])} \qquad (3\text{-}4)$$

3.6. Evaluation of Force Level Attribute and Capability Values

Force level attribute values are calculated by combining SIW in equation (3-4) and rating each WS received for each attribute using weighted sum method (WSM) in equation (3-5 where FAV [j,f] represents an alternative (f) value for an attribute (j). Figure-15 depicts the evaluation structure.

$$FAV\,[j,f] = \sum_{s=1}^{s} av[j,s].SIW\,[j,s,f] \qquad (3\text{-}5)$$

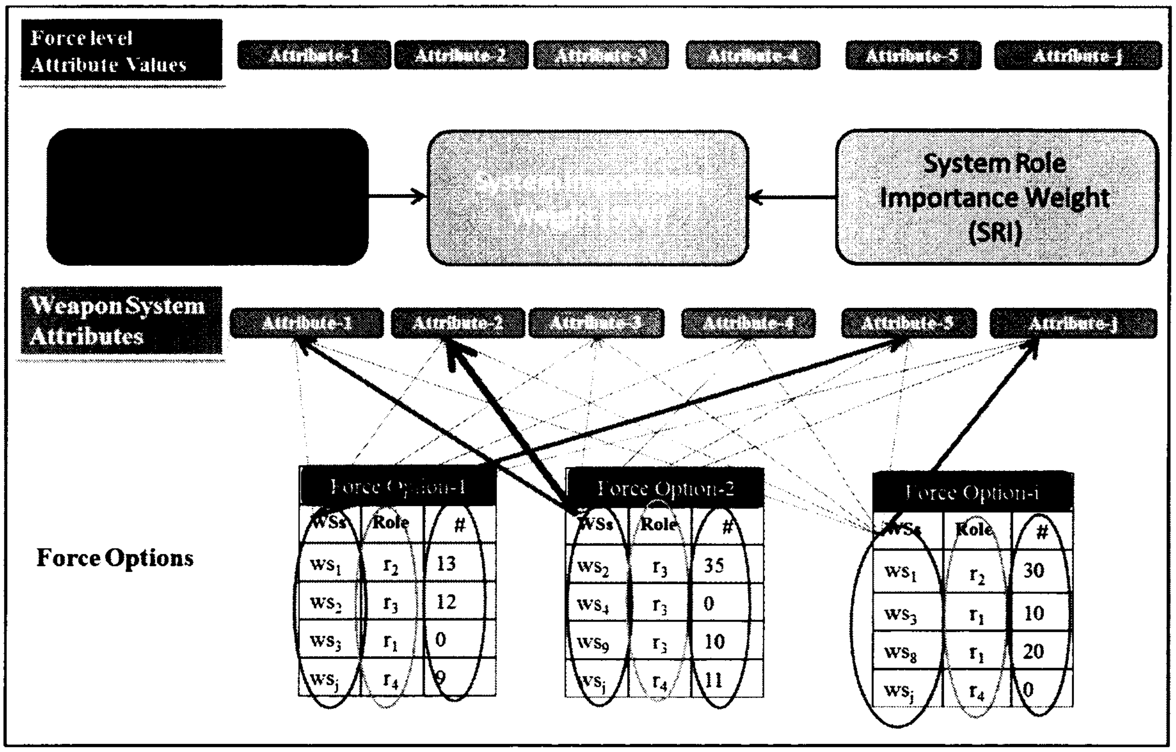

Figure 13 Evaluation of Force Level Attributes

Similar to attribute evaluation, force level capability values (FCV) are evaluated using equation (3-6) where FCV stands for the value of l^{th} capability of f^{th} force, and aw [j,l] stands for importance of j^{th} attribute for l^{th} capability.

$$FCV\ [l,f] = \sum_{a=1}^{j} FAV[j,f].aw\ [j,l] \qquad (3\text{-}6)$$

3.7. Evaluation of Mission effectiveness

At the final stage of evaluation mission effectiveness of force alternatives (MAV [m,f]) are calculated using importance rates of each capability cw (l,m) for each mission (m) and the FCV [l,f] from equation (3-6).

$$MEV\ [m,f] = \sum_{a=1}^{l} FCV[l,f].cw\ [l,m] \qquad (3\text{-}7)$$

3.8. Prioritization

It is worthwhile to underline again that during the evaluation judgments of experts are used to create distributions instead of aggregating them to point values. Assume that five experts rated importance of three attributes for two capabilities as shown in Table 10. If those ratings are aggregated into an average or mean value, different views of experts and the uncertain nature of the problem might be disregarded. Using distributions instead of point values allows exploitation of simulation and representation of uncertainty therefore provides a better baseline for prioritization.

Table 7 Sample Expert Judgment Aggregation

	Capability-1			Capability-2		
	Attribute-1	Attribute-2	Attribute-3	Attribute-1	Attribute-2	Attribute-3
Expert-1	5	6	8	8	4	6
Expert-2	6	7	8	9	5	6
Expert-3	5	8	9	7	3	5
Expert-4	4	5	8	7	3	5
Expert-5	6	8	7	7	3	5
Aggregation (average)	**5,2**	**5.6**	**8**	**9.5**	**4.5**	**4.5**
Discreet Distribution Function	**{(4,5,6), P(0.2,0.4,0.4) }**	**{(5,6,7,8), P(0.2,0.2,0.2,0.4))**	**{(7,8,9), P(0.2,0.6,0.2))**	**{(7,8,9), P(0.6,0.2,0.2) }**	**{(3,4,5), P(0.6,0.2,0.2))**	**{(5,6), P(0.6,0.4))**

Prioritization of Alternatives is done by comparing the mission effectiveness of options in two different ways. Both of them take the advantage of probabilistic nature of outcomes.

3.8.1. Comparison of All Alternatives

Outcomes of the model are results of Monte Carlo simulation iterations (e.g. 1000 runs). Due to the probabilistic nature effectiveness values of each option may change at each iteration. Thus the outranking force option may change, so the first method ranks the options under consideration for each iteration then sums up the rankings of each option. Table 11 represents this ranking. Ranking frequencies of options provide an overview of the performances of options relative to one another in each mission, but this does not always indicate how often one particular option is more effective than any other particular one.

Table 8 Rank Frequency Calculation

	Effectiveness Values Of Option for Mission-3				Ranking Frequencies			
	Option-1	Option-2	Option-3	Option-4	Opt-1	Opt-2	Opt-3	Opt-4
Iteration-1	4.016360	3.508936	3.864604	4.140096	2	4	3	1
Iteration-2	3.840400	3.164424	4.092129	4.395349	3	4	2	1
Iteration-3	4.052797	3.52389	4.118748	4.376426	3	4	2	1
Iteration-4	3.806544	3.487989	4.641163	4.183877	3	4	1	2
Iteration-5	4.105547	3.422478	4.65436	4.323440	3	4	1	2
.	.	.	.	.	.	.	.	.
Iter-1000	4.25077	3.564533	4.034750	4.230750	1	4	3	2

3.8.2. Pairwise Comparison of Alternatives

To better understand the ranking frequencies of competing options for a mission model compare them one on one. This information is easily obtained by comparing the effectiveness of two competing options in every simulation iteration and summing the frequency of one option outranking other.

3.9. Perturbations

So far in the model alternatives are evaluated against each mission but no importance ratings are assigned to the missions, so they are assumed to have equal importance. At this step ranking of each option analyzed under different mission importance to understand how much the outranking of options are influenced by the perturbations. Changes in the mission weights should be enough to make decisions on ranking alternatives.

3.10. Conclusions

This chapter described the nine phases of the proposed MAGDM model in general terms. A major purpose of this dissertation is to demonstrate the contributions of this model to MAGDM by applying it to U.S. ground force evaluation. Thus, Chapter 4 discusses how the model was applied to a specific problem and interprets this analysis to illustrate how this process can yield useful insights and inform complex force decision problems in an uncertain environment.

CHAPTER 4

APPLICATION AND ANALYSIS

> We have heavy forces that have no peer in the world, but they are challenged to deploy rapidly. The Army has the world's finest light infantry, but it lacks adequate lethality, survivability, and mobility once in theatre in some scenarios. We must change.

General Shinseki

US Army Chief of Staff, 1999

This chapter demonstrates the application of the proposed MAGDM model, described in Chapter 3. During the analysis five NATO military personnel are used as Subject Matter Experts (SME)[2]. The chapter mainly follows the steps of methodology and begins by describing the missions that alternative force options can be tasked with performing. Then force level capabilities and system level attributes are defined and their importances are evaluated to set the stage for the analysis. This phase is followed by generation of alternatives where force options and their component weapon systems (WS) are described. Later using criteria hierarch force level capability values are derived and force options are ranked under each mission. Rankings are done using the results of each of 10000 Monte Carlo iterations. This chapter ends with additional analysis of force ranking by perturbation of mission's importance. Table 9 summarizes the criteria sets that are used for the analysis.

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[2]Brief information about experts can be found in Appendix-D.

Table 9 Sets used for Analysis

Sets	Description	Set Content
Missions	Tasks that an **alternative force option** may perform.	• Humanitarian Assistance (HA) • Show of Force (SoF) • Sanctuary Denial (SD) • Support to Foreign Unconventional Forces (SFUF) • Opposed Stabilization (OS) • Major Combat Campaign (MCC)
Force Level Capabilities	Essential capabilities of a ground force to successfully perform the tasks.	• Survivability • Deployability • Menaverability • Sustainability • Lethality • Interoperability • Agility
System Level Attributes	Set of features that a **weapon system** should have.	• Mobility • Firepower • Concealment • Protection • Self-Sufficiency • Detection • Transportability • Command and Control
Alternatives	**Force options,** comprised of multiple **weapon systems,** to be ranked and evaluated across **mission** set.	• Motorized Infantry Brigade • Airborne Infantry Brigade • Heavy Armored Brigade • Stryker Brigade
Component Weapon Systems (WS)	Constituent elements of **alternatives.**	• Bradley Infantry Fighting Vehicle • M1A2 Abrams Tank • 81mm Mortar • Javelin Anti-tank Missile • M777A2 Howitzer • .etc.
System Roles	Tasks that a **weapon system** may perform in combat. Every WS performs a specific role in combat and that requires some **attributes** more than others.	• Fire Attack • Fire Support • Indirect Fire • Reconnaissance

4.1. Mission Scenarios

Force options are evaluated using a set of six representative mission scenarios: Humanitarian Assistance (HA), Show of Force (SoF), Sanctuary Denial (SD), Support to

Unconventional Foreign Forces (SFUF), Opposed Stabilization (OS), and Major Combat Campaign (MCC). These missions are retrieved from the FM 3-07 (2003), Frier (2011), and FM 3-0 (2011) and vary considerably in both context and intensity. As shown in Figure 14, they are spanning a wide range of ground operations that ground forces might be expected to perform in the future.

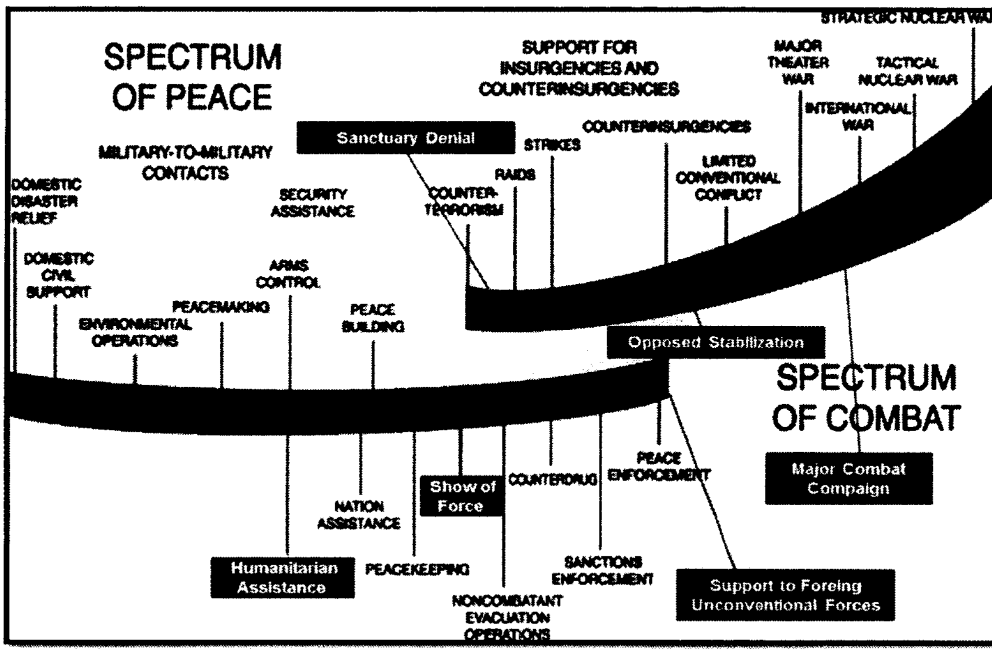

Figure 14 Placement of Missions used in Analysis in the Operations Spectrum

4.1.1 Humanitarian Assistance (HA)

This mission covers the actions conducted to diminish or relieve the results of manmade or natural disasters or other widespread conditions such as human pain, disease, hunger, or privation that might present a serious threat to life or that can result in great damage to or loss of property. Humanitarian assistance provided by land forces is limited in scope and duration. The assistance provided is designed to supplement the efforts of the host nation civil authorities or agencies that may have the primary responsibility for providing humanitarian assistance. During Hurricane Katrina (2005), and earthquakes in Haiti (2010) and Japan (2011) many land forces from different nations conducted HA operations independently or in a brother joint command.

- Scenario

Aggravating existing drought and food scarcities, a magnitude 7.0 earthquake occurs in an East African Country. The epicenter is approximately 70 km from the Capital city center. In Capital City, the destruction is extensive, with estimates of 4,500 killed, 20,000 injured and 700,000 homeless. The two main towns of the country are destroyed, with tens of thousands estimated killed and injured. Throughout the affected area key infrastructure is severely damaged (communications electricity, water) and all public and emergency services have collapsed. The government struggles to demonstrate its control and is expected to request humanitarian assistance. U.S. and foreign nongovernmental organizations are seeking assistance to reach the disaster location (Frier 2011).

4.1.2 Show of Force

Show of Force (SoF) is an operation intended to show a nation's determination. SoF involves increased visibility of deployed forces in an attempt to mollify a specific situation by establishing clear red lines for those purposefully threatening the security of key states or regions. If allowed to remain these situations may require extended use of military power and become unfavorable to national interests or objectives (JP 3-0).

- Scenario

As a Strong Asian Country prepares to conduct a major military exercise along the borders of an Eastern European country, the Foreign Minister furthermore provides provocative comments regarding unification into a federation with its smaller neighborhoods. Unexpectedly, a major cyber-attack cripples the air defense networks and command and control systems of another bordering country. As this Strong Asian country begins positioning its ground forces for the alleged exercise, the Bordering States call on NATO to prevent any possible aggression. The U.S. considers swift movements of some land troops to demonstrate resolve (Frier 2011).

4.1.3 Sanctuary Denial (SD)

Insurgents generally conduct small scale, time limited attacks, and withdraw to their secure sanctuary at ungoverned, distant areas. Permeable spaces and borders for sanctuary, which provide operating space, can lengthen an insurgency if the counterinsurgent overlooks them or handles them inadequately (Celeski, 2006).

The main aim of sanctuary denial operations is to control and occupy territory in order to preclude its use as a safe haven by adversaries. The U.S. Invasion of Cambodia in 1970, Israel's 1982 attack on Southern Lebanon are some of the examples of sanctuary Denial operations. U.S. Army forces may conduct sanctuary denial operations to:

- Address a threat causing serious harm to core U.S. interests,
- Prevent serious criminal or terrorist activity posing persistent hazards;
- Disrupt or terminate adversary leadership, networks, and capabilities that enable hostile or illegal actions.

- Scenario

Concerned by Yellow Country's interference in Blue Country affairs, Haushi rebels increasingly reach out to Yerhan for support. Not only does Green Country provide multiple shipments of sophisticated weapons, including SA-7s that can be used by individuals, but U.S. intelligence also confirms that dozens of Quds Force personnel are operating in Blue towns near the Yellow border. Reports that Haushi militias are selling their SA-7s abroad raise major concerns for U.S. leadership. The latest shoot-down of a Yellow Country transport helicopter prompts Yellow to start a ground offensive into northwestern Blue. Well-equipped and led by Quds Force experts, Haushi guerillas destroy dozens of Yellow Country tanks as they enter town centers. Missiles let the rebels to deny Yellow air forces the ability to operate safely in the region. After successive setbacks, Saudi forces pull back and are unable to resume their offensive action. Meanwhile, the Blue government weakens further, enabling the Haushis to gain more power in the northwest while al Qaeda forces continue to operate at training camps in the southeast. With the Blue government unable to challenge these two sanctuaries and Blue Forces still regrouping, the United States considers taking immediate and decisive action to eliminate both Haushi and al Qaeda networks (Frier 2011).

4.1.4 Support to Unconventional Foreign Forces

The best and most current example for this type of operation is the current situation in Syria. Support to foreign unconventional forces (SFUF) involves the employment of ground forces in direct support of a surrogate force of irregular foreign fighters who are in the midst of a conflict with a state or group hostile to the nation providing SFUF (JP 3-05). Ground forces conducting SFUF assist foreign irregular forces, in generating, fielding, employing, and sustaining guerrilla forces to implement offensive actions against a hostile government or group and/or protect vulnerable people against the attacks of enemy military or paramilitary forces (FM 3-07.1, 2009).

- Scenario

In the coming years, al Qaeda and its affiliated networks gain momentum in southern Blue. President Haleh's government remains weak and faces continuing challenges from groups inspired by the Arab Spring. Green increases its support for al Haushi rebels in the Baada region, further increasing the pressure on Haleh's regime. By the end of 2012 the southern separatists have established a strong state within a state, enabling al Qaeda and its affiliates to safely train and organize. A complex proxy war ensues with Yellow and Green as the main protagonists, while intelligence warns of more Anti-Western terrorist plots originating in Blue. To contest the al Qaeda foothold, the United States develops an indigenous Blue insurgent force with the tacit support and covert cooperation of Blue to combat the new central government and Green proxies in the north.

4.1.5 Opposed Stabilization (OS)

OS is the type of mission conducted when a rival or partner nation has lost control over security in all or part of its sovereign region and the related disorder and internal conflict puts U.S. interests at risk. The configuration of deployed forces will initially favor offensive combat capabilities. French Intervention in Zaire (1978) is an example of OS mission (Frier, 2011).

- Scenario

A separatist religious movement (AIAI) based in a Middle East country initiates a more violent Arab Spring by declaring independence from the State and claiming sovereign rights to southern provinces of the country. AIAI fighters drive off the State security forces, seizing control of two main cities and one costal city with an important port. Divided loyalties in the military and police formations result in escalation of the uprising. Shortly after this insurgency, another separatist movement with the same motives assassinated one of the modern and moderate kings of region. Due to that event violence spreads between the Regular army and National Guard forces spreads eastward, triggering widespread intra- and inter-communal violence around key petroleum extraction and port facilities. Heavy fighting within and between Religious fighters, irregular/tribal formations, and the government forces the shutdown of a number of main seaports. Looking to help stabilize the province, the United States and some regional actors consider intervention (Frier 2011).

4.1.6 Major Combat Campaign (MCC)

MCC includes well known conventional combats. A considerable number of the military actions in a MCC occur according to the conventions of traditional war fighting. They are extensive operations focused on defeating enemy state's conventional and irregular military capabilities and methods. The British operation to recapture the Falkland Islands after their seizure by Argentina in 1982, Operation Just Cause (Panama, 1989), Operation Desert Storm (Kuwait/Iraq, 1991) are contemporary examples of MCC (Frier, 2011).

- Scenario

North Red Country (NRC) remains to keep one of the major armies in the region holds a broad amount of Weapon of Mass Destruction (WMD), and maintains a hostile posture to South Blue Country (SBC). As the NRC economy continues to contract, its people become increasingly beset by famine and, as a result, become restive. In an attempt to maintain national cohesion, the NRC government takes a highly aggressive stance towards its neighbor to the south, and begins to conduct recurrent strikes and raids. Initially exercising control, the SBC government eventually takes limited acts of retaliation. These limited operations in turn inflame an invasion from the North. Even though U.S. forces stationed on the SBC have been reduced, those remaining are instantly drawn into conflicts to shore-up the South's defenses, repel North Korean forces. The United States implements its war plans, racing to deploy additional forces to the SBC (Frier, 2011).

The main variables that differentiate missions among each other are basically strategic warning to deploy necessary forces to the operational area, expected duration of mission, and expected enemy and the terrain types where forces perform their missions.

The above described mission scenarios are selected by experts taking into consideration of current political situation in different regions around the world and past U.S. operations. These missions do not cover the whole spectrum and should be considered as spots in the multidimensional mission space. Hundreds of scenarios can be generated using the variables of mission, strategic warning, duration, adversary type, and terrain. Table 10 summarizes the mission scenarios.

Table 10 Mission Scenarios by Key Variables.

Mission Scenarios	Strategic Warning	Duration	Adversary Type	Terrain
Humanitarian Assistance (HA)	Extremely Short	Short, Moderate	Criminals and Terrorists.	Urban area and City
Show of Force (SoF)	Short	Moderate	Capable State Military	Open terrain
Sanctuary Denial (SD)	Short	Long	Criminals, Terrorists, Militia, Insurgents	Mountains, Rural and villages
Support to Foreign Unconventional Forces (SFUF)	Moderate	Moderate, Medium	State army with relatively lower capability	Mixture of rural areas and open terrain
Opposed Stabilization (OS)	Moderate	Medium, long	Terrorists, Insurgents	Urban environment,
Major Combat Campaign (MCC)	Long	Long	Capable State army	Rural areas and open terrain

Duration/Strategic Warning	
Extremely Short	Hours
Short	Days
Moderate	Weeks
Long	Months
Very Long	Year(s)

4.2. Force Level Capabilities

As illustrated in the scenarios each mission scenario requires some capabilities more than others due to the effects of key variables. In order to reflect this, force level capabilities are defined. The following capabilities portray crucial properties of a force.

- **Survivability**

  Capability to protect personnel, weapons systems, and necessary equipment while retaining functionality and simultaneously deceiving the enemy. Survivability includes employing frequent movement, using concealment, deception, and camouflage. (JP 3-34)

- **Deployability**

  Capability to move forces (including systems, crews, support personnel, equipment, and everything else the force needs to operate quickly and effectively) over long distances. This can be between theatres or regions (NATO- MC319/1,n.d.)

- **Maneuverability**

  It is the capability to move land forces in a position of advantage over the enemy on the battlefield. Units perform movement in combination with fires in order to engage, disengage avoid or funnel enemy forces (JP 3-0).

- **Sustainability**

  It is the ability to maintain the necessary level and duration of operational effectiveness by providing materiel, consumables and services like fuel, ammunition, parts, maintenance, etc. to achieve military objectives.

- **Lethality**

  It is the capability to destroy or disable opposing forces in an efficient and timely manner.

- **Interoperability**

  It is the capability to operate in synergy with the other units and partners in the execution of assigned missions (JP 3-0). Due to the technological differences interoperability is generally an issue among coalition partners on communications and electronics equipment when information or services need to be exchanged between them.

- **Agility**

  It is the ability of a force to rapidly respond to changes in the operational environment by adapting its original formation. It is important because there will be changes in the environment between planning phase and the execution phase of the operation and during the operation itself.

The capability set agreed upon by experts is consistent with military literature and the army documents. In the U.S. Army's capstone doctrinal manual FM 1-The Army establishes doctrine for employing land power. This document lists future core army capabilities as "responsive, deployable, lethal, versatile, agile, survivable, and sustainable". Krepinevich (2002, 2009) and many other researchers (City, 1999; Brendle & Jaczkowski, 2002; Plichta&Hamlen, 2002; Shisler, 2001) underline the importance of lethality, maneuverability, sustainability, and survivability as core capabilities of land forces.

4.3. Evaluating Importance of Force Level Capabilities

After identifying the capability set, experts evaluated each capability under each mission. The capability weights are obtained using the pair wise comparison method developed by Saaty (1980). Using this method experts rate the importance of each capability (i) as compared to each of the other capability under each mission (m). At this step experts are asked to make 126 comparisons between capabilities. The scale and details of the aggregation method are explained in Chapter 3. Table 11 shows the weights of each capability given by each expert, under each mission.

It is worth mentioning the degree of agreement among experts on the importance of capabilities under each mission. Table 14 shows the experts' ratings, where most agreed capabilities are shaded and most disputed ones are shown in **bold**. At this stage it is worth emphasizing that, the ratings of experts will not be aggregated in to a single value and they will be used to create a probability distribution. So that final result will be output of simulation that, represent the probabilistic nature of the analysis rather than having single value to prioritize alternatives.

For the OS and MCC missions there is no major difference between experts' ratings and they strongly agreed on the importance of survivability, sustainability, lethality. Under SFUF and SoF missions, a more than "0.1" difference occurred between experts views for two capabilities (deployability, agility; deployability, lethality respectively). Experts strongly agree on the importance of "sustainability" and "interoperability" under each mission and their assessments never diverged more than "0.1".

Table 11 Weights of Force Level Capabilities under each Mission Scenario

	Humanitarian Assistance (HA)						
	Survivability	Deployability	Menaverability	Sustainability	Lethality	Interoperability	Agility
Expert-1	0.03	0.41	0.08	0.18	0.02	0.12	0.16
Expert-2	0.03	0.37	0.24	0.15	0.02	0.07	0.12
Expert-3	0.04	0.34	0.22	0.17	0.02	0.08	0.13
Expert-4	0.03	0.42	0.23	0.14	0.02	0.08	0.08
Expert-5	0.03	0.44	0.21	0.13	0.02	0.08	0.09

	Show of Force (SoF)						
	Survivability	Deployability	Menaverability	Sustainability	Lethality	Interoperability	Agility
Expert-1	0.17	0.27	0.23	0.07	0.15	0.04	0.07
Expert-2	0.22	0.27	0.18	0.06	0.19	0.04	0.03
Expert-3	0.20	0.24	0.22	0.07	0.21	0.02	0.03
Expert-4	0.21	0.23	0.19	0.08	0.23	0.03	0.03
Expert-5	0.24	0.09	0.26	0.09	0.26	0.03	0.05

	Sanctuary Denial (SD)						
	Survivability	Deployability	Menaverability	Sustainability	Lethality	Interoperability	Agility
Expert-1	0.13	0.18	0.14	0.20	0.05	0.11	0.19
Expert-2	0.20	0.11	0.23	0.13	0.06	0.05	0.21
Expert-3	0.28	0.09	0.18	0.14	0.06	0.03	0.22
Expert-4	0.27	0.10	0.21	0.14	0.07	0.05	0.16
Expert-5	0.26	0.10	0.25	0.14	0.06	0.04	0.15

	Support to Unconventional Foreign Forces (SFUF)						
	Survivability	Deployability	Menaverability	Sustainability	Lethality	Interoperability	Agility
Expert-1	0.13	0.20	0.05	0.19	0.02	0.20	0.21
Expert-2	0.17	0.07	0.06	0.17	0.02	0.21	0.30
Expert-3	0.18	0.06	0.05	0.14	0.08	0.17	0.32
Expert-4	0.16	0.06	0.06	0.15	0.07	0.17	0.31
Expert-5	0.19	0.07	0.05	0.15	0.07	0.19	0.29

	Opposed Stabilization (OS)						
	Survivability	Deployability	Menaverability	Sustainability	Lethality	Interoperability	Agility
Expert-1	0.08	0.06	0.19	0.29	0.03	0.17	0.18
Expert-2	0.07	0.06	0.21	0.31	0.03	0.13	0.18
Expert-3	0.07	0.05	0.22	0.36	0.02	0.12	0.15
Expert-4	0.07	0.06	0.21	0.38	0.02	0.13	0.13
Expert-5	0.07	0.05	0.21	0.39	0.02	0.13	0.13

	Major Combat Campaign (MCC)						
	Survivability	Deployability	Menaverability	Sustainability	Lethality	Interoperability	Agility
Expert-1	0.18	0.03	0.29	0.06	0.30	0.06	0.09
Expert-2	0.19	0.03	0.34	0.06	0.24	0.06	0.08
Expert-3	0.20	0.03	0.39	0.06	0.19	0.06	0.07
Expert-4	0.22	0.02	0.30	0.06	0.25	0.07	0.07
Expert-5	0.19	0.03	0.34	0.07	0.21	0.08	0.09

Due to the importance of the reaction time in Humanitarian Assistance Mission, experts gave the highest importance to deployability and mobility (nearly half of the weight of deployability) while lethality received the lowest importance. For the Show of Force (SoF) mission survivability, deployability, lethality, and maneuverability received the highest ranks with minor difference while interoperability and agility received the lowest weights. Experts argued that SoF mission is conducted to show the determination of the country and the force required to conduct small scale engagements with opponents conventional forces, so this mission requires the capabilities that are mainly necessary in a major combat. Under Sanctuary Denial mission survivability, maneuverability and agility received the highest weights accordingly while interoperability received the lowest. Agility is the highest weighted capability for SFUF mission where supporting forces have to adapt to the frequent changes in operational environment. For Opposed Stabilization sustainability received the highest weight where lethality received lowest. Survivability, maneuverability, and lethality, as the core capabilities of conventional combat, received nearly the same weights under MCC.

Figure 15 summarizes the expert's assessments and weights of each capability under each mission. For HA, SoF, SFUF, OS, and MCC missions one of the capacities importance is prominent while for SD mission there is no prominent capability. When all missions are considered heights weights received by: Deployability under HA; Lethality followed by Maneuverability, and Deployability under SoF, Sustainability under OS; Agility under SFUF; Lethality, Survivability, and Maneuverability under MCC.

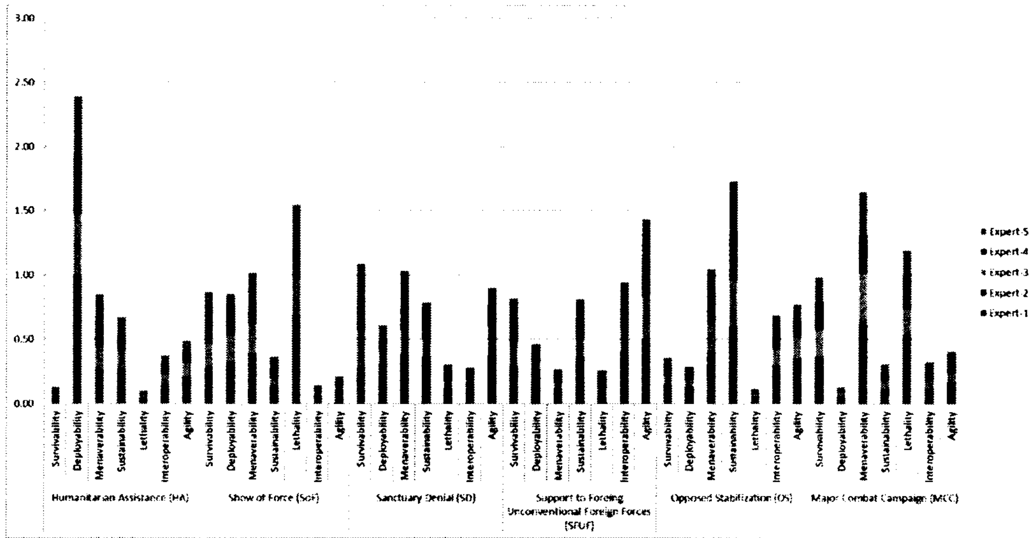

Figure 15 Capability weights for each Mission

4.4. Weapon System (WS) Attributes

WS attributes represent the bottom level of the evaluation hierarchy. Alternative force options that constituted by WSs will be evaluated at the next steps using scales that created for each attribute. Higher level force capabilities are assessed by the contribution of WS attributes. Eight attributes are determined, that represent the crucial properties of a WS. These attributes are used to evaluate weapon systems by Cheng & Mon (1994), Deng &Shen (2006), Gao, Wen & Liu (2004), Dağdeviren, Yavuz & Kılınç (2009) and many other researchers. To better explain each attribute, a number of contributing factors, scale proxies are defined and a nine grade scale created to rate WSs under each attribute.

Table 12 WS Attribute and Proxy List

Attributes	Proxies
Firepower	Most lethal weapon of the system
Mobility	Range of system without refueling & typical Speed.
Protection	Most lethal threat addressed
Concealment	Signature, size of the WS
Detection	Least prominent system that can be detected
Self-Sufficiency	Rate of consumption
Transportability	System weight, Smallest transportation platform
Command &Control	Information exchange means, Data transfer time

Eight attributes, listed in Table 15 are distinct from each other, and every one of them is the main contributor to at least one Force Capability. They also contribute to other capabilities - to the extent rated by experts. Firepower is the major source to lethality of the force while mobility primarily enables maneuverability, and protection is a major contributor to survivability. Concealment is the complement of protection to contribute survivability. It includes those system properties that make it harder to be detected and attacked. Detection is the second contributor to lethality following firepower as well as having a high stake in Agility. Self-sufficiency defines the degree of dependency to necessary supplies therefore a key factor in determining sustainability. Transportability- measure of carrying a WS to/from combat area- is the main contributor to deployability. Lastly, Command and Control, the measurement of communication, information sharing, and control, is the determiner of interoperability.

4.4.1 Firepower

Firepower is defined as the ability of a WS to terminate or damage an opponent system in combat. Contributing factors to firepower and the Scale Proxy are defined on the Table 16. The most lethal weapon on board is used as proxy for the ratings and contributing factors are defined to support experts during their evaluation. The levels of scale are associated with different types of weapons and they are arranged in order of increasing capability. The scale includes a broad mix of weapons that use different types of attack mechanisms and energy to damage enemy systems, so well-known measures of lethality, like penetration ability or energy are not stated since they are only suitable for the compression of similar weapon types.

Table 13 Rating Scale for Firepower

Contributing Factors	
Range:	Maximum effective distance over which it can throw its projectile.
Accuracy:	Likelihood of hitting a target on the first shot.
Effectiveness:	Likelihood of destroying a target when hit.
Rate of fire:	Speed of delivering shots to target. It may change for multiple targets, or for long time periods.
Scale Proxy Most lethal weapon of the system	
Scale Level	**Rating Scale for Firepower**
1	Small Arms (Rifles, machine Guns)
2	14-30 mm Armor piercing rounds
3	RPG/ATM(Small Unitary)
4	30-50 mm FS KEP
5	RPG/ATGM Large unitary Small Tandem
6	RPG/ATGM Large unitary Large Tandem ATGM
7	120-130mm KEP Top EFP
8	LOSAT EFOG-M
9	130-150mm KEP
Abbreviations	RPG: Rocket propelled grenade ATGM: Anti-tank guided missile FS :Fin-Stabilized KEP: Kinetic Energy Penetrator DPCIM: Dual-Purpose Improved Conventional Munitions LOSAT: Line-of sight Antitank EFOG-M: Enhanced Fiber-Optic Guided Missile

4.4.2 Mobility

It is the ability of a WS to move effectively on the battlefield. This includes movement on harsh terrain and weather and over obstacles as well as on roads. Speed and range are used are used as proxies as they address two key aspects of mobility; off-road speed is essential in tactical situations, while maximum on road range is important in an operational context. Other characteristics of mobility such as obstacle passing, and amphibious capabilities are not represented on the scale but increases in these properties are every so often correlated with upper speed and range. Scale levels in Table 14 represent differences in mobility across a wide range of systems, from dismounted soldier at the lowest level to wheeled and tracked vehicles at higher levels.

Table 14 Rating Scale for Mobility

Contributing Factors	
Battlefield Mobility	Swiftness in combat and versatility over harsh terrain
Tactical Mobility	Moving between engagements on flat terrain and trails
Operational Mobility	Moving on main roads
Scale Proxy Maximum Range of system without refueling, Typical Speed of WS during combat.	
Scale Level	**Rating Scale for Mobility**
1	20 km, 2 km/hr
2	60 km, 10 km/hr
3	100 km, 30 km/hr
4	200 km, 50 km/hr
5	300 km, 70 km/hr
6	400 km, 80 km/hr
7	500km, 90 km/hr
8	600 km, 100 km/hr
9	700+ km, 120+ km/hr

4.4.3 Protection

It is the ability of a system to minimize the probability of being hit when under fire, and preventing the damage that is likely to be incurred if it is hit. Firepower and protection are like opposite sides of a coin; protection is the ability of a system to prevent itself from being destroyed, while firepower measures ability to kill enemy systems. Due to that relation, exactly the same scales are used to measure firepower and protection attributes (Table 15). There may be minor deficiencies in the coverage but overall expert ratings took such factors into account.

Table 15 Rating Scale for Protection

Contributing Factors	
Coverage	Completeness of covering attacks from different directions; from frontal only coverage to spherical coverage.
Reliability	Continuousness of protection to multiple attacks; from fragile highly vulnerable systems to robust systems that can stay operational even after multiple hits.
Active-Passive	Type of protection; from active techniques to reduce the probability of being hit to more passive techniques that decrease consequences of being hit.
Scale Proxy Most lethal threat addressed by WS	
Scale Level	**Rating Scale for Protection**
1	Small Arms (Rifles, machine Guns)
2	14-30 mm Armor piercing rounds
3	RPG/ATM (Small Unitary)
4	30-50 mm FS KEP
5	RPG/ATGM Large unitary Small Tandem
6	RPG/ATGM Large unitary Large Tandem ATGM
7	120-130mm KEP Top EFP
8	LOSAT EFOG-M
9	130-150mm KEP
Abbreviations	RPG: Rocket propelled grenade ATGM: Anti-tank guided missile FS :Fin-Stabilized KEP: Kinetic Energy Penetrator DPCIM: Dual-Purpose Improved Conventional Munitions LOSAT: Line-of sight Antitank EFOG-M: Enhanced Fiber-Optic Guided Missile

4.4.4 Concealment

It is the ability of system to minimize the probability of being detected, tracked and targeted by enemy systems. The rating scale for concealment defined using two proxies: signature and size. Given all the other factors equal, if a system is smaller and less visible in the combat, it is less likely to be detected by opponent systems. Therefore, a lower signature, and smaller size make a WS more concealed. It is assumed that signature and size tend to vary together across different system types, ranging from very huge highly noticeable systems to very small systems that have negligible signature. To better explain the scale an example WS is attached with each rating.

Table 16 Rating Scale for Concealment

Contributing Factors	
Radiations	Grade of measures to decrease WS' emissions (Exhaust, infra-red, electromagnetic, acoustic etc.); starting from passive and basic (e.g., heat shields), to more evolved (e.g., exhaust muffler).
Design	Extent of measures to which WS's overall appearance is modified to reduce its presence in the battlefield by modifications in size, shape, surfaces.
Deception	Degree to which dedicated devices (e.g., decoys) are used to redirect and confuse opponent's attention.
Scale Proxy Signature, size of the WS and an example for each level.	
Scale Level	**Rating Scale for Concealment**
1	Very Noticeable Very Large (Tank in combat)
2	↔
3	Noticeable Large (Mobile artillery)
4	↔
5	Modest Medium (Scout vehicle)
6	↔
7	Low Small (Robotic scout)
8	↔
9	Minimal Very small (SOF soldier)

4.4.5 Detection

Detection contributes to exploration and gaining information about the enemy units, environment, and weapon system to attack or process information to other friendly forces. Concealment and detection have the same relationship that firepower and protection have (opposite sides of a coin); detection measures ability of detecting enemy systems, while concealment is the ability of a system to prevent itself from being detected. Due to that relation, same scales are used to measure concealment and detection attributes. There may be minor deficiencies in the coverage but overall expert ratings took such factors into account.

Table 17 Rating Scale for Detection

Contributing Factors	
Reliability	Functionality regardless of weather and environmental conditions; from systems that are easily effected by sun, wind cloud (e.g., eye view, binoculars, telescope) to systems that can operate in harsh weather conditions, night and day.
Range	Distance from which a WS can effectively identify a target; from eye sight to radars and thermal cameras.
Diversity	Number of different detection devices mounted on the WS; from single telescope to WS that uses multiple detection systems like thermal camera, radar, night vision.
Scale Proxy Least prominent system that can be detected by WS.	
Scale Level	**Rating Scale for Detection**
1	Very Noticeable Very Large (Tank in combat)
2	⇔
3	Noticeable Large (Mobile artillery)
4	⇔
5	Modest Medium (Scout vehicle)
6	⇔
7	Low Small (Robotic, scout)
8	⇔
9	Minimal Very small (SOF soldier)

4.4.6 Self-Sufficiency

It is the ability to reduce the dependency on supplies, services and other support to retain its critical abilities during combat. WSs are dependent on supplies and services (e.g., gas, and ammunition) to function properly during combat. If the systems use up supplies slower they need to refill their stores less frequently, so they have a tendency to be less dependent and more self-sufficient. WS's rate of consumption for essential supplies is used as proxy to measure self- sufficiency. Every other level of scale is defined with a qualitative description of consumption rate, from "very high" to "very low". To make the scale more meaningful, a WS is associated with each rating level.

Table 18 Rating Scale for Self-Sufficiency

Contributing Factors	
Stamina	Maximum length of continuous activity during operations.
Reliability	Time between failures that cause significant decrease in functionality.
Maintenance	Frequency and length of essential service and repairs required for a WS to function properly.
Scale Proxy WS's rate of consumption for essential supplies.	
Scale Level	**Rating Scale for Self-Sufficiency**
1	Very High (Tank)
2	⇔
3	High (Light tank/IFV)
4	⇔
5	Moderate (Tracked APC/scout vehicle)
6	⇔
7	Low (Wheeled APC/scout vehicle)
8	⇔
9	Very low (Robotic vehicle, small elite team)
Abbreviations	APC: Armored personnel carrier IFV: Infantry fighting vehicle

4.4.7 Transportability

It is the ease and speed of carrying a WS to and from the combat area. A direct relationship works between system weight and resource necessary to carry it long distances. The heavier a system is, the harder it is to transport. Weight is the foremost determinant of transportability therefore "weight of WS" is used as proxy to measure transportability. To anchor the scale, an example transport vehicle is included in each level. For example CH-47 Chinook at level 6 can carry up to 15 tons while C-130 can carry up to 22 tons therefore weight range at level 5 is 16-22 tons (above CH-47's but within C-130 capacity.

Table 19 Rating Scale for Transportability

Contributing Factors	
Arrangements	Activities that needs be completed after arrival, but before engaging in combat (e.g., calibration, installation).
Dimensions	Volume and mass of WS during transportation.
Scale Proxy System weight, Smallest vehicle that can carry the WS	
Scale Level	**Rating Scale for Transportability**
1	75+ tons Slow sea lift
2	55-75 tons C-5/C-17
3	40-55 tons RORO sea lift
4	25-35 tons A400M Atlas aircraft
5	16-22 tons C-130
6	12-15 tons Large helicopter (CH-47 Chinook)
7	4-10 tons C-27J Spartan
8	1-3 tons Helicopter/V-22/
9	Under 1 ton Small parachute
Abbreviations	C-5, C-17: Strategic cargo aircraft. RORO: Roll-on/Roll-off sealift ship SSTOL: Super Short Takeoff and Landing

4.4.8 Command & Control (C&C)

It is the ability to communicate and to upper and lower echelons and execute control to lower levels by sending and receive information. The rating scale for C&C aimed to measure ease with which critical information can be exchanged in a timely and secure manner. It is defined using two proxies: Information exchange means and the time required to transfer data. In the scale, shown in Table 20, level definitions means are expressed by different communication devices, ranging from voice, gestures, and signs to sensors and satellite communication, while the time needed to transfer data is given in intervals that range from minutes to real-time.

Table 20 Rating Scale for Command & Control

Contributing Factors	
Reliability	Ability to function regardless of weather and combat conditions; from systems that are easily effected by precipitation, sunshine, electromagnetic pulse, and jamming (e.g., voice, eye sight, radio) to systems that can operate in harsh conditions (e.g., multiple radio & satellite devices).
Range	Distance from which a WS can transmit and receive data effectively; from eye sight to radars and thermal cameras.
Diversity	Number of different communication devices mounted on the WS; from no devices to multiple communication systems like sensors, radio, and satellite.
Scale Proxy Information exchange means, Time required to transfer data	
Scale Level	**Rating Scale for Command & Control**
1	Voice, Gesture and signs Minutes
2	⇔
3	Single channel radio 1-2 minutes
4	⇔
5	Multiple channel-high range radio Less than 1 minute
6	⇔
7	Sensors &Multiple channel-high range radio Seconds
8	⇔
9	Satellite & improved radio Real time

4.5. Evaluation of Weapon System Attributes

After identifying the Weapon System Attributes, experts evaluated the contribution of each attribute to each Capability. The capability weights are obtained by applying the pairwise comparison method used for the evaluation of Force Level Capabilities. Using this method, experts rated the degree of contribution of each attribute as compared to each of the other attribute under each capability. This step required each expert to make 196 comparisons between System Attributes. The scale and details of the aggregation method is explained in Chapter 3.

Experts made independent assessments and generally assigned similar weights to system attributes under each capability. It is worthwhile to mention the degree of agreement among experts on the attribute contribution to capabilities. Table 21 shows the results of the each expert rating, where most agreed attributes are shaded and most disputed ones are shown in **bold**.

Experts showed strong agreement on ratings except under “agility”. A more than “0.1” difference occurred between experts views for attributes contribution to “Agility”. Some experts argued that changes that may occur in the battlefield cannot be predicted and they may require different attributes to adapt for different situations. So, some rated all attributes equally to “agility” while others gave a higher rating to command & control.

On the other hand experts showed strong agreement on contributions to deployability due to the fact that transportability is the main contributor and firepower, concealment, and protection are not major factors.

Table 21 System Attribute Weights Under Each Capability

Survivability	Mobility	Firepower	Concealment	Protection	Self-Sufficiency	Detection	Transportability	C&C
Expert-1	0.1	0.03	0.25	0.42	0.06	0.04	0.02	0.08
Expert-2	0.13	0.03	0.24	0.39	0.04	0.07	0.02	0.08
Expert-3	0.13	0.03	0.23	0.41	0.05	0.06	0.02	0.09
Expert-4	0.16	0.03	0.21	0.39	0.05	0.05	0.02	0.1
Expert-5	0.17	0.04	0.22	0.38	0.06	0.05	0.02	0.08

Deployability	Mobility	Firepower	Concealment	Protection	Self-Sufficiency	Detection	Transportability	C&C
Expert-1	0.06	0.06	0.06	0.06	0.06	0.06	0.56	0.06
Expert-2	0.12	0.05	0.05	0.05	0.11	0.05	0.52	0.05
Expert-3	0.18	0.05	0.05	0.05	0.05	0.05	0.51	0.06
Expert-4	0.12	0.06	0.06	0.05	0.06	0.05	0.54	0.06
Expert-5	0.18	0.04	0.04	0.04	0.14	0.04	0.48	0.05

Maneuverability	Mobility	Firepower	Concealment	Protection	Self-Sufficiency	Detection	Transportability	C&C
Expert-1	0.51	0.05	0.05	0.05	0.14	0.05	0.05	0.09
Expert-2	0.54	0.06	0.06	0.06	0.06	0.06	0.06	0.1
Expert-3	0.52	0.06	0.06	0.06	0.11	0.06	0.06	0.1
Expert-4	0.5	0.06	0.07	0.06	0.11	0.06	0.04	0.1
Expert-5	0.52	0.09	0.09	0.08	0.06	0.05	0.05	0.07

Sustainability	Mobility	Firepower	Concealment	Protection	Self-Sufficiency	Detection	Transportability	C&C
Expert-1	0.06	0.06	0.06	0.06	0.56	0.06	0.06	0.06
Expert-2	0.09	0.08	0.06	0.09	0.52	0.07	0.05	0.05
Expert-3	0.09	0.05	0.09	0.09	0.54	0.05	0.05	0.05
Expert-4	0.05	0.05	0.11	0.14	0.52	0.05	0.05	0.05
Expert-5	0.04	0.05	0.17	0.11	0.51	0.04	0.04	0.04

Table 21 Weights of System Attributes under each Capability (Continued)

	Lethality							
	Mobility	**Firepower**	Concealment	Protection	Self-Sufficiency	Detection	Transportability	C&C
Expert-1	0.125	**0.46**	0.038	0.031	0.038	0.19	0.029	0.087
Expert-2	0.093	**0.49**	0.033	0.036	0.034	0.124	0.031	0.157
Expert-3	0.104	**0.51**	0.039	0.039	0.039	0.16	0.035	0.077
Expert-4	0.087	**0.55**	0.047	0.047	0.053	0.093	0.043	0.079
Expert-5	0.121	**0.53**	0.054	0.043	0.042	0.098	0.039	0.078

	Interoperability							
	Mobility	Firepower	Concealment	Protection	Self-Sufficiency	Detection	Transportability	C&C
Expert-1	0.076	0.062	0.062	0.062	0.062	0.062	0.062	0.552
Expert-2	0.049	0.049	0.088	0.049	0.049	0.136	0.049	0.531
Expert-3	0.098	0.098	0.098	0.098	0.121	0.195	0.089	0.203
Expert-4	0.11	0.101	0.101	0.101	0.11	0.16	0.101	0.216
Expert-5	0.099	0.099	0.11	0.121	0.121	0.121	0.121	0.208

	Agility							
	Mobility	**Firepower**	Concealment	**Protection**	Self-Sufficiency	**Detection**	**Transportability**	**C&C**
Expert-1	**0.08**	**0.08**	0.085	**0.07**	0.173	**0.19**	**0.02**	**0.3**
Expert-2	**0.22**	**0.22**	0.078	**0.22**	0.078	**0.08**	**0.03**	**0.09**
Expert-3	**0.13**	**0.13**	0.125	**0.13**	0.125	**0.13**	**0.13**	**0.13**
Expert-4	**0.06**	**0.09**	0.089	**0.08**	0.171	**0.18**	**0.04**	**0.3**
Expert-5	**0.1**	**0.07**	0.08	**0.07**	0.167	**0.17**	**0.02**	**0.34**

Figure 16 summarizes the expert assessments and weights of each attribute under each of the seven force capability. For each capability one of the attributes is the main determiner and the heights weights received by Protection under Survivability, Mobility under Maneuverability, Self-Sufficiency under Sustainability Firepower under Lethality, C &C under Interoperability and Agility.

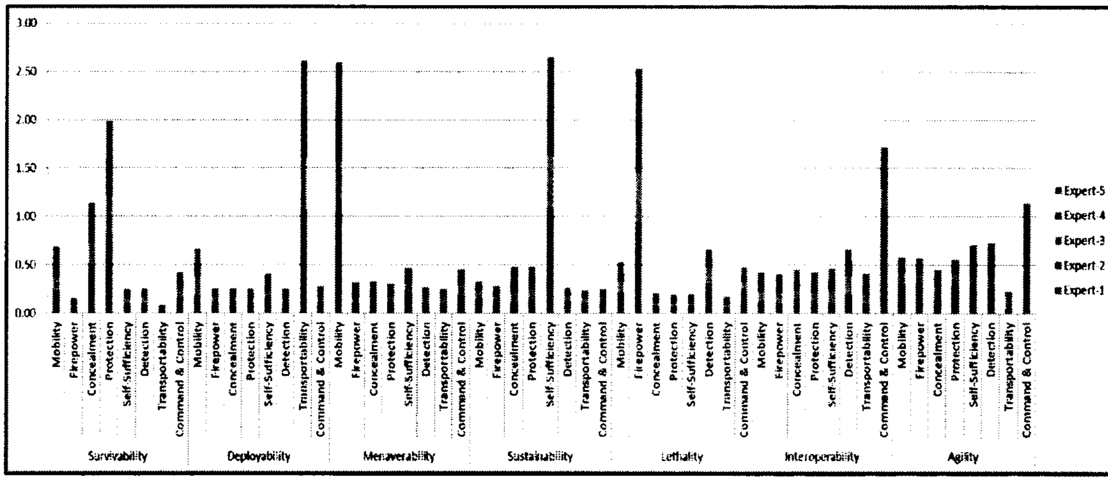

Figure 16 Importance of Attributes for Each Force Capability

For the Survivability protection followed by concealment are the main determiners although mobility has a substantial importance. As expected, transportability of the weapon system is the main determiner of the deployability of a force, followed by mobility which allows WS to be self-deployed within the operational area. For Maneuverability mobility is the highest contributor (more than a 0.5 weight) while Self-Sufficiency is also an important contributor. Lethality and sustainability capabilities are clearly determined by firepower and self-sufficiency as expected (both has an importance weight more than 0.5).

Interoperability and agility don't have a dominant main contributor but C&C is the main determiner of these capabilities with additional contribution from detection for both capabilities.

4.6. Weapon System Roles

Alternative force options, being evaluated, are composed of weapon systems. WSs perform many different roles, depending on their functions and capabilities. Different roles require some attributes more than others as mentioned in section 4.4. For instance WSs may provide indirect fires where "fire power" has upmost importance while others conduct reconnaissance role where "detection" and "C&C" have higher importance. Assigning a role to each system allows its attributes to be weighted accordingly when the capabilities of the force as whole are calculated. A set of five roles are determined to capture differences in the analysis. A description and a WS example are provided below for each role:

- **Fire Attack:** The fundamental mission of fire attack weapons is to move to contact with enemy forces and then fight them directly at relatively short distances. (< 5 km). Example: Armored fighting vehicle, main battle tank.
- **Fire Support:** providing infantry and line-of-sight fires to support more capable forces from short to moderate range (2 – 5 km) while avoiding direct contact with enemy forces while. Example: infantry fighting vehicle with ATGMs.
- **Indirect Fire:** Indirect fire weapons include artillery units equipped with either field guns (howitzers), or heavy mortars. Artillery is part of an army that controls the bigger, long range weapons (5 – 20 km), formerly referred to as cannons. In battle, the artillery's role is to provide fire support for the infantry, cavalry, armor and other units. The

projectile, rocket, missile, and bomb are the weapons of indirect-fire systems. Example: Mortar and artillery.

- **Reconnaissance:** This role requires operating in varied locations to gather and interpret battlefield information from both human observations and multiple sensors, than disseminate it to the other elements of the force. Example: scout vehicle.

These roles represent the groupings of tasks and activities that systems tend to engage in on the battlefield. A single role from this set is assigned to each component system based on its design and primary function. For example, a main battle tank would be assigned to the "fire attack" role because it best describes what this system is designed for.

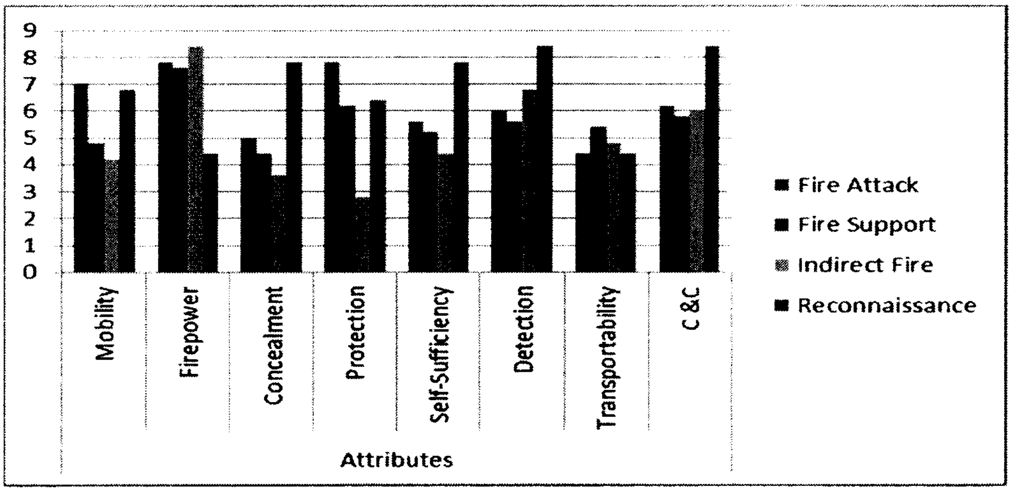

Figure 17 Importance of Weapon System Attributes for System Roles

After defining the system roles experts rated the importance of the system attributes for each of the four system roles. Average values of expert ratings are shown in Table 22 and depicted in Figure 17. These ratings are used to adjust the quantity-based weights associated with each system to account for its design and function when the force-level attributes are calculated. This method aggregates attributes in a manner that allows systems to supplement one another by playing roles that focus on their strengths but not the weaknesses.

Table 22 Expert ratings of for System Roles

	Mobility				Firepower				Concealment				Protection				Self-Sufficiency				Detection				Transportability				C &C			
	Fire Attack	Fire Support	Indirect Fire	Reconnaissance	Fire Attack	Fire Support	Indirect Fire	Reconnaissance	Fire Attack	Fire Support	Indirect Fire	Reconnaissance	Fire Attack	Fire Support	Indirect Fire	Reconnaissance	Fire Attack	Fire Support	Indirect Fire	Reconnaissance	Fire Attack	Fire Support	Indirect Fire	Reconnaissance	Fire Attack	Fire Support	Indirect Fire	Reconnaissance	Fire Attack	Fire Support	Indirect Fire	Reconnaissance
Expert-1	8	5	4	8	9	9	9	6	7	4	3	9	8	6	5	8	7	6	5	9	7	6	8	9	3	3	6	3	7	6	7	8
Expert-2	5	3	6	7	7	8	8	5	5	4	7	8	7	5	3	7	5	5	7	7	5	5	6	8	2	6	4	4	4	5	5	9
Expert-3	6	8	3	5	8	7	8	3	4	3	2	7	8	7	2	5	5	5	3	6	7	7	7	8	6	6	3	5	6	5	7	8
Expert-4	7	5	5	7	8	7	9	5	5	5	4	7	9	5	1	6	7	6	4	8	5	5	6	8	7	7	5	6	8	6	5	8
Expert-5	9	3	3	7	7	7	8	3	4	6	2	8	7	8	3	5	4	4	3	9	6	5	7	9	4	5	6	4	6	7	6	9

Table 22 represents experts' ratings for each WS attribute under each system role where a higher number represents higher importance. Before discussing the importance of each attribute it is worthwhile to mention some patterns in the amount of agreement among the experts. Ratings with a small response range are shaded, and those with a large range are shown in bold. First, in indirect fire role the range of responses is large (2-7, 1-5, and 3-7 respectively) for concealment, protection, and self-sufficiency. In the fire attack role, range of responses for transportability and C & C are also large (2-7, and 4-8 respectively).

There was a high level of agreement among the experts for some ratings. In particular, their responses differed very little on the ratings of firepower and detection in all of the system roles, and they agreed quite strongly on the ratings for detection and C & C in the reconnaissance role and for firepower in the indirect fire role. There are also some interesting patterns in the values of these ratings. Very low ratings are quite rare (only a 1 and a couple of 2s), while very high ratings are quite common (34 of them are either 8 or 9).

The ratings for the direct fire and fire support roles are very similar across all attributes with minor differences. Firepower and protection received the highest rating in the direct fire and fire support roles followed by detection and mobility. For the indirect fire role firepower and detection have received the highest ratings while protection received the lowest. Lastly, detection, C & C, concealment, and self-sufficiency were rated as the most important attributes in reconnaissance role while the other attributes received nearly the same ratings. These ratings are logical since reconnaissance systems, operating near the enemy lines, need to have higher detection and C&C capabilities to collect information and send it to higher echelons also need to be less dependent and conspicuous than other systems.

4.7. Alternative Generation

This section first lists and describes each of the WS that is a component of the Alternative force options, than discusses the alternatives that composed of these WS. Four brigade level force options are considered for analysis: Motorized Infantry, Airborne Infantry, Heavy Armored, and Stryker brigades. These force options are sufficiently distinct from each other and roughly the same as the U.S. Army brigades. Main reason for using these current force options is to compare results of the proposed model with previous studies on these force options and test the model.

Component systems are listed and briefly explained in Table 23 but during the analysis more detailed information and specifications are used by experts to rate WSs on attributes that are described in section 4.4[3].

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[3]Descriptions/specifications of the WSs and composition of alternative forces are obtained from Army Weapon Systems Book 2010, Brigade Combat Teams (Infantry & Armour Schools, 2009) Federation of American Scientists web site: http://www.fas.org/man/dod101/sys/land/index.html, last accessed Feb 22, 2013.

Table 23 Component Weapon System Descriptions

Name of System	Description
M1A2	Latest version of Abrams main battle tank. It is equipped with 120 mm. main gun as well as other small arms also covered with steel encased depleted uranium armor.
M1A2-SEP	M1A2 with enhanced electronic and computing system program
M1109 Reconnaissance Vehicle	Up-Armored Armament Carrier configuration of the HMMWV family. The vehicles are equipped with additional armor to protect the crew from small arms ammunition and mines.
M1038A1 troop carrier	The vehicle are equipped with basic armor and used to transport equipment, materials, and/or personnel up to 2,500 pounds.
M2A3 Bradley 2 IFV	It is a fully tracked, armored vehicle that offers high level protection and transportation to infantry in the battlefield.
Mounted Sniper Team (M1038A1)	Mounted sniper team (3 personnel) equipped with XM107 .50 Caliber Anti-Personnel, Anti-Material Sniper Rifle
M3A3 Bradley CFV	Bradley Cavalry Fighting Vehicle is a tracked armored reconnaissance vehicle with 25mm cannon turret. It is compatible with the inter-vehicular communication system of the M1A2 Abrams tank and AH-64D Apache helicopter.
M2A3 Bradley Mortar Carrier	The Bradley Mortar Carrier provides immediate indirect fire support for armored and mechanized battalions and armored cavalry squadrons. Vehicle provides a battle proven survivability and mobility platform to support maneuver forces in all battlefield conditions.
M1151 w/LRAS3 Surveillance vehicle	Long Range Advanced Scout Surveillance System provides the real-time ability to detect, recognize, identify and geo-locate distant targets. It is mounted to HMMWV multi-purpose vehicle.
SP M109A6 Paladin	Paladin is the latest advancement in 155mm self-propelled artillery. It can operate independently, from on the move, it can receive a fire mission, compute firing data, select and take up its firing position, automatically unlock and point its cannon, fire and move out .
Target Acquisition System (M1151 UAH)	AN/TPQ-36(V) is a short and medium range mortar weapons locating system using projectile tracking. It can locate enemy position, detect, verify and track projectiles in flight from single or multiple weapons firing simultaneously by using a combination of radar and computer controlled techniques.
M1129A2 Stryker 120 mm. Mortar Carrier	M1129A2 is an 8×8 wheeled armored mortar carrier of the Stryker family. It supports infantry units with screening obscurants, suppressive forces and on-call supporting fires. 120 mm mortar carrier variants provide complimentary capabilities with responsive, accurate and lethal indirect fire support to the dismounted infantry assault.
M1128 Stryker MGS 105 mm.	The vehicle is primarily outfitted to support infantry combat operations. While it could take on some of the roles of tanks, it is not designed to engage in combat with tanks. The MGS can store 18 rounds of main gun ammunition in the turret. It has a rate of fire of six rounds per minute.

Table 23 Component Weapon Systems of Alternatives (Continued)

Name of System	Description
M1126A2 Stryker ICV (Infantry Squad)	The Infantry Carrier Vehicle provides protected transport and, during dismounted assault, supporting fire for the infantry squad. The Stryker is a full time four-wheel drive, selectively eight-wheel drive, armored vehicle weighing approximately 19 ton which carries an infantry squad with their equipment.
M777A2 howitzer w/M1152A2	The M777 howitzer is a towed 155 mm artillery weapon. The M777 uses a digital fire-control system similar to that found on self-propelled howitzers such as the M109A6 Paladin to provide navigation, pointing and self-location.
M1134A2 Stryker AT	Anti-Tank Guided Missile Vehicle is capable of defeating many armored threats up to 4 kilometers away using the TOW missile system while providing protection and mobility.
81mm Mortar (w/ M1152)	It is a medium-weight smooth-bore, muzzle-loading, high-angle-of-fire weapon used for long-range indirect fire with a range of 5 km. It is carried with HMMWV but needs to be dismounted to operate and fire.
Javelin team (w/M1152)	Javelin is a fire-and-forget missile with lock-on before launch and automatic self-guidance. The system takes a top-attack flight profile against armored vehicles (attacking the top armor, which is generally thinner), but can also take a direct-attack mode for use against buildings
HMMVW-Inf Team	Infantry team (9 personnel), mounted or dismounted, is to close with the enemy by means of fire and maneuver to defeat or capture him, or to repel his assault by fire, close combat, and counterattack.
HMMVW-TOW	TOW antitank missile mounted to M1045 multipurpose wheeled vehicle. It has a range up to 3750 m.
HMMVW-TOW	TOW antitank missile mounted to M1045 multipurpose wheeled vehicle. It has a range up to 3750 m.
120 mm Mortar (w/ M1152)	It is a high-weight smooth-bore, muzzle-loading, high-angle-of-fire weapon used for long-range indirect fire with a range of 7 km. It is carried with HMMWV but needs to be dismounted to operate and fire.
M119A3 105 MM Howitzer (Towed w/ M998)	The M119 Howitzer is a lightweight 105mm howitzer with a 11 km. range. It can be easily airlifted, even by helicopter, or dropped by parachute.
Reconnaissance Team (Dismounted)	Dismounted Recce teams with light weapons and portable reconnaissance equipment. It is airlifted, by helicopter, or dropped by parachute.
Mortar 81 mm. (Dismounted)	It is a medium-weight smooth-bore, muzzle-loading, high-angle-of-fire weapon used for long-range indirect fire with a range of 5 km.
Rifle Section (Dismounted)	Dismounted infantry units equipped with machine gun, 60mm. small mortars, and grenade launchers.
Weapons Team (w/M1151 UHA)	Mounted to HMMVW-TOW vehicle and equipped with MK-19, TOW-2, and grenade launcher.

Weapon systems that a brigade contains in its portfolio are not limited to the above mentioned list. These are the main systems that have significant impact on the effectiveness of brigade. Those systems not included in the list fall into two categories. First, systems/vehicles that provides logistical support to above mentioned systems. Secondly, small arms that have a minor effect on effectiveness and since all alternatives include these small weapons they don't cause any major difference between alternatives. Table 24 provides information about the composition of each option (amount of WSs), and the roles that WSs plays.

4.7.1 Motorized Infantry Brigade

Motorized infantry brigade differs from airborne infantry primarily by having wheeled platforms available to transport all elements of the unit when necessary. This option is mainly composed of light armored wheeled systems (different variants of HMMVW) that do not include any tracked system. HMMVW-Infantry carrier-transports personnel and light cargo behind the front line and provide fire support to dismounted infantry as required- is the main system with a 42% ratio and provides mobility to infantry troops with low level of protection. This option has a higher amount (18%) of antitank systems (HMMVW-TOW and Javelin), and several mortar systems in its portfolio compared to Stryker and heavy options. Overall due to the light wheeled platforms WSs in this option have a good amount of mobility, self-sufficiency and transportability while lacking armor protection.

4.7.2 Airborne infantry Brigade

Airborne infantry is set up to be moved by aircraft and "dropped" into an operation area as needed. Thus, it has the capability to deploy almost anywhere with short notice. On the other hand, it lacks the systems and equipment for lengthy combat operations. Dismounted rifle section is the main component (38%) this option with little firepower, mobility, and protection, but extreme transportability. Dismounted javelin antitank missile systems and light mortar sections provides additional firepower. Option also contains limited amount of HMMVW vehicles to carry weapon systems that are necessary for fire support, but too heavy to be carried by dismounted infantry.

4.7.3 Heavy Armored Brigade

Primary WSs that compose this alternative are tracked armored vehicles. M2A3 Bradley IFV and M2A2 constitute more than 60% of the force (29% and 23% respectively). These two WSs have higher firepower and mobility but they are heavy (hard to transport) and prominent (hard to conceal) in the combat. M109A6 Paladin (155mm) and Bradley Mortar Carrier (120mm) are the main indirect fire support systems of the alternative with a 15% ratio. This option also includes different variants of HMMVW wheeled systems (M1028, M1109) for reconnaissance troops and sniper teams with a 15% ratio.

Table 24 Rates and Roles of WSs in Alternative Force Options

Name of System	System Role	Motorized Infantry	Airborne Infantry	Heavy Armored	Stryker
M2A3 Bradley 2 IFV	2	0	0	90	0
M1A2-SEP	1	0	0	15	0
M1109 Rec. Vehicle	4	24	0	12	8
M1038A1 troop carrier	2	0	0	12	0
M1A2	1	0	0	72	0
Mounted Sniper Team (M1038A1)	1	6	0	15	8
M3A3 Bradley CFV	4	0	0	18	0
M2A3 Bradley Mortar Carrier	2	0	0	24	0
M1151 w/LRAS3 Surveillance vehicle	4	0	0	10	0
SP M109A6 Paladin	3	0	0	16	0
Target Acquisition System (M1151 UAH)	3	2	2	2	2
Stryker 120 mm. Mortar Carrier	3	0	0	0	20
M1130A2 Stryker CV	2	0	0		12
M1128 MGS 105 mm.	2	0	0	0	54
Stryker ICV (Inf. Squad)	1	0	0	0	104
M777A2 w/M1152A2	3	0	0	0	12
M1134A2 Stryker AT	2	0	0	0	30
81mm Mortar (w/ M1152)	3	56	0	0	8
Javelin team (w/M1152)	2	18	0	0	15
HMMVW-Inf. Carrier	1	144	0	0	0
HMMVW-TOW	2	64	0	0	0
120 mm Mortar (w/ M1152)	3	8	0	0	0
M119A3 105 (w/ M998)	3	16	16	0	0
Recce Team (Dismounted)	4	0	16	0	0
Mortar 81mm (Dismounted)	3	0	20	0	0
Rifle Section (Dismounted)	1	0	98	0	0
Javelin team (Dismounted)	2	0	48	0	0
Sniper Team (Dismounted)	1	0	6	0	0
Weapons Team (w/M1151)	1	0	72	0	0
System Roles: 1. Fire attack, 2 Fire support, 3. Indirect fire, 4. Reconnaissance					

4.7.4 Stryker Brigade

The Stryker brigade is the infantry force option structured around Stryker vehicles. Stryker is a medium weight, eight-wheeled armored vehicle with two main variants - the Infantry Carrier Vehicle (ICV) and the Mobile Gun System (MGS). ICV, the main component of this option (38%), transports and provides protection to infantry within combat and provides fire support to dismounted troops as required. MGS variants-ATGM, mortar carriers- provide additional direct and indirect fire support with high level of mobility. Overall this option falls between HMMVW equipped motorized infantry and M1A2/Bradley equipped heavy armored brigade options.

4.8. Evaluation of Weapon Systems

After defining the alternatives and the component weapon systems each WS listed on Table 24 is evaluated on each of the eight attributes that are defined and described in Section 4.4.

Table 25 represents ratings given by the experts for each WS under each attribute. Before discussing the rating it is worthwhile to mention some patterns in the amount of agreement and disagreement among the experts. Ratings with a small response range (0) are shaded, and those with a large range (4) are shown in **bold**. Rating for transportability shows very small range and in most cases differences between ratings are not higher than two grades. Protection is the second most agreed attribute where dismounted teams received lowest grades as they lacks armored protection of a vehicle. The largest difference between expert ratings is not more than 4 grades and the ratio of them is minor (less than 4%). Ratings with a large range also don't show any particular patterns.

It is also worth to highlight the ratings of WS. Highest ratings are underlined and the lowest ones are shown in italic. Stryker vehicles received – followed by M1A2 tanks – the highest ratings for mobility while dismounted mortar team received the lowest rating. For the firepower, protection, and

Table 25 Ratings of Weapon Systems for Each Attributes

Name of System	Mobility	Firepower	Concealment	Protection	Self-Sufficiency	Detection	Transportability	C &C
M1A2	7 7 6 8 8	7 8 8 7 7	1 2 1 1 1	7 8 9 9 7	1 2 4 3 3	5 6 6 8 7	2 1 1 2 1	8 7 6 8 8
M1A2-SEP	7 7 6 8 8	7 8 8 7 7	1 2 1 1 1	7 8 9 9 7	3 3 4 3 3	5 6 8 8 7	2 1 1 2 1	8 7 8 8 8
M1109 Rec. Vehicle	6 7 6 8 6	3 4 4 3 4	5 6 5 4 6	1 2 3 1 1	7 8 8 7 8	5 6 7 7 5	5 5 5 5 5	5 7 5 6 4
M1038A1 troop carrier	6 7 6 8 7	1 2 3 2 2	5 6 5 4 6	1 2 3 1 1	7 8 7 7 8	3 4 3 3 3	8 8 8 8 8	5 5 5 5 4
M2A3 Bradley 2 IFV	6 5 7 7 8	5 6 5 5 6	3 4 3 2 4	4 5 4 5 5	3 2 3 3 3	6 5 6 7 5	4 4 4 4 4	7 7 8 6 7
Mounted Sniper Team (M1038A1)	7 7 6 7 7	2 1 2 2 1	5 6 5 4 7	1 2 3 1 1	7 7 7 8 8	6 4 6 4 5	8 8 8 8 8	5 6 5 6 4
M3A3 Bradley CFV	6 5 4 5 6	5 6 5 5 6	3 4 3 2 4	4 5 4 3 5	3 2 4 3 3	6 5 6 7 5	4 4 4 4 4	7 8 8 8 7
M2A3 Bradley Mortar Carrier	5 5 4 4 5	6 7 6 5 6	3 2 3 2 4	4 5 4 3 5	3 2 2 3 3	6 5 6 7 5	4 4 4 4 4	7 7 8 6 7
M1151 w/LRAS3 Surveillance vehicle	6 5 6 7 6	1 1 1 1 1	6 6 5 4 6	1 2 3 1 1	7 8 7 8 8	6 5 6 7 5	8 8 7 8 7	8 7 8 8 7
SP M109A6 Paladin	4 5 4 5 4	9 9 8 9 9	3 4 3 2 3	2 3 1 2 1	6 4 5 5 4	6 5 6 7 6	4 4 4 4 4	7 6 8 7 7
Target Acquisition System (M1151 UAH)	6 5 6 7 6	1 1 1 1 1	6 6 5 4 6	1 2 2 1 1	7 8 7 8 8	6 7 7 7 6	8 8 8 7 7	7 8 8 8 9
Stryker 120 mm. Mortar Carrier	8 7 7 6 7	5 7 6 6 5	3 4 3 4 4	2 2 1 2 2	7 6 6 8 8	5 6 5 4 5	4 5 5 5 5	7 7 8 7 6
M1130A2 Stryker CV	8 6 7 7 8	2 2 1 1 2	3 4 5 4 4	2 3 1 2 2	7 8 7 8 8	5 6 5 7 5	5 5 5 4 5	7 7 8 8 8
M1128 MGS 105 mm.	8 7 7 8 7	5 6 5 6 5	3 4 3 4 4	2 3 1 2 2	7 8 7 8 8	5 6 5 4 5	4 4 5 4 5	8 7 7 7 7
Stryker ICV (Inf. Squad)	8 7 7 8 7	3 4 3 3 4	6 4 5 4 5	2 2 1 2 2	7 6 7 6 6	4 6 5 4 5	5 4 5 4 5	7 6 6 8 6
M777A2 w/M1152A2	3 5 6 4 5	9 8 8 8 9	3 4 3 4 3	1 2 2 1 1	6 6 5 5 7	6 5 6 5 6	7 7 6 6 7	7 7 7 7 6
M1134A2 Stryker AT	7 6 7 6 8	7 7 7 6 7	3 4 3 4 4	2 3 1 2 2	7 6 7 6 6	6 5 6 5 5	5 5 5 5 5	7 7 8 6 6
81mm Mortar (w/ M1152)	6 5 6 4 5	5 6 5 5 6	3 4 3 4 3	1 2 1 1 1	6 7 5 5 7	4 5 4 5 4	6 6 7 7 7	5 6 7 7 7
Javelin team (w/M1152)	6 5 7 5 5	7 8 6 7 7	3 4 5 4 5	1 2 1 1 1	7 8 7 6 8	4 4 5 3 4	8 8 7 7 8	5 5 6 7 7
HMMVW-Inf Team	7 8 7 6 7	2 1 1 2 2	4 4 6 4 5	1 2 3 1 1	7 8 7 8 8	2 2 3 3 1	8 9 9 9 9	4 5 3 5 5
HMMVW-TOW	7 5 6 7 6	5 5 6 5 5	4 4 6 4 5	1 2 2 1 1	7 8 7 8 8	2 2 3 3 4	8 8 8 9 8	4 5 3 5 5
120 mm Mortar (w/ M1152)	4 5 6 4 5	5 5 6 6 5	3 4 3 3 3	1 2 1 1 1	6 6 5 5 7	4 5 4 5 4	7 7 6 8 6	4 5 5 5
M119A3 105 (w/ M998)	4 6 5 6 5	9 8 8 8 9	3 4 3 3 3	1 2 1 1 1	6 5 5 5 7	5 5 5 4 4	6 7 6 7 6	4 5 6 5 5
Recce Team (Dismounted)	2 1 3 1 1	2 1 1 3 2	8 8 8 8 9	1 1 1 1 1	8 8 7 7 6	4 5 3 3 4	9 9 9 9 9	3 4 3 4 4
Mortar 81mm (Dismounted)	2 1 1 2 1	6 5 5 5 6	4 6 5 5 6	1 1 1 1 1	7 8 7 7 6	2 3 4 5 4	9 9 9 9 9	3 4 5 4 5
Rifle Section (Dismounted)	2 2 3 1 2	2 3 3 2 2	8 9 9 8 8	1 2 1 1 2	8 7 6 7 8	3 3 2 2 3	9 9 9 9 9	3 1 3 2 2
Javelin team (Dismounted)	2 2 3 1 2	7 8 6 7 7	7 8 8 7 8	1 1 1 1 1	8 6 7 7 8	4 4 5 3 4	9 9 9 9 9	3 3 3 4 3
Sniper Team (Dismounted)	2 2 3 1 2	2 1 2 2 1	9 9 9 8 9	1 1 1 1 1	8 7 7 8 6	6 4 6 4 5	9 9 9 9 9	3 3 1 2 3
Weapons Team (w/M1151)	4 5 4 6 5	3 3 4 2 3	7 8 7 7 7	1 2 1 1 1	6 7 4 6 5	5 4 3 3 5	8 8 8 8 8	3 1 3 2 2

detection M1A2 has the top ratings (heights detection rating shared with target acquisition system) while surveillance systems and dismounted infantry teams received the lowest ratings. Contrary to firepower M1A2 received the lowest rating for concealment due to its high size and signature, while sniper team received the highest rating. For the self-sufficiency tracked vehicles (Bradley and M1A1) received lowest while wheeled platforms (Stryker and HMMVW) get the higher ratings. The highest ratings for C&C are shared by target acquisition systems Stryker MGS and M1A2 while the lowest ratings are received by dismounted units.

4.9. Attribute Values of Force Options

Up to this step alternatives that are subject to evaluation are generated, system roles, and the importance of each attribute for system roles (e.g. importance of mobility for indirect fire role) are obtained. Ratings of WS on each system attribute are also determined.

At this step attribute level of each alternative determined by aggregating system ratings on attributes (Table-22), the ratio of each system in each alternative, and system role values. It should be noted that these ratings are not single values instead distributions generated from the individual ratings of five expert[4]. Distributions represent uncertainty of WS effectiveness and operation environmental. They are fed into @RISK software so that the attribute values of each option and the following results will be output of simulation iterations (10000 iterations). Details of the aggregation process are explained in the methodology chapter.

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[4]Rating/evaluations of five experts are used to create discrete distribution instead of aggregating in single values. So each rating is a distribution not a single value. For example, in Table 28 experts rated M1A2 on mobility as (7,7,6,8,8) than discrete distribution will be as {(6,7,8), P(0.2,0.4,0.4)}.

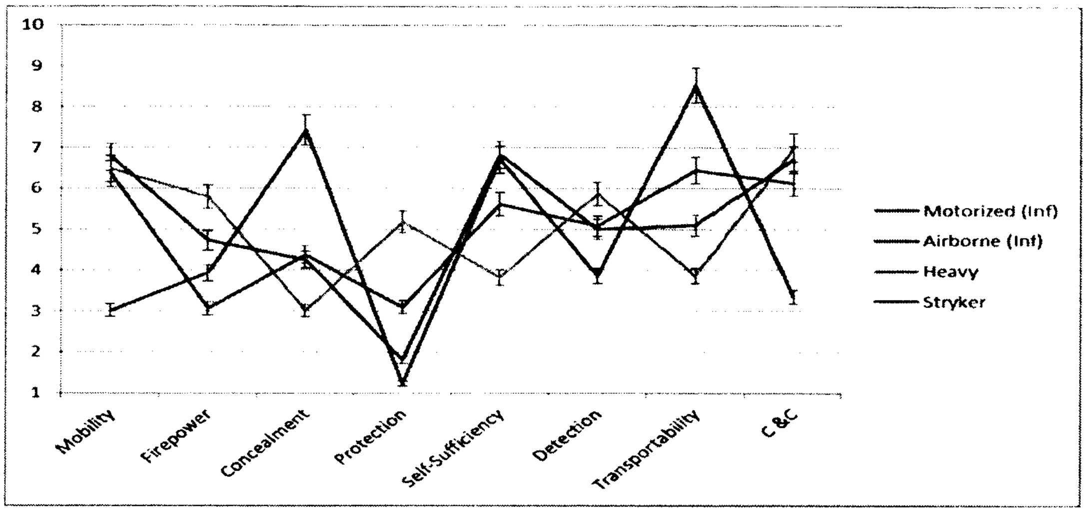

Figure 18 Attribute Values of Force Alternatives

Figure 18 shows the average values (with 5% error bars) that options got for each attribute. Airborne Infantry option received by far the highest values on transportability and concealment. On the other hand it also received the lowest values on all the other attributes except firepower. Motorized infantry option didn't get the heights value on any attribute but get good values on Mobility, concealment, and transportability. Heavy option received highest grades on four attributes (firepower, protection, protection, and C&C) but on the other hand it got lowest values on concealment, self-sufficiency, and transportability. Stryker is the only option which didn't get the lowest value on any attribute. Although by a small margin, it received the highest values on mobility and self-sufficiency followed by mechanized and airborne infantry. It is also worthwhile to highlight that Mechanized (inf), Heavy, and Stryker options received relatively close values compared to Airborne (inf).

Each force option is better than some of the other options at least for one attribute. None of the options is dominated by any other option for all attributes. That means no option should be excluded from the analysis at this point.

As a result of using distributions instead of point values, grades in Figure 20 are the average values of 10000 simulation iterations. Therefore, the deviations from the average values are also important to understand the effects of attributes on force level capabilities. Table 29 shows the highest and lowest values that each option received for each attribute. Rates with a small range (1) are shaded, and those with a larger range (~2) are shown in bold. The main pattern identified is that Motorized (inf) values have a high range on four attributes while the other options are two or less. This implies that results of Motorized (inf) deviates more from the average value. For further detailed statistical data please refer to Appendix-D

Table 26 Alternatives' Maximum and Minimum Attribute Values

Options/Attribute	Mobility	Firepower	Concealment	Protection	Self-Sufficiency	Detection	Transportability	C &C
Motorized (Inf)	7.080105634	3.760220126	**5.8691099**	**4.52305962**	**6.619242579**	**6.1953917**	7.044038668	6.828657315
	5.246963563	2.266964952	**3.0274566**	**2.07614213**	**4.474009901**	**4.2006048**	5.458272328	5.071559633
Airborne (Inf)	**4.09585492**	4.853808354	8.322932917	**1.80859375**	7.645640074	4.730519481	**8.668587896**	**4.3654189**
	2.00515464	3.066027689	6.524366472	**1**	5.737609329	3.034175334	**8.316770186**	**1.7203857**
Heavy	**7.3993865**	6.455426357	3.879177378	6.214609287	4.65625	**6.9726444**	4.326359833	7.692722372
	5.34557235	5.200379867	2.183029453	4.247761194	2.823129252	**4.9585308**	3.120853081	6.244623656
Stryker	7.485958486	5.403491756	5.345110929	2.362260343	7.457317073	5.910967742	**5.514352211**	7.780208333
	6.021110242	4.131177829	3.428336079	1.013917884	6.262482168	4.187096774	**4.518773946**	6.092592593

4.10. Capability Values of Force Options

Capability values of each option are calculated from attribute values that are calculated at the previous step and contribution weights determined in fifth step (see section 4.5). The average capability values of options are depicted in Figure 21 (with 95% confidence interval). The capability rates of options span a smaller range than the attribute values discussed and depicted above. Because they are substantially aggregated from attribute values calculated at previous step and that allows compensation of an options weaknesses by its strengths.

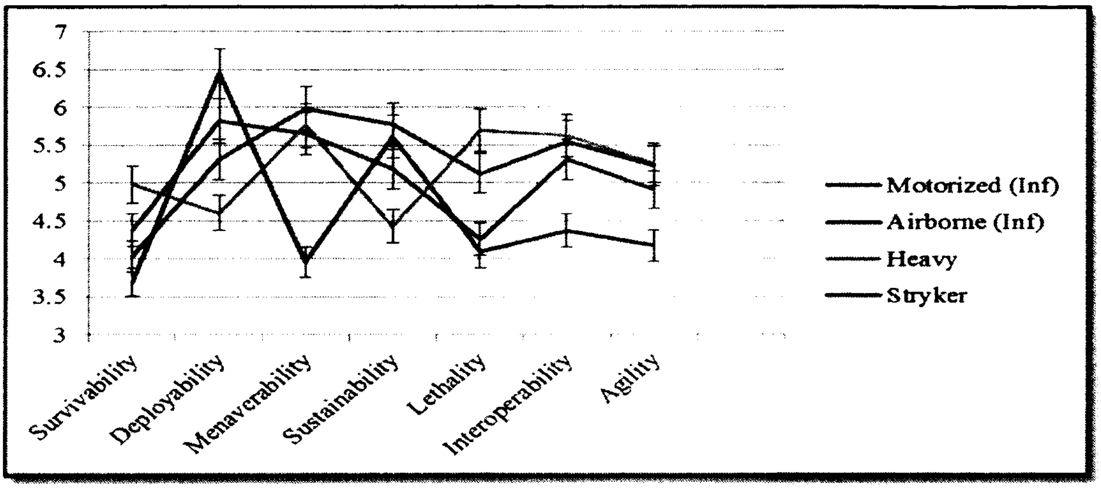

Figure 19 Average of Capability Value Diagram

Stryker is the most balanced option where all of its capability values are above 5 except survivability. Motorized (inf) and Heavy are also well balanced where four of their attribute values are above five. Airborne (inf) is the least balanced option with five attributes lower than five. It also has the lowest values for survivability and Maneuverability (both of them less than 4). On the other hand it has higher values on Deplorability (highest) and sustainability which are vital for force projection. Stryker option has the highest ratings on maneuverability and sustainability although the interval bars are overlap with other options has higher values on interoperability and agility. It is also worth to mention that none of the options gat a value higher than 5 for survivability.

4.11. Mission Effectiveness Values

Mission effectiveness values represent ratings of each option for each mission. A higher rating means more effective force. These values are calculated from capability values and their respective importance for each mission. Capability values of each option are calculated in the previous section (4.10) and the importance of each capability for each mission is calculated in Section 4.3

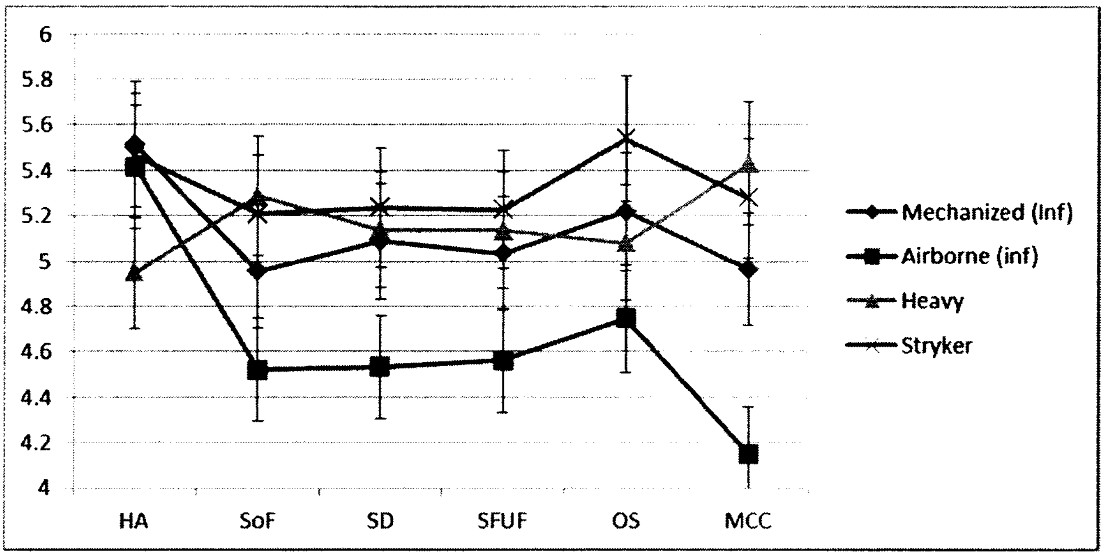

Figure 20 Mission Effectiveness Levels of Options

Average effectiveness values of alternatives (with 95% Confidence Interval) are depicted in Figure 20. Since these values are derived from the same set of attributes with different weight for each mission the results are not unexpected. Mainly Stryker, Heavy, and Mechanized (inf) options are competing for the highest value for each mission. Airborne (inf) only get a higher value than other options (heavy) for the Humanitarian Assistance (HA) mission. For all the other missions by far it received the lowest values. It is dominated by other options for five missions which is a clear indicator that this option will be in the fourth place in the rankings.

The Heavy option has the top spot for SoF, and MCC missions, while it has second place for SD and SFUF missions following Stryker, and third place after Mechanized (inf) for OS mission. It only got the forth place for HA mission which requires a high level of deployability. Mechanized (inf) has the third place for the four missions following Stryker and Heavy except OS mission (second place). It has the highest value only for HA mission which requires high level of deployability and mobility. Although Airborne (inf) has the highest deployability it couldn't get the first rank because, HA mission also requires other capabilities at a certain level that it has lower values compared to Mechanized (inf). Stryker option has the first level for three missions which is positioned at the middle of the operational spectrum. For the other missions it has the second rank and no third or fourth ranks. This clearly implies that the Stryker option seems to be the most effective option but additional analysis is still needed.

4.11.1 Rankings on Each Mission

As explained in Methodology Chapter and section 4.9 values represented on the figures and tables are average values of simulation results (10000 iterations) and they are distributions rather than point values. As shown in Figure 20 in most cases confidence intervals overlapped (only exception is SD and MCC for Airborne (inf)). Although overlaps represent the uncertainty additional analysis required to make a ranking decision between competing options. The easiest way to measure this is to compare the effectiveness values of each option for all simulation iterations.

Table 27 Ranking of Alternatives for 10000 Simulation Iterations

Mission/Alternative	Mechanized (Inf)				Airborne (Inf)				Heavy				Stryker			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
HA	4100	3187	2335	378	2531	3169	3550	750	95	367	1253	**8285**	3274	3277	2862	587
SoF	525	1778	7269	428	2	25	472	**9501**	5803	3385	780	32	3670	4812	1479	39
SD	2130	3395	4081	394	18	141	759	**9082**	2988	3401	3191	420	4864	3063	1969	104
SFUF	2219	3072	3464	1245	142	619	1990	**7249**	3306	3168	2541	985	4333	3141	2005	521
OS	1716	4660	2954	670	51	506	1862	**7581**	875	2851	4572	1702	7358	1983	612	47
MCC	219	1381	8390	10	0	0	10	**9990**	6815	2877	308	0	2966	5742	1292	0

Table 27 shows how often a force potion placed in each rank in 10000 iterations. For example in the HA mission Mechanized (inf) get the highest values in 4100 iterations, Stryker get the second highest with 3274 times while Airborne and Heavy followed them with 2531 and only 95 hits respectively. The highest number of first ranks are shaded while forth ranks are shown in bold. The Stryker option is clearly dominant in less traditional missions, SD, SFUF, and OS, while competing for the first rank in all the other missions. It rarely got the fourth place. For conventional MCC and SoF missions heavy option received by far the highest ratings at more than 5800 runs as expected. It also competes with Stryker for SD and SFUF. Airborne (inf) by far got the fourth place in all missions it only got the third place for HA mission following Stryker.

4.11.2 Pairwise Analysis between Options

Table 27 and Figure 20 show ranking of each option in the group but they do not indicate pairwise comparisons of options. To better understand the ranking frequencies of competing (overlapping) options they compared one on one. Table 28 shows the pairwise comparison of the alternative mission's effectiveness.

Table 28 Results of Pairwise Comparison of Force Options

	Stryker-Mechanized (inf)	Heavy-Stryker	Heavy-Mechanized (inf)
HA	0.44	0.076	0.05
SoF	0.82	0.61	0.88
SD	0.67	0.38	0.55
SFUF	0.64	0.43	0.57
OS	0.8	0.12	0.35
MCC	0.86	0.69	0.95

Results of pairwise comparison for Stryker and Mechanized (inf) showed that Stryker is better at on all missions except HA. Stryker is more effective than Mechanized (inf) in over 8000 of the 10000 Monte Carlo runs for SoF, OS, and MCC. It is also more effective on SFUF and SD with slightly lower run times (over 6000 of the 10000 runs). Mechanized infantry is slightly more effective than Stryker only for HA mission and the difference are minor (5600 of the 10000 runs). This comparison shows that Stryker option is far better than the Mechanized (inf) option.

Comparison of Heavy and Stryker also revealed interesting results. Heavy is very good at MCC and SOF (at over 6900 and 6100 runs) but its effectiveness is very low at HA and OS (Stryker won around 90% of the runs). SD and SFUF are two other missions for which Stryker is better than Heavy.

Heavy is also compared to Mechanized (inf), and it is clearly dominant for SoF and MCC missions as expected (88 and 95% of the runs), but that dominance is not clear for SD and SFUF (55% of runs). Mechanized (inf) is more effective than Heavy on OS mission over 65% of the times.

4.12. Perturbations

So far alternatives are evaluated against each mission but no importance rating assigned to missions so they are assumed to be equal (1/6 for each). At this step ranking of each option analyzed under different mission importance. Table 29 shows three importance set for missions. First MCC is significantly import (0.6) compared to others (0.08). Secondly SD, SFUF, and OS are twice more important (0.23) than other missions (0.1). Lastly HA is significantly more important than other missions (0.08). Each of these three weight groups is in favor of one of the options; importance of MCC and HA is for Heavy and Mechanized (inf), while the second is for Stryker.

Table 29 Importance of Missions

	Importance/Missions	HA	SoF	SD	SFUF	OS	MCC
1.	MCC has significantly more importance	0.08	0.08	0.08	0.08	0.08	**0.6**
2.	SD,SFUF, and OS have more importance	0.1	0.1	**0.233**	**0.233**	**0.233**	0.1
3.	HA has significantly more importance	**0.6**	0.08	0.08	0.08	0.08	0.08

Numbers in Table 30 represent how many times each option got the first place for the given mission weights in 10000 Monte Carlo simulation runs. For example for the first weight group the Heavy option got the highest rank for 4617 times while Stryker got for 4599 times and Mechanized (inf) 784 times and Airborne (inf) 0 times in 10000 Monte Carlo iterations. Although the third weight group is in favor of Mechanized (inf) Stryker is more effective than Mechanized (inf) and Heavy in over 5600 times of the 10000 Monte Carlo runs. Although the first weight group is in favor of Heavy, it got the first place only for 4617 times and Stryker followed it with 4599 hits. Thus, even within this weight group the difference between Stryker's and Heavy's performance is very minor (Heavy got first place 18 times more than Stryker).

Table 30 Ranking Frequency of Alternatives

	Importance of Missions / Alternatives	Mechanized (Inf)	Airborne (Inf)	Heavy	Stryker
1	MCC has significantly more importance	784	0	**4617**	4599
2	SD,SFUF, and OS have slightly more importance	1960	28	2376	**5636**
3	HA has significantly more importance	3677	520	629	**5174**

4.13. Conclusions

This chapter demonstrated the application of the proposed MAGDM model to evaluate currently used brigade level U.S. ground forces. Analysis allowed representing uncertainty in the decision problem that, assigning point values to the criteria sets and their corresponding weights are very difficult. Detailed results and recommendations are discussed in Chapter 5.

CHAPTER 5

5. CONCLUSIONS AND RECOMMENDATIONS

This chapter discusses the implications of the results, conclusions and recommendations of the dissertation.

5.1. Introduction

Countries are dedicating even more declining resources to large ground forces to keep them in position for today's and tomorrow's uncertain war spectrum. This diverse spectrum ranges from the least severe peacetime missions like Humanitarian Assistance or Security Assistance to the most severe ones like international war or nuclear warfare.

Owing to the broadness of the scenario range, armies as a whole require capabilities and skill sets that are sufficiently different from each other. In practical terms capabilities are mostly achieved through units comprised of different weapon systems with different ratios. Weapon systems (WS) requirements of a peace building mission in an urban environment are completely different from a Strike or conventional conflict mission in a steppe or rural area.

Currently, most countries maintain different types of units like Airborne, Mechanized (inf), Heavy Armored, and Stryker divisions, but these unit types and their percentage within the army is under great scrutiny:

- Should the Army still keep armored brigades?
- Should the Army dissolve the current units and go for a multi- purpose unit type that can effectively be used in the whole combat spectrum?
- What should be the percentage of the unit types within the Army?

- How do newly emerged combat types affect the force mix in the Army?

The main objective of this dissertation was to propose an expert based multi attribute group decision making model (MAGDM) for Military Portfolio Evaluation and demonstrate it by applying it to evaluate U.S. like brigade types in different missions. The purpose of the study was to provide a model for decision makers within the force development process to assist them in finding solutions for above mentioned questions.

Chapter 1 outlined the justification for the research. With limited literature regarding the application of MADM and its military applications, this dissertation defines land force options as portfolios composed of weapon systems and proposes a MADGM model for their evaluation.

Chapter 2 brought clarity to the research and showed traces of issues and theory evolution of the research and main principles of MCDM and force evaluation. Specifically, multi criteria and multi attribute decision making (MCDM, MADM) use of multiple decision makers in MADM, and the representation of uncertainty in MADM. Application of MADM in individual weapon systems evaluation is elaborately presented, and it is concluded that there are gaps in the application of MADM in military unit evaluation that comprise multiple weapon systems.

Chapter 3 described the proposed model which includes 8 phases: defining criteria set and hierarchy, weight assignment to criteria, alternative generation, evaluation of weapon system weights, evaluation of force level attribute and capability values, evaluation of mission effectiveness, prioritization, perturbation. Although the process resembles the regular MADM process, the model allowed the evaluation of army force units comprised of subsystems. Secondly, the model intensively used simulation in the MAGDM process.

In Chapter 4, the proposed model was used to evaluate the current U.S. brigade level forces: Airborne (inf) Mechanized (inf), Heavy, Stryker brigades. During the evaluation five Experts were used from NATO Allied Command Transformation (ACT) Headquarters.

Finally, Chapter 5 outlined the findings of the research problem, research contributions, implications for theory and practice, limitations and recommendations for future studies.

5.2. Research Findings

Using the steps of the analysis, research findings can be summarized in three groups which also have some insights for practical applications.

5.2.1. System Attributes:

Force level capabilities are evaluated using eight attributes. Figure 23 shows the average weights of the importance of each attribute in determining the capabilities of force options. It is concluded that firepower, mobility, transportability, and self-sufficiency are the dominant determiners for one of the capabilities (lethality, maneuverability, deployability, sustainability). Protection is assumed to be the dominant determiner for survivability, but it didn't receive as much weight as expected. Protection shared an important role with concealment and mobility. This also provides some insights about the utility of the heavily armored brigades.

Detection and concealment attributes didn't have a dominant role in determining any of the capabilities but support other dominant attributes for agility, interoperability, and survivability capabilities.

It is also concluded that none of these attributes has a major dominance over other attributes in determining the whole set of capabilities. Each of them is the main contributor to a capability but none of them clearly contributes more than other attributes in total. This also gives some insights for weapon design and appropriate levels of attributes for individual weapon systems.

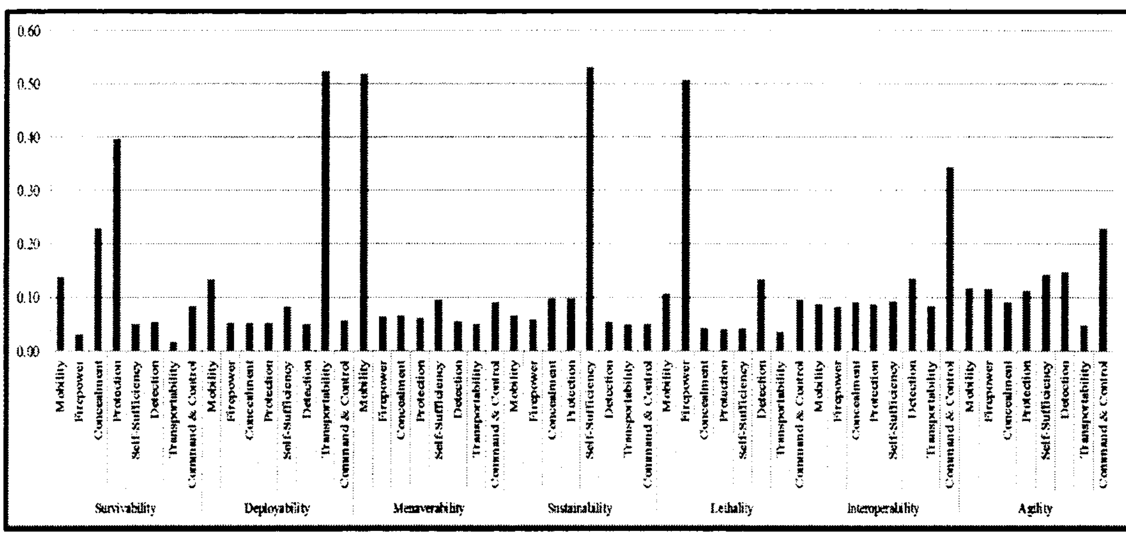

Figure 21 Attribute importance for Capabilities

5.2.2. Force Capabilities

Although the military mission spectrum includes many other missions that a force may be asked to accomplish, in this study, alternative force options are prioritized across six different missions. Each of these missions requires some capabilities more than others. Seven capabilities are evaluated across the mission set. Figure 22 demonstrates the average weights of the importance of each capability in each mission.

For each mission heights weights received by *Deployability* under HA, *Sustainability* under OS, *Agility* under SFUF, *Lethality*, *Survivability* and *Maneuverability* under MCC. Therefore except interoperability, second important capability for SFUF, each capability is dominant in one of the mission types. Although mobility and lethality have slightly more importance across missions, results showed that none of the capabilities has any major dominance across all missions. These results are also provides some insights about practical implications for the ratio of force types in the army.

Deployability and mobility is the main determiner of effectiveness in HA mission due to the importance of the reaction time. For the SoF mission, lethality, followed by maneuverability, survivability and deployability, received the highest rank. Survivability, maneuverability and agility have the highest weights accordingly for the SD mission while lethality has a very low importance. Agility is the highest weighted capability for the SFUF mission where supporting forces have to adapt to frequent changes in the operational environment. Maneuverability, lethality, and Survivability, as the core capabilities of conventional combat, received high weights under MCC.

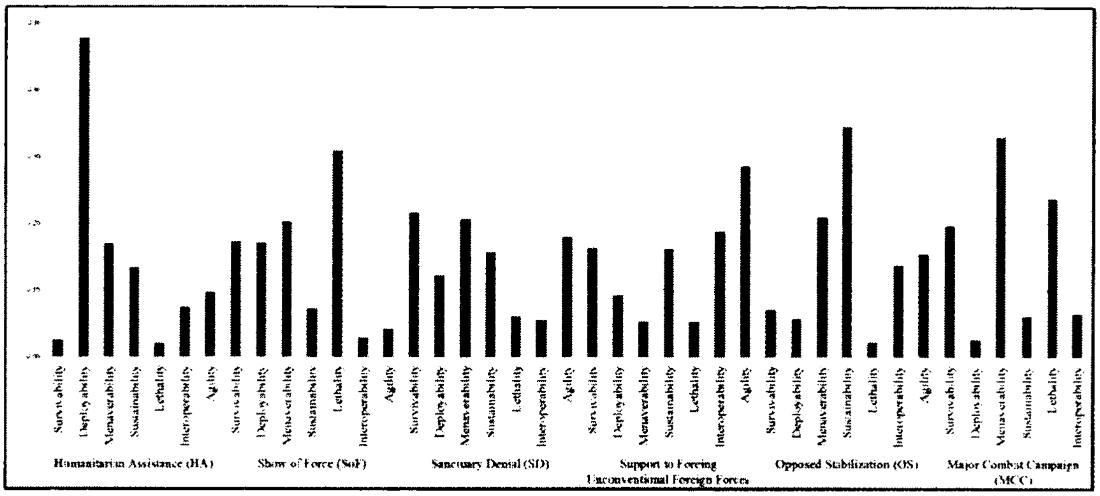

Figure 22 Capabilities Across Missions

5.2.3. Ranking of Alternatives

Ranking of alternatives are completed by three consecutive analyses: the number of outranking on every simulation iteration, pairwise comparisons, and perturbations.

Table 31 Ranking Results of Options

Mission Alternatives	Mechanized (Inf)				Airborne (Inf)				Heavy				Stryker			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
HA	4100	3187	2335	378	2531	3169	3550	750	95	367	1253	**8285**	3274	3277	2862	587
SoF	525	1778	7269	428	2	25	472	**9501**	5803	3385	780	32	3670	4812	1479	39
SD	2130	3395	4081	394	18	141	759	**9082**	2988	3401	3191	420	4864	3063	1969	104
SFUF	2219	3072	3464	1245	142	619	1990	**7249**	3306	3168	2541	985	4333	3141	2005	521
OS	1716	4660	2954	670	51	506	1862	**7581**	875	2851	4572	1702	7358	1983	612	47
MCC	219	1381	8390	10	0	0	10	**9990**	6815	2877	308	0	2966	5742	1292	0

	Stryker-Mechanized (inf)	Heavy-Stryker	Heavy-Mechanized (inf)
HA	0.44	0.076	0.05
SoF	0.82	0.61	0.88
SD	0.67	0.38	0.55
SFUF	0.64	0.43	0.57
OS	0.8	0.12	0.35
MCC	0.86	0.69	0.95

Inortance of Missions / Alternatives	Mechanized (Inf)	Airborne (Inf)	Heavy	Stryker
MCC has significanlty more importance	784	0	**4617**	4599
SD,SFUF, and OS have slighly more importance	1960	28	2376	**5636**
HA has signigicantly more importance	3677	520	629	**5174**

Table 31 summarizes the results of the alternative prioritization completed in the last step of the analysis.

Airborne (inf) (by more than 90%) got fourth place for all missions except for Humanitarian Assistance mission. It got first place for 2531 times for HA mission but the Mechanized (inf) option almost doubled it and received the highest values 4100 times in 10000 iterations. Even though it showed some visibility for the HA mission, the Airborne (inf) alternative is dominated by the Mechanized (inf) option. Therefore, Airborne (inf) should not be taken into account as a major component of the army structure. The ratio of this force type within the army should be very minor and should be used as a supplement to other force alternatives in the operations.

Mechanized (inf) is better than other options only in HA mission, even in that mission Stryker option has very close rates to Mechanized (inf) (pairwise comparison ration is 44%). Although it showed some visibility at SD, SFUF, and OS missions, the rest of the five missions Mechanized (inf) is dominated by the Stryker or Heavy options. Results suggest that the Mechanized (inf) option should be kept in the Army's portfolio for low intensity combats types such as humanitarian assistance, peace building, peace keeping, and security assistance, but the ratio should be kept minimal (10-20%).

The Heavy option is dominant in conventional type MCC and SoF missions. It received by far the highest ratings for more than 5800 runs as expected. It also competes with Stryker for SD and SFUF. Although the conventional type missions are getting less and less expected (Frier, 2011) the consequences of being unprepared for this type of mission is very high. Thus, the results suggest that the heavy option should be kept in the army. The ratio of this force should be higher than Mechanized (inf) but less than Stryker (20-25%).

Results showed that Stryker is better than other options in three missions (SD, SFUF, OS) and took second place for the other three mission types. It got fourth place in less than 0.5% in the simulation runs. It also clearly dominated other options in the perturbation step where missions are weighted to represent three future strategic environments. It clearly outranked the other options and got nearly the same ratings as the Heavy option (4617-4599) at the first ranking group (conventional mission MCC has a weight of 0.6). These results showed that Stryker is the most balanced option compared to other options in the given mission set. Therefore, the ratio of the Stryker in the army should be far more than Heavy and Mechanized (inf) options (more than 50%).

5.3. Implications for Theory

As explained in the literature review many studies have been conducted to evaluate individual weapon systems, but there is a gap in the application of MADM to evaluate military units composed of multiple weapon systems. This study –to the best of the researcher's knowledge –is among the first to apply probabilistic MAGDM to the evaluation of forces that consist of multiple weapon systems and fills a knowledge gap in MADM.

The proposed model is structured in a way as to represent uncertainty explicitly and during the analysis Monte Carlo simulation is embedded into the evaluations. Results of iterations are used to compare alternatives rather than aggregated average values as used in traditional MADM models.

The first phase of the model is the generation of criteria sets. It is important because criteria sets should be decomposable, encompassing, meaningful, nun-redundant and transparent (Keeney and Raiffa, 1993). Thus, it requires a detailed literature review and discussion. Therefore, criteria sets, developed for application of the proposed model, are themselves a significant contribution to military force development.

Last but not least, the proposed model, the main contribution of this dissertation, can assess the effectiveness of different force options across a spectrum of missions, and then compare their strategic values in a range of alternative futures by quantifying the tradeoffs among key force capabilities, and linking them to concrete weapon systems attributes.

The model used Monte Carlo simulation runs to prioritize the options. Using the results of Monte Carlo simulation runs as a prioritization tool in MADM can also be applied to other MADM problems where uncertainty has to be represented.

5.4. Implications for Practice

In the study force options were the portfolio of weapon systems and their rankings for each mission aggregated from the attribute levels of weapon systems. Analysis showed that a more balanced Stryker alternative, composed mostly by Stryker vehicles, ranked higher than extremely survivable but much less deployable Heavy and extremely deployable by very vulnerable Airborne (inf). This suggests that special effort should be made to keep attributes such as transportability, firepower, mobility, of the weapon systems balanced. Therefore, these WSs will be less vulnerable to the effect of uncertainties and contribute more to the forces they are in.

Low intensity missions are becoming more common and are expected to be even more so in the future (Krepinevich, 2009). Consequently, the use of Stryker and, to some extent, Motorized (inf) will increase, but due to technologic advances and the proliferation of arms state and non-state actors are easily obtaining hand held anti-armor guided missiles. Without adequate protection against these threats Stryker force will be vulnerable to attacks in these type of missions. To increase the protection of these vehicles, lightweight add-on defense measures like reactive armor active protection, should be invested.

Heavy forces within the Army also act as a deterrent to hostility and assurance if the deterrence fails, but as the analysis suggests, deployability is the main problem of Heavy forces. To compensate for this weakness, heavy units should be stationed close to the areas where national interests are clearly at stake.

5.5. Limitations of the Study

The model uses experts to rate the attribute and capability weights and those are determined using pairwise comparisons. Each expert made more than 500 evaluations to determine the criteria weights. This sometimes caused fatigue over experts and evaluations were done separately and conducted at different times.

This dissertation focused on physical weapon systems to evaluate force options in different missions, but it is worthwhile to mention that there are other factors (Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities-DOTMLPF) that contribute to the effectiveness of a force. It is assumed that all the other factors are equal across alternatives. A comprehensive evaluation of forces should take other factors into account.

Although the model is able to evaluate multiple force options across multiple missions, for demonstration purposes six diverse missions are selected. Results represent the ratings according to these selected missions. It should also be noted that the spectrum of missions is very broad and it is quite difficult to evaluate alternatives across all the missions from nuclear warfare to domestic disaster relieve.

5.6. Recommendations for Future Studies

Some possible improvements that came to light during the application of the model to U.S. ground forces are as follows.

First, demonstration of the model did not include the exploratory analysis where effects of the change in the problem structure (e.g. weights of attributes, ratio of weapon systems in each alternative, adding new systems to force alternatives) are investigated in the final results. Thus, in future applications it would be better to conduct exploratory analysis to get additional insights about the force options and their ranking sensitivities.

Second, five experts were used for evaluation, and they made over 500 hundred ratings and comparisons. Sometimes it became overwhelming for the experts. The number of experts could be increased in the future, and experts could be asked to provide responses depending on their background and expertise.

Third, the proposed model could also be applied to other services such as the Navy, Air force or other country's armed forces. Of course, there might be some changes required to customize the model for different service needs.

Last but not least, detailed simulation results are not used to have additional analysis about the alternatives. The results listed in Appendix D should be used to have additional insights about the importance of attributes and alternatives.

5.7. Conclusion

The most important conclusion of this dissertation is that it proposed a model to structure expert advice to inform complex and uncertain force development decisions. The proposed method combines simulation with Multi Attribute Group Decision Making (MAGDM) to provide additional perspectives and insights to traditional MADM models. Specifically, rather than imposing group consensus among experts, it uses expert judgments to provide more ground to analysis and guide exploration.

It provides a well-structured model to evaluate multiple force alternatives under multiple force options. Additionally, it provides a framework for the evaluation of systems that comprise sub systems with different roles and characteristics (e.g. vehicle fleets and sports teams).

Finally, this study is, to the best of the researcher's knowledge, is among the first work to apply MAGDM with simulation to ground force evaluation.

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APPENDICES

APPENDIX-A MULTI ATTRIBUTE DECISION MAKING MODELS

1. Weighted Sum Model (WSM)

The Weighted Sum Model (WSM) is one of the most used approaches, particularly in uni-dimensional decision problems. If a decision problem has *M* alternatives and *N* criteria, the best alternative is the one that satisfies (in the maximization case) the following expression (Triantaphyllou, 2000):

$$A^{*}_{WSM} = \max_{i} \sum_{j=1}^{N} q_{ij} w_j, \quad for \quad i = 1, 2, 3, \ldots, M. \qquad 1\text{-}1$$

where AWSM* is the WSM score of the best alternative, N is the number of decision criteria, aij is the actual value of the i-th alternative in terms of the j-th criterion, and Wj is the weight of importance of the j-th criterion. The assumption that governs this model is the additive utility assumption. That is, the total value of each alternative is equal to the sum of products given as (1-1). In uni-dimensional problems, in which all the units are the same (e.g., mile, $, ton), the WSM can be used without difficulty. The difficulty with this technique emerges when it is applied to multi-dimensional decision-making problems. Then, in merging different dimensions, and consequently different units, the additive utility assumption is violated (Triantaphyllou, Shu, Sanchez, and Ray, 1998).

- **Example**

Suppose that an MCDM problem involves four criteria, which are expressed in exactly the same unit, and three alternatives. The relative weights of the four criteria were determined to be: W1 = 0.20, W2 = 0.15, W3 = 0.40, and W4 = 0.25. The corresponding data (i.e., decision matrix) for this MCDM problem are as follows:

	Criteria			
	C_1	C_2	C_3	C_4
Alt.	(0.20	0.15	0.40	0.25)
A_1	25	20	15	30
A_2	10	30	20	30
A_3	30	10	30	10

1-2

When formula (1-1) is applied to the matrix (1-2), the scores of the three alternatives are:

A1(WSM) = 25×0.20 + 20×0.15 + 15×0.40 + 30×0.25 = 21.50.

A2(WSM) = 22.00,

A3(WSM) = 20.00.

Therefore, in the maximization case the best alternative is alternative *A2* (highest WSM). Moreover, the following ranking is derived: A2 > A1 > A3.

2. Weighted Product Model (WPM)

The weighted product model (WPM) is similar to the WSM. The main dissimilarity is that WPM uses multiplication instead of addition. Alternatives are compared with each other by multiplying a number of ratios, one for each criterion. Each ratio is raised to the power equivalent to the relative weight of the corresponding criterion. In general, in order to compare the alternatives *AK* and *AL*, the following product has to be calculated (Miller and Starr, 1969):

$$R(A_K/A_L) = \prod_{j=1}^{N} (a_{Kj}/a_{Lj})^{w_j}, \quad \text{2-1}$$

where N is the number of criteria, a_{ij} is the actual value of the *i-th* alternative in terms of the *j-th* criterion, and W_j is the weight of importance of the *j-th* criterion.

If the term $R(A_K / A_L)$ is greater than one, then in the maximization case, alternative A_K is more desirable than alternative A_L. The best alternative is the one that is better than or at least equal to all the other alternatives.

Contrary to WSM, WPM structure eliminates any units of measure. Consequently, the WPM can be used in multi-dimensional decision-making problems. An advantage of the method is that instead of the actual values it can use relative ones. This is true because:

$$\frac{a_{Kj}}{a_{Lj}} = \frac{a_{Kj} / \sum_{i=1}^{N} a_{Ki}}{a_{Lj} / \sum_{i=1}^{N} a_{Li}} = \frac{a'_{Kj}}{a'_{Lj}} \qquad \text{2-2}$$

A relative value a'_{Kj} is calculated by using equation (2-3) where the a_{Kj}'s are the actual values.

$$a'_{Kj} = a_{Kj} / \sum_{i=1}^{N} a_{Ki} \qquad \text{2-3}$$

- **Example**

Consider the problem presented in the WSM. When the WPM is applied, then the following values are derived:

$R(A1/A2) = (25/10)^{0.20} \times (20/30)^{0.15} \times (15/20)^{0.40} \times (30/30)^{0.25} = 1.007 > 1.$

$R(A1/A3) = 1.067 > 1,$

$R(A2/A3) = 1.059 > 1.$

Therefore, the best alternative is *A1*, since it is superior to all the other alternatives. Moreover, the ranking of these alternatives is as follows: A1 > A2 > A3.

3. Analytical Hierarchy Process (AHP)

The AHP organizes the basic rationale of the decision problem by breaking it down into smaller constituent parts and then calling for only one simple pairwise comparison of judgments to develop priorities within each hierarchy (Tsamboulas, 1999).

The pair wise comparison method was originally developed by Thurstone (1927). Thomas Saaty, the developer of the Analytic Hierarchy Process, is well known for popularizing the use of pair wise comparison matrices to determine weights. Saaty provides his commonly used 1-9 measurement scale for quantifying decision maker judgments as listed in Table 38. For example, if a decision maker believes that criterion (i) is moderately more important than criterion (j), then this judgment is represented by number 3.

Table 32 Scale of Relative Importance (Saaty, 1980)

Intensity or Relative Importance	Definition	Explanation
1	Equal importance	Two criteria contribute equally to the objective
3	Moderate importance of one over another	Experience and judgment slightly favor one criterion over another
5	Essential or strong importance	Experience and judgment strongly favor one criterion over another
7	Very strong importance	An criterion is strongly favored and its dominance
9	Extremely important	The evidence favor one criterion over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values between the two adjacent judgments	When comparison is needed
Reciprocals of above non-zero numbers		If the criterion (i) has one of the above non-zero numbers assigned to it when compared with criterion j, then j has the reciprocal value when compared to (i)

This information is usually provided by the decision maker or in some cases by subject matter experts, and entered into a pair wise comparison matrix. The comparison matrix is also referred to as a reciprocal matrix as depicted in equation (3-1), "where *a* expresses a referee's relative preference of stimulus X over Y, *b* expresses preference of stimulus X over Z, and *c* is a relative preference of stimulus Y over stimulus Z."

$$R = \begin{bmatrix} & X & Y & Z \\ X & 1 & a & b \\ Y & 1/a & 1 & c \\ Z & 1/b & 1/c & 1 \end{bmatrix} \quad (3\text{-}1)$$

The next step in the AHP deals with the structure of an $M \times N$ matrix (where M is the number of alternatives and N is the number of criteria). This matrix is constructed by using the relative importance of the alternatives in terms of each criterion. The vector $(a_{i1}, a_{i2}, a_{i3}, \ldots, a_{iN})$ for each i is the principal eigenvector of an $N \times N$ reciprocal matrix which is determined by pairwise comparisons of the impact of the M alternatives on the *i-th* criterion as explained above.

The entry aij, in the $M \times N$ matrix, represents the relative value of the alternative Ai when it is considered in terms of criterion Cj. In the AHP the sum $\sum_{i=1}^{n} a_{ij}$ is equal one.

In AHP method for maximization problems the best alternative is indicated by the following equation (3-2):

$$A^{*}_{AHP} = \max_{i} \sum_{j=1}^{N} q_{ij} w_j, \quad for \quad i = 1, 2, 3, \ldots, M. \quad 3\text{-}2$$

The resemblance between the AHP and the WSM is obvious. The only difference is that AHP uses relative values instead of actual ones. Thus, it can be used both in uni and multi-dimensional problems.

- **Example**

Consider that data equation (3-3) is given (note that as in the WPM case the restriction to express all criteria in terms of the same unit is not needed). The AHP uses a series of pairwise comparisons to determine the relative performance of each alternative in terms of each one of the decision criteria. In other words, instead of the absolute data, the AHP would use the data in the relative data in matrix (3-3).

		Criteria			
	C_1	C_2	C_3	C_4	
Alt. (	0.20	0.15	0.40	0.25)	
A_1	25/65	20/55	15/65	30/65	3-3
A_2	10/65	30/55	20/65	30/65	
A_3	30/65	5/55	30/65	5/65	

That is, the columns in the decision matrix have been normalized to add up to 1. When formula (3-2) is applied to the data, the following scores are derived:

$A_1 = (25/65)\times0.20 + (20/55)\times0.15 + (15/65)\times0.40 + (30/65)\times0.25 = 0.34.$
$A_2 = 0.35$
$A_3 = 0.31$

Thus, the best alternative is A_2. Moreover, the following ranking is derived: $A_2 > A_1 > A_3$.

4. Technique for Order Preference by Similarity to Ideal Solution (TOPSIS)

Yoon (1980) developed the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). The basic premise of TOPSIS is that "the chosen alternative should have the shortest distance from the ideal solution and the farthest from the negative-ideal solution" (Wang, 2001, p. 3). Figure 25, illustrates this principle assuming two criteria and providing definitions of the positive ideal solution (A^+) and negative ideal solution (A^-).

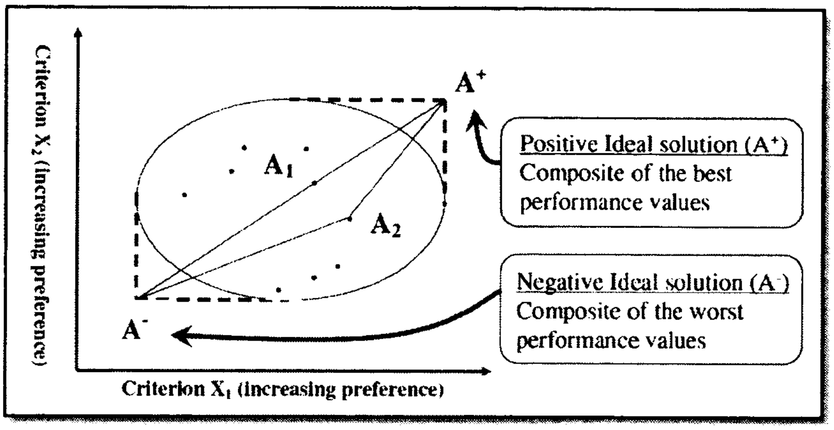


Figure 23 Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) (Georgiadis, Mazzuchi & Sarkani, 2011)

The TOPSIS method evaluates the decision matrix in (4-1) which refers to *M* alternatives which are evaluated in terms of *N* criteria:

$$D = \begin{bmatrix} x_{11} & x_{12} & x_{13} & \cdots & x_{1N} \\ x_{21} & x_{22} & x_{23} & \cdots & x_{2N} \\ . & & & & . \\ . & & & & . \\ . & & & & . \\ x_{M1} & x_{M2} & x_{M3} & \cdots & x_{MN} \end{bmatrix} \qquad 4\text{-}1$$

where xij denotes the performance measure of the i-th alternative in terms of the j-th criterion. For a clear view of this method, the TOPSIS method is presented next as a series of successive steps.

4.1. Construct the Normalized Decision Matrix

This process tries to convert the various attribute dimensions into non-dimensional attributes. An element r_{ij} of the normalized decision matrix R can be calculated as follows:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{M} x_{ij}^2}} . \qquad \text{4-2}$$

4.2. Construct the Weighted Normalized Decision Matrix

A set of weights W = (w_1, w_2, w_3, ..., w_N), (where: $\sum w_i = 1$) defined by the decision maker is accommodated to the decision matrix to generate the weighted normalized matrix V as follows:

$$V = \begin{bmatrix} w_1 r_{11} & w_2 r_{12} & w_3 r_{13} & \cdots & w_N r_{1N} \\ w_1 r_{21} & w_2 r_{22} & w_3 r_{23} & \cdots & w_N r_{2N} \\ . & & & & . \\ . & & & & . \\ . & & & & . \\ w_1 r_{M1} & w_2 r_{M2} & w_3 r_{M3} & \cdots & w_N r_{MN} \end{bmatrix} . \qquad \text{4-3}$$

4.3. Determine the Ideal and the Negative-ideal Solutions

The ideal A* and the negative-ideal A- solutions are defined as follows:

$$A^* = \{ (\max_i v_{ij} \mid j \in J), (\min_i v_{ij} \mid j \in J') \mid i = 1,2,3, ..., M\} = \{ v_{1*}, v_{2*}, ..., v_{N*} \}. \qquad \text{4-4}$$

$$A^- = \{ (\min_i v_{ij} \mid j \in J), (\max_i v_{ij} \mid j \in J') \mid i = 1,2,3, ..., M\} = \{ v_{1^-}, v_{2^-}, ..., v_{N^-} \}. \qquad \text{4-5}$$

where: $J = \{j = 1,2,3, ..., N \mid j$ associated with benefit criteria$\}$,

$J' = \{j = 1,2,3, ..., N \mid j$ associated with cost criteria$\}$.

For the benefit criteria, the decision maker wants to have a maximum value among the alternatives. For the cost criteria, the decision maker wants to have a minimum value among alternatives. Obviously, A* indicates the most preferable alternative or ideal solution. Similarly, A- indicates the least preferable alternative or negative-ideal solution.

4.4. Calculate the Separation Measure

The N-dimensional Euclidean distance method is next applied to measure the separation distances of each alternative to the ideal solution and negative-ideal solution.

$$Si^* = (\sum(vij - vj^*)^2)^{1/2}, i = 1,2,3, ..., M, \quad (4\text{-}6)$$

where Si* is the separation (in the Euclidean sense) of each alternative from the ideal solution.

$$Si- = (\sum(vij - vj-)^2)^{1/2}, i = 1,2,3, ..., M, \quad (4\text{-}7)$$

where *Si-* is the separation (in the Euclidean sense) of each alternative from the negative-ideal solution.

4.5. Calculate the Relative Closeness to the Ideal Solution

The relative closeness of an alternative Ai with respect to the ideal solution A* is defined as follows:

$$Ci^* = Si- / (Si^* + Si-), 0 \leq Ci^* \leq 1, i = 1,2,3, ..., M. \quad (4\text{-}8)$$

Apparently, $Ci^* = 1$, if $Ai = A^*$, and $Ci- = 0$, if $Ai = A^-$.

4.6. Rank the Preference Order

The best satisfied alternative can now be decided according to preference rank order of Ci^*. Therefore, the best alternative is the one that has the shortest distance to the ideal solution. The relationship of alternatives reveals that any alternative which has the shortest distance to the ideal solution is guaranteed to have the longest distance to the negative-ideal solution.

APPENDIX-B LIST OF MADM METHODS IN LITERATURE

Method	References
Simple Additive Weighting (SAW) or Weighted Sum Method (WSM)	Fishburn, (1965, 1968);.Triantaphyllou, Sanchez, & Ray, (1998); Jibao, Huiqiang& Liang (2006); Zavadskas, Turskis, Dejus&Viteikiene (2007)
Fuzzy Simple Additive Weighting	Kahraman, Ruan, & Ibrahim (2003); Chou, Chang, &Shen (2008)
Weighted Product Model (WPM)	Triantaphyllou, Sanchez, & Ray, (1998);Triantaphyllou, & Sánchez (2007). Wang, (2011)
Technique for Order Preference by Similarity to Ideal Solution(TOPSIS)	Yoon, (1980);Hwang & Yoon, (1981); Lai, Liu, & Hwang, (1994); Triantaphyllou, Sanchez, & Ray, (1998); Abo-Sinna&Amer, (2005)
Fuzzy TOPSIS	Kahraman, Çevik, Ates, and Gülbay (2007), Sun, & Lin, (2009), Lo, Chen, Tsai & Chao (2010)
Analytic Hierarchy Process (AHP)	Saaty, (1986, 2008); Nydick& Hill, (1992); Barzilai&Golany, (1994); Triantaphyllou, Sanchez, & Ray, (1998); Kurttila, Pesonen, Kangas&Kajanus (2000)
Analytic Network Process (ANP)	Saaty, (1999, 2004); Thakkar, Deshmukh, Gupta & Shankar, (2006); Yang, Shieh, Leu&Tzeng, (2008); Yüksel & Dağdeviren (2010).
Preference Ranking Organization Method for Enrichment of Evaluations (PROMETHEE)	Brans &Vincke, (1985);Vincke, (1986, 1992); Wolters&Mareschal, (1995);Özelkan&Duckstein (1996); Albadvi, (2004); Brans &Mareschal (2005) Hopfe, (2009)
ELimination and Choice Expressing Reality (ELECTRE)	Roy, (1991, 1996); Roy &Vanderpooten, (1996);Triantaphyllou, Sanchez, & Ray, (1998); Cho, (1998); Figueira, Mousseau& Roy, (2005);Fülöp, (2005)
Multi-Attribute Utility Theory (MAUT)	Keeney, (1975); Keeney &Raiffa, (1993);Cho, (1998); Fülöp, (2005);Butler, et al., (2005);Grabisch, Kojadinovic& Meyer (2008)
The Evidential Reasoning Approach (ER)	Yang & Singh, (1994); Chin, Wang, KaKwai Poon & Yang (2009); Guo, Yang, Chin, Wang & Liu (2009); Fu & Yang (2010)
Measuring Attractiveness by a Categorical Based Evaluation Technique (MACBETH)	Bana E Costa &Vansnick, (1997);Bana e Costa, Corte &Vansnick (2011); Gürbüz, Alptekin, &Işiklar, (2012)
Data Envelopment Analysis (DEA)	Charnes, Cooper & Rhodes, (1978);Karsak&Ahiska, (2008); Salo&Punkka (2009);Lofti, Fallahnejad&Navidi, (2011)
Dominance Based Rough Set Approach (DRSA)	Greco, Matarazzo&Slowinski, (2001);Dembczyński, Pindur&Susmaga (2003); Figueira, Greco &Ehrgott (2005);Kotłowski, Dembczynski, Greco &Słowinski, (2008)

LIST OF MADM METHODS IN LITERATURE (CONTINUED)

Potentially All Pairwise Rankings of all possible Alternatives (PAPRIKA)	Hansen &Ombler, (2009); Taylor, Singh, Saag, Dalbeth, MacDonald, Edwards,... & Schumacher, (2011; Taylor, Brown, Aati, Weatherall&Dalbeth (2013)
Superiority and Inferiority Ranking method (SIR method)	Xu, (2001); Tam, Tong & Wong (2004); Chan, Yu & Yung (2011)
Superiority and inferiority grey relational analysis (SIGRA)	Alvandi, Elahi, Memarzade, Hesaraki (2011)
Superiority and Inferiority Ranking method (SIR method)	Xu, (2001); Tam, Tong & Wong (2004); Chan, Yu & Yung (2011)
Randomization Aggregated Indices Method (RAIM)	Vladimirovich, (2010);Hovanov N.V., Yudaeva & Hovanov K., (2009); Hovanov&Yudaeva, (2011)
Decision Making Trial and Evaluation Laboratory (DEMATEL)	Li &Tzeng, (2009); Tzeng, Chiang & Li, (2007);Yang, Shieh, Leu&Tzeng, (2008)
Multi-Objective Optimization on the Basis of Ratio Analysis (MOORA)	Brauers&Zavadskas, (2006); Kalibatas&Turskis, (2008); Chakraborty (2011)
Grey Relational Analysis (GRA)	Kung & Wen, (2007); Tseng (2010); Jangra, Jain & Grover (2010); Wei (2011)
Multiple Attribute Group Decision Making (MAGDM)	Kim, Choi & Kim, (1999);Park & Kim, (1997); Wei (2010).
Complex Proportional Assessment of Alternatives (COPRAS)	Ustinovichius, Zavadskas&Podvezko, (2007; Zavadskas, Liias&Turskis, (2008); Zavadskas, Kaklauskas&Vilutiene, (2009); Chatterjee, Athawale&Chakraborty (2011)
New Approach to Appraisal (NATA)	Affuso, Masson & Newberry, 2003);Shepherd, Timms& May, (2006); Geurs, Zondag, De Jong & de Bok (2010); Carse (2011)
Multi Attribute Global Inference of Quality (MAGIQ)	Barron, (1992);Edwards & Barron, (1994); Barron & Barrett, (1996); McCaffrey &Koski, 2006); McCaffrey, (2009); Ravi (2012)
VIseKriterijumsIcaOptimizacija I KompromisnoResenje (VIKOR)	Liu & Wang, (2011);Opricovic & Tzeng, (2004);Zavadskas, Liias&Turskis, (2008)
Interpretive Structural Modeling (ISM)	Mandal & Deshmukh, (1994);Thakkar, Deshmukh, Gupta & Shankar (2006); Singh & Kant (2007)

LIST OF MADM METHODS IN LITERATURE (CONTINUED)

Simple Multi Attribute Rating Technique (SMART)	Edwards & Barron, (1994);Weber & Borcherding, (1993; Hämäläinen&Salo, (2005)
Treatment of the Alternatives aCcording To the Importance of Criteria(TACTIC)	Vansnick, (1986);Bouyssou, (1986); Bouyssou&Vansnick, (1986);Bouyssou&Pirlot, (2001, 2006)
Preference Ranking Global Frequencies in Multicriterion Analysis(PRAGMA)	Matarazzo, (1988)
Quality Function Deployment (QFD)	Akao& Mizuno, (1994);Crow, (2002); Chan & Wu, (2002)
Value Analysis (VA), Value engineering (VE)	Shillito& De Marle, (1992);Cheah& Ting, (2005; SAVE, (2007)
Stochastic Multicriteria Acceptability Analysis (SMAA)	Lahdelma, Hokkanen, &Salminen, (1998); Lahdelma, Salminen, &Hokkanen, (2002);Tervonen, Almeida-Dias, Figueira, Lahdelma & Salminen, (2005); Aertsen, Kint, Van Orshoven&Muys (2011)
Preference Ratios in Multiattribute Evaluation (PRIME)	Salo & Hamalainen (1992); Salo & Hämäläinen, (2001)
Rank Inclusion in Criteria Hierarchies (RICH)	Punkka&Salo, (2001);Salo&Punkka, (2005);Makkonen (2005)
Alternative Ranking Interactive Aid based on DomiNance structural information Elicitation (ARIADNE)	White, Sage, &Dozono, (1984); Optimality Conditions Hazen, (1986); Goicoechea, (1988);Mattia (2012).
Generalized Regression with Intensities of Preference (GRIP),	Figueira, Greco & Slowinski (2009)
Dominance and Potential Optimality	Eum, Park & Kim, (2001); Mustajoki, Hämäläinen & Salo (2005).
Preference Programming	Arbel, (1989);Salo&Hämäläinen, (2001);Mustajoki (2011).
Even Swaps (Smart Swaps)	Hammond, Keeney, &Raiffa, (1998);Mustajoki & Hämäläinen, (2005); Dolan (2010)

APPENDIX-C LIST OF EXPERTS

	Rank	Name	Service
1	CAPT	CAPT Jim Byerly	US Navy
2	LTC	James White	US Army
3	Col (Retired)	Leendert Nijssen	Army
4	Maj. (Retired)	Anthony.Icayan	Army
5	LTC	Mehmet Seçilmiş	Army (TU)

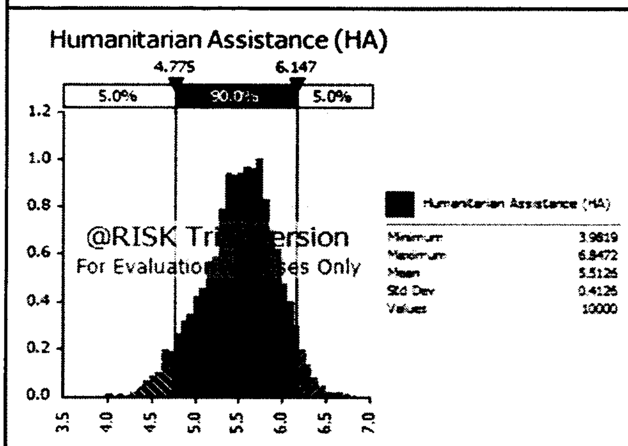
APPENDIX-D SIMULATION RESULTS OF @RISK SOFTWARE

Mechanized (inf) Option-Missions

@RISK Output Report for Humanitarian Assistance (HA)

Performed By: Metin

Date: Thursday, April 11, 2013 9:33:25 PM



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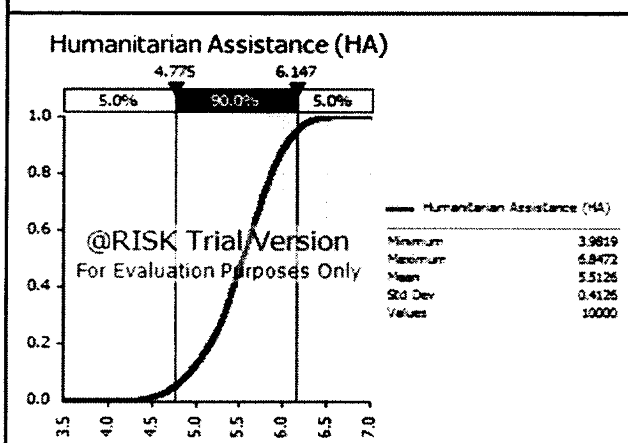
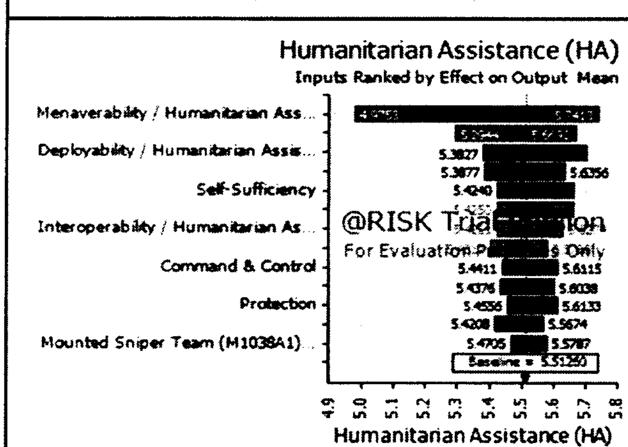
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Humanitarian Assistance (I

Statistics		Percentile	
Minimum	3.98188638	5%	4.775314
Maximum	6.847238966	10%	4.9395013
Mean	5.512597312	15%	5.066931
Std Dev	0.412627957	20%	5.1721618
Variance	0.170261831	25%	5.2561015
Skewness	-0.285059112	30%	5.3265881
Kurtosis	2.888240193	35%	5.3805793
Median	5.536075752	40%	5.43318
Mode	5.596454436	45%	5.4858437
Left X	4.775314045	50%	5.5360758
Left P	5%	55%	5.5924334
Right X	6.146965752	60%	5.6440219
Right P	95%	65%	5.695151
Diff X	1.371651707	70%	5.7445161
Diff P	90%	75%	5.7990227
#Errors	0	80%	5.8626571
Filter Min	Off	85%	5.9356237
Filter Max	Off	90%	6.0244826
#Filtered	0	95%	6.1469658



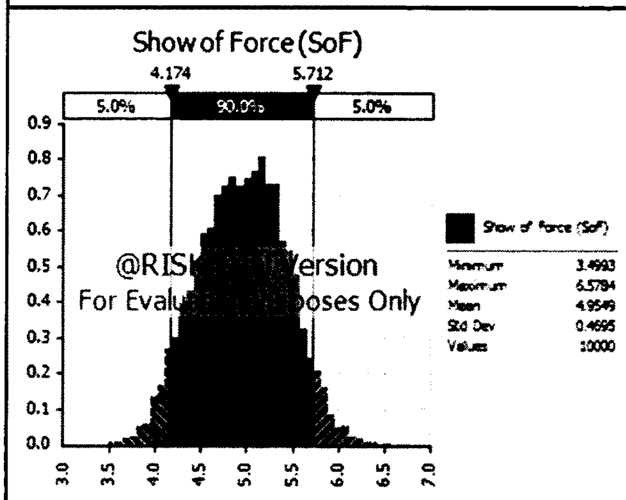
Change in Output Statistic for Humanitarian Assis

Rank	Name	Lower	Upper
1	Menaverability /	4.9752571	5.7412777
2	Mobility	5.2943657	5.6691595
3	Deployability / H	5.3826991	5.7012598
4	Transportability	5.3876718	5.6356252
5	Self-Sufficiency	5.423963	5.6627245
6	Agility / Humanit	5.424953	5.6633714
7	Interoperability	5.4220647	5.6274202
8	Command & Con	5.4011212	5.5787868
9	Command & Con	5.4410626	5.611479
10	Fire Attack	5.4375849	5.6037932
11	Protection	5.4555634	5.6132941
12	Fire Support	5.4207872	5.5674046
13	Mounted Sniper	5.4704947	5.5786506
14	Self-Sufficiency	5.4677208	5.573425

@RISK Output Report for Show of Force (SoF)

Performed By: Metin

Date: Thursday, April 11, 2013 9:33:39 PM



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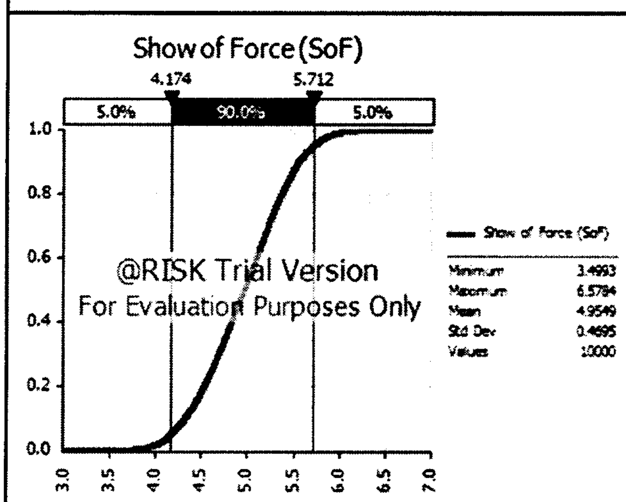
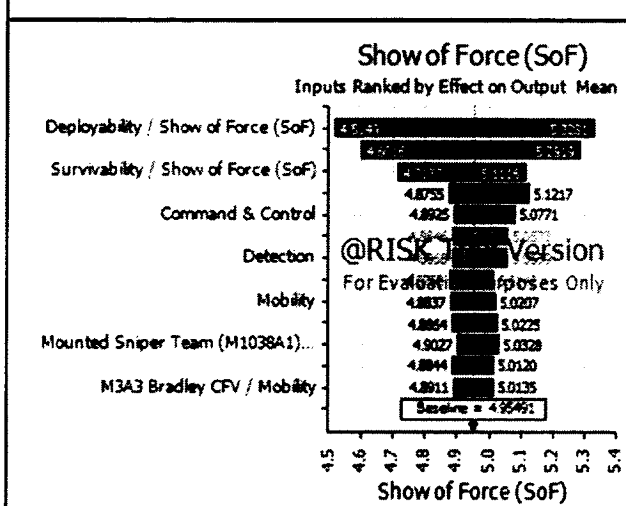


Summary Statistics for Show of Force (SoF)

Statistics		Percentile	
Minimum	3.499319607	5%	4.1735549
Maximum	6.578355603	10%	4.3282462
Mean	4.954910696	15%	4.4406379
Std Dev	0.469546579	20%	4.531426
Variance	0.22047399	25%	4.6168704
Skewness	-0.027946372	30%	4.6899678
Kurtosis	2.577352297	35%	4.7607684
Median	4.96577697	40%	4.8309102
Mode	5.129551514	45%	4.8966998
Left X	4.173554895	50%	4.965777
Left P	5%	55%	5.0330948
Right X	5.712373695	60%	5.0987277
Right P	95%	65%	5.1600144
Diff X	1.5388188	70%	5.2257786
Diff P	90%	75%	5.2930051
#Errors	0	80%	5.3690707
Filter Min	Off	85%	5.4553584
Filter Max	Off	90%	5.5536935
#Filtered	0	95%	5.7123737



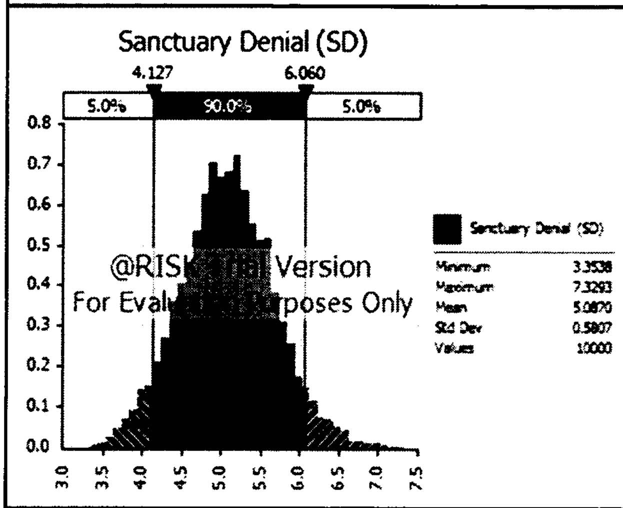
Change in Output Statistic for Show of Force (SoF)

Rank	Name	Lower	Upper
1	Deployability / S	4.5148548	5.3280908
2	Lethality / Show	4.6015987	5.2819241
3	Survivability / Sh	4.7136769	5.1115786
4	Agility / Show of F	4.8755335	5.1216775
5	Command & Con	4.8925291	5.0771341
6	Menaverability /	4.8845703	5.0573465
7	Detection	4.8868448	5.0558578
8	Sustainability / S	4.8758474	5.014173
9	Mobility	4.8836922	5.0206597
10	Mounted Sniper	4.886379	5.0225207
11	Mounted Sniper	4.9027347	5.0327905
12	Mounted Sniper	4.8844189	5.011989
13	M3A3 Bradley CF	4.8910585	5.0135456
14	Mobility	4.9079416	5.029012

@RISK Output Report for Sanctuary Denial (SD)

Performed By: Metin

Date: Thursday, April 11, 2013 9:33:52 PM



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Number of Inputs	1103
Number of Outputs	84
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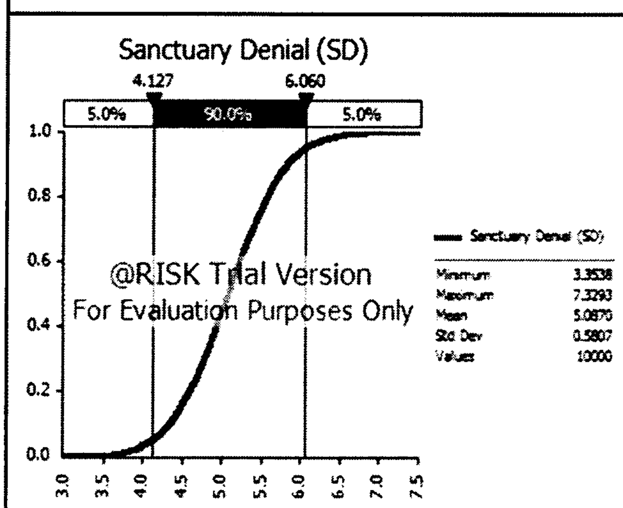
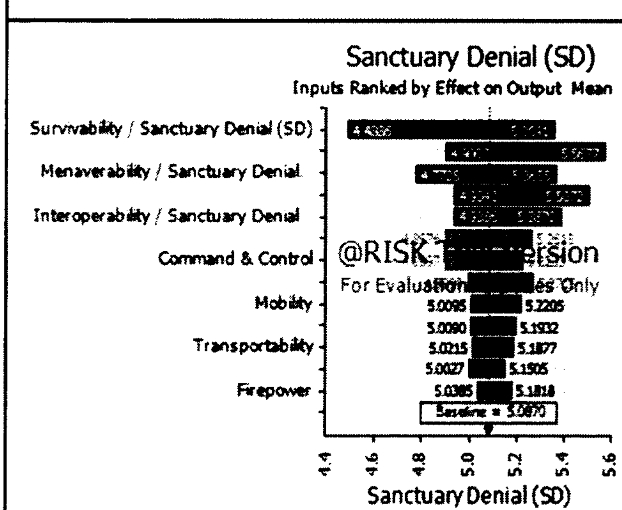
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Sanctuary Denial (SD)

Statistics		Percentile	
Minimum	3.353787386	5%	4.1272553
Maximum	7.329341208	10%	4.343886
Mean	5.087048678	15%	4.4799574
Std Dev	0.580683299	20%	4.5990007
Variance	0.337193094	25%	4.7017177
Skewness	0.117456159	30%	4.780784
Kurtosis	3.005660836	35%	4.8599387
Median	5.081352004	40%	4.9341736
Mode	4.853285856	45%	5.0071676
Left X	4.127255344	50%	5.081352
Left P	5%	55%	5.154407
Right X	6.059747682	60%	5.2222971
Right P	95%	65%	5.2975365
Diff X	1.932492338	70%	5.3840507
Diff P	90%	75%	5.4748081
#Errors	0	80%	5.5709
Filter Min	Off	85%	5.6799158
Filter Max	Off	90%	5.8255338
#Filtered	0	95%	6.0597477



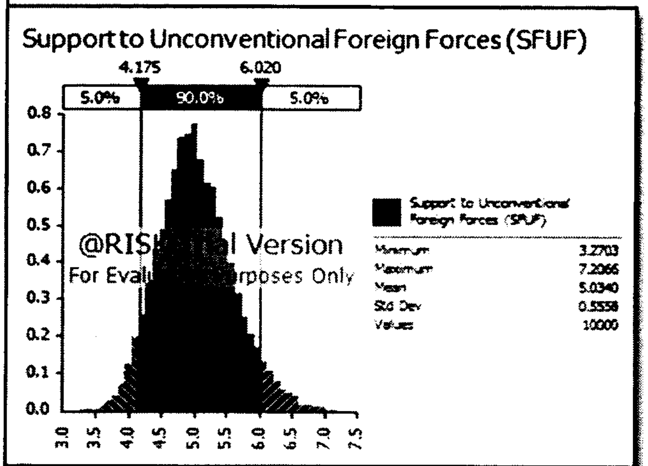
Change in Output Statistic for Sanctuary Denial (S

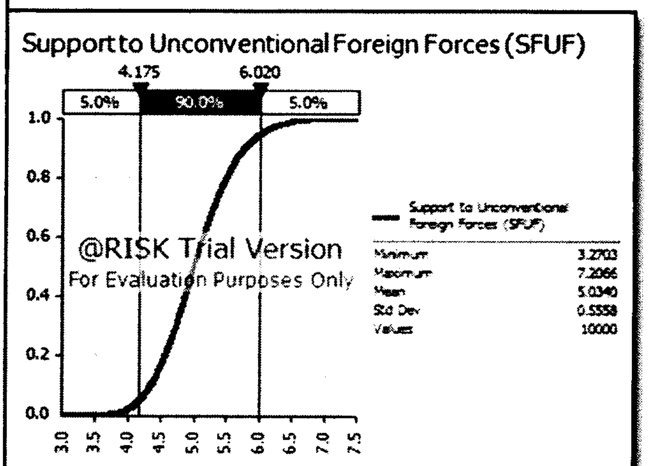
Rank	Name	Lower	Upper
1	Survivability / Sa	4.4885855	5.3591491
2	Deployability / Sa	4.9006634	5.5677425
3	Menaverability /	4.772524	5.3655011
4	Sustainability / S	4.9342668	5.507154
5	Interoperability /	4.9385575	5.3870217
6	Agility / Sanctuar	4.8975895	5.2617829
7	Command & Con	4.8996603	5.223317
8	Protection	4.9999036	5.2715283
9	Mobility	5.0095229	5.2205229
10	Command & Con	5.0090111	5.1931519
11	Transportability	5.0214631	5.1877301
12	M3A3 Bradley CF	5.0026952	5.1505123
13	Firepower	5.0384679	5.1817501
14	M3A3 Bradley CF	5.0136847	5.155032

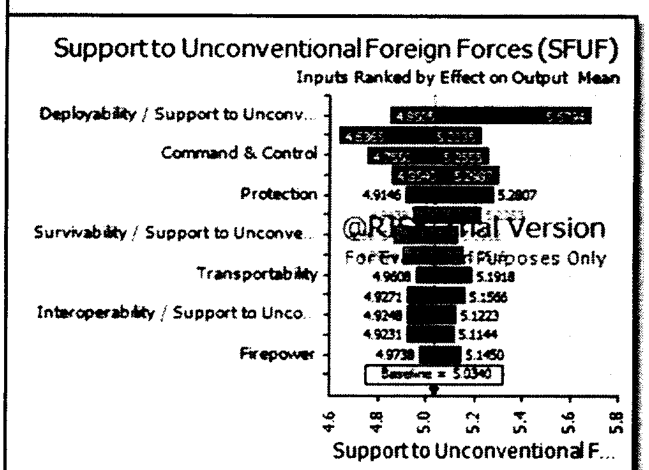
@RISK Output Report for Support to Unconventional Foreign Force

Performed By: Metn

Date: Thursday, April 11, 2013 9:34:06 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Support to Unconventiona

Statistics		Percentile	
Minimum	3.270305228	5%	4.1751217
Maximum	7.206590586	10%	4.3411765
Mean	5.03402876	15%	4.4592674
Std Dev	0.555803281	20%	4.5593753
Variance	0.308917287	25%	4.6470136
Skewness	0.350378524	30%	4.7244532
Kurtosis	3.038074632	35%	4.7977628
Median	4.993551522	40%	4.8630637
Mode	4.973326292	45%	4.929858
Left X	4.175121704	50%	4.9935515
Left P	5%	55%	5.0647182
Right X	6.019899469	60%	5.1356414
Right P	95%	65%	5.2155932
Diff X	1.844777765	70%	5.2968096
Diff P	90%	75%	5.3873632
#Errors	0	80%	5.4929253
Filter Min	Off	85%	5.6126784
Filter Max	Off	90%	5.7676853
#Filtered	0	95%	6.0198995

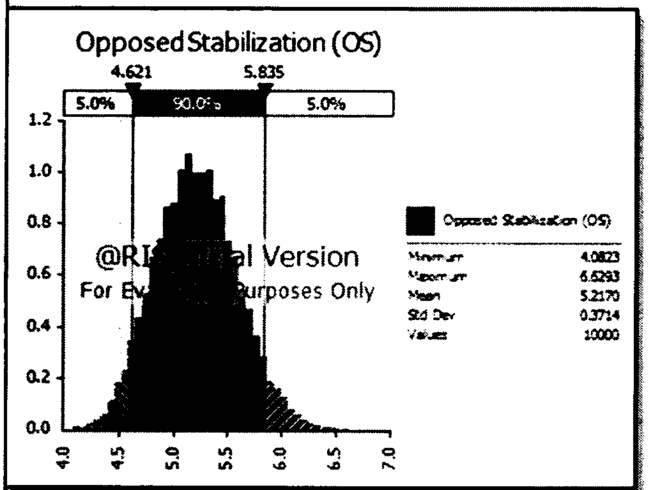
Change in Output Statistic for Support to Uncon

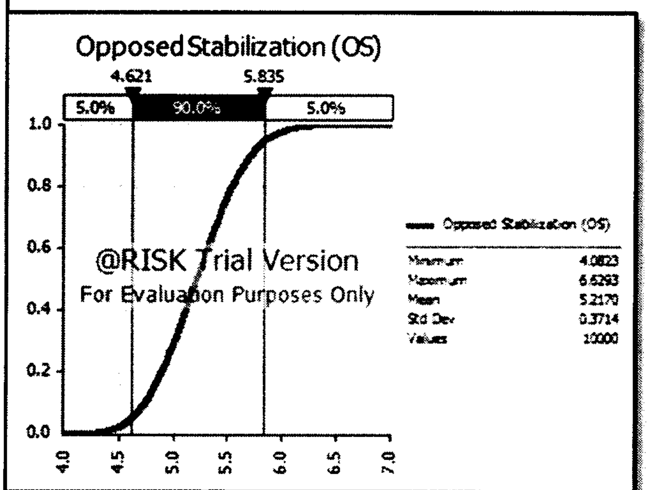
Rank	Name	Lower	Upper
1	Deployability / Su	4.8505302	5.6794126
2	Agility / Support t	4.6365073	5.2234661
3	Command & Con	4.7549835	5.2555397
4	Command & Con	4.8540149	5.2987114
5	Protection	4.9146112	5.2806839
6	Mobility	4.9438262	5.2282521
7	Survivability / Su	4.8674547	5.131172
8	Lethality / Suppo	4.8994453	5.1518337
9	Transportability	4.9608005	5.1917681
10	Sustainability / S	4.9271288	5.1565911
11	Interoperability /	4.9248169	5.1222572
12	Self-Sufficiency	4.9230855	5.1144032
13	Firepower	4.9738017	5.1449594
14	Mounted Sniper	4.9442514	5.0970522

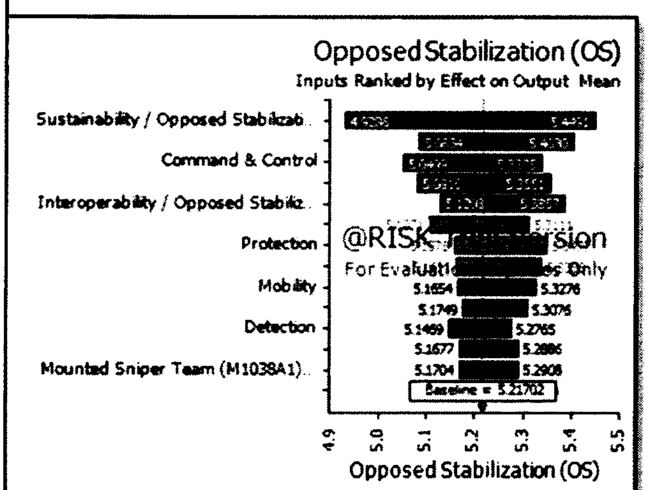
@RISK Output Report for Opposed Stabilization (OS)

Performed By: Metin

Date: Thursday, April 11, 2013 9:34:19 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Opposed Stabilization (OS)

Statistics		Percentile	
Minimum	4.08228695	5%	4.6210208
Maximum	6.629280047	10%	4.7411154
Mean	5.217015762	15%	4.8214533
Std Dev	0.371417872	20%	4.892826
Variance	0.137951236	25%	4.9531871
Skewness	0.135944552	30%	5.0115139
Kurtosis	2.803506381	35%	5.0625758
Median	5.206956945	40%	5.1119178
Mode	5.163501851	45%	5.1599104
Left X	4.621020849	50%	5.2069569
Left P	5%	55%	5.2596054
Right X	5.835271407	60%	5.3090387
Right P	95%	65%	5.3586839
Diff X	1.214250559	70%	5.4144857
Diff P	90%	75%	5.4663681
#Errors	0	80%	5.5334509
Filter Min	Off	85%	5.6076415
Filter Max	Off	90%	5.7056266
#Filtered	0	95%	5.8352714

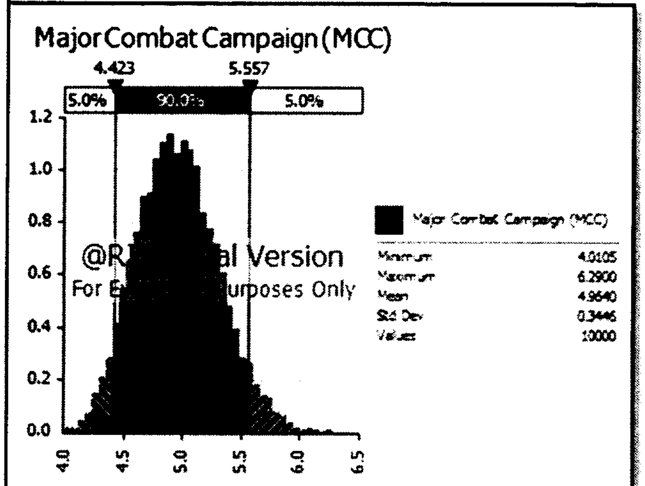
Change in Output Statistic for Opposed Stabilizat

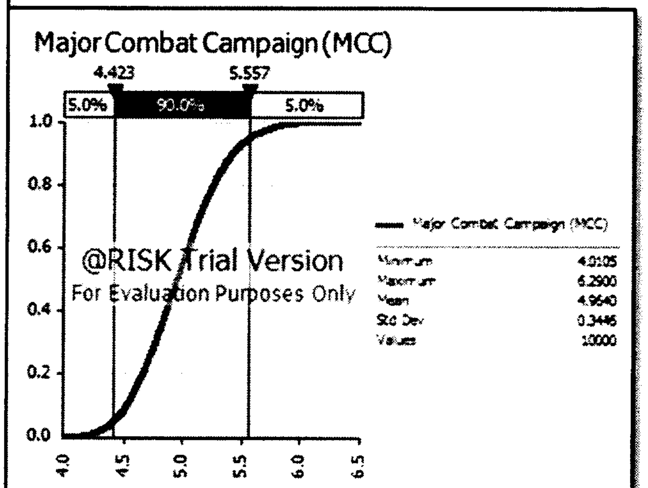
Rank	Name	Lower	Upper
1	Sustainability / O	4.9286347	5.4490734
2	Command & Con	5.0834367	5.4030376
3	Command & Con	5.0498729	5.3374782
4	Agility / Opposed	5.0816305	5.3551094
5	Interoperability /	5.1297617	5.3857197
6	Maneuverability /	5.1071373	5.3111408
7	Protection	5.1577694	5.34766
8	Concealment	5.1611167	5.3387702
9	Mobility	5.1653526	5.3276209
10	Transportability	5.1748684	5.3076018
11	Detection	5.1468535	5.2764529
12	Mounted Sniper	5.1676955	5.2886453
13	Mounted Sniper	5.1704047	5.2908474
14	Self-Sufficiency	5.1632329	5.282928

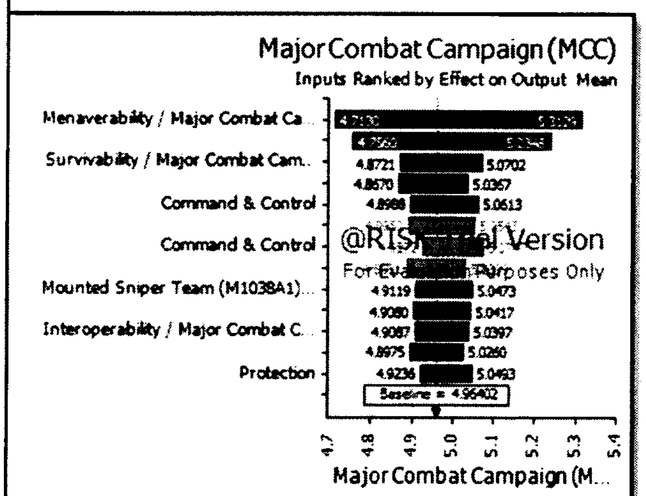
@RISK Output Report for Major Combat Campaign (MCC)

Performed By: Metin

Date: Thursday, April 11, 2013 9:34:33 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Major Combat Campaign (			
Statistics		**Percentile**	
Minimum	4.01051597	5%	4.4234765
Maximum	6.290038493	10%	4.5254864
Mean	4.96402133	15%	4.5984854
Std Dev	0.344626743	20%	4.66296
Variance	0.118767592	25%	4.7160706
Skewness	0.251748739	30%	4.7670759
Kurtosis	2.865171375	35%	4.8160872
Median	4.947957969	40%	4.8612501
Mode	4.918402518	45%	4.9042319
Left X	4.423476516	50%	4.947958
Left P	5%	55%	4.9969039
Right X	5.557341943	60%	5.0419009
Right P	95%	65%	5.0874413
Diff X	1.133865427	70%	5.1362497
Diff P	90%	75%	5.1932888
#Errors	0	80%	5.2561473
Filter Min	Off	85%	5.3270331
Filter Max	Off	90%	5.4167209
#Filtered	0	95%	5.5573419

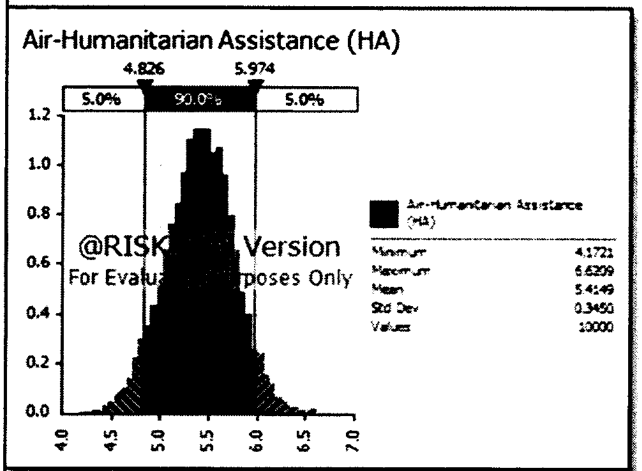
Change in Output Statistic for Major Combat Cam			
Rank	**Name**	**Lower**	**Upper**
1	Menaverability /	4.7130012	5.3128838
2	Lethality / Major	4.7559974	5.2347549
3	Survivability / Ma	4.8720596	5.0701964
4	Command & Con	4.8670232	5.0366931
5	Command & Con	4.8988081	5.06133
6	Self-Sufficiency	4.8952198	5.0542705
7	Command & Con	4.9272383	5.0746745
8	M3A3 Bradley CF	4.8901472	5.0309065
9	Mounted Sniper	4.9119054	5.0472564
10	Detection	4.9079898	5.0417012
11	Interoperability	4.9087492	5.0397339
12	Mounted Sniper	4.8975179	5.0259718
13	Protection	4.923559	5.0493404
14	Mounted Sniper	4.8955671	5.0180723

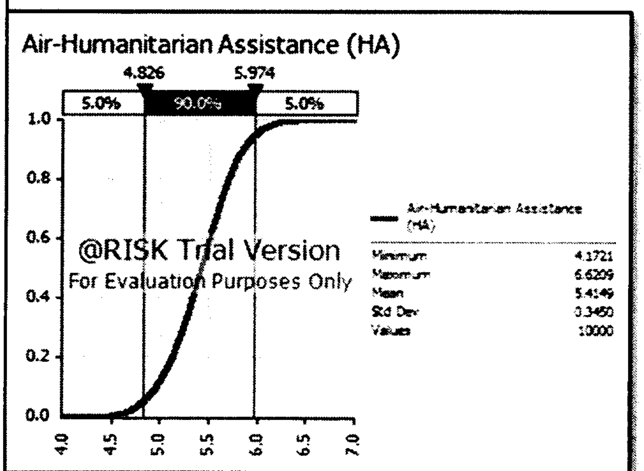
Airborne (inf)- Missions

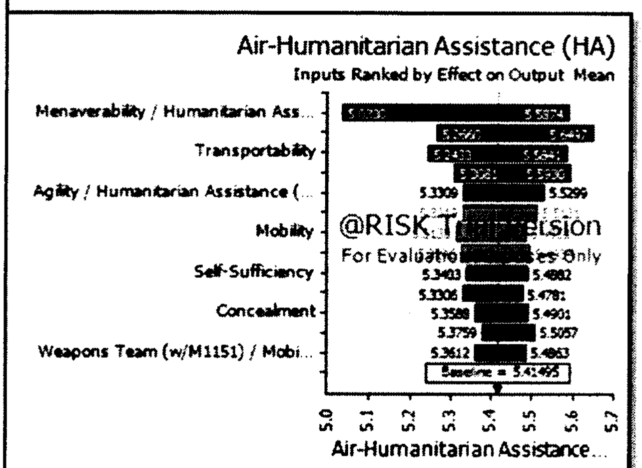
@RISK Output Report for Air-Humanitarian Assistance (HA)

Performed By: Metin

Date: Thursday, April 11, 2013 9:34:46 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

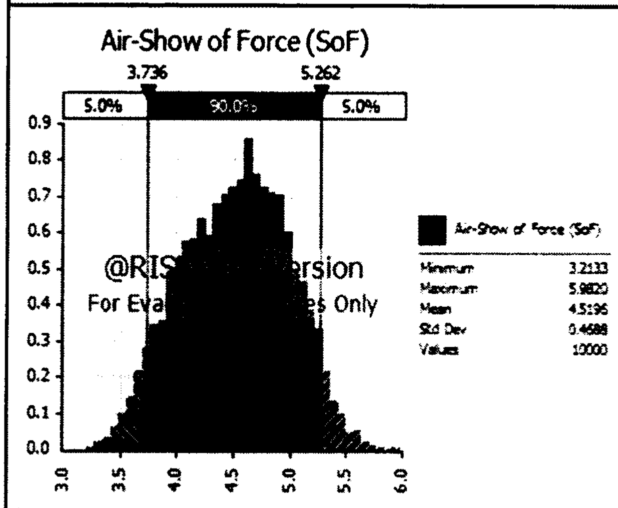
Summary Statistics for Air-Humanitarian Assistan			
Statistics		**Percentile**	
Minimum	4.172142628	5%	4.8260753
Maximum	6.620920284	10%	4.9629124
Mean	5.414946639	15%	5.0513683
Std Dev	0.344972866	20%	5.1255534
Variance	0.119006278	25%	5.1850391
Skewness	-0.047087938	30%	5.2396302
Kurtosis	2.951345756	35%	5.2924331
Median	5.422834373	40%	5.3344151
Mode	5.213500147	45%	5.3776922
Left X	4.826075301	50%	5.4228344
Left P	5%	55%	5.4656367
Right X	5.973785524	60%	5.5080693
Right P	95%	65%	5.5545079
Diff X	1.147710223	70%	5.6013467
Diff P	90%	75%	5.649794
#Errors	0	80%	5.7025954
Filter Min	Off	85%	5.7657915
Filter Max	Off	90%	5.846285
#Filtered	0	95%	5.9737855

Change in Output Statistic for Air-Humanitarian A			
Rank	**Name**	**Lower**	**Upper**
1	Menaverability /	5.0330114	5.5874336
2	Deployability / H	5.2659733	5.6497085
3	Transportability	5.2433319	5.5841362
4	Self-Sufficiency	5.3080989	5.5929547
5	Agility / Humanit	5.3309449	5.5299257
6	Interoperability /	5.3319199	5.513129
7	Mobility	5.3138448	5.4858156
8	Weapons Team (	5.3246364	5.4933818
9	Self-Sufficiency	5.3403473	5.4881554
10	Rifle Section (Dis	5.3305604	5.478118
11	Concealment	5.3588169	5.4901008
12	Transportability	5.3758645	5.5057026
13	Weapons Team (	5.3612031	5.4863495
14	Sustainability / H	5.3520165	5.4705376

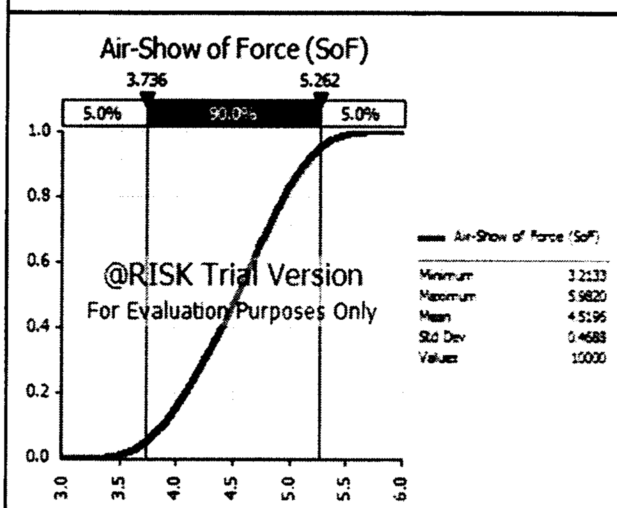
@RISK Output Report for Air-Show of Force (SoF)

Performed By: Metin

Date: Thursday, April 11, 2013 9:34:59 PM

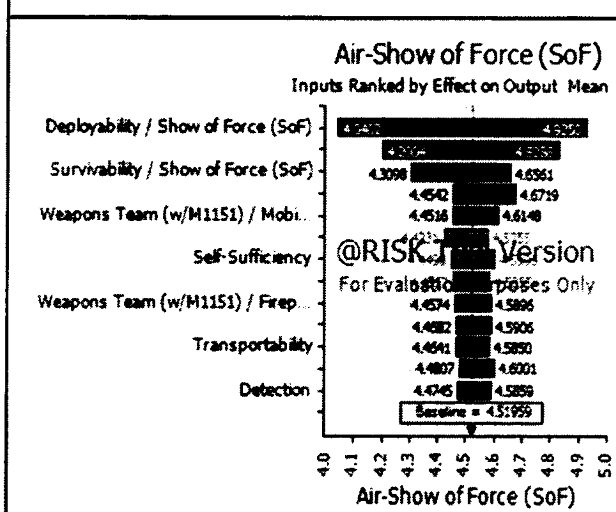


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Air-Show of Force (SoF)

Statistics		Percentile	
Minimum	3.213265095	5%	3.7360521
Maximum	5.981984023	10%	3.8813693
Mean	4.519588094	15%	3.9906944
Std Dev	0.468771945	20%	4.0812345
Variance	0.219747136	25%	4.1678638
Skewness	-0.07944219	30%	4.2455363
Kurtosis	2.39886361	35%	4.3286608
Median	4.541692898	40%	4.4029456
Mode	4.613129007	45%	4.4738378
Left X	3.736052093	50%	4.5416929
Left P	5%	55%	4.607806
Right X	5.262048118	60%	4.6652975
Right P	95%	65%	4.7306365
Diff X	1.525996025	70%	4.8008249
Diff P	90%	75%	4.8707983
#Errors	0	80%	4.941396
Filter Min	Off	85%	5.0245765
Filter Max	Off	90%	5.1275814
#Filtered	0	95%	5.2620481

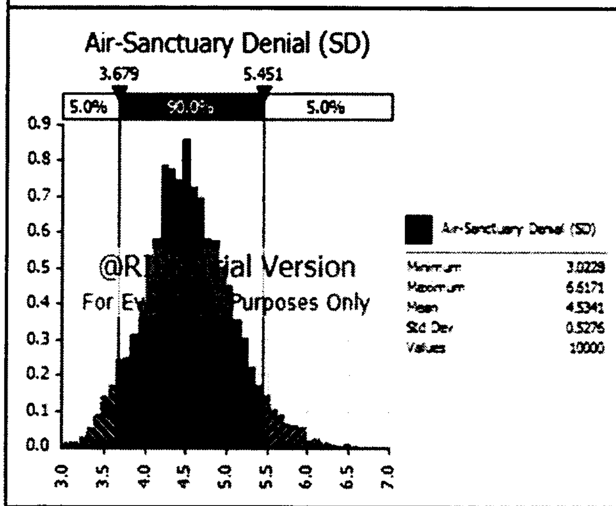


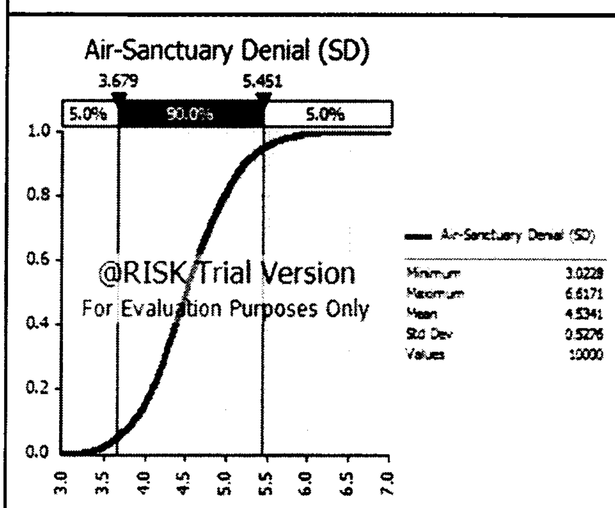
Change in Output Statistic for Air-Show of Force

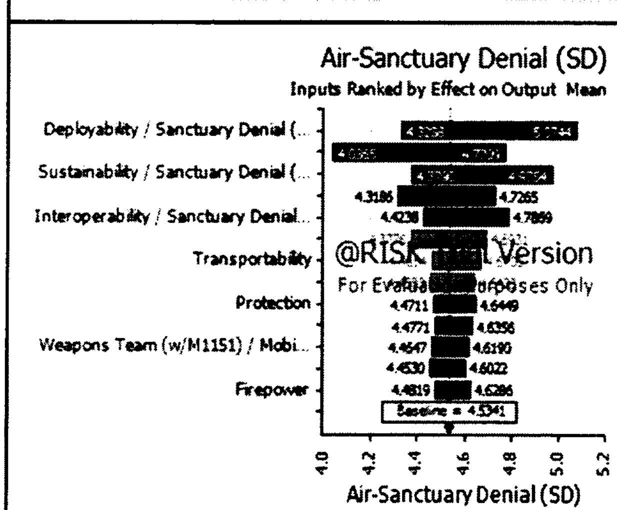
Rank	Name	Lower	Upper
1	Deployability / Sl	4.0402246	4.9249794
2	Lethality / Show (	4.2004204	4.8288268
3	Survivability / Sh	4.3097806	4.6560684
4	Agility / Show of F	4.4542118	4.6718706
5	Weapons Team (	4.4515922	4.6148202
6	Sustainability / S	4.4231272	4.5754914
7	Self-Sufficiency	4.4489868	4.599639
8	Rifle Section (Dis	4.4511659	4.5855067
9	Weapons Team (	4.4573685	4.5895916
10	Menaverability /	4.4681615	4.5906444
11	Transportability	4.4640572	4.5849917
12	Command & Con	4.4807318	4.6001391
13	Detection	4.474507	4.5859228
14	Self-Sufficiency	4.4733721	4.5821876

@RISK Output Report for Air-Sanctuary Denial (SD)

Performed By: Metin
Date: Thursday, April 11, 2013 9:35:12 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Air-Sanctuary Denial (SD)

Statistics		Percentile	
Minimum	3.022811616	5%	3.6788616
Maximum	6.617093298	10%	3.8723286
Mean	4.53414344	15%	4.0058661
Std Dev	0.527629639	20%	4.1005815
Variance	0.278393036	25%	4.1871028
Skewness	0.246228871	30%	4.2519929
Kurtosis	3.068477539	35%	4.3153281
Median	4.505193306	40%	4.3796583
Mode	4.489726633	45%	4.4460041
Left X	3.67886165	50%	4.5051933
Left P	5%	55%	4.5670237
Right X	5.451466555	60%	4.6378348
Right P	95%	65%	4.7090154
Diff X	1.772604905	70%	4.7916555
Diff P	90%	75%	4.8731393
#Errors	0	80%	4.9709376
Filter Min	Off	85%	5.0772102
Filter Max	Off	90%	5.2209524
#Filtered	0	95%	5.4514666

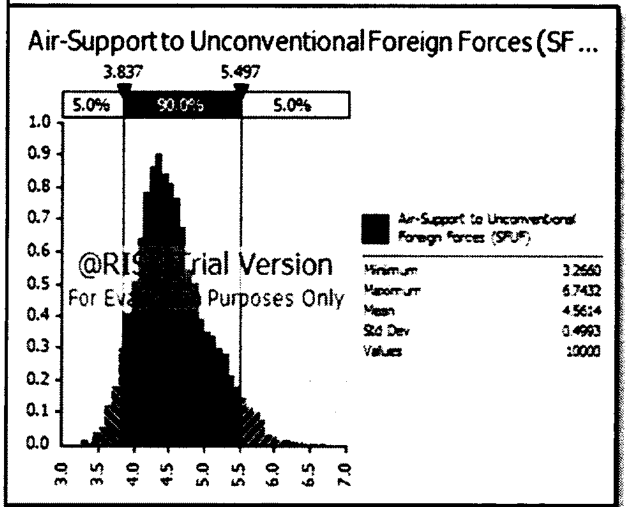
Change in Output Statistic for Air-Sanctuary Deni

Rank	Name	Lower	Upper
1	Deployability / Sa	4.3287814	5.0743872
2	Survivability / Sa	4.0365483	4.7708747
3	Sustainability / S	4.3789623	4.9753709
4	Menaverability /	4.3185824	4.7265298
5	Interoperability /	4.4238448	4.7869327
6	Agility / Sanctuar	4.3775511	4.6930542
7	Transportability	4.4654346	4.6705878
8	Weapons Team (	4.4583059	4.6423195
9	Protection	4.4711076	4.6449207
10	Concealment	4.4770861	4.6355782
11	Weapons Team (	4.4646645	4.6189583
12	Command & Con	4.4530358	4.6021876
13	Firepower	4.4819164	4.6285722
14	Rifle Section (Dis	4.4552344	4.6006144

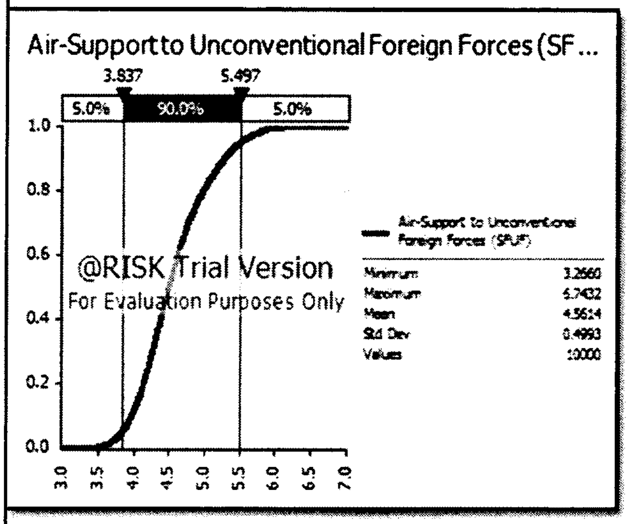
@RISK Output Report for Air-Support to Unconventional Foreign Fo

Performed By: Metin

Date: Thursday, April 11, 2013 9:35:26 PM

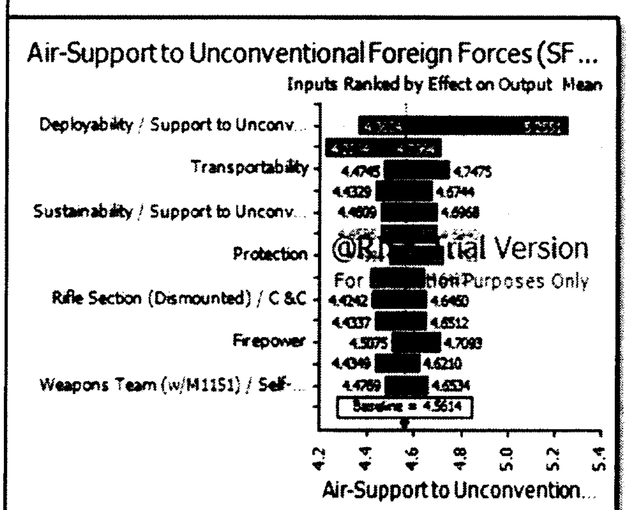


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Air-Support to Unconvent

Statistics		Percentile	
Minimum	3.265995514	5%	3.8373808
Maximum	6.743196379	10%	3.971219
Mean	4.56136732	15%	4.0667911
Std Dev	0.499279594	20%	4.1393669
Variance	0.249280113	25%	4.204616
Skewness	0.544834306	30%	4.2670967
Kurtosis	3.041531977	35%	4.3221643
Median	4.493554069	40%	4.3774677
Mode	4.38262407	45%	4.4333051
Left X	3.837380754	50%	4.4935541
Left P	5%	55%	4.5571753
Right X	5.497382851	60%	4.6215825
Right P	95%	65%	4.6928258
Diff X	1.660002097	70%	4.768388
Diff P	90%	75%	4.8604288
#Errors	0	80%	4.9754497
Filter Min	Off	85%	5.1196344
Filter Max	Off	90%	5.2756021
#Filtered	0	95%	5.4973829



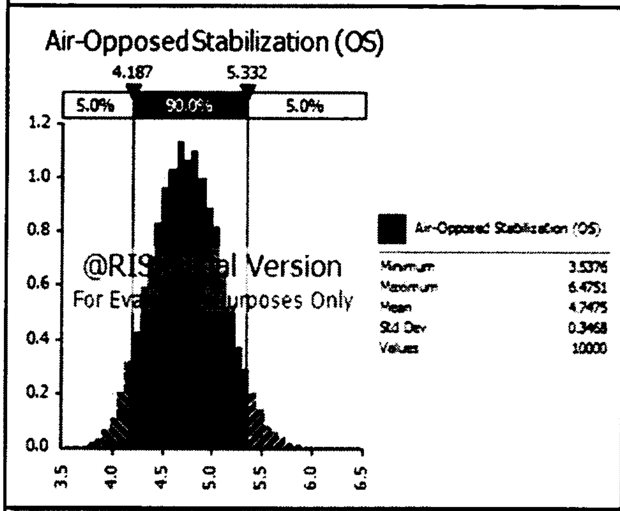
Change in Output Statistic for Air-Support to Unc

Rank	Name	Lower	Upper
1	Deployability / S	4.3624385	5.2551437
2	Agility / Support	4.2234151	4.7063871
3	Transportability	4.4745257	4.7474535
4	Command & Con	4.4328633	4.674382
5	Sustainability / S	4.4608792	4.6967507
6	Command & Con	4.4585545	4.6939927
7	Protection	4.4931071	4.721426
8	Survivability / Su	4.4159785	4.6420092
9	Rifle Section (Dis	4.4241936	4.6459819
10	Lethality / Suppo	4.4336613	4.6511991
11	Firepower	4.5075397	4.709277
12	Self-Sufficiency	4.4349004	4.6209578
13	Weapons Team (	4.4769334	4.6533718
14	Weapons Team (	4.4670968	4.6341246

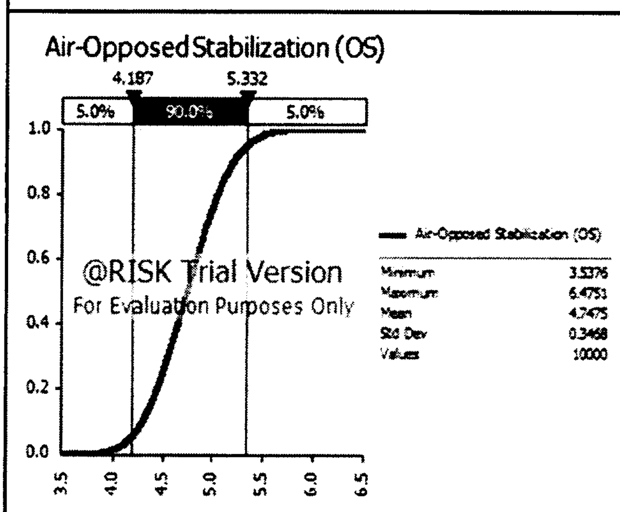
@RISK Output Report for Air-Opposed Stabilization (OS)

Performed By: Metin

Date: Thursday, April 11, 2013 9:35:39 PM

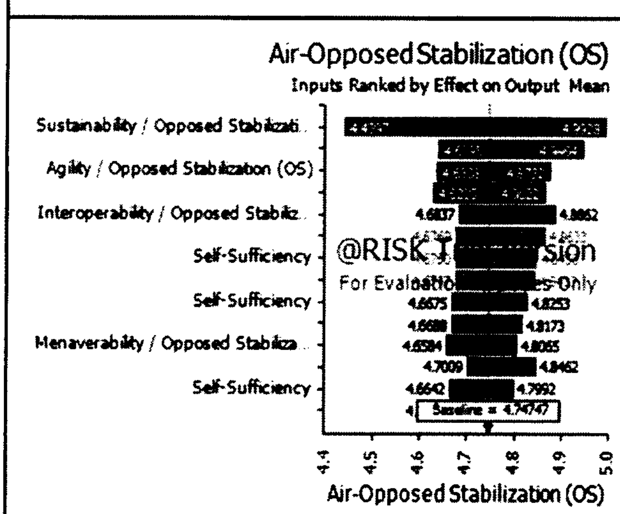


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Air-Opposed Stabilization

Statistics		Percentile	
Minimum	3.537634246	5%	4.1866169
Maximum	6.475117679	10%	4.2990496
Mean	4.747473969	15%	4.3777424
Std Dev	0.346795427	20%	4.4427065
Variance	0.120267068	25%	4.5031262
Skewness	0.126654944	30%	4.551753
Kurtosis	2.820884298	35%	4.6019672
Median	4.740993133	40%	4.6528977
Mode	4.700492635	45%	4.6966393
Left X	4.186616931	50%	4.7409931
Left P	5%	55%	4.7883455
Right X	5.332048343	60%	4.8340002
Right P	95%	65%	4.8811474
Diff X	1.145431411	70%	4.930283
Diff P	90%	75%	4.9851401
#Errors	0	80%	5.0442269
Filter Min	Off	85%	5.112048
Filter Max	Off	90%	5.19787
#Filtered	0	95%	5.3320483



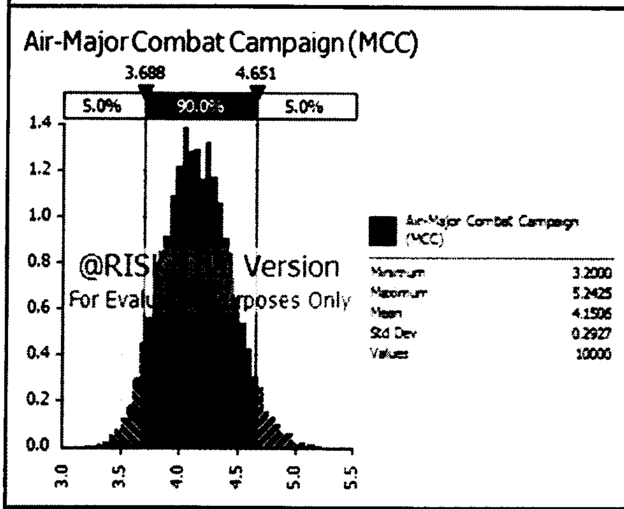
Change in Output Statistic for Air-Opposed Stabil

Rank	Name	Lower	Upper
1	Sustainability / O	4.4397141	4.9928347
2	Concealment	4.6394517	4.9464377
3	Agility / Opposed	4.6337718	4.8732268
4	Weapons Team (	4.6284814	4.8621601
5	Interoperability /	4.6836605	4.8861783
6	Transportability	4.6768894	4.8633187
7	Self-Sufficiency	4.6759661	4.8458499
8	Command & Con	4.6747266	4.8417281
9	Self-Sufficiency	4.6674533	4.8252898
10	Command & Con	4.6687826	4.817316
11	Menaverability /	4.6584022	4.8065016
12	Protection	4.7008947	4.8462317
13	Self-Sufficiency	4.6642002	4.7991581
14	Weapons Team (	4.6641489	4.7977516

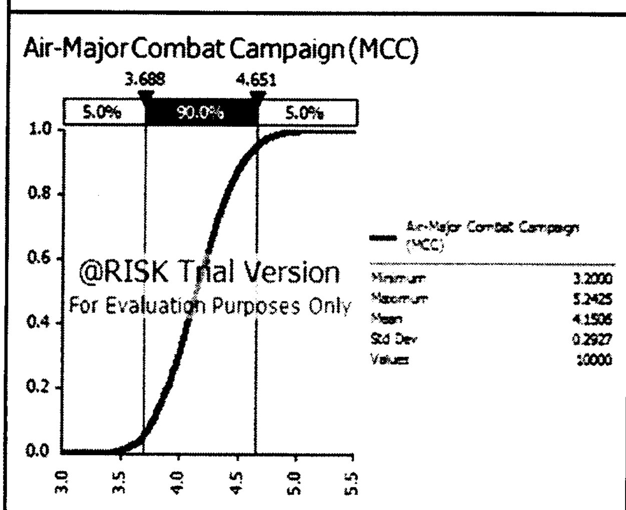
@RISK Output Report for Air-Major Combat Campaign (MCC)

Performed By: Metin

Date: Thursday, April 11, 2013 9:35:52 PM

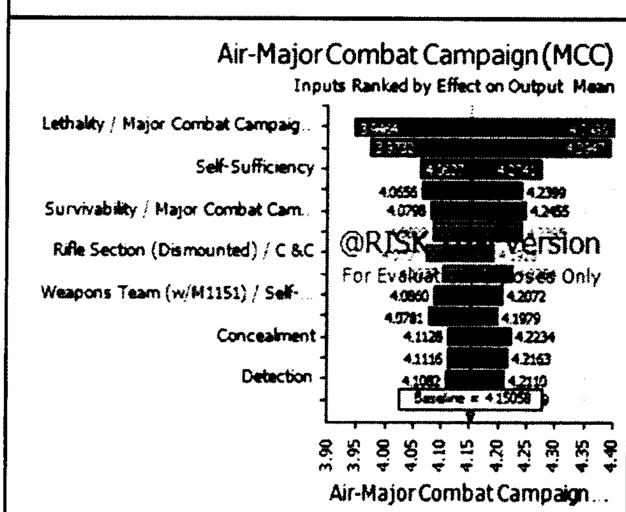


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Air-Major Combat Campai

Statistics		Percentile	
Minimum	3.200040733	5%	3.6875881
Maximum	5.242472426	10%	3.7773285
Mean	4.150576883	15%	3.8385326
Std Dev	0.292741117	20%	3.8950117
Variance	0.085697362	25%	3.94203
Skewness	0.186891248	30%	3.9875312
Kurtosis	2.834241793	35%	4.0273984
Median	4.141347584	40%	4.0633797
Mode	4.053772323	45%	4.101053
Left X	3.687588052	50%	4.1413476
Left P	5%	55%	4.1795834
Right X	4.650869313	60%	4.2225747
Right P	95%	65%	4.2600185
Diff X	0.96328126	70%	4.301573
Diff P	90%	75%	4.3477303
#Errors	0	80%	4.3994502
Filter Min	Off	85%	4.4600505
Filter Max	Off	90%	4.536191
#Filtered	0	95%	4.6508693



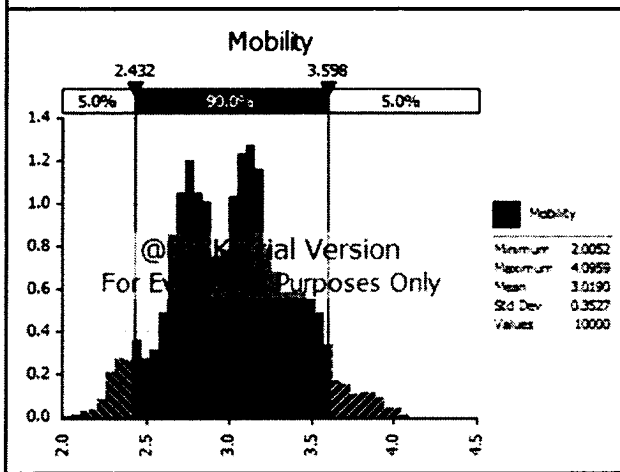
Change in Output Statistic for Air-Major Combat

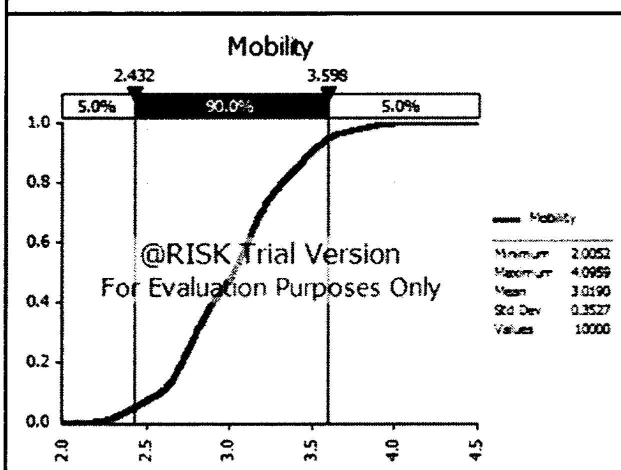
Rank	Name	Lower	Upper
1	Lethality / Major	3.9463856	4.3984761
2	Menaverability /	3.9731649	4.3947044
3	Self-Sufficiency	4.0627171	4.2741489
4	Rifle Section (Dis	4.0656132	4.2399021
5	Survivability / Ma	4.0798197	4.2455421
6	Weapons Team (	4.0829027	4.2394552
7	Rifle Section (Dis	4.0706864	4.1928089
8	Interoperability /	4.1037011	4.2253858
9	Weapons Team (	4.0860498	4.2071507
10	Weapons Team (	4.0780639	4.1978813
11	Concealment	4.112836	4.2234473
12	Command & Con	4.1115836	4.2163485
13	Detection	4.1081838	4.2110315
14	Command & Con	4.1215028	4.2119498

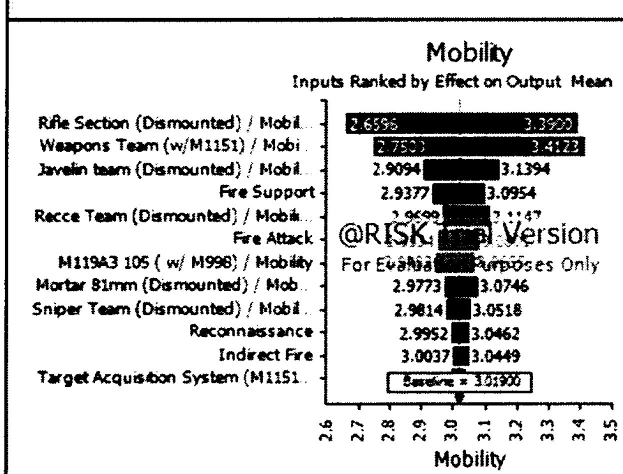
Airborne (Inf)-Attributes

@RISK Output Report for Mobility

Performed By: Meth
Date: Thursday, April 11, 2013 9:36:05 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Mobility

Statistics		Percentile	
Minimum	2.005154639	5%	2.4319527
Maximum	4.095854922	10%	2.5895522
Mean	3.018995123	15%	2.6692668
Std Dev	0.352730537	20%	2.7170543
Variance	0.124418832	25%	2.7600768
Skewness	0.146383208	30%	2.8028169
Kurtosis	2.717629626	35%	2.850208
Median	3.026785714	40%	2.9042146
Mode	3	45%	2.9693548
Left X	2.431952663	50%	3.0267857
Left P	5%	55%	3.0690608
Right X	3.597864769	60%	3.1102362
Right P	95%	65%	3.148855
Diff X	1.165912106	70%	3.190709
Diff P	90%	75%	3.2471358
#Errors	0	80%	3.321489
Filter Min	Off	85%	3.4087481
Filter Max	Off	90%	3.4919169
#Filtered	0	95%	3.5978648

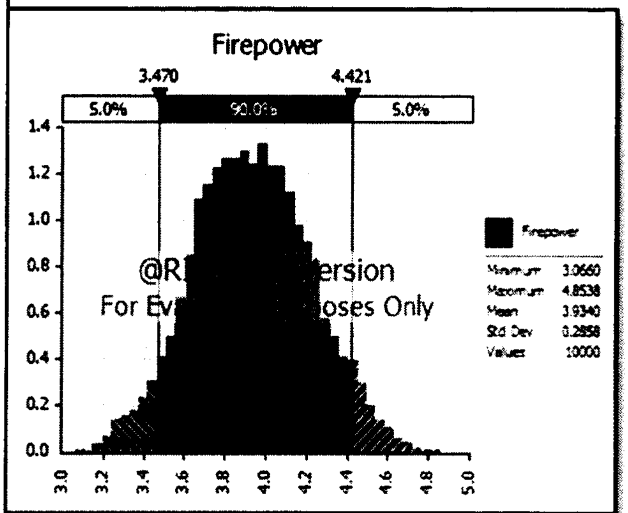
Change in Output Statistic for Mobility

Rank	Name	Lower	Upper
1	Rifle Section (Dis	2.6596006	3.3899899
2	Weapons Team (	2.7503321	3.412324
3	Javelin team (Dis	2.9094121	3.1393555
4	Fire Support	2.9377429	3.0954118
5	Recce Team (Dis	2.969889	3.1146689
6	Fire Attack	2.9533529	3.0800544
7	M119A3 105 (w/	2.9482097	3.0654699
8	Mortar 81mm (D	2.9772927	3.0745793
9	Sniper Team (Dis	2.981449	3.0518349
10	Reconnaissance	2.9951563	3.0461885
11	Indirect Fire	3.0037392	3.0449267
12	Target Acquisitio	2.9970345	3.0338767

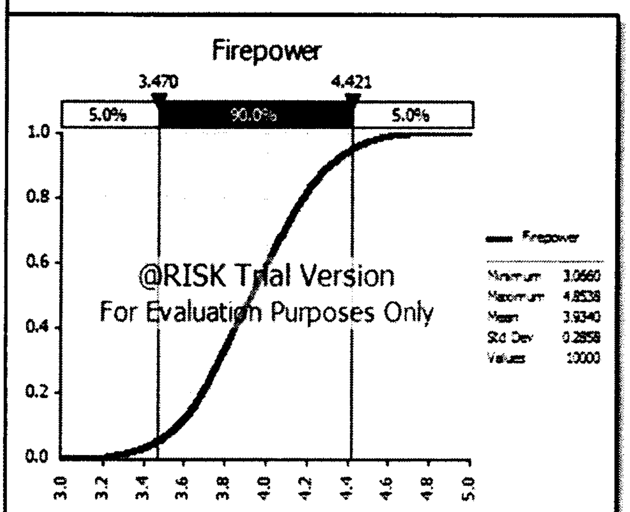
@RISK Output Report for Firepower

Performed By: Metin

Date: Thursday, April 11, 2013 9:36:13 PM

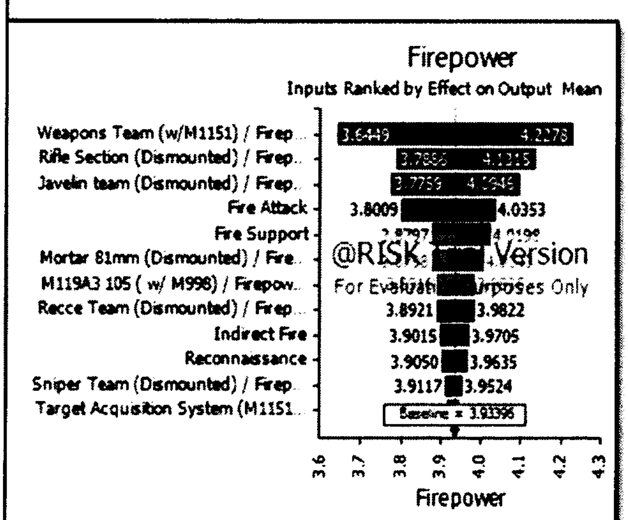


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Firepower

Statistics		Percentile	
Minimum	3.066027689	5%	3.4699205
Maximum	4.853808354	10%	3.5749718
Mean	3.933957177	15%	3.6375921
Std Dev	0.285814773	20%	3.6870748
Variance	0.081690084	25%	3.7307275
Skewness	0.061449066	30%	3.7717647
Kurtosis	2.720766538	35%	3.8124281
Median	3.928870293	40%	3.8506024
Mode	3.731984829	45%	3.8894231
Left X	3.469920545	50%	3.9288703
Left P	5%	55%	3.9683258
Right X	4.421109902	60%	4.0057537
Right P	95%	65%	4.0464241
Diff X	0.951189357	70%	4.0888889
Diff P	90%	75%	4.1296505
#Errors	0	80%	4.1805094
Filter Min	Off	85%	4.2366589
Filter Max	Off	90%	4.3094945
#Filtered	0	95%	4.4211099



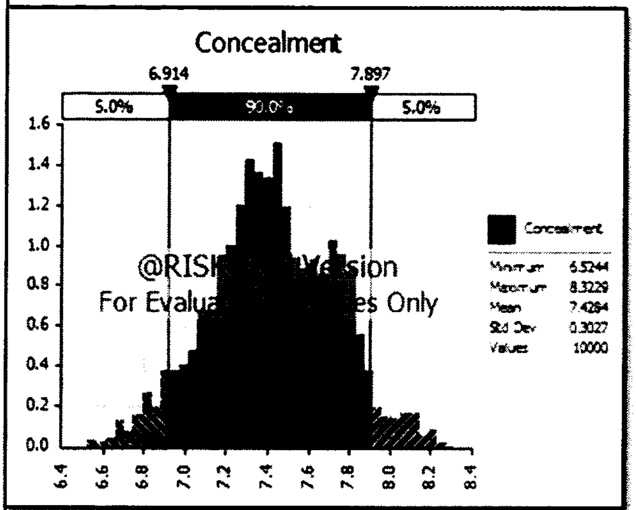
Change in Output Statistic for Firepower

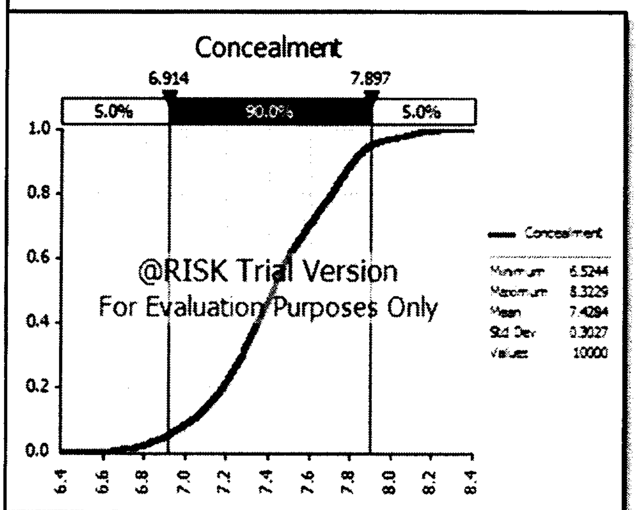
Rank	Name	Lower	Upper
1	Weapons Team (	3.6449313	4.2278131
2	Rifle Section (Dis	3.7886306	4.1315453
3	Javelin team (Dis	3.7758903	4.0946459
4	Fire Attack	3.8008938	4.0353098
5	Fire Support	3.8797445	4.0197509
6	Mortar 81mm (Di	3.8797813	4.0042775
7	M119A3 105 (w/	3.8915957	3.9835682
8	Recce Team (Dis	3.8921356	3.9821757
9	Indirect Fire	3.901525	3.9704651
10	Reconnaissance	3.9049532	3.9635109
11	Sniper Team (Dis	3.9116729	3.9523632
12	Target Acquisitio	3.9175844	3.9419796

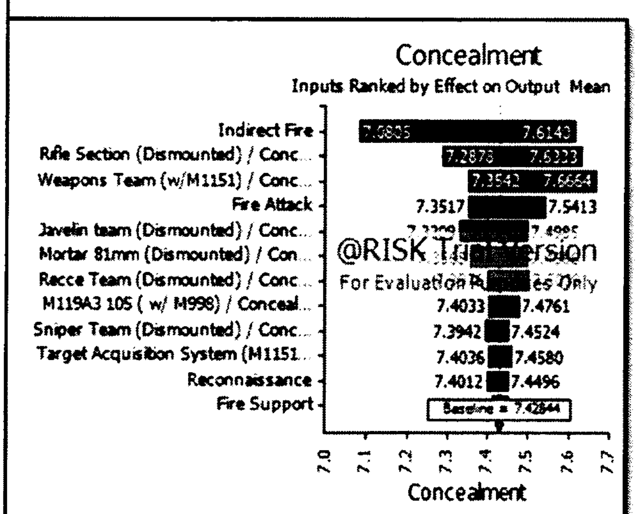
@RISK Output Report for Concealment

Performed By: Metin

Date: Thursday, April 11, 2013 9:36:22 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Concealment

Statistics		Percentile	
Minimum	6.524366472	5%	6.9141914
Maximum	8.322932917	10%	7.0377358
Mean	7.42844389	15%	7.1156915
Std Dev	0.302722402	20%	7.1833333
Variance	0.091640852	25%	7.2318182
Skewness	-0.043009297	30%	7.2775591
Kurtosis	2.809308638	35%	7.3126294
Median	7.421686747	40%	7.3484252
Mode	7.784158416	45%	7.3854167
Left X	6.914191419	50%	7.4216867
Left P	5%	55%	7.4557439
Right X	7.897087379	60%	7.4914197
Right P	95%	65%	7.5437616
Diff X	0.982895959	70%	7.5963432
Diff P	90%	75%	7.6510949
#Errors	0	80%	7.7081545
Filter Min	Off	85%	7.7569231
Filter Max	Off	90%	7.8116505
#Filtered	0	95%	7.8970874

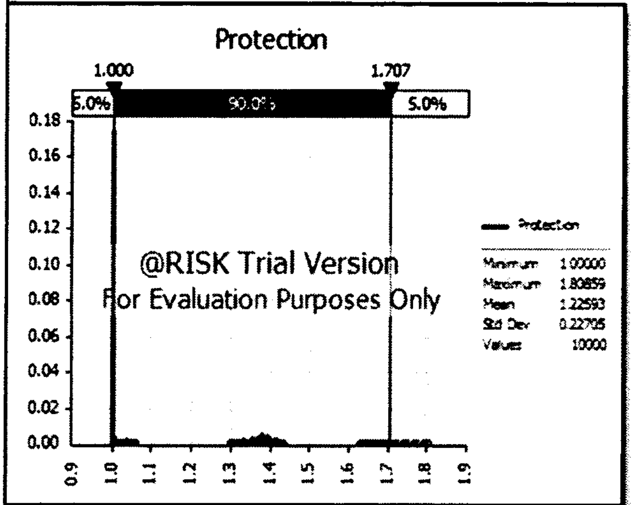
Change in Output Statistic for Concealment

Rank	Name	Lower	Upper
1	Indirect Fire	7.0804939	7.6139834
2	Rifle Section (Dis	7.28781	7.6333247
3	Weapons Team (	7.3541754	7.666372
4	Fire Attack	7.3516635	7.5412513
5	Javelin team (Dis	7.3309148	7.4985181
6	Mortar 81mm (Di	7.3567868	7.4966381
7	Recce Team (Dis	7.3976369	7.5009193
8	M119A3 105 (w/	7.4033047	7.47612
9	Sniper Team (Dis	7.394196	7.4524332
10	Target Acquisitio	7.4035549	7.4579609
11	Reconnaissance	7.401157	7.4495614
12	Fire Support	7.414055	7.4498412

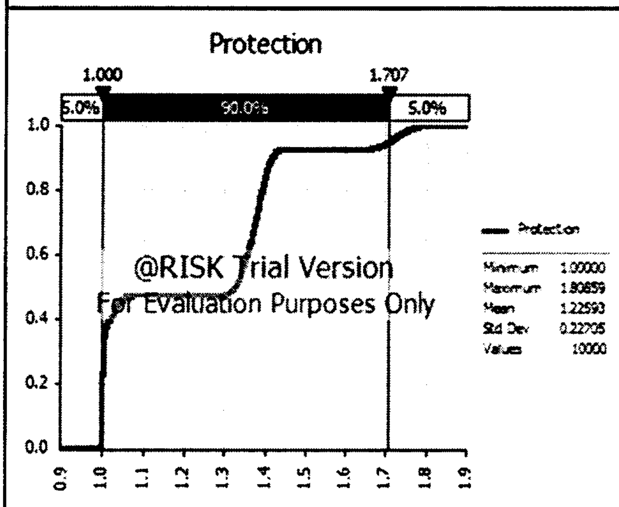
@RISK Output Report for Protection

Performed By: Metin

Date: Thursday, April 11, 2013 9:36:30 PM

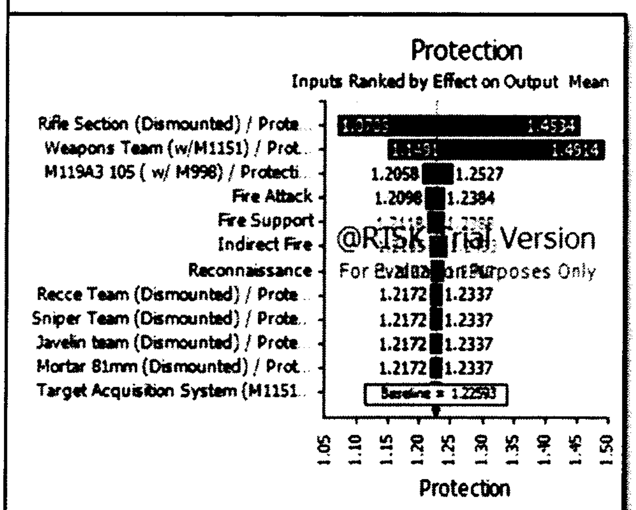


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Protection

Statistics		Percentile	
Minimum	1	5%	1
Maximum	1.80859375	10%	1
Mean	1.225933737	15%	1
Std Dev	0.227049494	20%	1
Variance	0.051551473	25%	1.0015576
Skewness	0.507405257	30%	1.0038023
Kurtosis	2.281786191	35%	1.0057339
Median	1.326210826	40%	1.0210526
Mode	1	45%	1.0364372
Left X	1	50%	1.3262108
Left P	5%	55%	1.3448735
Right X	1.706997085	60%	1.3571429
Right P	95%	65%	1.366879
Diff X	0.706997085	70%	1.3758701
Diff P	90%	75%	1.3835616
#Errors	0	80%	1.3920455
Filter Min	Off	85%	1.4022346
Filter Max	Off	90%	1.4156627
#Filtered	0	95%	1.7069971



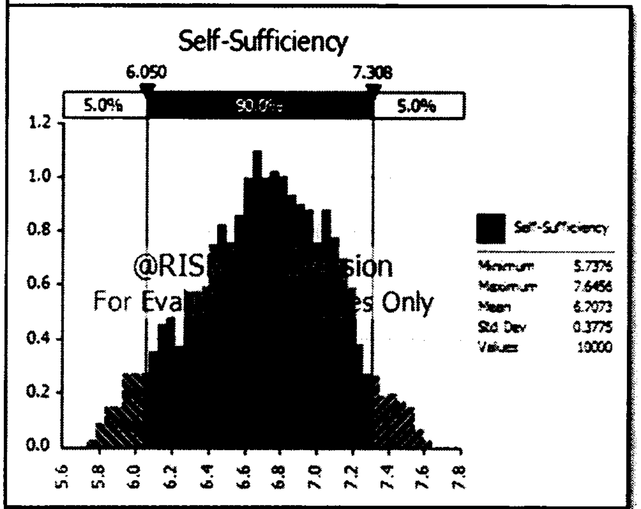
Change in Output Statistic for Protection

Rank	Name	Lower	Upper
1	Rifle Section (Dis	1.0705093	1.4534148
2	Weapons Team (	1.1491207	1.4913652
3	M119A3 105 (w/	1.2058408	1.2527254
4	Fire Attack	1.2097621	1.2384064
5	Fire Support	1.2117654	1.2388177
6	Indirect Fire	1.2165034	1.2433034
7	Reconnaissance	1.2177152	1.2367496
8	Recce Team (Dis	1.2172047	1.2336594
9	Sniper Team (Dis	1.2172047	1.2336594
10	Javelin team (Dis	1.2172047	1.2336594
11	Mortar 81mm (Di	1.2172047	1.2336594
12	Target Acquisitio	1.2193757	1.2344885

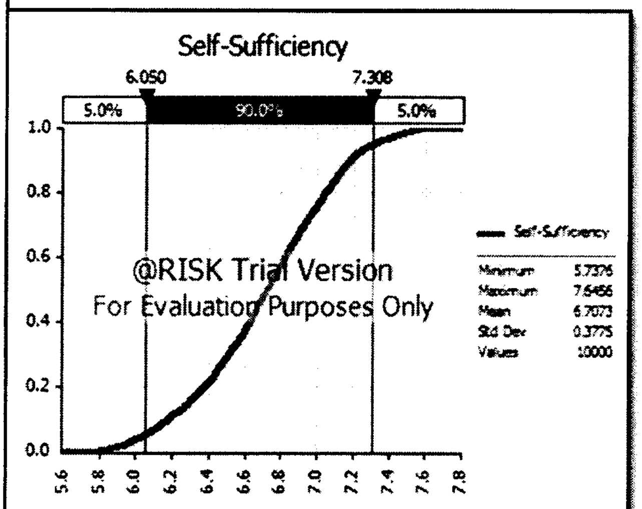
@RISK Output Report for Self-Sufficiency

Performed By: Metin

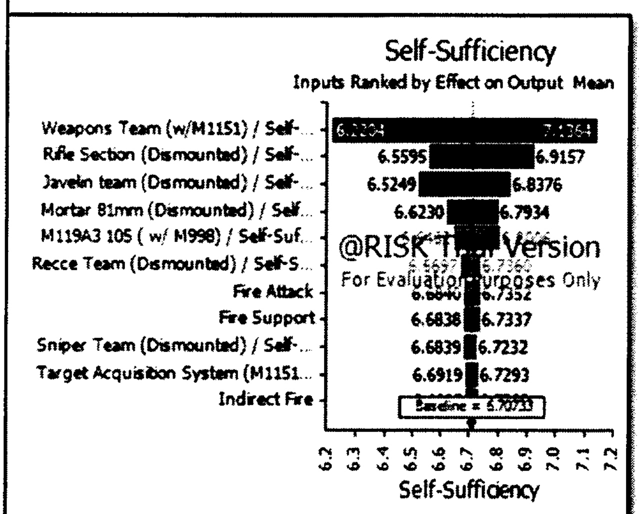
Date: Thursday, April 11, 2013 9:36:38 PM



Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Self-Sufficiency			
Statistics		Percentile	
Minimum	5.737609329	5%	6.0502717
Maximum	7.645640074	10%	6.1787072
Mean	6.70732865	15%	6.2870722
Std Dev	0.37749681	20%	6.3742331
Variance	0.142503842	25%	6.446729
Skewness	-0.136315829	30%	6.5092025
Kurtosis	2.500793462	35%	6.572973
Median	6.723053892	40%	6.6261682
Mode	7	45%	6.668883
Left X	6.050271739	50%	6.7230539
Left P	5%	55%	6.7724551
Right X	7.308108108	60%	6.8194888
Right P	95%	65%	6.8711656
Diff X	1.257836369	70%	6.9279141
Diff P	90%	75%	6.9833333
#Errors	0	80%	7.0437318
Filter Min	Off	85%	7.1093294
Filter Max	Off	90%	7.1784314
#Filtered	0	95%	7.3081081

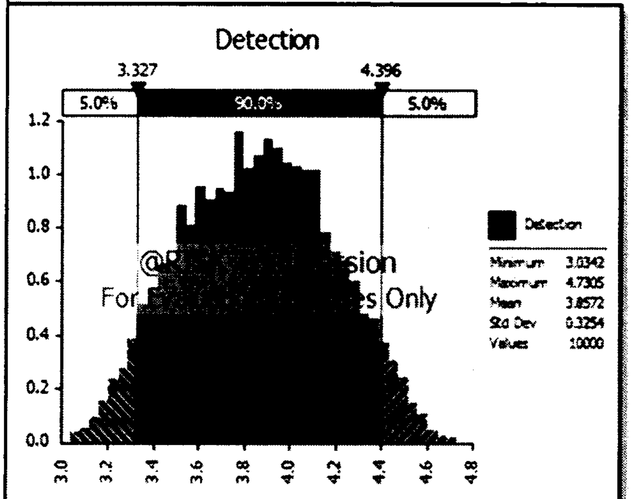


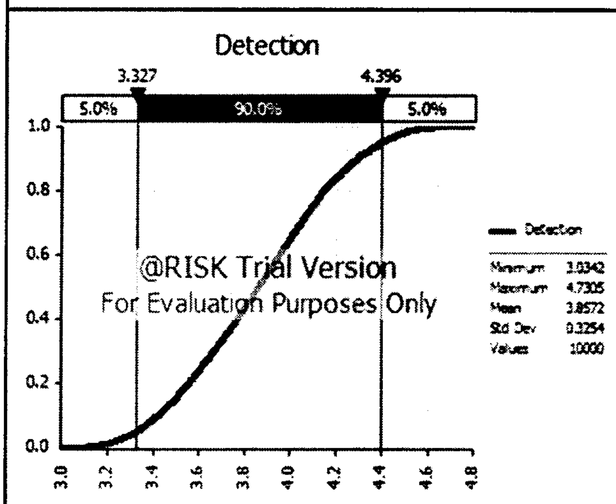
Change in Output Statistic for Self-Sufficiency			
Rank	Name	Lower	Upper
1	Weapons Team (	6.2204277	7.1363514
2	Rifle Section (Dis	6.5594596	6.9156638
3	Javelin team (Dis	6.5249438	6.8375677
4	Mortar 81mm (Di	6.6229846	6.7933817
5	M119A3 105 (w/	6.6461945	6.8006481
6	Recce Team (Dis	6.6696671	6.7360161
7	Fire Attack	6.6839955	6.7351514
8	Fire Support	6.6837693	6.7337462
9	Sniper Team (Dis	6.6838503	6.7232098
10	Target Acquisitio	6.6918638	6.7293346
11	Indirect Fire	6.6936748	6.730244

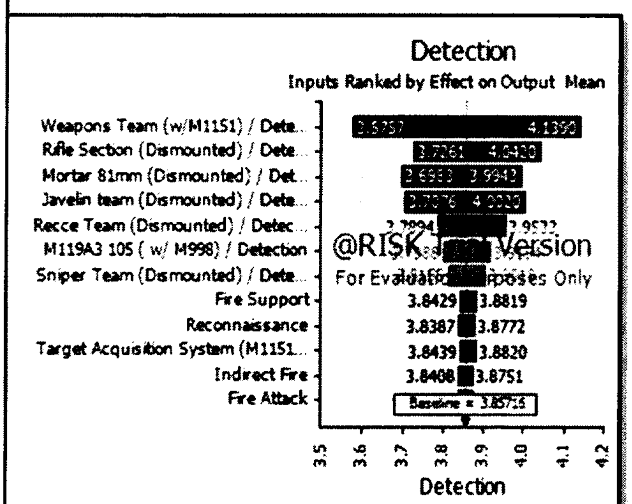
@RISK Output Report for Detection

Performed By: Metin

Date: Thursday, April 11, 2013 9:36:46 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Detection

Statistics		Percentile	
Minimum	3.034175334	**5%**	3.3271605
Maximum	4.730519481	**10%**	3.4208809
Mean	3.85716436	**15%**	3.4939107
Std Dev	0.325438822	**20%**	3.5534106
Variance	0.105910427	**25%**	3.6124031
Skewness	0.005793459	**30%**	3.6649916
Kurtosis	2.344978573	**35%**	3.7178683
Median	3.859594384	**40%**	3.7688504
Mode	4	**45%**	3.8123953
Left X	3.327160494	**50%**	3.8595944
Left P	5%	**55%**	3.9070465
Right X	4.395550062	**60%**	3.9518414
Right P	95%	**65%**	3.998557
Diff X	1.068389568	**70%**	4.0474934
Diff P	90%	**75%**	4.096463
#Errors	0	**80%**	4.1490765
Filter Min	Off	**85%**	4.2175325
Filter Max	Off	**90%**	4.2926174
#Filtered	0	**95%**	4.3955501

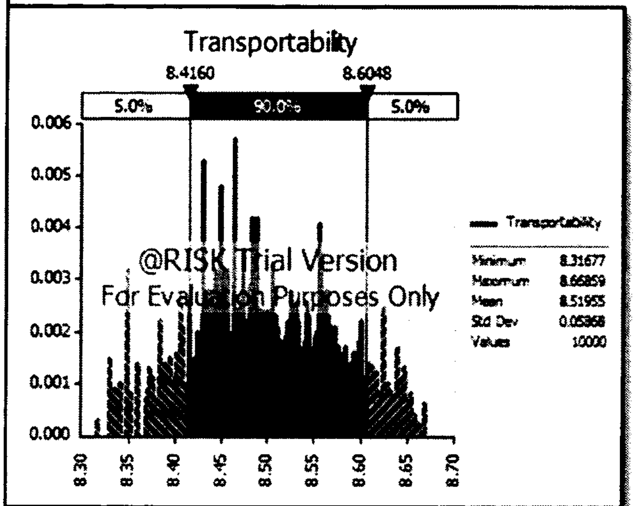
Change in Output Statistic for Detection

Rank	Name	Lower	Upper
1	Weapons Team (	3.5756537	4.1390255
2	Rifle Section (Dis	3.7261244	4.0420007
3	Mortar 81mm (Di	3.698297	3.9942914
4	Javelin team (Dis	3.7075567	4.0020379
5	Recce Team (Dis	3.789381	3.9532612
6	M119A3 105 (w/	3.7987922	3.9154165
7	Sniper Team (Dis	3.8154786	3.9018479
8	Fire Support	3.8429043	3.8818896
9	Reconnaissance	3.8386956	3.8771819
10	Target Acquisitio	3.8439343	3.8819763
11	Indirect Fire	3.8407891	3.8751432
12	Fire Attack	3.8412366	3.8751686

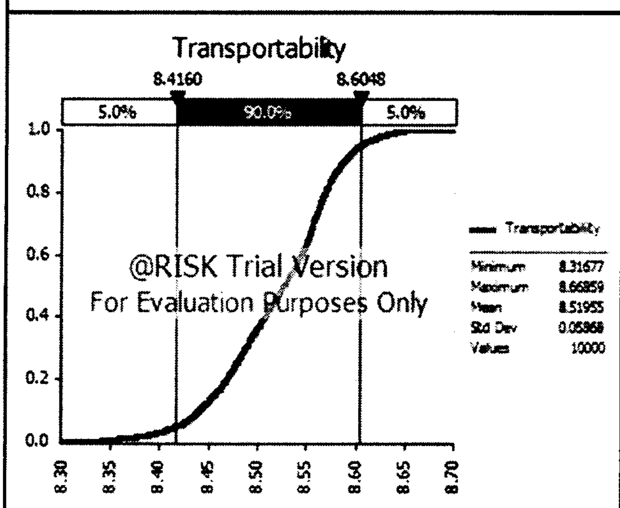
@RISK Output Report for Transportability

Performed By: Metin

Date: Thursday, April 11, 2013 9:36:54 PM

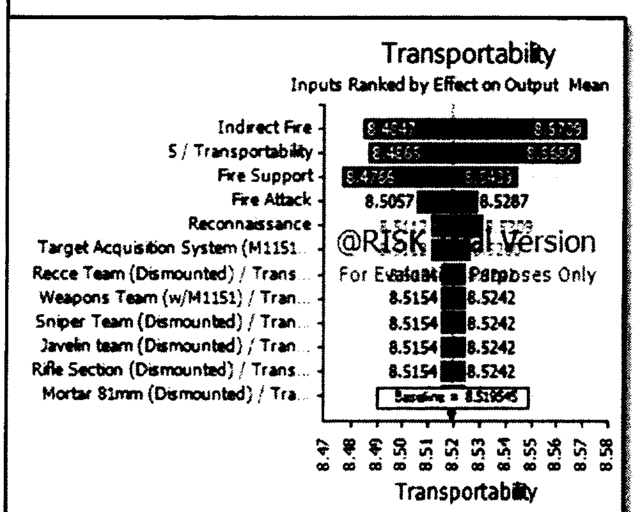


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Transportability

Statistics		Percentile	
Minimum	8.316770186	5%	8.4159664
Maximum	8.668587896	10%	8.4411765
Mean	8.519545015	15%	8.4565826
Std Dev	0.058676615	20%	8.4689441
Variance	0.003442945	25%	8.4791045
Skewness	-0.425168698	30%	8.4883721
Kurtosis	2.902519353	35%	8.4976744
Median	8.526695527	40%	8.5072464
Mode	8.463320463	45%	8.5175719
Left X	8.415966387	50%	8.5266955
Left P	5%	55%	8.537037
Right X	8.604819277	60%	8.5446154
Right P	95%	65%	8.5519126
Diff X	0.188852891	70%	8.556701
Diff P	90%	75%	8.5625
#Errors	0	80%	8.5686275
Filter Min	Off	85%	8.5771028
Filter Max	Off	90%	8.5884774
#Filtered	0	95%	8.6048193



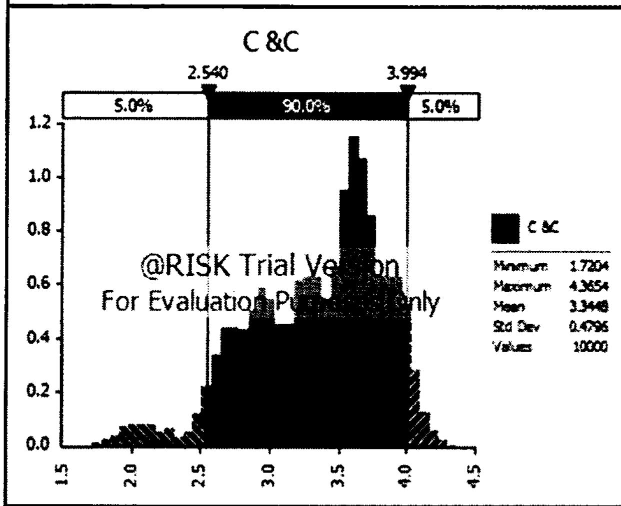
Change in Output Statistic for Transportability

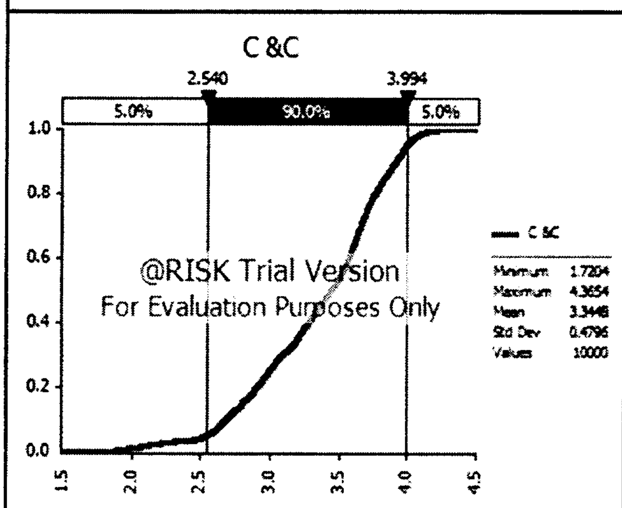
Rank	Name	Lower	Upper
1	Indirect Fire	8.4846772	8.5708919
2	5 / Transportabil	8.4865392	8.5686065
3	Fire Support	8.4766411	8.5439428
4	Fire Attack	8.5056606	8.5286931
5	Reconnaissance	8.5112203	8.5309164
6	Target Acquisitio	8.5111514	8.5260492
7	Recce Team (Dis	8.5153713	8.524211
8	Weapons Team (	8.5153713	8.524211
9	Sniper Team (Dis	8.5153713	8.524211
10	Javelin team (Dis	8.5153713	8.524211
11	Rifle Section (Dis	8.5153713	8.524211
12	Mortar 81mm (Di	8.5153713	8.524211

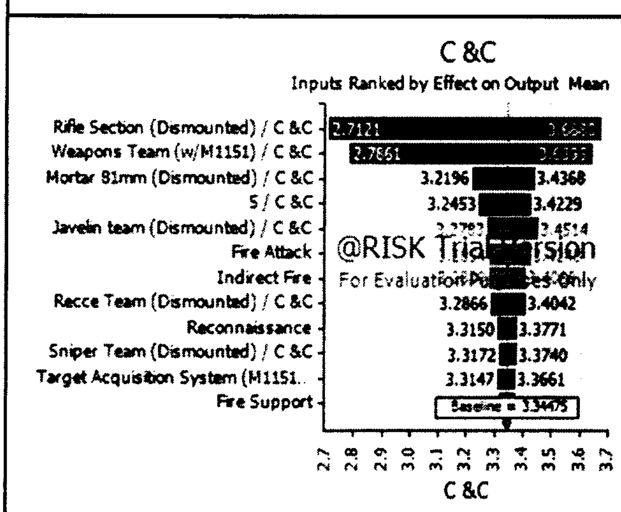
@RISK Output Report for C &C

Performed By: Metin

Date: Thursday, April 11, 2013 9:37:02 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for C &C

Statistics		Percentile	
Minimum	1.720385675	5%	2.5404313
Maximum	4.365418895	10%	2.685254
Mean	3.344753616	15%	2.8
Std Dev	0.479601901	20%	2.90887
Variance	0.230017984	25%	2.9940828
Skewness	-0.636803102	30%	3.0904393
Kurtosis	2.936006632	35%	3.1988166
Median	3.445103858	40%	3.2767528
Mode	4	45%	3.3564103
Left X	2.540431267	50%	3.4451039
Left P	5%	55%	3.5156483
Right X	3.994227994	60%	3.568567
Right P	95%	65%	3.6130653
Diff X	1.453796727	70%	3.6552316
Diff P	90%	75%	3.7033557
#Errors	0	80%	3.7602257
Filter Min	Off	85%	3.8360071
Filter Max	Off	90%	3.91423
#Filtered	0	95%	3.994228

Change in Output Statistic for C &C

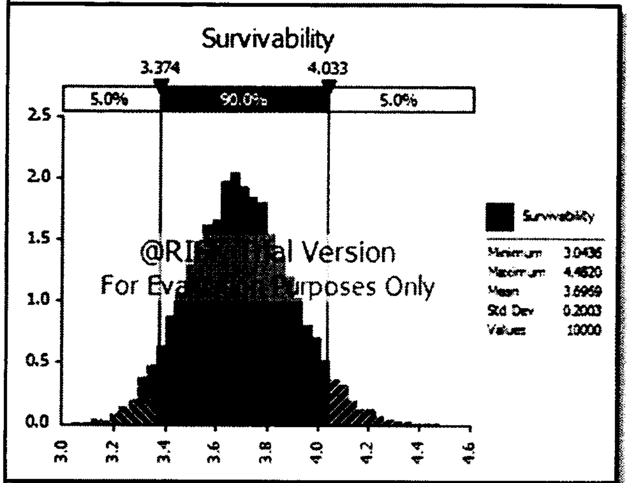
Rank	Name	Lower	Upper
1	Rifle Section (Dis	2.712111	3.6680027
2	Weapons Team (	2.7861199	3.6394537
3	Mortar 81mm (Di	3.2196074	3.4368432
4	5 / C&C	3.2452619	3.4229475
5	Javelin team (Dis	3.2782794	3.4514413
6	Fire Attack	3.2854127	3.424821
7	Indirect Fire	3.2829667	3.406807
8	Recce Team (Dis	3.2865701	3.404179
9	Reconnaissance	3.3150486	3.3771188
10	Sniper Team (Dis	3.3172325	3.3740333
11	Target Acquisitio	3.3147187	3.3661338
12	Fire Support	3.3183765	3.3682958

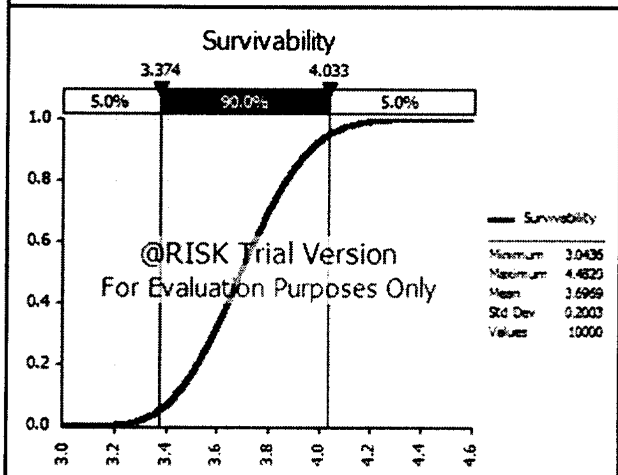
Airborne (inf)-Capabilities

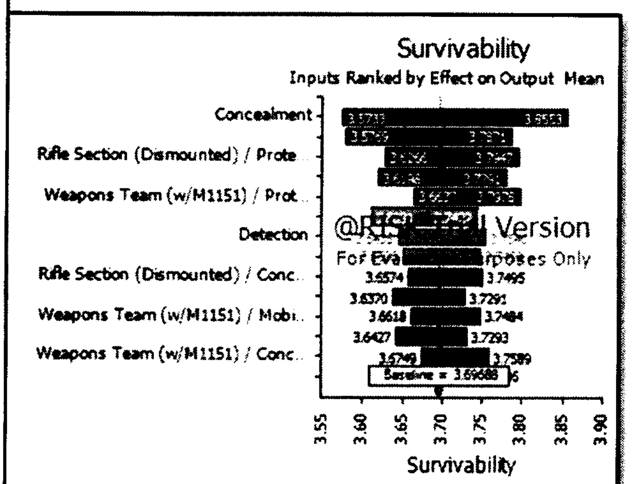
@RISK Output Report for Survivability

Performed By: Metin

Date: Thursday, April 11, 2013 9:37:10 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Survivability

Statistics		Percentile	
Minimum	3.043553156	5%	3.3736388
Maximum	4.482036906	10%	3.4394366
Mean	3.696877226	15%	3.485232
Std Dev	0.200272845	20%	3.5224899
Variance	0.040109212	25%	3.5555936
Skewness	0.15143284	30%	3.5854137
Kurtosis	2.843586952	35%	3.615573
Median	3.6910655	40%	3.6421119
Mode	3.654425855	45%	3.6672858
Left X	3.373638845	50%	3.6910655
Left P	5%	55%	3.7163129
Right X	4.033261737	60%	3.7435263
Right P	95%	65%	3.7716587
Diff X	0.659622893	70%	3.7987392
Diff P	90%	75%	3.8314343
#Errors	0	80%	3.8668638
Filter Min	Off	85%	3.9086698
Filter Max	Off	90%	3.9584184
#Filtered	0	95%	4.0332617

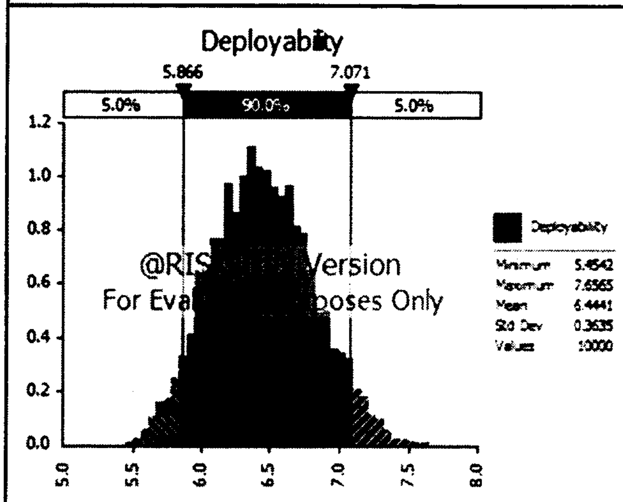
Change in Output Statistic for Survivability

Rank	Name	Lower	Upper
1	Concealment	3.573312	3.8553004
2	Mobility	3.5768501	3.787108
3	Rifle Section (Dis	3.6266267	3.794722
4	Self-Sufficiency	3.6197692	3.7791374
5	Weapons Team (	3.6636813	3.7977848
6	Indirect Fire	3.6090577	3.7422462
7	Detection	3.6436436	3.7540284
8	Rifle Section (Dis	3.6499628	3.7468605
9	Rifle Section (Dis	3.6574275	3.7495101
10	Weapons Team (	3.6370488	3.729083
11	Weapons Team (	3.6617776	3.7484333
12	Rifle Section (Dis	3.6427329	3.7293194
13	Weapons Team (	3.6748985	3.7589445
14	Command & Con	3.6689437	3.7436495

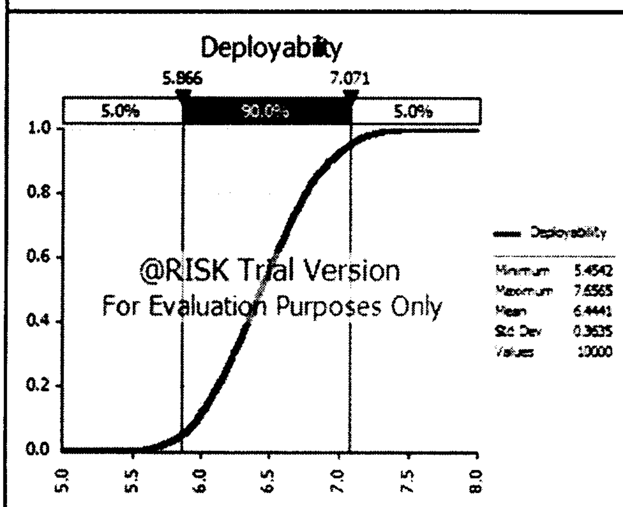
@RISK Output Report for Deployability

Performed By: Metin

Date: Thursday, April 11, 2013 9:37:22 PM

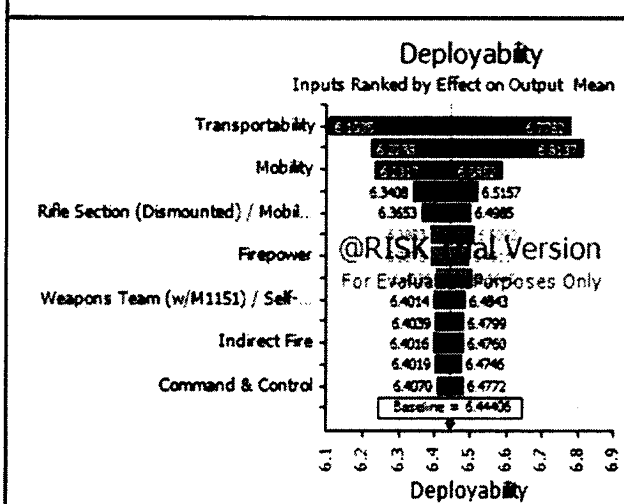


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Deployability

Statistics		Percentile	
Minimum	5.454209222	5%	5.8659339
Maximum	7.656470003	10%	5.9806797
Mean	6.444055936	15%	6.0541812
Std Dev	0.363498054	20%	6.1202862
Variance	0.132130835	25%	6.1825802
Skewness	0.14524751	30%	6.2334318
Kurtosis	2.648282572	35%	6.2899312
Median	6.430870886	40%	6.3399784
Mode	6.426867291	45%	6.3846777
Left X	5.865933908	50%	6.4308709
Left P	5%	55%	6.4807577
Right X	7.071168222	60%	6.530764
Right P	95%	65%	6.584961
Diff X	1.205234314	70%	6.6379605
Diff P	90%	75%	6.6933388
#Errors	0	80%	6.7547219
Filter Min	Off	85%	6.8301841
Filter Max	Off	90%	6.9296068
#Filtered	0	95%	7.0711682



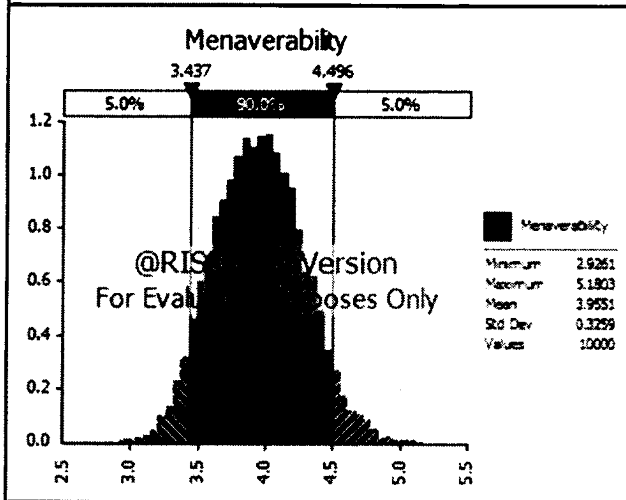
Change in Output Statistic for Deployability

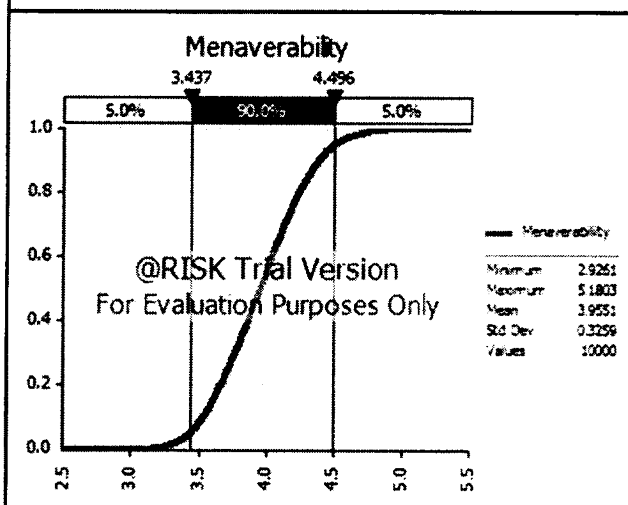
Rank	Name	Lower	Upper
1	Transportability	6.1034601	6.7781812
2	Self-Sufficiency	6.2238361	6.8137193
3	Mobility	6.2317449	6.5851836
4	Concealment	6.3407749	6.5156894
5	Rifle Section (Dis	6.3653494	6.4985337
6	Detection	6.3883158	6.5091998
7	Firepower	6.3877517	6.491115
8	Weapons Team (	6.4035739	6.5045199
9	Weapons Team (	6.4014176	6.4843277
10	Reconnaissance	6.4039214	6.479877
11	Indirect Fire	6.4015661	6.4760077
12	Rifle Section (Dis	6.4019017	6.4745778
13	Command & Con	6.4069945	6.4771536
14	Weapons Team (	6.4030284	6.4719715

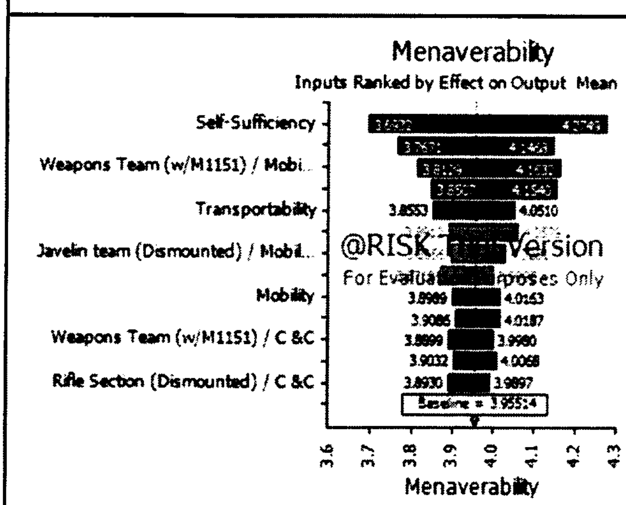
@RISK Output Report for Menaverability

Performed By: Metin

Date: Thursday, April 11, 2013 9:37:33 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Menaverability

Statistics		Percentile	
Minimum	2.92608244	5%	3.4368441
Maximum	5.180271385	10%	3.5321977
Mean	3.955140296	15%	3.6053005
Std Dev	0.325935749	20%	3.6650103
Variance	0.106234112	25%	3.7187735
Skewness	0.133293113	30%	3.770036
Kurtosis	2.731410282	35%	3.8181597
Median	3.951802607	40%	3.8637657
Mode	3.82184046	45%	3.9059077
Left X	3.436844108	50%	3.9518026
Left P	5%	55%	3.9946191
Right X	4.496279669	60%	4.0370616
Right P	95%	65%	4.082533
Diff X	1.059435561	70%	4.1278869
Diff P	90%	75%	4.1805922
#Errors	0	80%	4.235003
Filter Min	Off	85%	4.3053874
Filter Max	Off	90%	4.3823541
#Filtered	0	95%	4.4962797

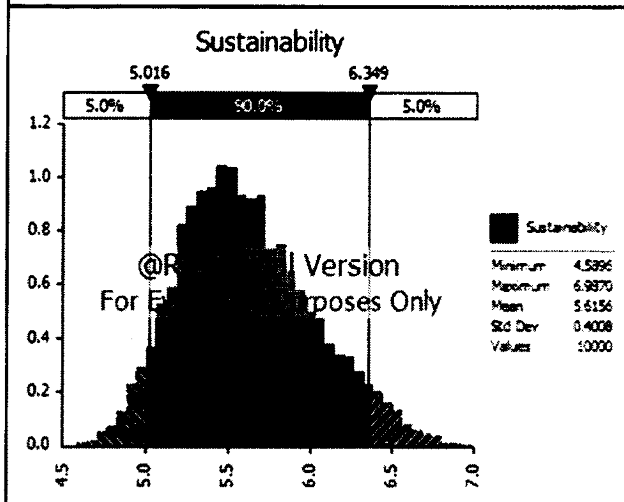
Change in Output Statistic for Menaverability

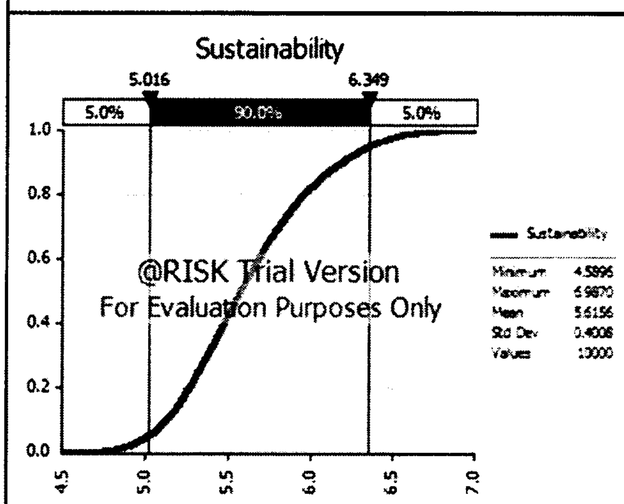
Rank	Name	Lower	Upper
1	Self-Sufficiency	3.6931607	4.2748706
2	Rifle Section (Dis	3.7670525	4.1468493
3	Weapons Team (	3.8128925	4.1631807
4	Concealment	3.8507198	4.1539595
5	Transportability	3.8553334	4.0510077
6	Firepower	3.891167	4.057933
7	Javelin team (Dis	3.8956107	4.0281111
8	Command & Con	3.8718185	3.999816
9	Mobility	3.8989299	4.016313
10	Weapons Team (	3.9085671	4.0186999
11	Weapons Team (	3.8898922	3.9979794
12	Detection	3.9032458	4.0067948
13	Rifle Section (Dis	3.893037	3.989712
14	M119A3 105 (w/	3.8993367	3.988533

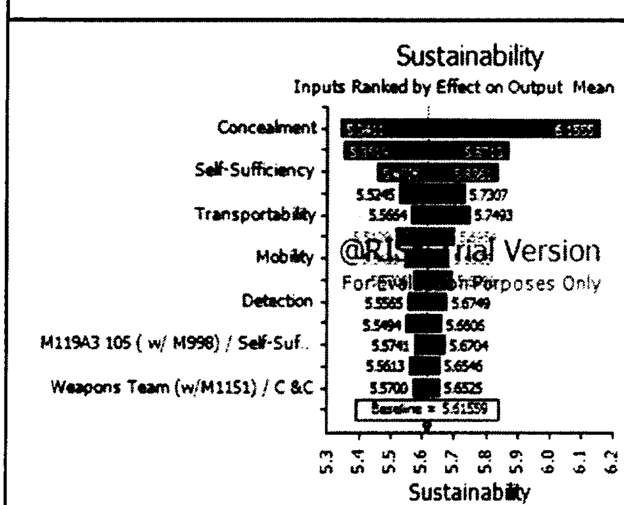
@RISK Output Report for Sustainability

Performed By: Metin

Date: Thursday, April 11, 2013 9:37:45 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

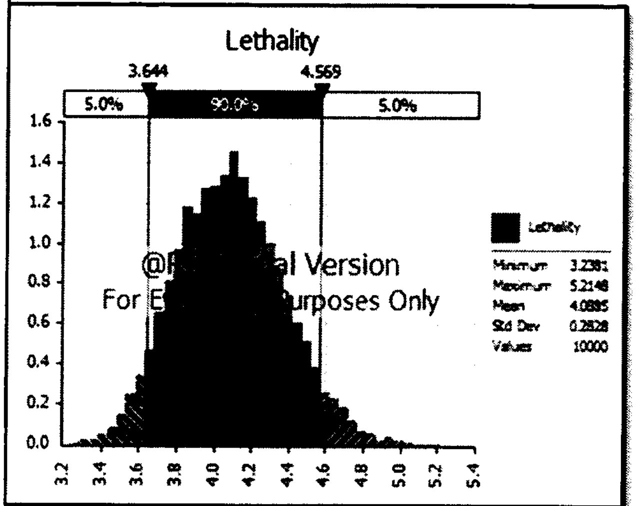
Summary Statistics for Sustainability			
Statistics		**Percentile**	
Minimum	4.589565958	5%	5.0162734
Maximum	6.987002408	10%	5.128183
Mean	5.615591722	15%	5.2080069
Std Dev	0.400757611	20%	5.2653782
Variance	0.160606663	25%	5.3207357
Skewness	0.41181245	30%	5.3746039
Kurtosis	2.780730932	35%	5.426055
Median	5.572551026	40%	5.4726994
Mode	5.469686059	45%	5.523088
Left X	5.016273352	50%	5.572551
Left P	5%	55%	5.6271923
Right X	6.348777972	60%	5.6803911
Right P	95%	65%	5.7342206
Diff X	1.33250462	70%	5.804269
Diff P	90%	75%	5.8752543
#Errors	0	80%	5.9553522
Filter Min	Off	85%	6.0546217
Filter Max	Off	90%	6.1865607
#Filtered	0	95%	6.348778

Change in Output Statistic for Sustainability			
Rank	**Name**	**Lower**	**Upper**
1	Concealment	5.3411363	6.155458
2	Weapons Team (	5.3518873	5.8709799
3	Self-Sufficiency	5.4525867	5.8361376
4	Rifle Section (Dis	5.5244837	5.7306547
5	Transportability	5.56636	5.749318
6	Javelin team (Dis	5.5129279	5.6954057
7	Mobility	5.5438528	5.6825271
8	Firepower	5.5708186	5.6899545
9	Detection	5.5564554	5.674863
10	Mortar 81mm (Di	5.5493792	5.6605713
11	M119A3 105 (w/	5.5741061	5.6704456
12	Protection	5.561312	5.6545927
13	Weapons Team (	5.5699796	5.6524503
14	Weapons Team (	5.579136	5.6606838

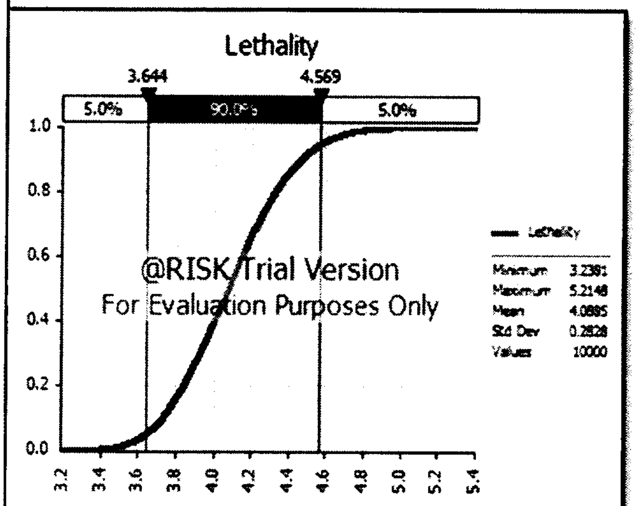
@RISK Output Report for Lethality

Performed By: Metin

Date: Thursday, April 11, 2013 9:37:56 PM

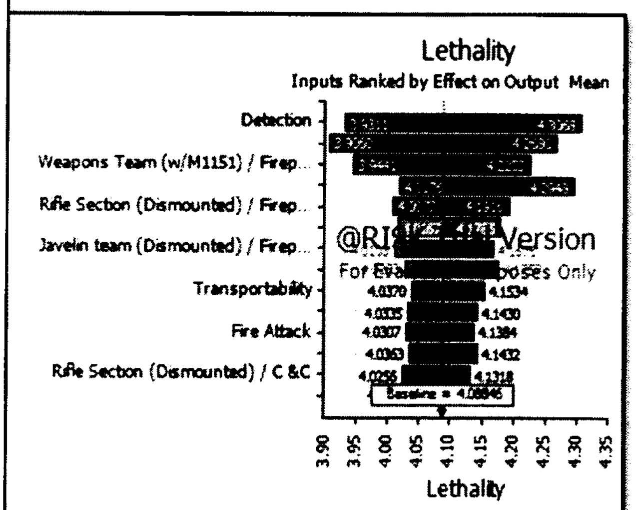


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Lethality

Statistics		Percentile	
Minimum	3.238123953	5%	3.6436133
Maximum	5.214812092	10%	3.7311496
Mean	4.088461615	15%	3.7911348
Std Dev	0.282805874	20%	3.8409314
Variance	0.079979162	25%	3.8828184
Skewness	0.223335814	30%	3.9261589
Kurtosis	2.875964878	35%	3.9657264
Median	4.080789465	40%	4.0050079
Mode	4.119119255	45%	4.0439008
Left X	3.643613315	50%	4.0807895
Left P	5%	55%	4.115949
Right X	4.568679415	60%	4.1511715
Right P	95%	65%	4.1893437
Diff X	0.9250661	70%	4.2314629
Diff P	90%	75%	4.2773549
#Errors	0	80%	4.327925
Filter Min	Off	85%	4.3851295
Filter Max	Off	90%	4.4623811
#Filtered	0	95%	4.5686794



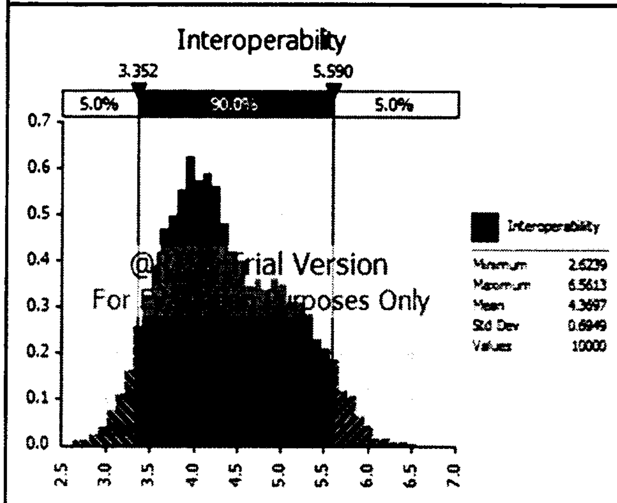
Change in Output Statistic for Lethality

Rank	Name	Lower	Upper
1	Detection	3.931143	4.3068149
2	Firepower	3.906037	4.2680498
3	Weapons Team (	3.9441436	4.2252907
4	Command & Con	4.017623	4.2948256
5	Rifle Section (Dis	4.0077009	4.1915906
6	Concealment	4.0166537	4.1784686
7	Javelin team (Dis	4.0103256	4.1675912
8	Self-Sufficiency	4.028314	4.1757062
9	Transportability	4.0370387	4.1534114
10	Weapons Team (	4.0334637	4.1430249
11	Fire Attack	4.0306667	4.138374
12	Mobility	4.0363262	4.1432377
13	Rifle Section (Dis	4.0255682	4.1317879
14	Rifle Section (Dis	4.0382267	4.1336696

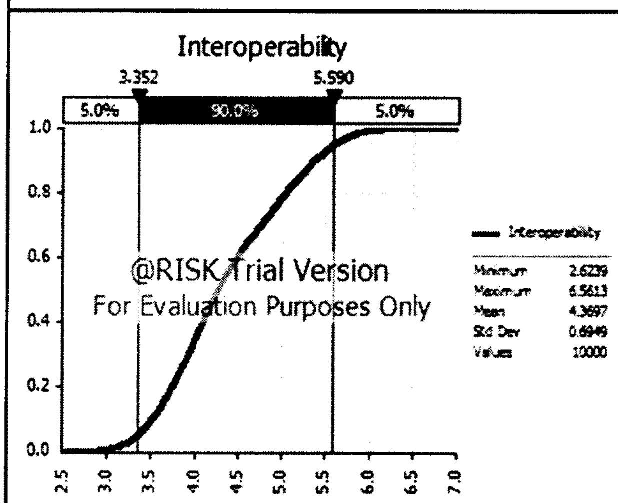
@RISK Output Report for Interoperability

Performed By: Metin

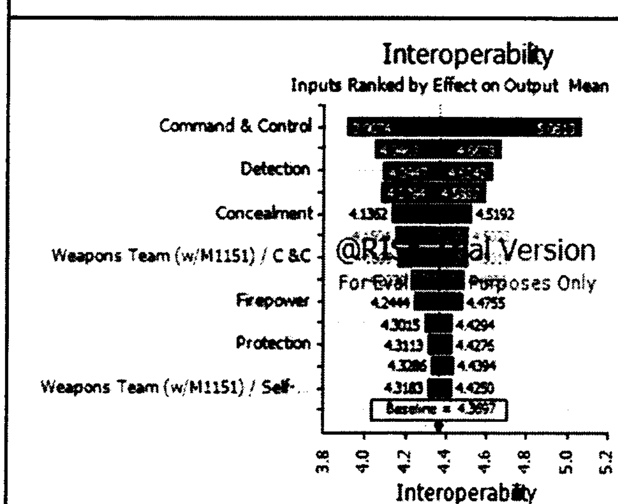
Date: Thursday, April 11, 2013 9:38:08 PM



Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Interoperability			
Statistics		**Percentile**	
Minimum	2.623933971	5%	3.3522709
Maximum	6.561268857	10%	3.5191971
Mean	4.369723695	15%	3.6428189
Std Dev	0.694919998	20%	3.7439055
Variance	0.482913803	25%	3.8360931
Skewness	0.318033704	30%	3.9315582
Kurtosis	2.344658174	35%	4.0101239
Median	4.266276156	40%	4.0945474
Mode	3.986228472	45%	4.1796515
Left X	3.352270877	50%	4.2662762
Left P	5%	55%	4.3683271
Right X	5.590077246	60%	4.4861704
Right P	95%	65%	4.6092732
Diff X	2.23780637	70%	4.7531405
Diff P	90%	75%	4.8990875
#Errors	0	80%	5.0394907
Filter Min	Off	85%	5.1984562
Filter Max	Off	90%	5.3637797
#Filtered	0	95%	5.5900772

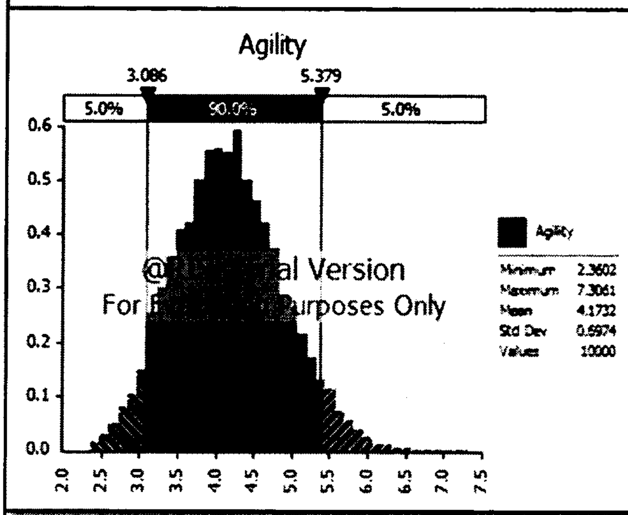


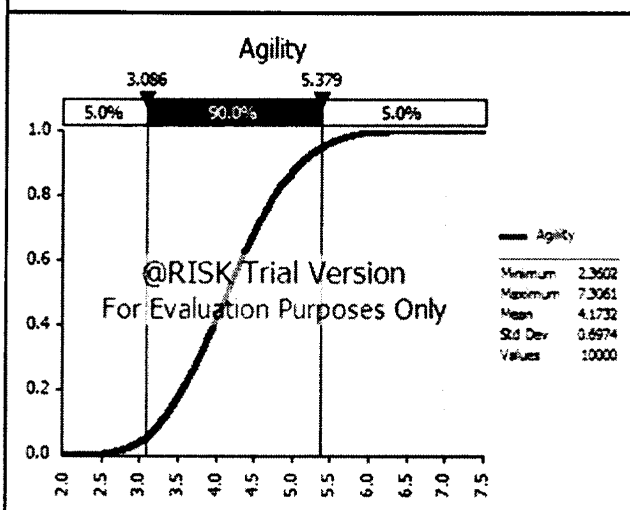
Change in Output Statistic for Interoperability			
Rank	**Name**	**Lower**	**Upper**
1	Command & Con	3.9073675	5.0612661
2	Transportability	4.0462709	4.6678396
3	Detection	4.0947335	4.6241828
4	Self-Sufficiency	4.0793923	4.5886907
5	Concealment	4.1362359	4.5191913
6	Rifle Section (Dis	4.1503676	4.5022611
7	Weapons Team (	4.1605255	4.5018986
8	Mobility	4.2269814	4.4836032
9	Firepower	4.2443544	4.4755483
10	Weapons Team (	4.3014574	4.4294068
11	Protection	4.3112527	4.4276105
12	Sniper Team (Dis	4.328567	4.4394011
13	Weapons Team (	4.3182867	4.4249612
14	Fire Attack	4.3254532	4.4281613

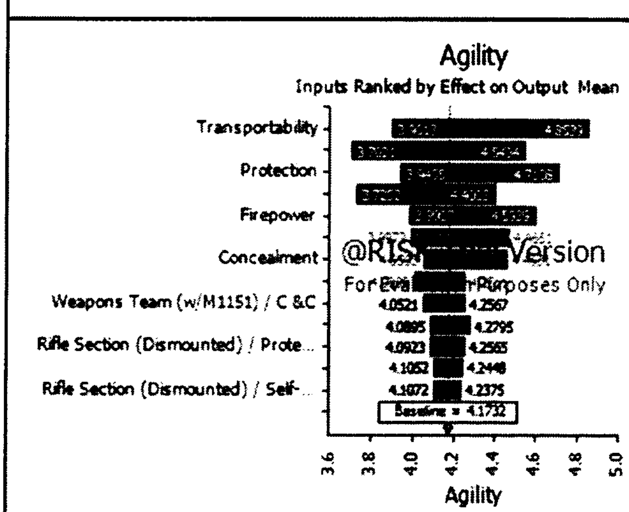
@RISK Output Report for Agility

Performed By: Metin

Date: Thursday, April 11, 2013 9:38:19 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Agility

Statistics		Percentile	
Minimum	2.360215749	5%	3.0861852
Maximum	7.30612915	10%	3.2785381
Mean	4.173241173	15%	3.4271403
Std Dev	0.697426471	20%	3.5583925
Variance	0.486403682	25%	3.677832
Skewness	0.237603084	30%	3.7896485
Kurtosis	2.876867786	35%	3.8780921
Median	4.148472213	40%	3.9711359
Mode	4.296845692	45%	4.0581606
Left X	3.086185175	50%	4.1484722
Left P	5%	55%	4.2348787
Right X	5.379186614	60%	4.3224841
Right P	95%	65%	4.4168992
Diff X	2.293001439	70%	4.5214403
Diff P	90%	75%	4.6346703
#Errors	0	80%	4.7574795
Filter Min	Off	85%	4.9127207
Filter Max	Off	90%	5.0957912
#Filtered	0	95%	5.3791866

Change in Output Statistic for Agility

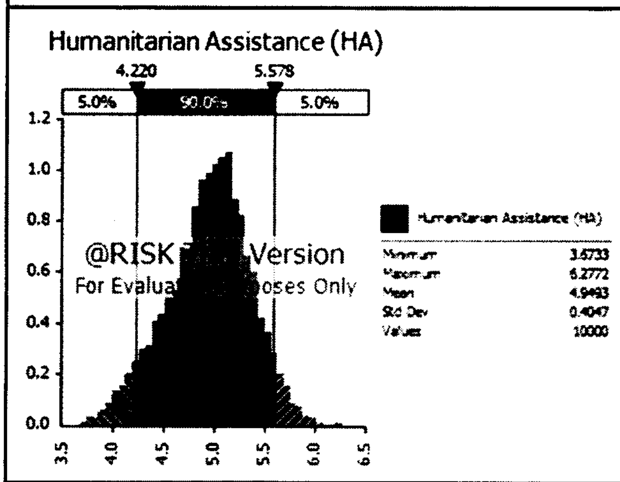
Rank	Name	Lower	Upper
1	Transportability	3.9013389	4.8539045
2	Command & Con	3.7021395	4.5433976
3	Protection	3.9455209	4.7107644
4	Self-Sufficiency	3.7251848	4.4003447
5	Firepower	3.990676	4.5938651
6	Mobility	3.9972415	4.4661393
7	Concealment	4.0593192	4.4631357
8	Rifle Section (Dis	4.0098863	4.2511137
9	Weapons Team (	4.0521095	4.2566855
10	Weapons Team (	4.089518	4.2795453
11	Rifle Section (Dis	4.0922925	4.2564675
12	Weapons Team (	4.1051675	4.2448018
13	Rifle Section (Dis	4.1072163	4.2375388
14	Weapons Team (	4.1113732	4.2348206

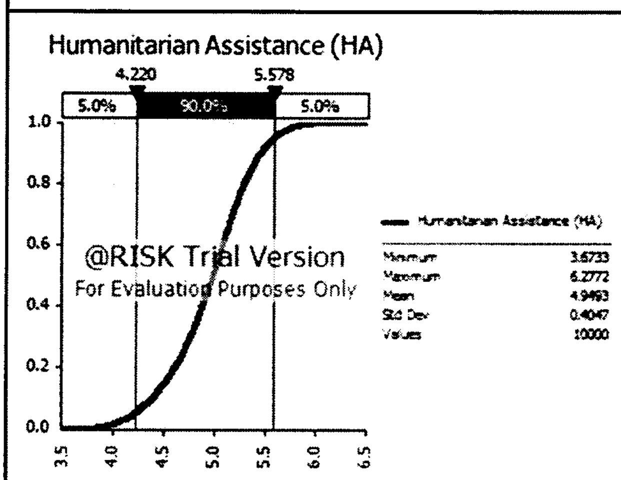
Heavy Option- Missions

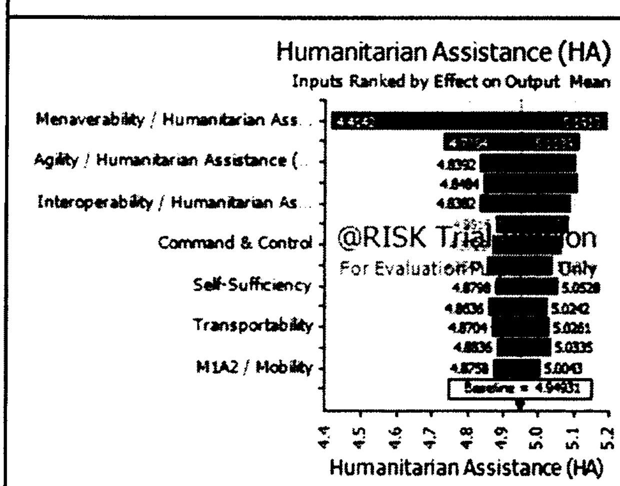
@RISK Output Report for Humanitarian Assistance (HA)

Performed By: Metin

Date: Thursday, April 11, 2013 9:38:31 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Humanitarian Assistance (

Statistics		Percentile	
Minimum	3.673320369	5%	4.2202862
Maximum	6.277156437	10%	4.3897562
Mean	4.949309267	15%	4.5108951
Std Dev	0.40470385	20%	4.608054
Variance	0.163785206	25%	4.6920434
Skewness	-0.270180337	30%	4.7656327
Kurtosis	2.869713554	35%	4.8263619
Median	4.98006332	40%	4.8772332
Mode	5.148866316	45%	4.9300516
Left X	4.220286236	50%	4.9800633
Left P	5%	55%	5.0301017
Right X	5.577871593	60%	5.0773796
Right P	95%	65%	5.1248383
Diff X	1.357585357	70%	5.1710374
Diff P	90%	75%	5.2278763
#Errors	0	80%	5.2863482
Filter Min	Off	85%	5.3601263
Filter Max	Off	90%	5.4451812
#Filtered	0	95%	5.5778716

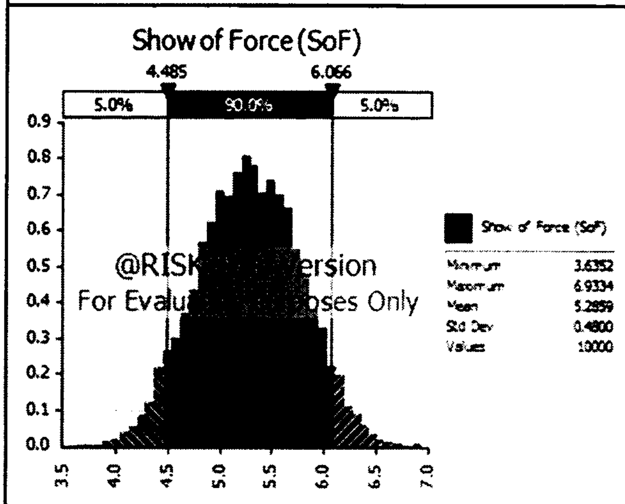
Change in Output Statistic for Humanitarian Assi

Rank	Name	Lower	Upper
1	Menaverability /	4.414191	5.1912965
2	Mobility	4.7353508	5.11389
3	Agility / Humanit	4.8391889	5.1018088
4	Deployability / H	4.8483657	5.1071105
5	Interoperability /	4.8382331	5.0847094
6	Protection	4.8816068	5.0823428
7	Command & Con	4.8728604	5.0606453
8	Command & Con	4.8547409	5.0373842
9	Self-Sufficiency	4.8797527	5.0527907
10	Fire Attack	4.8635612	5.0241626
11	Transportability	4.8703857	5.0261047
12	M2A3 Bradley 2 I	4.8836428	5.033455
13	M1A2 / Mobility	4.8757963	5.0042509
14	M1A2 / Self-Suffic	4.8864765	4.9994414

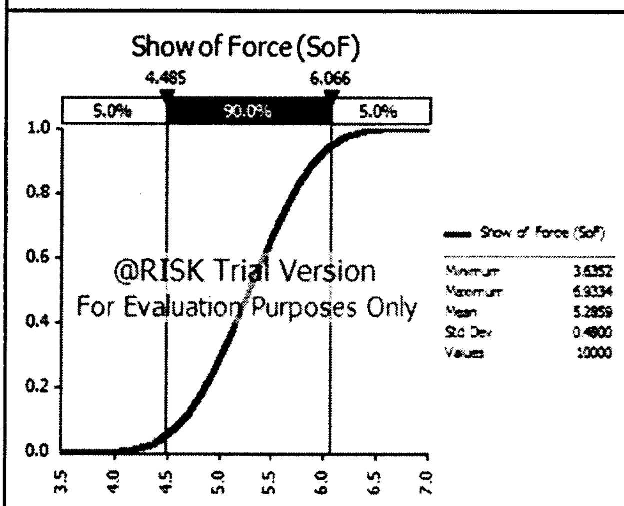
@RISK Output Report for Show of Force (SoF)

Performed By: Metin

Date: Thursday, April 11, 2013 9:38:45 PM

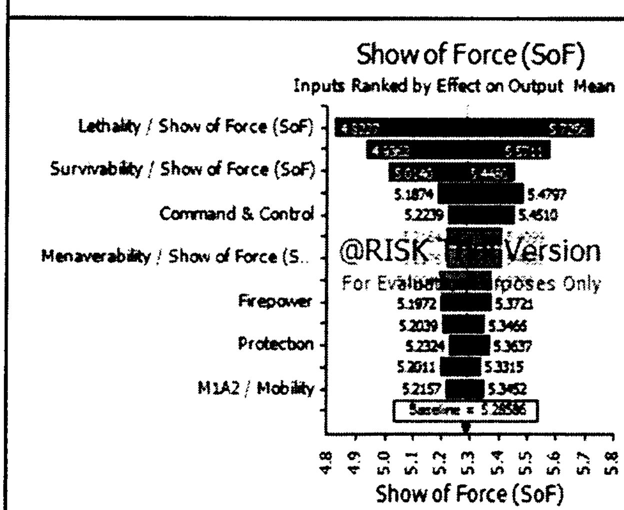


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Show of Force (SoF)

Statistics		Percentile	
Minimum	3.6351899	5%	4.4849439
Maximum	6.933351053	10%	4.6564576
Mean	5.285858405	15%	4.772042
Std Dev	0.479967775	20%	4.8671558
Variance	0.230369065	25%	4.9486737
Skewness	-0.001112583	30%	5.018282
Kurtosis	2.677602964	35%	5.0885992
Median	5.285052836	40%	5.159593
Mode	5.25457056	45%	5.2232676
Left X	4.48494393	50%	5.2850528
Left P	5%	55%	5.3493382
Right X	6.066182815	60%	5.416183
Right P	95%	65%	5.4849897
Diff X	1.581238885	70%	5.5530143
Diff P	90%	75%	5.6255525
#Errors	0	80%	5.7039364
Filter Min	Off	85%	5.7969967
Filter Max	Off	90%	5.9104408
#Filtered	0	95%	6.0661828

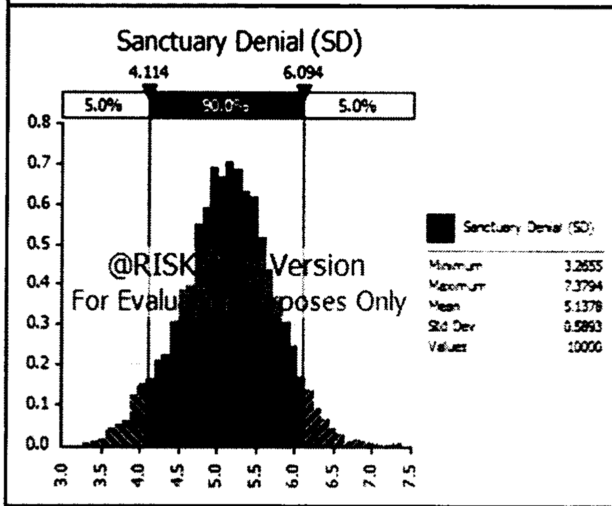


Change in Output Statistic for Show of Force (SoF

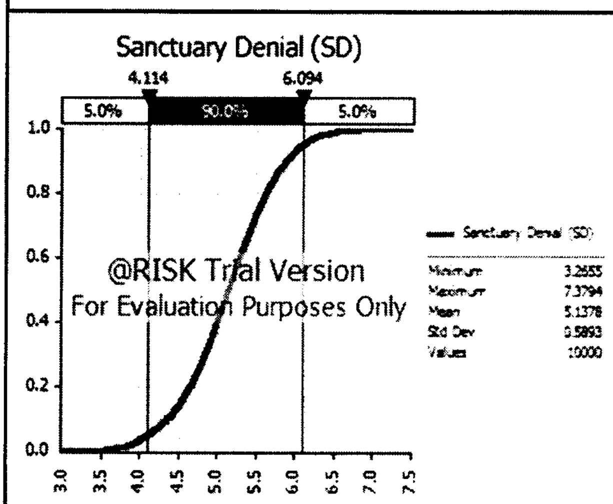
Rank	Name	Lower	Upper
1	Lethality / Show	4.8227237	5.7255615
2	Deployability / Sh	4.936207	5.5710661
3	Survivability / Sh	5.0139962	5.4480217
4	Agility / Show of F	5.1873757	5.4797225
5	Command & Con	5.223874	5.4509779
6	Detection	5.2164413	5.4098765
7	Menaverability /	5.2176112	5.4052679
8	M2A3 Bradley 2 I	5.1903537	5.373612
9	Firepower	5.1972109	5.3721311
10	Mobility	5.2039338	5.3466313
11	Protection	5.2324196	5.3636951
12	Sustainability / S	5.2011322	5.331509
13	M1A2 / Mobility	5.2156834	5.3451536
14	Mobility	5.2220863	5.3367834

@RISK Output Report for Sanctuary Denial (SD)

Performed By: Metin
Date: Thursday, April 11, 2013 9:38:59 PM

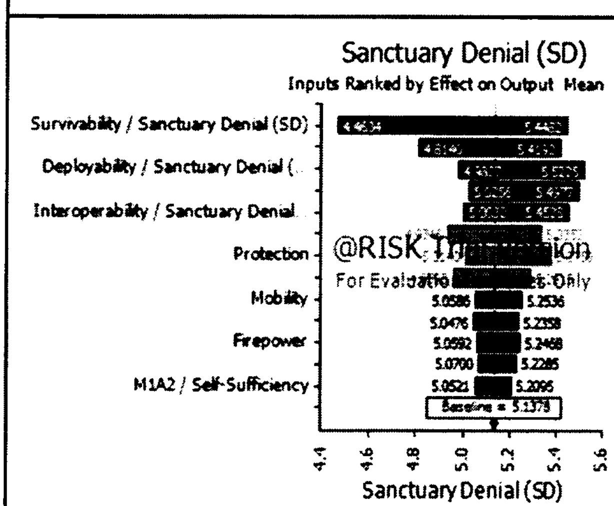


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Sanctuary Denial (SD)

Statistics		Percentile	
Minimum	3.265473658	5%	4.1144513
Maximum	7.379389046	10%	4.3608968
Mean	5.137839339	15%	4.533404
Std Dev	0.589285377	20%	4.6558814
Variance	0.347257255	25%	4.7610752
Skewness	-0.050469038	30%	4.8495624
Kurtosis	3.002722658	35%	4.9258801
Median	5.146502842	40%	4.9984248
Mode	5.282747694	45%	5.0762417
Left X	4.114451318	50%	5.1465028
Left P	5%	55%	5.2199918
Right X	6.093884846	60%	5.2890689
Right P	95%	65%	5.3638932
Diff X	1.979433528	70%	5.4480289
Diff P	90%	75%	5.5302088
#Errors	0	80%	5.6278197
Filter Min	Off	85%	5.7416183
Filter Max	Off	90%	5.885785
#Filtered	0	95%	6.0938848

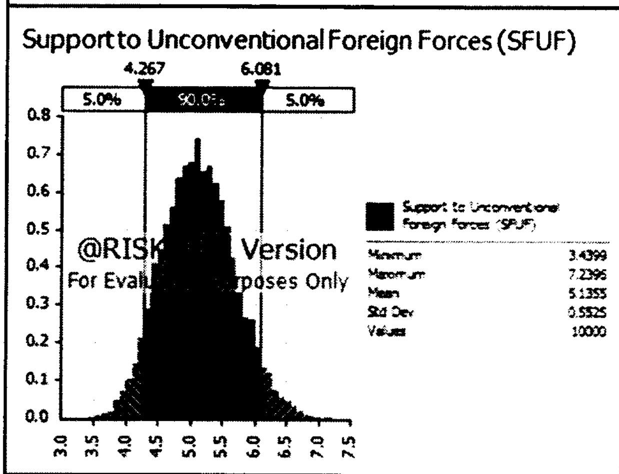


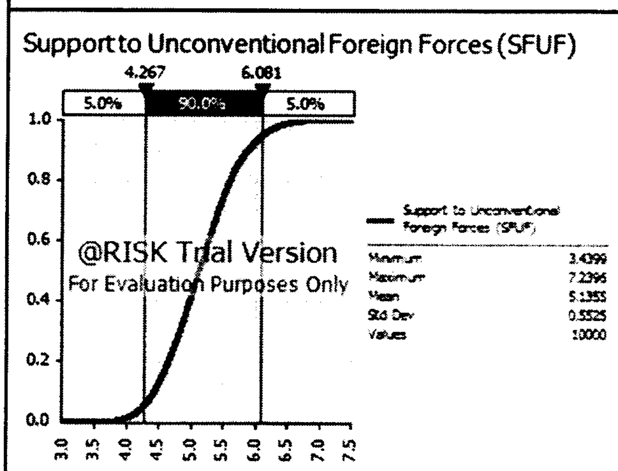
Change in Output Statistic for Sanctuary Denial (S

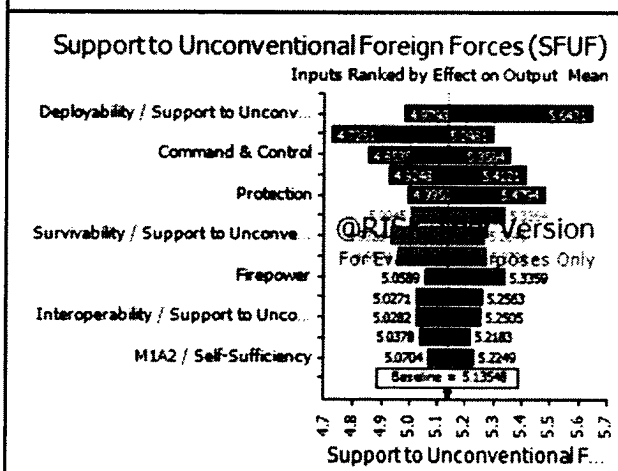
Rank	Name	Lower	Upper
1	Survivability / Sa	4.4633879	5.4482319
2	Menaverability /	4.813962	5.4191848
3	Deployability / S	4.9827097	5.5224931
4	Sustainability / S	5.0255885	5.4976507
5	Interoperability /	5.0032326	5.4528204
6	Agility / Sanctuar	4.9345695	5.3352983
7	Protection	5.0139632	5.3758309
8	Command & Con	4.9592514	5.2915183
9	Mobility	5.0586338	5.2536224
10	M2A3 Bradley 2 I	5.0476452	5.2357501
11	Firepower	5.0591623	5.2467888
12	Command & Con	5.0700485	5.2284778
13	M1A2 / Self-Suffic	5.0521269	5.2095448
14	M1A2 / Mobility	5.055864	5.211793

@RISK Output Report for Support to Unconventional Foreign Forces

Performed By: Metin
Date: Thursday, April 11, 2013 9:39:13 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Support to Unconventiona

Statistics		Percentile	
Minimum	3.439866975	5%	4.2673477
Maximum	7.239554558	10%	4.4308241
Mean	5.135481051	15%	4.5494406
Std Dev	0.552528465	20%	4.6503891
Variance	0.305287705	25%	4.7408974
Skewness	0.21120972	30%	4.8211601
Kurtosis	2.823165355	35%	4.9009886
Median	5.115245942	40%	4.974717
Mode	5.066283583	45%	5.0457986
Left X	4.267347682	50%	5.1152459
Left P	5%	55%	5.1909364
Right X	6.080995084	60%	5.261834
Right P	95%	65%	5.338927
Diff X	1.813647402	70%	5.4144525
Diff P	90%	75%	5.5017092
#Errors	0	80%	5.5981636
Filter Min	Off	85%	5.7127442
Filter Max	Off	90%	5.8652816
#Filtered	0	95%	6.0809951

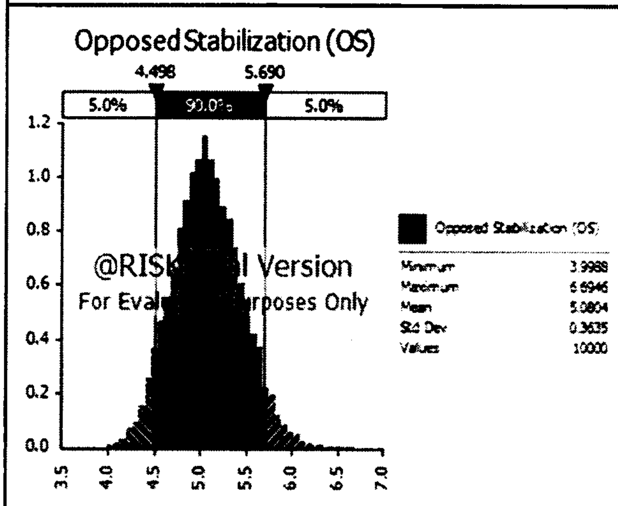
Change in Output Statistic for Support to Uncony

Rank	Name	Lower	Upper
1	Deployability / S	4.9797694	5.6430721
2	Agility / Support t	4.7251258	5.2980718
3	Command & Con	4.8534969	5.3583553
4	Command & Con	4.9247658	5.4120743
5	Protection	4.9950318	5.4794301
6	Mobility	5.0044592	5.3364464
7	Survivability / Su	4.9326103	5.2640615
8	Lethality / Suppo	4.9573529	5.2720902
9	Firepower	5.0588671	5.3358653
10	Sustainability / S	5.0271315	5.256317
11	Interoperability /	5.0281539	5.2505328
12	Detection	5.0378311	5.2183072
13	M1A2 / Self-Suffic	5.0703828	5.22493
14	Self-Sufficiency	5.0346802	5.1807916

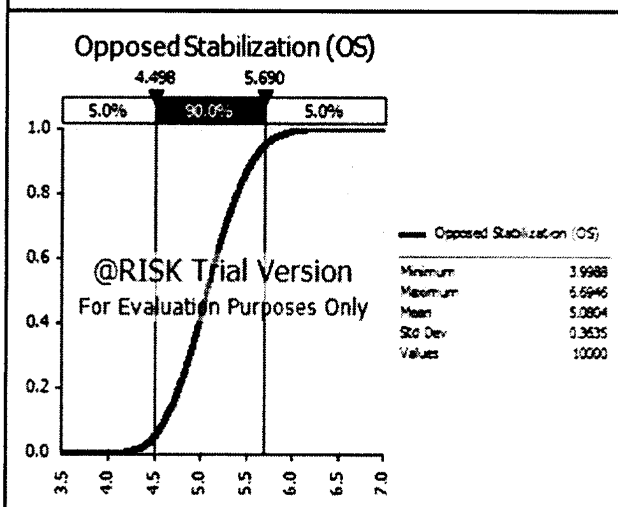
@RISK Output Report for Opposed Stabilization (OS)

Performed By: Metin

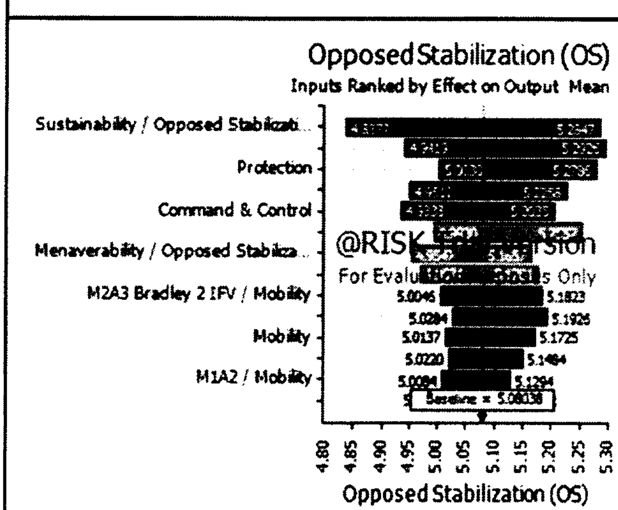
Date: Thursday, April 11, 2013 9:39:27 PM



Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Opposed Stabilization (OS)			
Statistics		**Percentile**	
Minimum	3.998773183	5%	4.4983801
Maximum	6.694577061	10%	4.6111892
Mean	5.080380067	15%	4.6984791
Std Dev	0.36349478	20%	4.7673596
Variance	0.132128455	25%	4.8300281
Skewness	0.173333698	30%	4.8814762
Kurtosis	2.872039606	35%	4.9312426
Median	5.06468413	40%	4.9781799
Mode	5.053132933	45%	5.0243667
Left X	4.498380134	50%	5.0646841
Left P	5%	55%	5.1142851
Right X	5.68993303	60%	5.1597546
Right P	95%	65%	5.2114447
Diff X	1.191552896	70%	5.2662459
Diff P	90%	75%	5.3258471
#Errors	0	80%	5.3900428
Filter Min	Off	85%	5.4661142
Filter Max	Off	90%	5.5602243
#Filtered	0	95%	5.689933

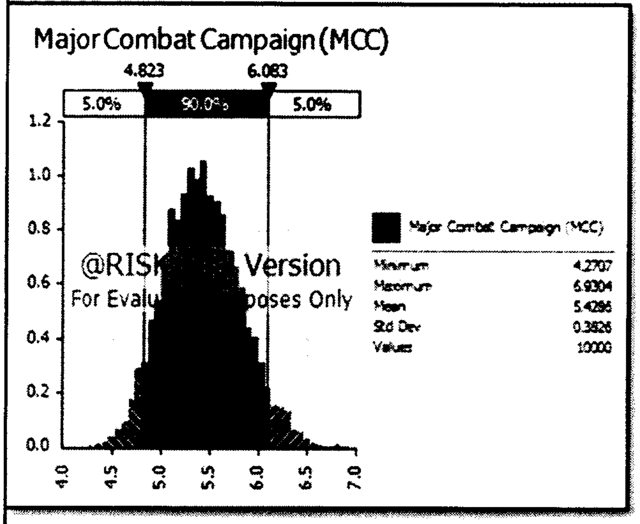


Change in Output Statistic for Opposed Stabilizat			
Rank	**Name**	**Lower**	**Upper**
1	Sustainability / O	4.8376913	5.2847206
2	Command & Con	4.9419229	5.2926231
3	Protection	5.0029716	5.2785607
4	Agility / Opposed	4.9511839	5.2257968
5	Command & Con	4.9338206	5.2034594
6	Interoperability /	4.992998	5.255198
7	Menaverability /	4.9547382	5.165669
8	M1A2 / Self-Suffic	4.9674347	5.178141
9	M2A3 Bradley 2 I	5.0046251	5.1823323
10	Firepower	5.0284099	5.1926026
11	Mobility	5.0136802	5.1724814
12	Protection	5.0220187	5.1484206
13	M1A2 / Mobility	5.0083857	5.1294201
14	Detection	5.0191683	5.1331952

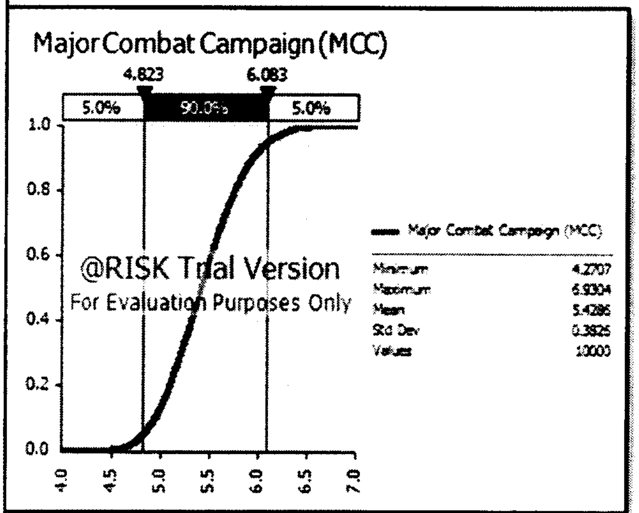
@RISK Output Report for Major Combat Campaign (MCC)

Performed By: Metin

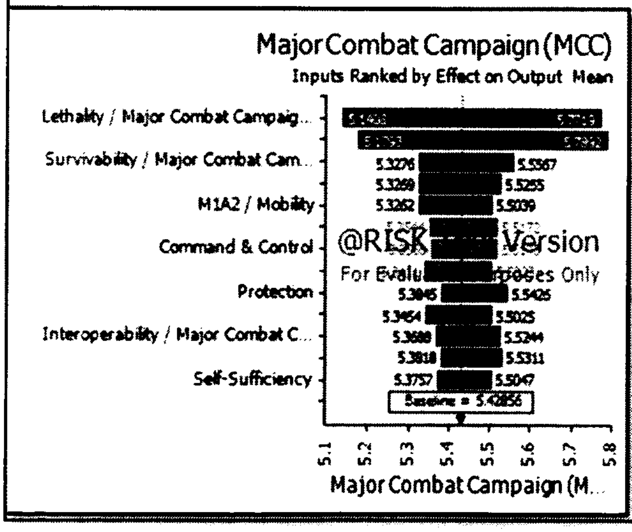
Date: Thursday, April 11, 2013 9:39:41 PM



Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Major Combat Campaign (			
Statistics		**Percentile**	
Minimum	4.270708829	5%	4.8227467
Maximum	6.930441234	10%	4.9429383
Mean	5.428560475	15%	5.0284024
Std Dev	0.382572867	20%	5.0958415
Variance	0.146361999	25%	5.1530388
Skewness	0.232504517	30%	5.209582
Kurtosis	2.847742477	35%	5.2634813
Median	5.41330718	40%	5.3145781
Mode	5.318999316	45%	5.3627561
Left X	4.822746693	50%	5.4133072
Left P	5%	55%	5.4598845
Right X	6.082839575	60%	5.5121309
Right P	95%	65%	5.566049
Diff X	1.260092882	70%	5.6227757
Diff P	90%	75%	5.6838434
#Errors	0	80%	5.7531337
Filter Min	Off	85%	5.8336715
Filter Max	Off	90%	5.936659
#Filtered	0	95%	6.0828396

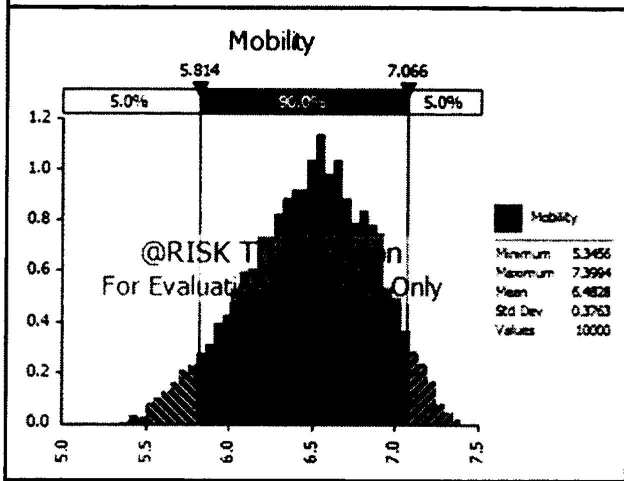


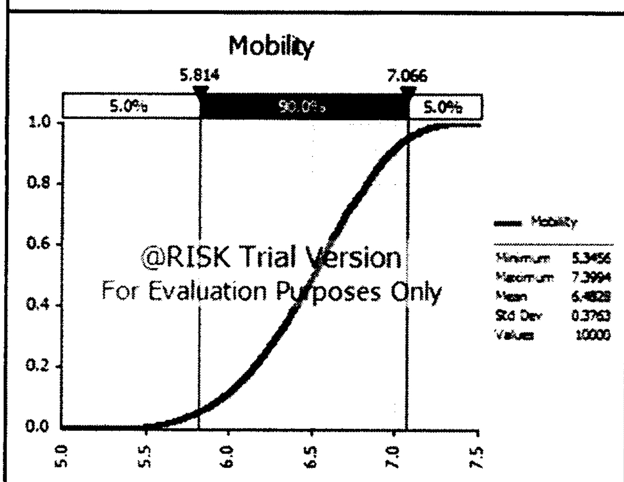
Change in Output Statistic for Major Combat Cam			
Rank	**Name**	**Lower**	**Upper**
1	Lethality / Major	5.1407854	5.7719173
2	Menaverability /	5.1793445	5.789245
3	Survivability / Ma	5.3275778	5.5567431
4	M2A3 Bradley 2 I	5.3268706	5.5255018
5	M1A2 / Mobility	5.3262404	5.5038925
6	Detection	5.3543815	5.5172262
7	Command & Con	5.3559814	5.517543
8	Command & Con	5.3411485	5.5022976
9	Protection	5.3845291	5.5425874
10	Firepower	5.3454265	5.5024829
11	Interoperability /	5.3687821	5.5244219
12	Command & Con	5.3818373	5.5310791
13	Self-Sufficiency	5.3757349	5.5047112
14	Firepower	5.3833352	5.4926385

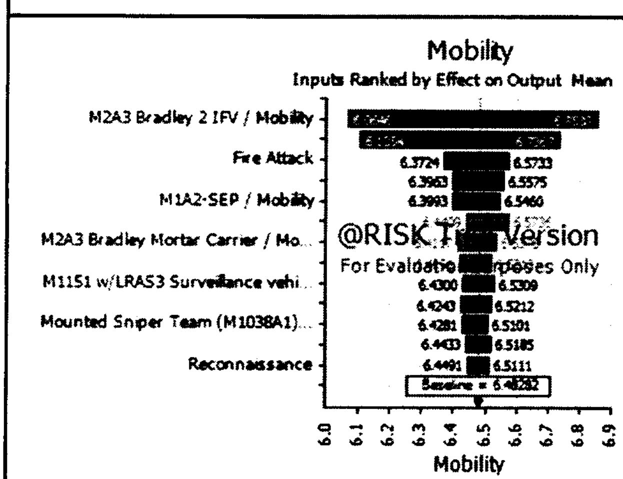
Heavy Option- Attributes

@RISK Output Report for Mobility

Performed By: Metin
Date: Thursday, April 11, 2013 9:39:55 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

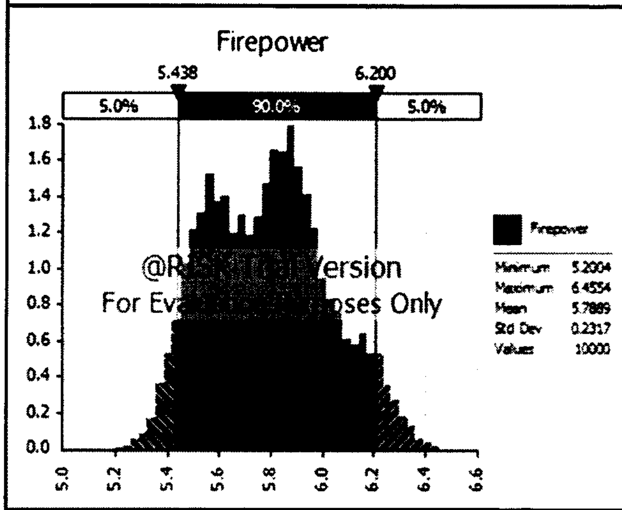
Summary Statistics for Mobility			
Statistics		Percentile	
Minimum	5.345572354	5%	5.8143767
Maximum	7.399386503	10%	5.9674355
Mean	6.482822484	15%	6.0707865
Std Dev	0.376344414	20%	6.1534789
Variance	0.141635118	25%	6.2223292
Skewness	-0.252186592	30%	6.2903696
Kurtosis	2.564004947	35%	6.3492736
Median	6.507088332	40%	6.4029126
Mode	6	45%	6.4596026
Left X	5.814376706	50%	6.5070883
Left P	5%	55%	6.5542312
Right X	7.066315789	60%	6.601108
Right P	95%	65%	6.6513158
Diff X	1.251939083	70%	6.7008141
Diff P	90%	75%	6.7625806
#Errors	0	80%	6.8245161
Filter Min	Off	85%	6.886836
Filter Max	Off	90%	6.9574468
#Filtered	0	95%	7.0663158

Change in Output Statistic for Mobility			
Rank	Name	Lower	Upper
1	M2A3 Bradley 2 I	6.0646274	6.853801
2	M1A2 / Mobility	6.1054027	6.7366609
3	Fire Attack	6.3724248	6.5732602
4	M3A3 Bradley CF	6.3963265	6.5575301
5	M1A2-SEP / Mobi	6.3992637	6.5459533
6	M1109 Rec. Vehi	6.4409077	6.5736059
7	M2A3 Bradley Mo	6.4117169	6.5377895
8	Fire Support	6.4191189	6.5213234
9	M1151 w/LRAS3 S	6.4299797	6.5309423
10	Indirect Fire	6.4242766	6.5211926
11	Mounted Sniper T	6.4280913	6.5100747
12	SP M109A6 Palad	6.4432598	6.5185456
13	Reconnaissance	6.4490667	6.5110892
14	M1038A1 troop c	6.4523875	6.5128585

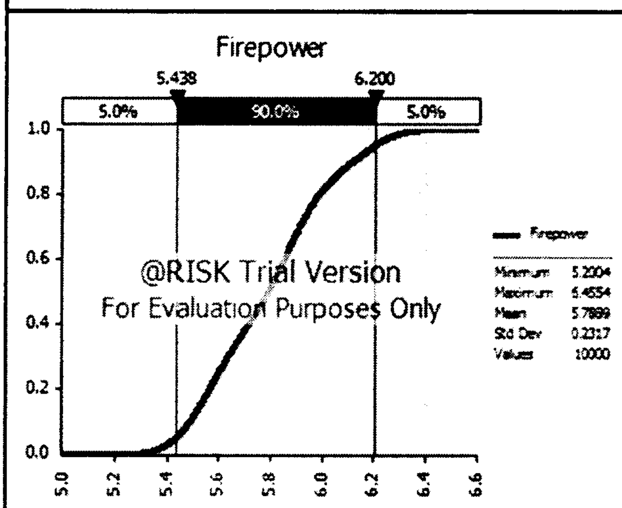
@RISK Output Report for Firepower

Performed By: Metin

Date: Thursday, April 11, 2013 9:40:03 PM

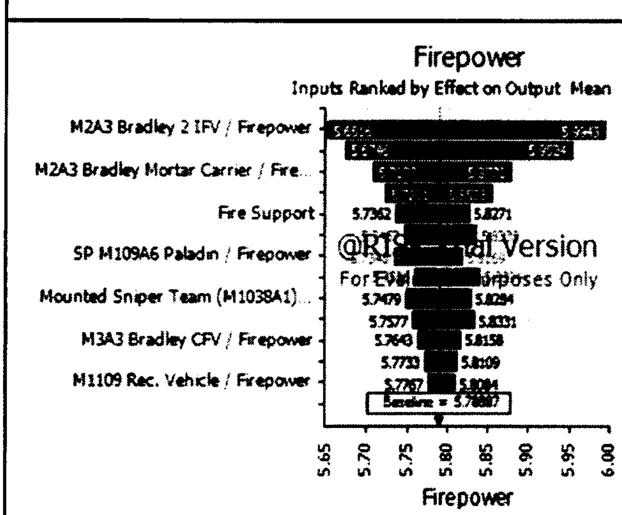


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Firepower

Statistics		Percentile	
Minimum	5.200379867	5%	5.438172
Maximum	6.455426357	10%	5.4889225
Mean	5.788865462	15%	5.5291262
Std Dev	0.231717301	20%	5.5651982
Variance	0.053692908	25%	5.5980126
Skewness	0.210365154	30%	5.6344086
Kurtosis	2.361793495	35%	5.6757246
Median	5.790419162	40%	5.7163668
Mode	5.597311828	45%	5.7566331
Left X	5.438172043	50%	5.7904192
Left P	5%	55%	5.8219557
Right X	6.20020429	60%	5.8529412
Right P	95%	65%	5.8802395
Diff X	0.762032247	70%	5.9106231
Diff P	90%	75%	5.9454545
#Errors	0	80%	5.9852802
Filter Min	Off	85%	6.0405784
Filter Max	Off	90%	6.116194
#Filtered	0	95%	6.2002043



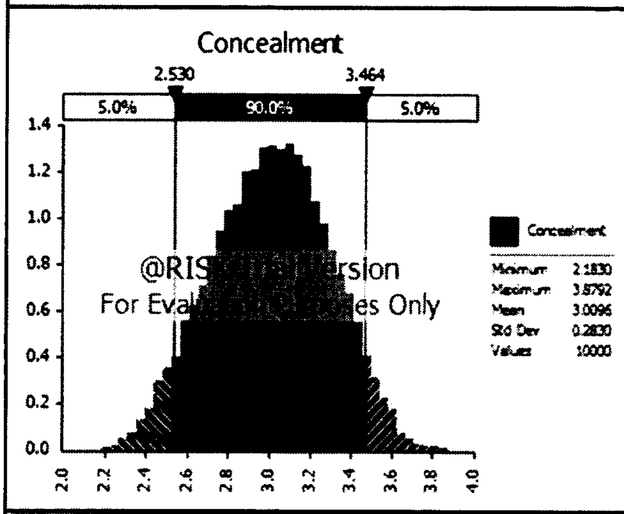
Change in Output Statistic for Firepower

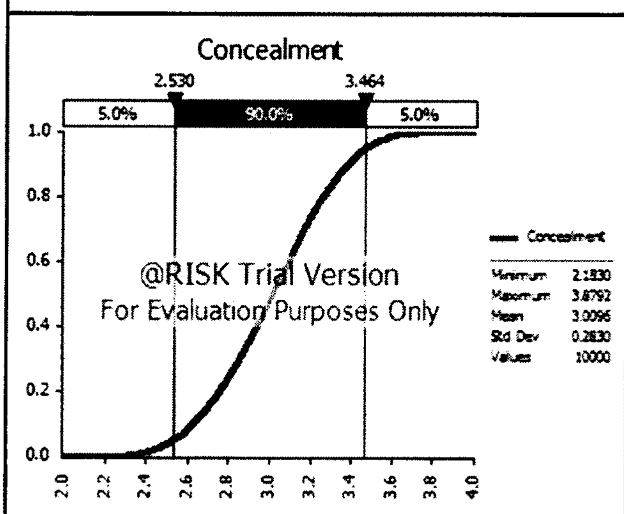
Rank	Name	Lower	Upper
1	M2A3 Bradley 2 I	5.6515599	5.994285
2	M1A2 / Firepowe	5.6746193	5.9523736
3	M2A3 Bradley Mo	5.7076976	5.8770401
4	Reconnaissance	5.7231112	5.8533052
5	Fire Support	5.7361646	5.8270823
6	M1038A1 troop c	5.7457106	5.8337526
7	SP M109A6 Palad	5.7347539	5.8168553
8	M1A2-SEP / Firep	5.7585873	5.839435
9	Mounted Sniper	5.7479219	5.8284089
10	Fire Attack	5.757673	5.8331077
11	M3A3 Bradley CF	5.7642977	5.815751
12	Indirect Fire	5.773347	5.8109488
13	M1109 Rec. Vehi	5.7766984	5.8083532
14	Target Acquisitio	5.7773682	5.8022249

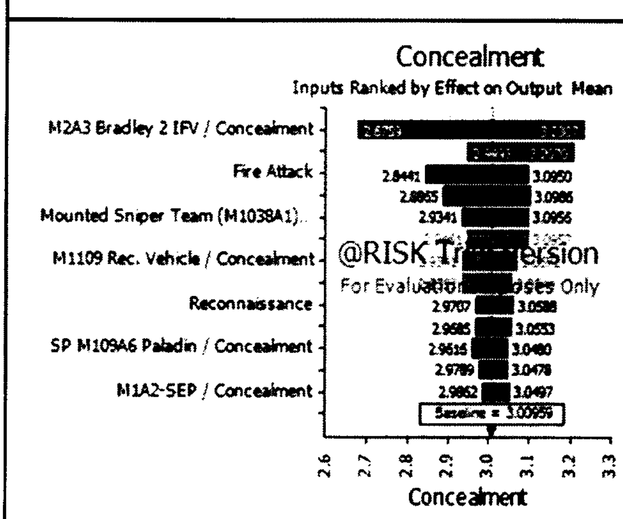
@RISK Output Report for Concealment

Performed By: Metin

Date: Thursday, April 11, 2013 9:40:11 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Concealment

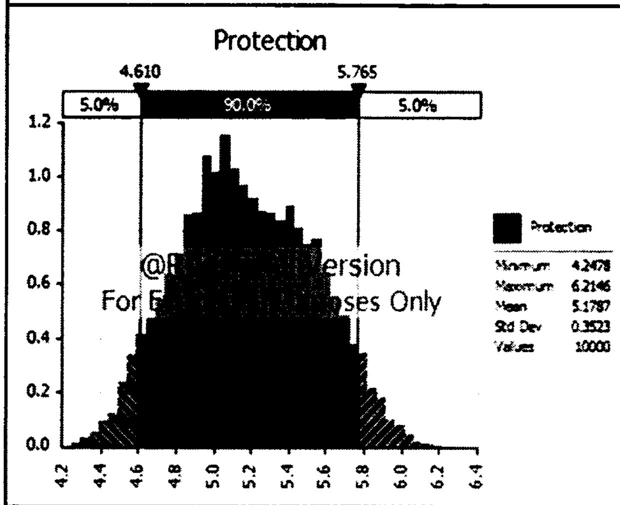
Statistics		Percentile	
Minimum	2.183029453	5%	2.5302843
Maximum	3.879177378	10%	2.6299639
Mean	3.009590175	15%	2.6993428
Std Dev	0.282988844	20%	2.7554688
Variance	0.080082686	25%	2.8084337
Skewness	-0.05341151	30%	2.8539007
Kurtosis	2.53300615	35%	2.8968134
Median	3.01541307	40%	2.9369085
Mode	3	45%	2.9774648
Left X	2.530284302	50%	3.0154131
Left P	5%	55%	3.0547771
Right X	3.464285714	60%	3.0922882
Right P	95%	65%	3.1286255
Diff X	0.934001413	70%	3.1683239
Diff P	90%	75%	3.2123894
#Errors	0	80%	3.2605634
Filter Min	Off	85%	3.3150685
Filter Max	Off	90%	3.3801792
#Filtered	0	95%	3.4642857

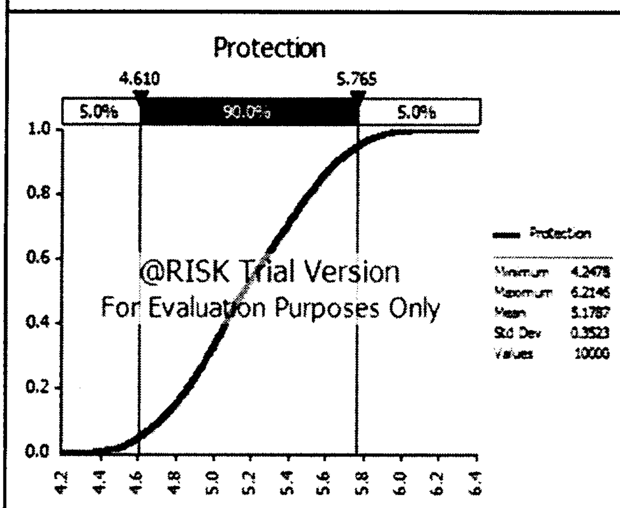
Change in Output Statistic for Concealment

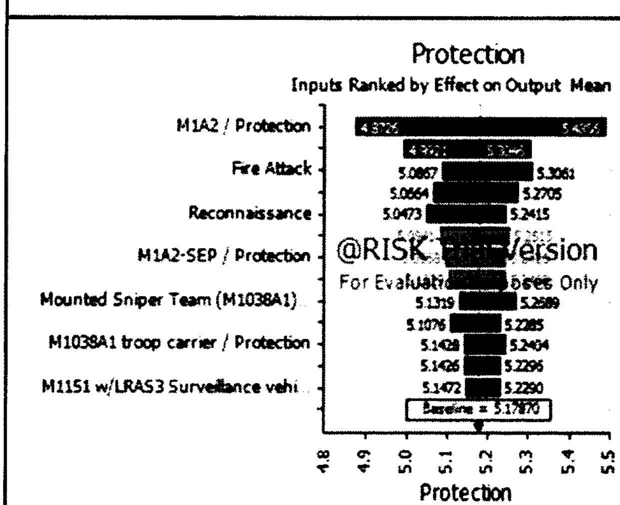
Rank	Name	Lower	Upper
1	M2A3 Bradley 2 I	2.6758965	3.2307119
2	M1A2 / Concealm	2.9493069	3.2070497
3	Fire Attack	2.844103	3.0950206
4	M3A3 Bradley CF	2.8864551	3.0985857
5	Mounted Sniper	2.9340836	3.0955974
6	M2A3 Bradley M	2.9460552	3.095704
7	M1109 Rec. Vehi	2.9341364	3.0672047
8	M1151 w/LRAS3	2.9353044	3.0544457
9	Reconnaissance	2.970749	3.0588038
10	Fire Support	2.96845	3.0552818
11	SP M109A6 Palad	2.9615615	3.0480431
12	M1038A1 troop c	2.9788821	3.0478383
13	M1A2-SEP / Conc	2.9861915	3.0496986
14	Target Acquisitio	2.9929797	3.0261043

@RISK Output Report for Protection

Performed By: Metin
Date: Thursday, April 11, 2013 9:40:19 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

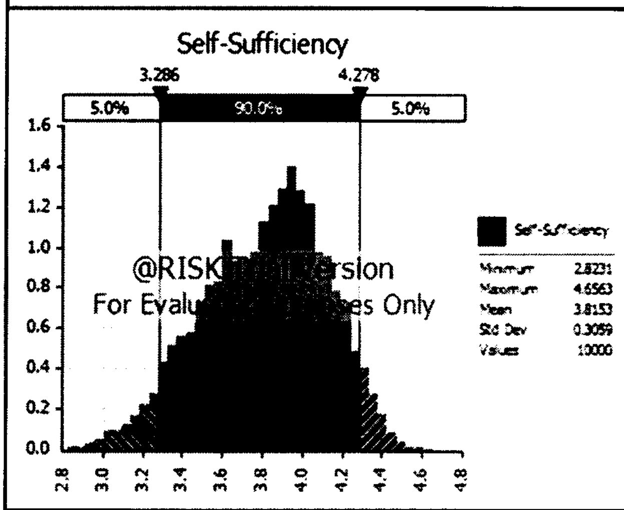
Summary Statistics for Protection			
Statistics		**Percentile**	
Minimum	4.247761194	5%	4.6095238
Maximum	6.214609287	10%	4.7156348
Mean	5.178702903	15%	4.796544
Std Dev	0.352264654	20%	4.8626761
Variance	0.124090386	25%	4.9196231
Skewness	0.076834931	30%	4.9711009
Kurtosis	2.362513375	35%	5.0181269
Median	5.159388646	40%	5.0648352
Mode	5	45%	5.1095119
Left X	4.60952381	50%	5.1593886
Left P	5%	55%	5.2130966
Right X	5.764705882	60%	5.2690125
Right P	95%	65%	5.3273743
Diff X	1.155182073	70%	5.3882212
Diff P	90%	75%	5.4463918
#Errors	0	80%	5.5077093
Filter Min	Off	85%	5.5731272
Filter Max	Off	90%	5.6546227
#Filtered	0	95%	5.7647059

Change in Output Statistic for Protection			
Rank	**Name**	**Lower**	**Upper**
1	M1A2 / Protectio	4.8726171	5.4856123
2	M2A3 Bradley 2 I	4.9921014	5.3045811
3	Fire Attack	5.0866907	5.3060663
4	Fire Support	5.0664016	5.2704932
5	Reconnaissance	5.0472628	5.2415169
6	M2A3 Bradley Mo	5.0841435	5.2515
7	M1A2-SEP / Prote	5.0968169	5.2426061
8	Indirect Fire	5.102907	5.2408211
9	Mounted Sniper T	5.1319428	5.2688575
10	M3A3 Bradley CF	5.107595	5.2284636
11	M1038A1 troop c	5.1427579	5.2403925
12	M1109 Rec. Vehi	5.1425755	5.2295503
13	M1151 w/LRAS3 S	5.1471693	5.2289649
14	SP M109A6 Palad	5.141144	5.2150371

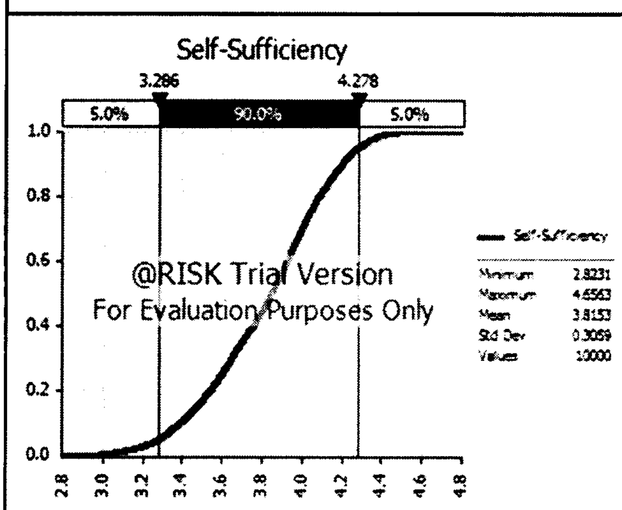
@RISK Output Report for Self-Sufficiency

Performed By: Metin

Date: Thursday, April 11, 2013 9:40:27 PM

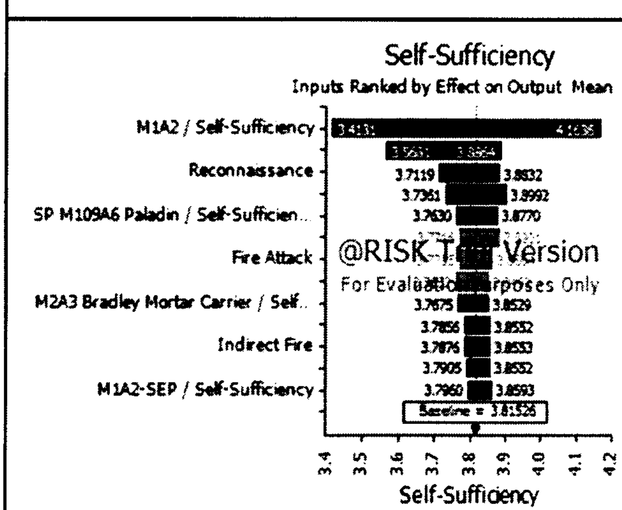


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Self-Sufficiency

Statistics		Percentile	
Minimum	2.823129252	5%	3.2855297
Maximum	4.65625	10%	3.3894558
Mean	3.815263953	15%	3.4745011
Std Dev	0.305914053	20%	3.5384615
Variance	0.093583408	25%	3.6001206
Skewness	-0.306734414	30%	3.6491228
Kurtosis	2.576599694	35%	3.7027027
Median	3.847478475	40%	3.7569956
Mode	4	45%	3.8057785
Left X	3.285529716	50%	3.8474785
Left P	5%	55%	3.8875256
Right X	4.278118609	60%	3.9256831
Right P	95%	65%	3.9624183
Diff X	0.992588894	70%	4
Diff P	90%	75%	4.0392491
#Errors	0	80%	4.0853659
Filter Min	Off	85%	4.138484
Filter Max	Off	90%	4.1991822
#Filtered	0	95%	4.2781186



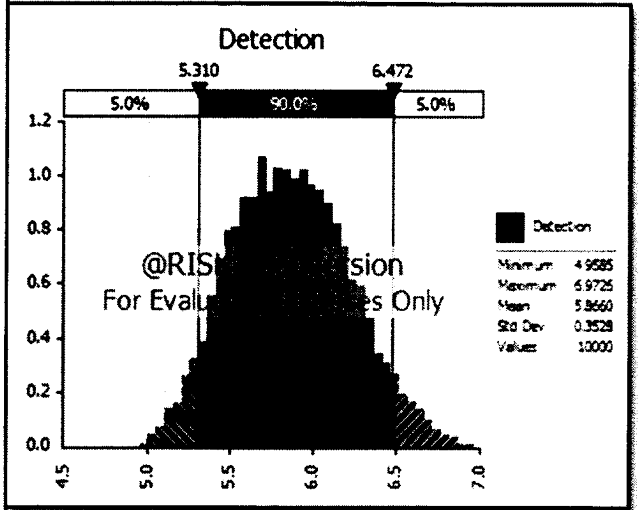
Change in Output Statistic for Self-Sufficiency

Rank	Name	Lower	Upper
1	M1A2 / Self-Suffic	3.4130781	4.1635785
2	M2A3 Bradley 2 I	3.5681466	3.8864288
3	Reconnaissance	3.7118679	3.8832137
4	M3A3 Bradley CF	3.7360606	3.8991925
5	SP M109A6 Palad	3.7629956	3.8770441
6	Fire Support	3.7715985	3.8800685
7	Fire Attack	3.7715488	3.8604076
8	M1109 Rec. Vehi	3.7631648	3.849217
9	M2A3 Bradley M	3.7674744	3.8529159
10	M1038A1 troop c	3.7855581	3.8551661
11	Indirect Fire	3.7876486	3.8553218
12	Mounted Sniper	3.7904969	3.855202
13	M1A2-SEP / Self-S	3.7960471	3.8593261
14	M1151 w/LRAS3	3.7783145	3.8352592

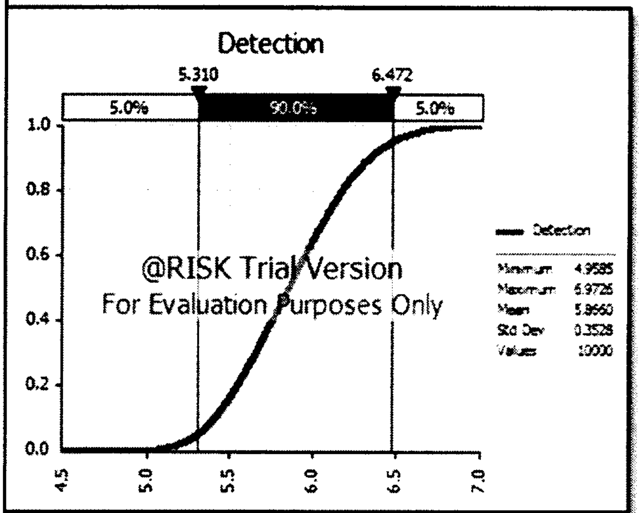
@RISK Output Report for Detection

Performed By: Metin

Date: Thursday, April 11, 2013 9:40:35 PM

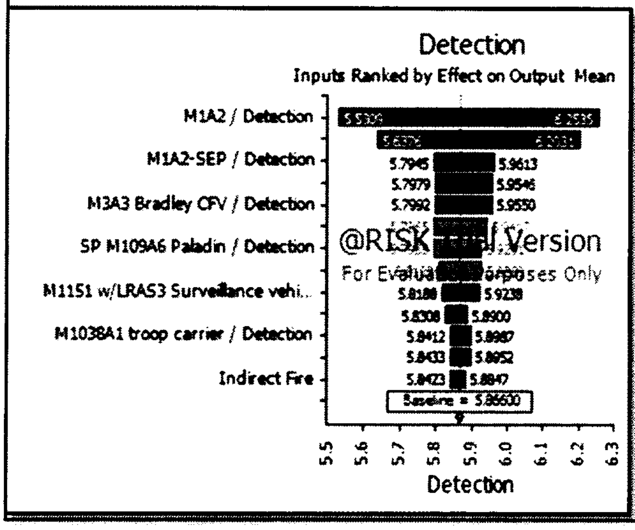


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Detection

Statistics		Percentile	
Minimum	4.958530806	5%	5.3096774
Maximum	6.972644377	10%	5.4155107
Mean	5.866003292	15%	5.4837905
Std Dev	0.352764358	20%	5.5479684
Variance	0.124442692	25%	5.6021445
Skewness	0.182090664	30%	5.6571429
Kurtosis	2.571979744	35%	5.7058824
Median	5.853085211	40%	5.7553191
Mode	6	45%	5.8059701
Left X	5.309677419	50%	5.8530852
Left P	5%	55%	5.9043716
Right X	6.471518987	60%	5.9531603
Right P	95%	65%	6.00369
Diff X	1.161841568	70%	6.0584192
Diff P	90%	75%	6.1131466
#Errors	0	80%	6.1731844
Filter Min	Off	85%	6.2453704
Filter Max	Off	90%	6.3349727
#Filtered	0	95%	6.471519



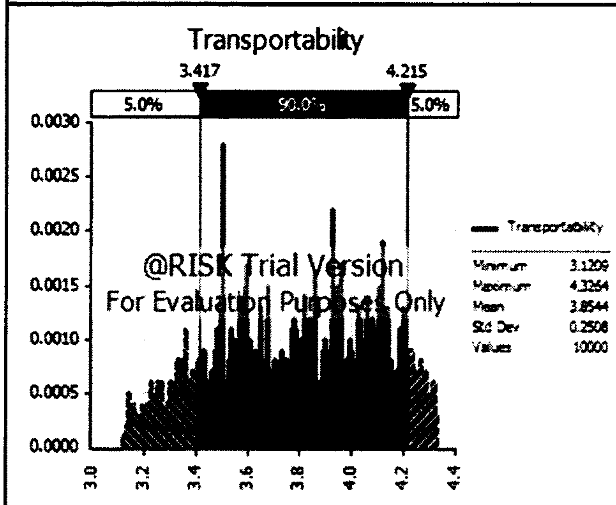
Change in Output Statistic for Detection

Rank	Name	Lower	Upper
1	M1A2 / Detectio	5.5308568	6.2534614
2	M2A3 Bradley 2 I	5.6375545	6.2030709
3	M1A2-SEP / Dete	5.7945041	5.9613261
4	M2A3 Bradley M	5.7978564	5.9546464
5	M3A3 Bradley CF	5.7992161	5.9550325
6	M1109 Rec. Vehi	5.7964879	5.9416786
7	SP M109A6 Palad	5.7957983	5.9290854
8	Mounted Sniper	5.8102303	5.9282468
9	M1151 w/LRAS3	5.8188016	5.9237945
10	Fire Support	5.8307518	5.890011
11	M1038A1 troop c	5.841193	5.8987037
12	Fire Attack	5.8432729	5.8952172
13	Indirect Fire	5.8423292	5.8847421
14	Target Acquisitio	5.8505336	5.887103

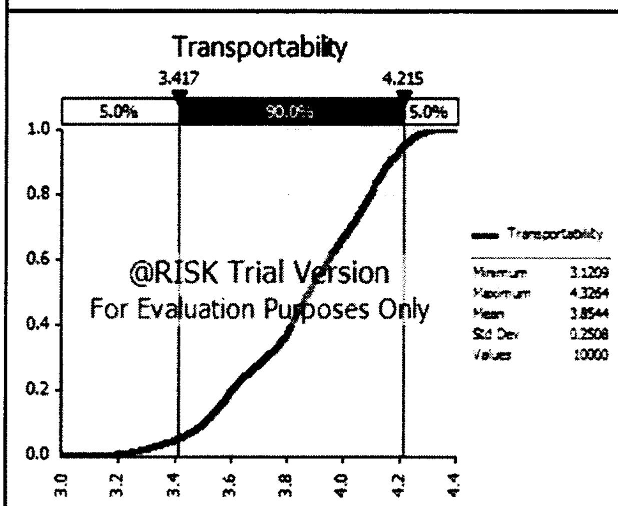
@RISK Output Report for Transportability

Performed By: Metin

Date: Thursday, April 11, 2013 9:40:43 PM

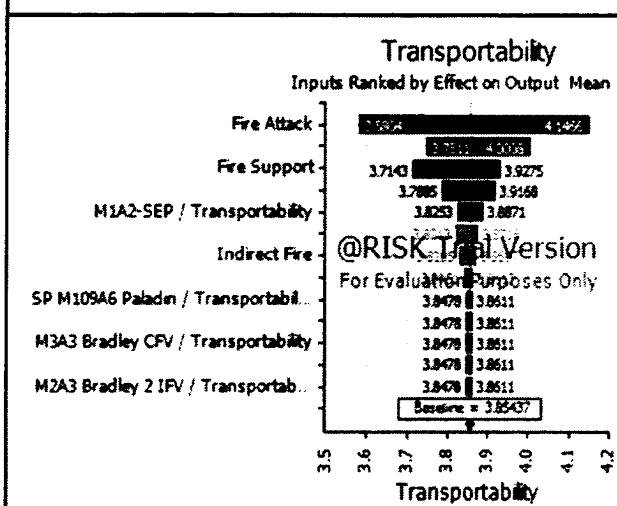


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Transportability

Statistics		Percentile	
Minimum	3.120853081	5%	3.4166667
Maximum	4.326359833	10%	3.5074627
Mean	3.854365101	15%	3.5635697
Std Dev	0.250809023	20%	3.6054254
Variance	0.062905166	25%	3.6620553
Skewness	-0.388215993	30%	3.7264574
Kurtosis	2.392590543	35%	3.780814
Median	3.876829268	40%	3.8157895
Mode	3.503452244	45%	3.8466899
Left X	3.416666667	50%	3.8768293
Left P	5%	55%	3.9089184
Right X	4.214611872	60%	3.9466165
Right P	95%	65%	3.9828767
Diff X	0.797945205	70%	4.0240642
Diff P	90%	75%	4.0606061
#Errors	0	80%	4.0957447
Filter Min	Off	85%	4.1269841
Filter Max	Off	90%	4.163227
#Filtered	0	95%	4.2146119



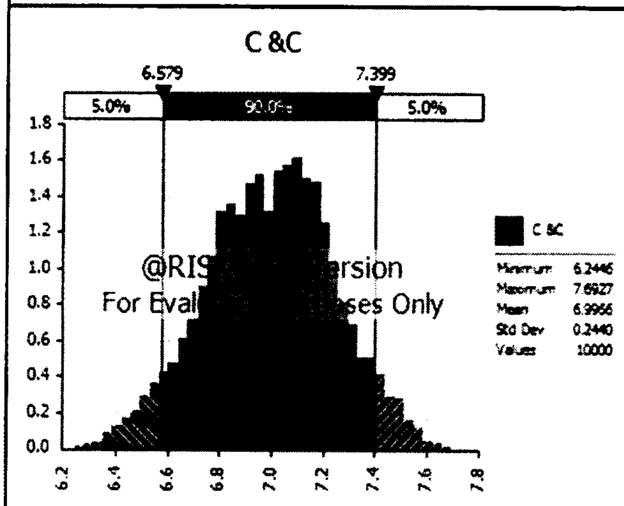
Change in Output Statistic for Transportability

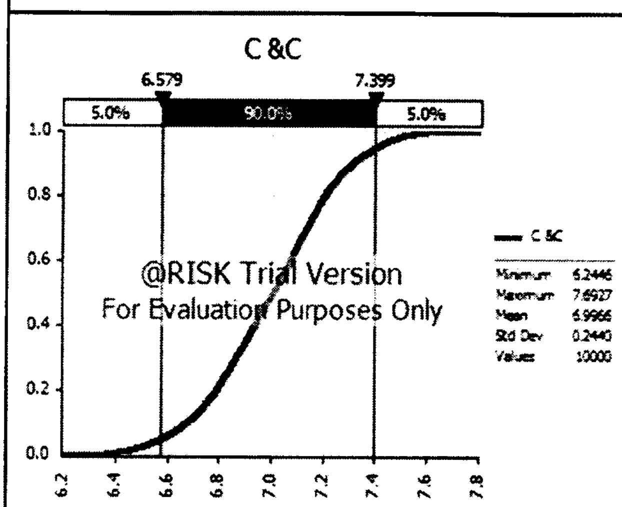
Rank	Name	Lower	Upper
1	Fire Attack	3.5804393	4.1466433
2	M1A2 / Transpor	3.7510505	4.0008497
3	Fire Support	3.7142676	3.9275217
4	Reconnaissance	3.7885403	3.916849
5	M1A2-SEP / Trans	3.8252904	3.8871208
6	M1151 w/LRAS3	3.8213134	3.8716455
7	Indirect Fire	3.8285284	3.8697323
8	Target Acquisitio	3.8450806	3.8612858
9	SP M109A6 Palad	3.8478341	3.8611346
10	M2A3 Bradley M	3.8478341	3.8611346
11	M3A3 Bradley CF	3.8478341	3.8611346
12	Mounted Sniper	3.8478341	3.8611346
13	M2A3 Bradley 2 I	3.8478341	3.8611346
14	M1038A1 troop c	3.8478341	3.8611346

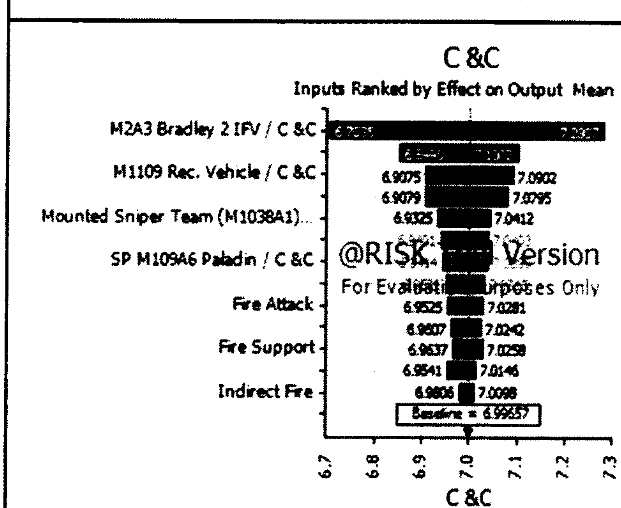
@RISK Output Report for C &C

Performed By: Metin

Date: Thursday, April 11, 2013 9:40:51 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for C &C

Statistics		Percentile	
Minimum	6.244623656	5%	6.5791962
Maximum	7.692722372	10%	6.6774542
Mean	6.996574843	15%	6.7402062
Std Dev	0.243968257	20%	6.7890947
Variance	0.05952051	25%	6.8260638
Skewness	-0.096213605	30%	6.8632856
Kurtosis	2.699918524	35%	6.8998836
Median	7.005512679	40%	6.9350716
Mode	7	45%	6.9680095
Left X	6.579196217	50%	7.0055127
Left P	5%	55%	7.0388298
Right X	7.398757764	60%	7.0703911
Right P	95%	65%	7.1012373
Diff X	0.819561546	70%	7.1343826
Diff P	90%	75%	7.1682848
#Errors	0	80%	7.2037618
Filter Min	Off	85%	7.2475248
Filter Max	Off	90%	7.308642
#Filtered	0	95%	7.3987578

Change in Output Statistic for C &C

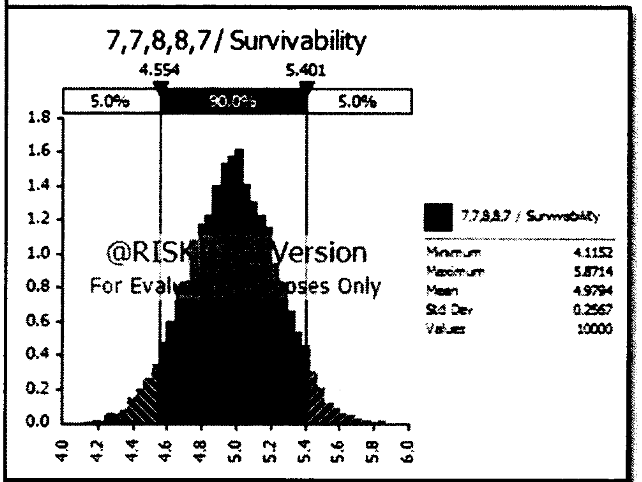
Rank	Name	Lower	Upper
1	M2A3 Bradley 2 I	6.7034546	7.2807016
2	M1A2 / C &C	6.8494545	7.1002112
3	M1109 Rec. Vehi	6.9074964	7.0901599
4	M2A3 Bradley M	6.9079483	7.0794785
5	Mounted Sniper	6.9324638	7.041164
6	M3A3 Bradley CF	6.940086	7.0402803
7	SP M109A6 Palad	6.9414487	7.0399006
8	M1151 w/LRAS3	6.9520946	7.031515
9	Fire Attack	6.9525326	7.0280735
10	M1A2-SEP / C &C	6.9606988	7.0241617
11	Fire Support	6.9636803	7.0257957
12	M1038A1 troop c	6.95413	7.0146492
13	Indirect Fire	6.9805912	7.0097593
14	Target Acquisitio	6.9854804	7.012451

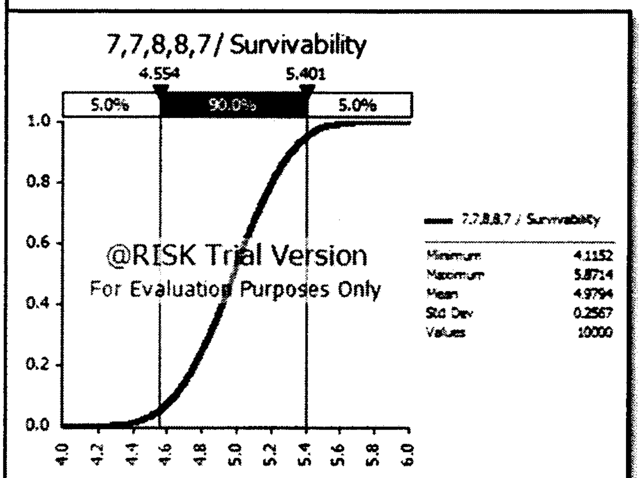
Heavy Option- Capabilities

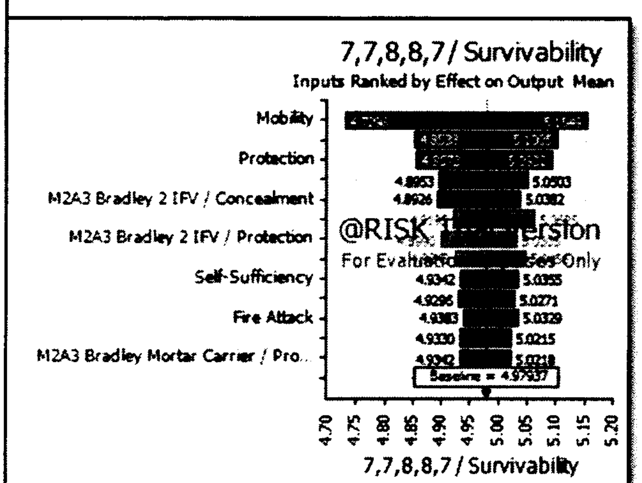
@RISK Output Report for Survivability

Performed By: Metin

Date: Thursday, April 11, 2013 9:40:59 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for 7,7,8,8,7 / Survivability

Statistics		Percentile	
Minimum	4.115204805	5%	4.5544439
Maximum	5.871435644	10%	4.645893
Mean	4.97936968	15%	4.7068989
Std Dev	0.256655394	20%	4.7579189
Variance	0.065871991	25%	4.8026579
Skewness	-0.031917963	30%	4.8441785
Kurtosis	2.807359609	35%	4.8833376
Median	4.981161669	40%	4.9173926
Mode	4.919925856	45%	4.9493793
Left X	4.554443919	50%	4.9811617
Left P	5%	55%	5.0112088
Right X	5.401243345	60%	5.0442128
Right P	95%	65%	5.0798804
Diff X	0.846799426	70%	5.1175109
Diff P	90%	75%	5.1582967
#Errors	0	80%	5.2009837
Filter Min	Off	85%	5.2510963
Filter Max	Off	90%	5.3121074
#Filtered	0	95%	5.4012433

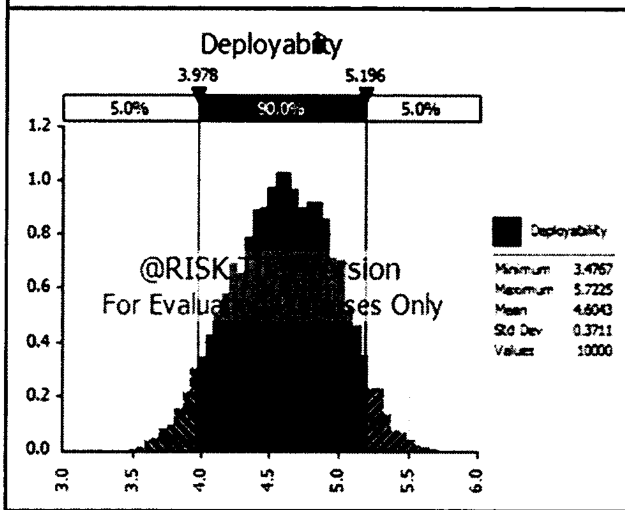
Change in Output Statistic for 7,7,8,8,7 / Surviva

Rank	Name	Lower	Upper
1	Mobility	4.7297854	5.1549481
2	M1A2 / Protectio	4.8538216	5.1004504
3	Protection	4.8572699	5.0931925
4	Detection	4.8952774	5.050285
5	M2A3 Bradley 2 I	4.8926306	5.0382418
6	Command & Con	4.9194796	5.0624826
7	M2A3 Bradley 2 I	4.8990173	5.0304831
8	Concealment	4.9248059	5.0456142
9	Self-Sufficiency	4.9342278	5.0355032
10	M2A3 Bradley 2 I	4.929625	5.0271452
11	Fire Attack	4.938294	5.0328815
12	Firepower	4.933011	5.0215274
13	M2A3 Bradley M	4.934196	5.0218439
14	M1A2 / Mobility	4.926919	5.013395

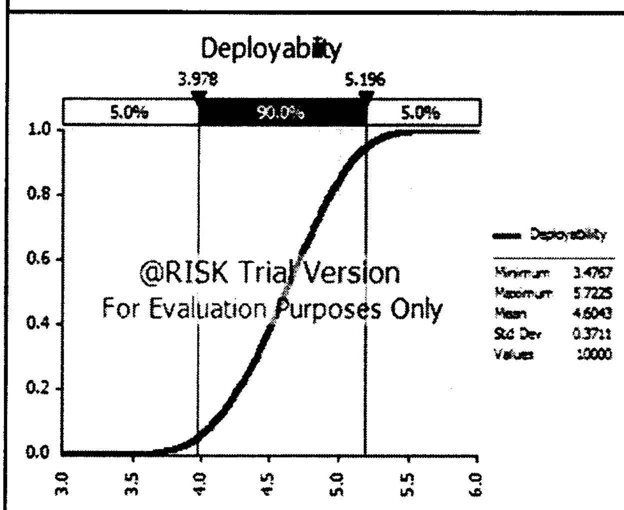
@RISK Output Report for Deployability

Performed By: Metin

Date: Thursday, April 11, 2013 9:41:11 PM

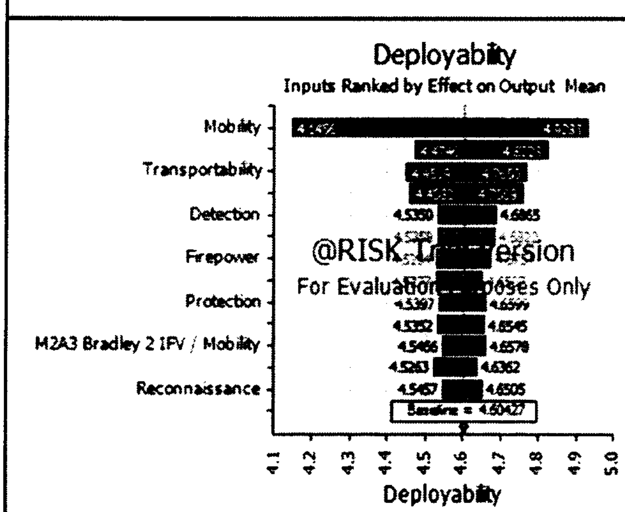


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Deployability

Statistics		Percentile	
Minimum	3.476659117	5%	3.9779696
Maximum	5.722527145	10%	4.104279
Mean	4.604266897	15%	4.1976772
Std Dev	0.371093792	20%	4.2702927
Variance	0.137710603	25%	4.3417939
Skewness	-0.087479962	30%	4.4056974
Kurtosis	2.541518613	35%	4.4587381
Median	4.611887422	40%	4.5130604
Mode	4.645774462	45%	4.5625124
Left X	3.977969631	50%	4.6118874
Left P	5%	55%	4.6595343
Right X	5.195639561	60%	4.7116031
Right P	95%	65%	4.7670312
Diff X	1.21766993	70%	4.8220665
Diff P	90%	75%	4.8765472
#Errors	0	80%	4.9338617
Filter Min	Off	85%	5.0032725
Filter Max	Off	90%	5.0813246
#Filtered	0	95%	5.1956396



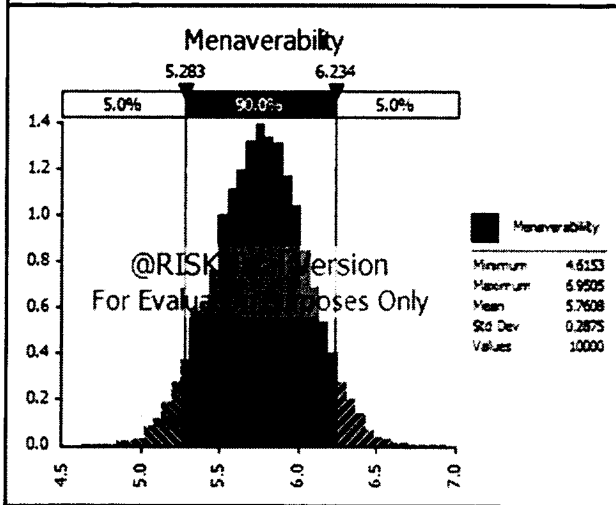
Change in Output Statistic for Deployability

Rank	Name	Lower	Upper
1	Mobility	4.1456087	4.9283294
2	Self-Sufficiency	4.4745811	4.8228209
3	Transportability	4.4519372	4.7649529
4	Fire Attack	4.4583284	4.7569176
5	Detection	4.5350038	4.6864675
6	M1A2 / Transpor	4.5358403	4.682194
7	Firepower	4.5294205	4.6753963
8	Command & Con	4.5277258	4.6506728
9	Protection	4.5397439	4.6599058
10	M1A2 / Mobility	4.53525	4.6545341
11	M2A3 Bradley 2 I	4.5465588	4.6578022
12	Fire Support	4.5263431	4.636232
13	Reconnaissance	4.5456619	4.6505471
14	Concealment	4.5631129	4.6493261

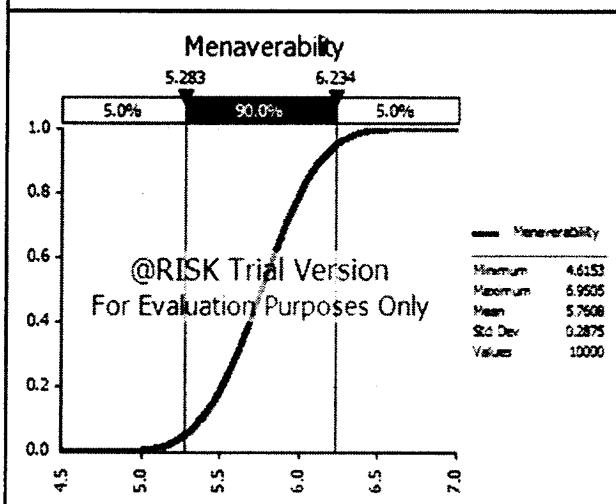
@RISK Output Report for Menaverability

Performed By: Metin

Date: Thursday, April 11, 2013 9:41:24 PM

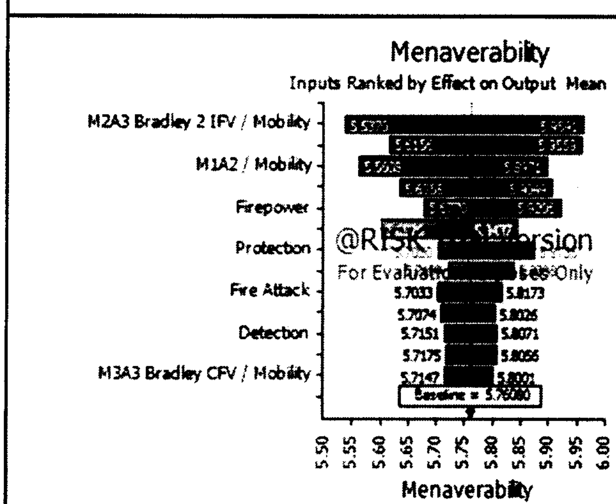


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Menaverability

Statistics		Percentile	
Minimum	4.615313243	5%	5.2825038
Maximum	6.950545075	10%	5.3827146
Mean	5.760798588	15%	5.4568149
Std Dev	0.287548943	20%	5.516015
Variance	0.082684395	25%	5.5619274
Skewness	-0.015327039	30%	5.6074101
Kurtosis	2.843290364	35%	5.6508024
Median	5.762646007	40%	5.6883721
Mode	5.810855145	45%	5.7264982
Left X	5.2825038	50%	5.762646
Left P	5%	55%	5.7994384
Right X	6.233616314	60%	5.8371817
Right P	95%	65%	5.8753991
Diff X	0.951112514	70%	5.9141121
Diff P	90%	75%	5.956824
#Errors	0	80%	6.0047656
Filter Min	Off	85%	6.0606286
Filter Max	Off	90%	6.1309453
#Filtered	0	95%	6.2336163



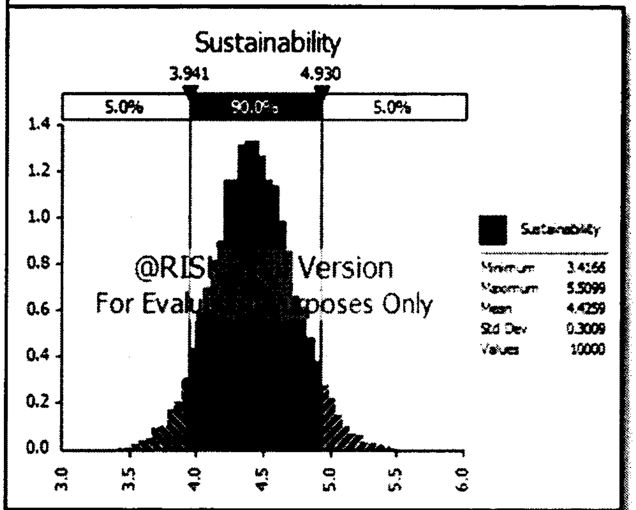
Change in Output Statistic for Menaverability

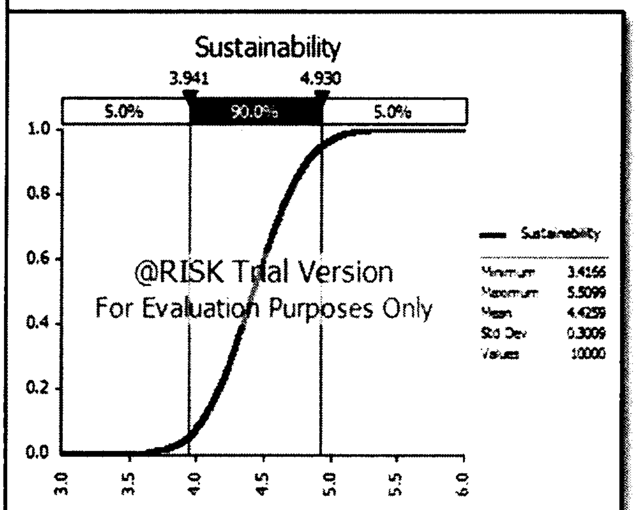
Rank	Name	Lower	Upper
1	M2A3 Bradley 2 I	5.5369635	5.9591423
2	Self-Sufficiency	5.6156189	5.9558521
3	M1A2 / Mobility	5.5607539	5.8971009
4	Mobility	5.635762	5.9048513
5	Firepower	5.6770407	5.9206484
6	Command & Con	5.6026498	5.8437252
7	Protection	5.7030123	5.8735005
8	Concealment	5.7194398	5.8387815
9	Fire Attack	5.7032852	5.817336
10	Transportability	5.7073761	5.8025802
11	Detection	5.7151327	5.807147
12	M1A2 / Self-Suffic	5.7174814	5.8056344
13	M3A3 Bradley CF	5.7147067	5.8000855
14	M2A3 Bradley Mc	5.7199832	5.8023517

@RISK Output Report for Sustainability

Performed By: Metin

Date: Thursday, April 11, 2013 9:41:36 PM

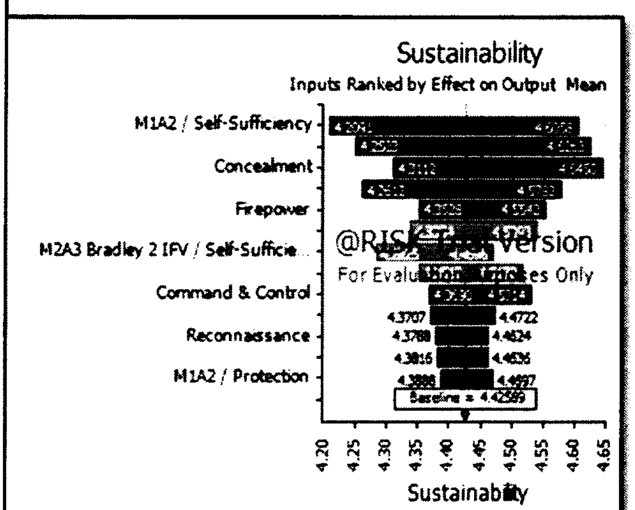




Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Sustainability

Statistics		Percentile	
Minimum	3.416614377	5%	3.9410821
Maximum	5.509875138	10%	4.0408518
Mean	4.425886868	15%	4.111621
Std Dev	0.300941852	20%	4.1707196
Variance	0.090565998	25%	4.2199837
Skewness	0.08550243	30%	4.2631822
Kurtosis	2.922315631	35%	4.3063085
Median	4.419474962	40%	4.3461066
Mode	4.45464618	45%	4.3832349
Left X	3.941082127	50%	4.419475
Left P	5%	55%	4.4579198
Right X	4.930016572	60%	4.497842
Right P	95%	65%	4.5384087
Diff X	0.988934444	70%	4.5813625
Diff P	90%	75%	4.6263567
#Errors	0	80%	4.6788921
Filter Min	Off	85%	4.7398387
Filter Max	Off	90%	4.8166782
#Filtered	0	95%	4.9300166



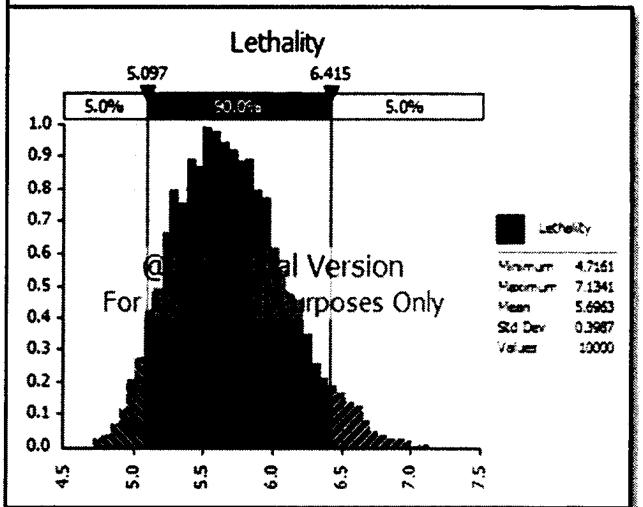
Change in Output Statistic for Sustainability

Rank	Name	Lower	Upper
1	M1A2 / Self-Suffic	4.2091485	4.6058353
2	Protection	4.250314	4.6263331
3	Concealment	4.3111865	4.6449718
4	Mobility	4.2612403	4.5782344
5	Firepower	4.3528058	4.5542333
6	Self-Sufficiency	4.3384022	4.5392883
7	M2A3 Bradley 2 I	4.2824748	4.4696484
8	Detection	4.3511691	4.5178255
9	Command & Con	4.3690074	4.5314343
10	M3A3 Bradley CF	4.3707131	4.4722432
11	Reconnaissance	4.3788476	4.4623603
12	M2A3 Bradley 2 I	4.381611	4.4636073
13	M1A2 / Protectio	4.3888025	4.4697068
14	Fire Support	4.3928906	4.4601468

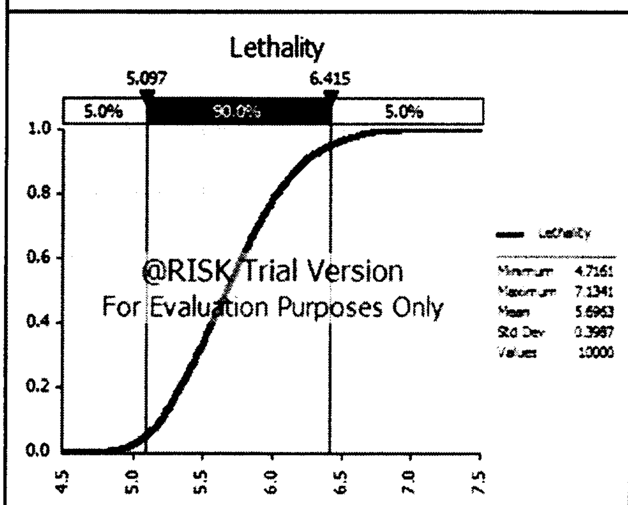
@RISK Output Report for Lethality

Performed By: Metin

Date: Thursday, April 11, 2013 9:41:48 PM

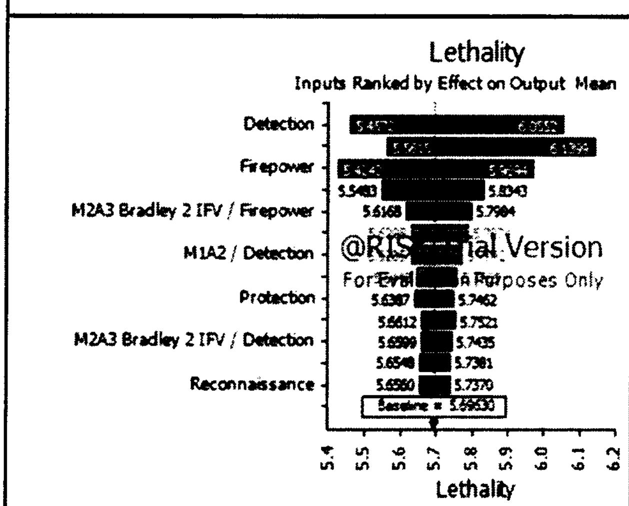


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Lethality

Statistics		Percentile	
Minimum	4.716136605	5%	5.0967251
Maximum	7.134114659	10%	5.2019333
Mean	5.696300373	15%	5.2747573
Std Dev	0.398685219	20%	5.3393181
Variance	0.158949904	25%	5.4019123
Skewness	0.379342594	30%	5.458357
Kurtosis	2.855592741	35%	5.5130147
Median	5.669927372	40%	5.5644239
Mode	5.674983578	45%	5.6140958
Left X	5.096725059	50%	5.6699274
Left P	5%	55%	5.722186
Right X	6.414589717	60%	5.7751549
Right P	95%	65%	5.8311818
Diff X	1.317864659	70%	5.8918541
Diff P	90%	75%	5.9564216
#Errors	0	80%	6.0268316
Filter Min	Off	85%	6.1201804
Filter Max	Off	90%	6.2281832
#Filtered	0	95%	6.4145897



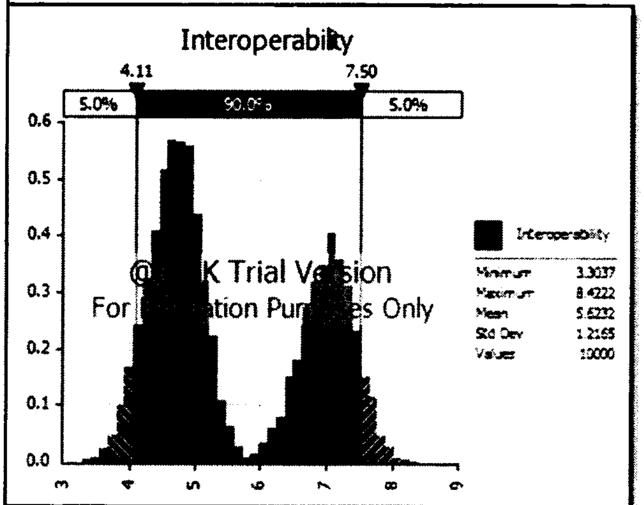
Change in Output Statistic for Lethality

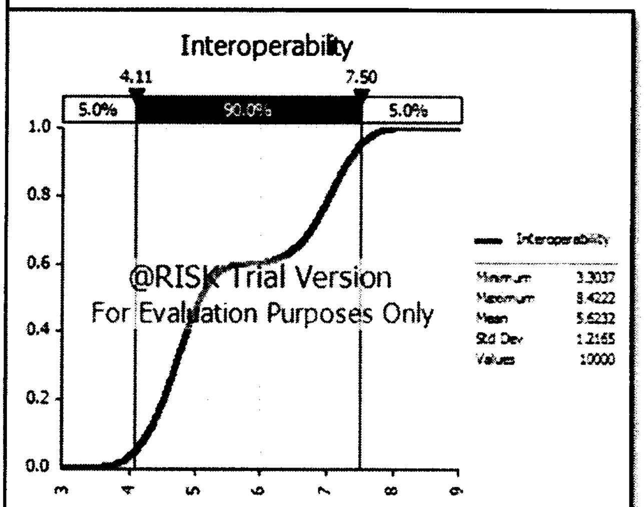
Rank	Name	Lower	Upper
1	Detection	5.4571505	6.0551635
2	Command & Con	5.561488	6.1399463
3	Firepower	5.4241826	5.9693513
4	Mobility	5.5482897	5.8343299
5	M2A3 Bradley 2 I	5.6167998	5.7984496
6	M1A2 / Firepowe	5.6298271	5.787407
7	M1A2 / Detectio	5.6284754	5.7742346
8	M2A3 Bradley M	5.6442543	5.756549
9	Protection	5.63874	5.746207
10	Self-Sufficiency	5.6612366	5.7520549
11	M2A3 Bradley 2 I	5.6599292	5.7435421
12	Transportability	5.6547855	5.7381299
13	Reconnaissance	5.656006	5.7370305
14	Concealment	5.6663269	5.7456644

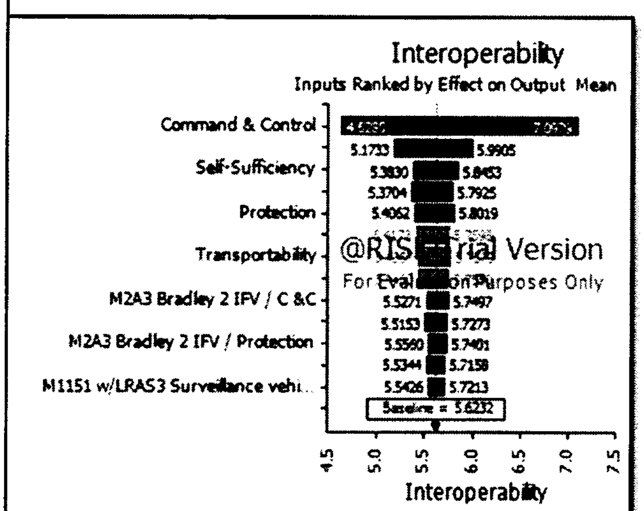
@RISK Output Report for Interoperability

Performed By: Metin

Date: Thursday, April 11, 2013 9:42:00 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Interoperability

Statistics		Percentile	
Minimum	3.303681808	5%	4.1066292
Maximum	8.422196118	10%	4.2848231
Mean	5.623236675	15%	4.415316
Std Dev	1.216535686	20%	4.5248485
Variance	1.479959075	25%	4.6135023
Skewness	0.345976262	30%	4.7011542
Kurtosis	1.557856951	35%	4.7911934
Median	5.08148443	40%	4.8746982
Mode	4.849723233	45%	4.9683489
Left X	4.106629203	50%	5.0814844
Left P	5%	55%	5.2329115
Right X	7.499173703	60%	5.713915
Right P	95%	65%	6.5366394
Diff X	3.392544501	70%	6.7528577
Diff P	90%	75%	6.9107674
#Errors	0	80%	7.0455026
Filter Min	Off	85%	7.1747506
Filter Max	Off	90%	7.3109646
#Filtered	0	95%	7.4991737

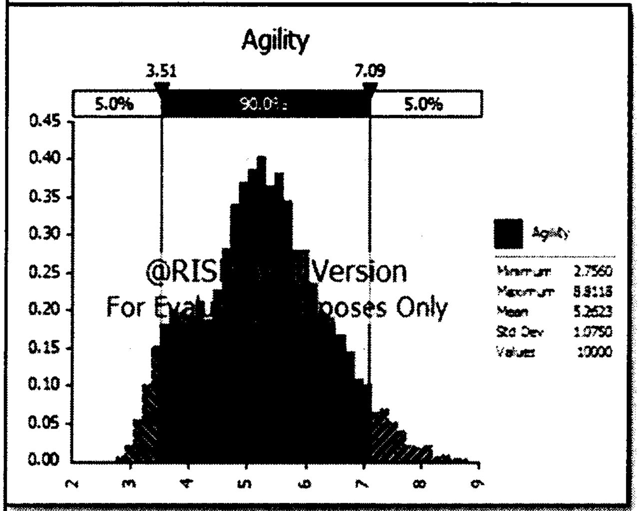
Change in Output Statistic for Interoperability

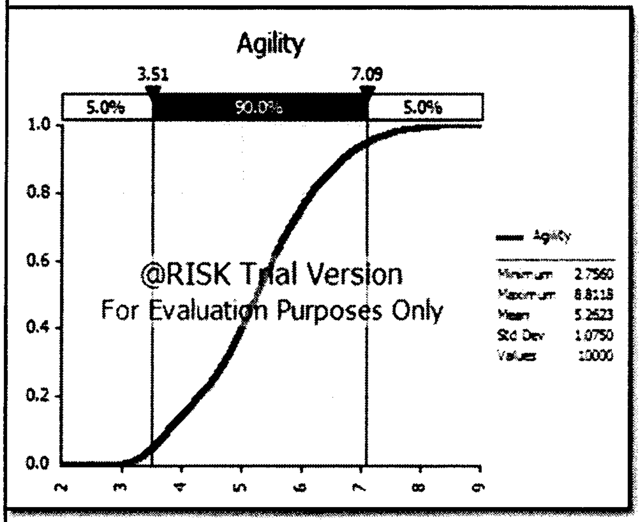
Rank	Name	Lower	Upper
1	Command & Con	4.6285366	7.0978617
2	Detection	5.1733118	5.9905007
3	Self-Sufficiency	5.3830438	5.8453344
4	Mobility	5.3704237	5.7925214
5	Protection	5.4061951	5.8018647
6	Firepower	5.417319	5.7597859
7	Transportability	5.4356843	5.7678635
8	Concealment	5.4459727	5.7549626
9	M2A3 Bradley 2 I	5.5271276	5.7496935
10	Mounted Sniper	5.5153015	5.7272718
11	M2A3 Bradley 2 I	5.5560134	5.7400539
12	M1109 Rec. Vehi	5.5343769	5.7157864
13	M1151 w/LRAS3	5.5425928	5.7213043
14	M1A2-SEP / Firep	5.519531	5.6879406

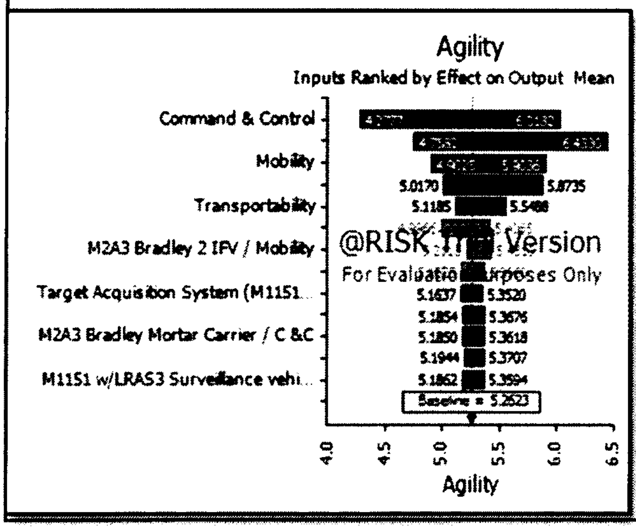
@RISK Output Report for Agility

Performed By: Metin

Date: Thursday, April 11, 2013 9:42:13 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Agility

Statistics		Percentile	
Minimum	2.755974084	5%	3.5106293
Maximum	8.811802743	10%	3.7730035
Mean	5.262345254	15%	4.0311814
Std Dev	1.074987184	20%	4.2754505
Variance	1.155597445	25%	4.5188329
Skewness	0.177037832	30%	4.7093539
Kurtosis	2.658398719	35%	4.8598054
Median	5.253452222	40%	4.9945081
Mode	5.033979501	45%	5.1188813
Left X	3.510629257	50%	5.2534522
Left P	5%	55%	5.3777488
Right X	7.090626314	60%	5.5104875
Right P	95%	65%	5.6464584
Diff X	3.579997058	70%	5.7984134
Diff P	90%	75%	5.96732
#Errors	0	80%	6.1626645
Filter Min	Off	85%	6.4072046
Filter Max	Off	90%	6.6854846
#Filtered	0	95%	7.0906263

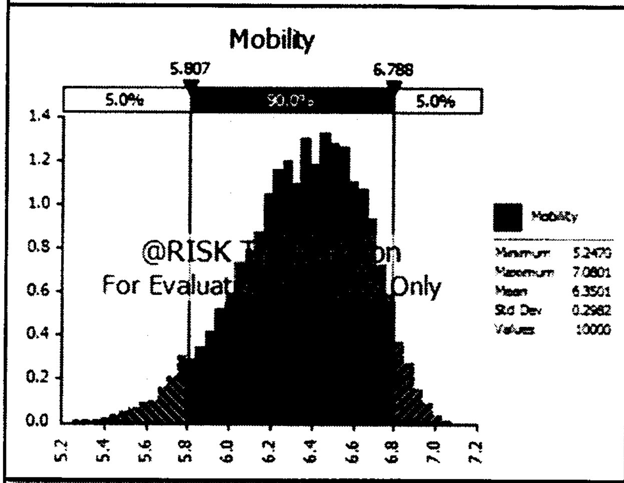
Change in Output Statistic for Agility

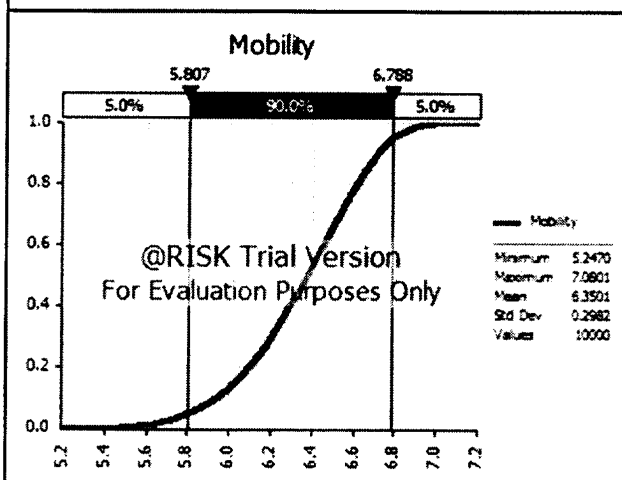
Rank	Name	Lower	Upper
1	Command & Con	4.2776544	6.0181944
2	Protection	4.7581889	6.4329602
3	Mobility	4.902498	5.9035755
4	Firepower	5.0170477	5.8735229
5	Transportability	5.1185465	5.5488324
6	Self-Sufficiency	4.9966215	5.4065496
7	M2A3 Bradley 2 I	5.211847	5.4309545
8	Target Acquisitio	5.1624672	5.3660344
9	Target Acquisitio	5.1637309	5.3519553
10	Concealment	5.1853845	5.3676392
11	M2A3 Bradley Mc	5.1850082	5.361847
12	M1151 w/LRAS3	5.1944244	5.3707434
13	M1151 w/LRAS3	5.1862407	5.3593527
14	M1151 w/LRAS3	5.1748773	5.3478436

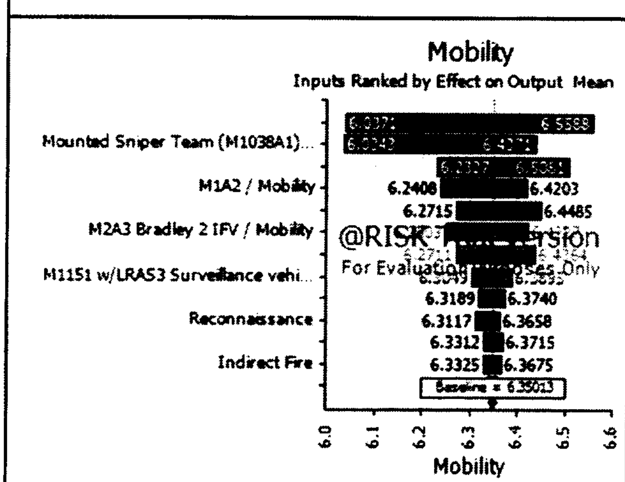
Motorized (inf) Attributes

@RISK Output Report for Mobility

Performed By: Metin
Date: Thursday, April 11, 2013 9:42:25 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Mobility

Statistics		Percentile	
Minimum	5.246963563	5%	5.8066116
Maximum	7.080105634	10%	5.9446328
Mean	6.350127826	15%	6.0308422
Std Dev	0.29824727	20%	6.0982368
Variance	0.088951434	25%	6.1565957
Skewness	-0.415388884	30%	6.2057264
Kurtosis	2.82491726	35%	6.248666
Median	6.377726751	40%	6.290287
Mode	6.235294118	45%	6.3367698
Left X	5.80661157	50%	6.3777268
Left P	5%	55%	6.4146621
Right X	6.787878788	60%	6.4568789
Right P	95%	65%	6.4932432
Diff X	0.981267218	70%	6.5326633
Diff P	90%	75%	6.5720762
#Errors	0	80%	6.6161702
Filter Min	Off	85%	6.6627535
Filter Max	Off	90%	6.716303
#Filtered	0	95%	6.7878788

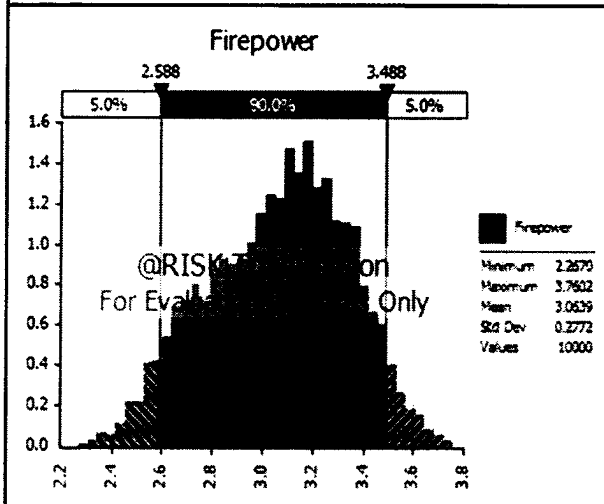
Change in Output Statistic for Mobility

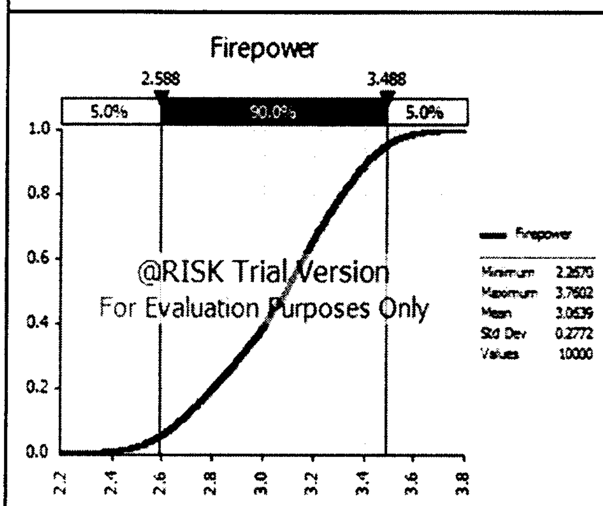
Rank	Name	Lower	Upper
1	M3A3 Bradley CF	6.0370959	6.5588044
2	Mounted Sniper T	6.034295	6.4371003
3	M1038A1 troop c	6.2326933	6.5080809
4	M1A2 / Mobility	6.2407813	6.4202843
5	Fire Support	6.2715308	6.4485145
6	M2A3 Bradley 2 I	6.2502972	6.422665
7	Fire Attack	6.2710658	6.4364205
8	M1151 w/LRAS3 S	6.3048935	6.3894579
9	M1A2-SEP / Mobi	6.3189488	6.3740089
10	Reconnaissance	6.311725	6.3658069
11	M2A3 Bradley Mo	6.3311702	6.3715324
12	Indirect Fire	6.3325344	6.3675201
13	M1109 Rec. Vehi	6.337447	6.3598023

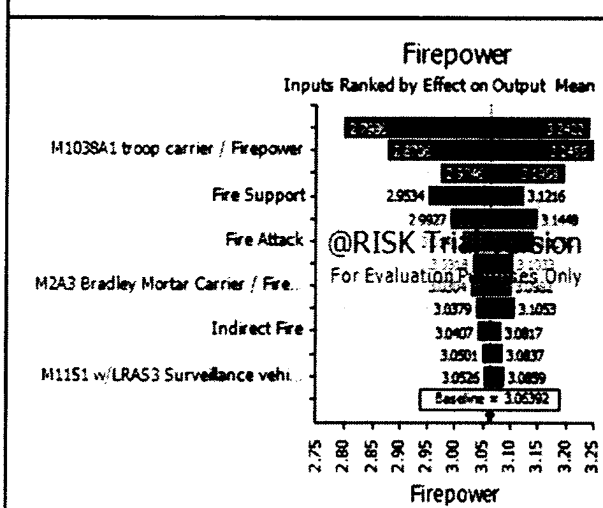
@RISK Output Report for Firepower

Performed By: Metin

Date: Thursday, April 11, 2013 9:42:33 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Firepower

Statistics		Percentile	
Minimum	2.266964952	5%	2.5883576
Maximum	3.760220126	10%	2.6732588
Mean	3.063923131	15%	2.7391304
Std Dev	0.277204545	20%	2.8048961
Variance	0.07684236	25%	2.8583129
Skewness	-0.213319712	30%	2.9130081
Kurtosis	2.39988445	35%	2.9629941
Median	3.090622537	40%	3.0102414
Mode	3.191993464	45%	3.0501213
Left X	2.588357588	50%	3.0906225
Left P	5%	55%	3.1244743
Right X	3.488057325	60%	3.1610228
Right P	95%	65%	3.1946472
Diff X	0.899699736	70%	3.2326087
Diff P	90%	75%	3.2710893
#Errors	0	80%	3.3145425
Filter Min	Off	85%	3.359401
Filter Max	Off	90%	3.4106845
#Filtered	0	95%	3.4880573

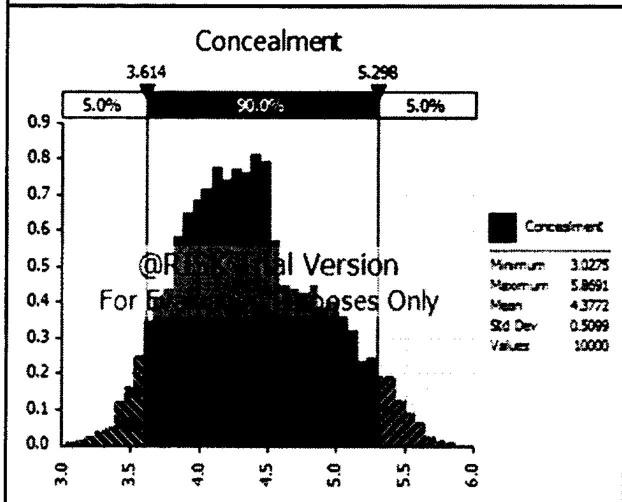
Change in Output Statistic for Firepower

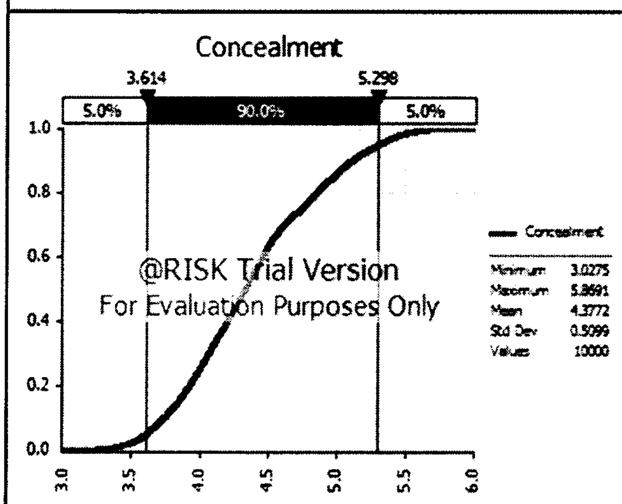
Rank	Name	Lower	Upper
1	Mounted Sniper	2.7986059	3.2422058
2	M1038A1 troop c	2.8786306	3.2454843
3	M3A3 Bradley CF	2.9746201	3.1958067
4	Fire Support	2.9533626	3.1215823
5	Reconnaissance	2.9927402	3.1448269
6	Fire Attack	3.014123	3.13898
7	M2A3 Bradley 2 I	3.0318372	3.1032668
8	M2A3 Bradley Mc	3.0304485	3.0982206
9	M1A2 / Firepowe	3.0379242	3.1052513
10	Indirect Fire	3.0407482	3.0816521
11	M1A2-SEP / Firep	3.0501304	3.0837082
12	M1151 w/LRAS3	3.0525746	3.0858906
13	M1109 Rec. Vehi	3.0503845	3.0784221

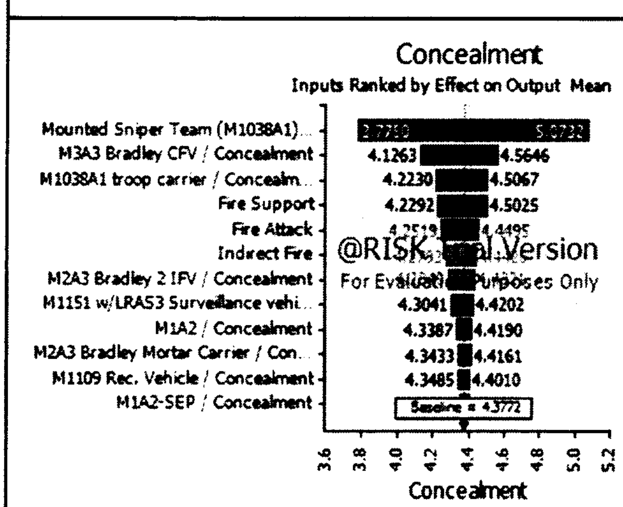
@RISK Output Report for Concealment

Performed By: Metin

Date: Thursday, April 11, 2013 9:42:41 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Concealment

Statistics		Percentile	
Minimum	3.027456647	**5%**	3.6137931
Maximum	5.869109948	**10%**	3.74
Mean	4.377183858	**15%**	3.8424242
Std Dev	0.509925911	**20%**	3.9274486
Variance	0.260024435	**25%**	3.9973856
Skewness	0.307920672	**30%**	4.0687204
Kurtosis	2.511443293	**35%**	4.1328413
Median	4.334298119	**40%**	4.2021484
Mode	3.66894198	**45%**	4.2696246
Left X	3.613793103	**50%**	4.3342981
Left P	5%	**55%**	4.3964844
Right X	5.298118669	**60%**	4.4573379
Right P	95%	**65%**	4.5237614
Diff X	1.684325565	**70%**	4.6165414
Diff P	90%	**75%**	4.7303754
#Errors	0	**80%**	4.8463508
Filter Min	Off	**85%**	4.9717608
Filter Max	Off	**90%**	5.1062802
#Filtered	0	**95%**	5.2981187

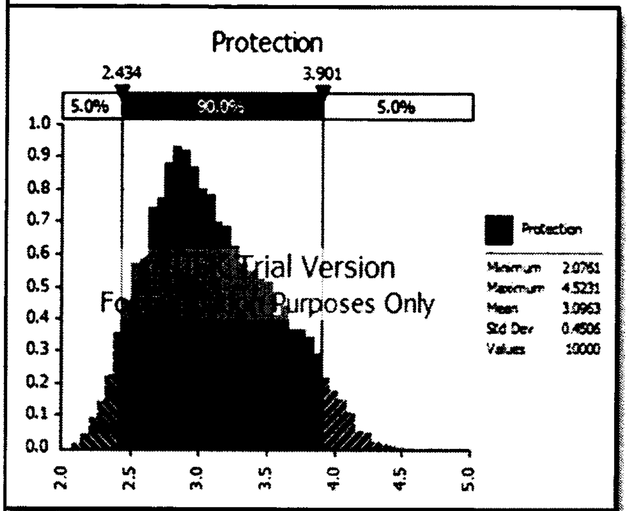
Change in Output Statistic for Concealment

Rank	Name	Lower	Upper
1	Mounted Sniper `	3.7749997	5.0731821
2	M3A3 Bradley CF	4.1262806	4.5646307
3	M1038A1 troop c	4.2230051	4.5066913
4	Fire Support	4.2291818	4.5025293
5	Fire Attack	4.2519447	4.4494687
6	Indirect Fire	4.2792871	4.442026
7	M2A3 Bradley 2 I	4.2840248	4.4321442
8	M1151 w/LRAS3	4.3040867	4.4202299
9	M1A2 / Concealn	4.3387412	4.4190403
10	M2A3 Bradley Mc	4.3433327	4.4160673
11	M1109 Rec. Vehi	4.3484791	4.4010153
12	M1A2-SEP / Conc	4.353732	4.4020931

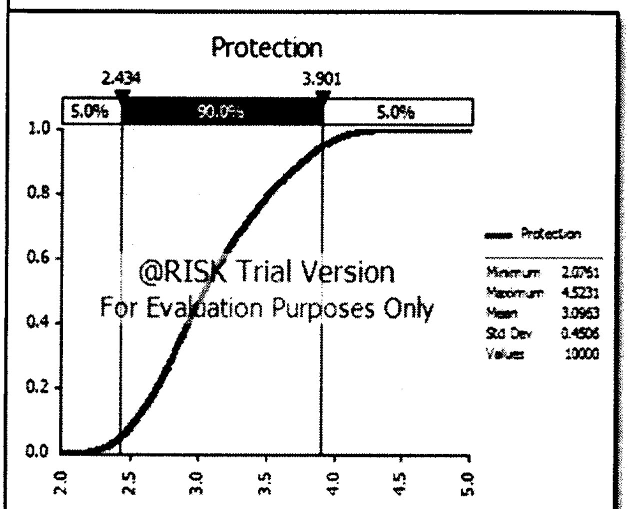
@RISK Output Report for Protection

Performed By: Metin

Date: Thursday, April 11, 2013 9:42:49 PM

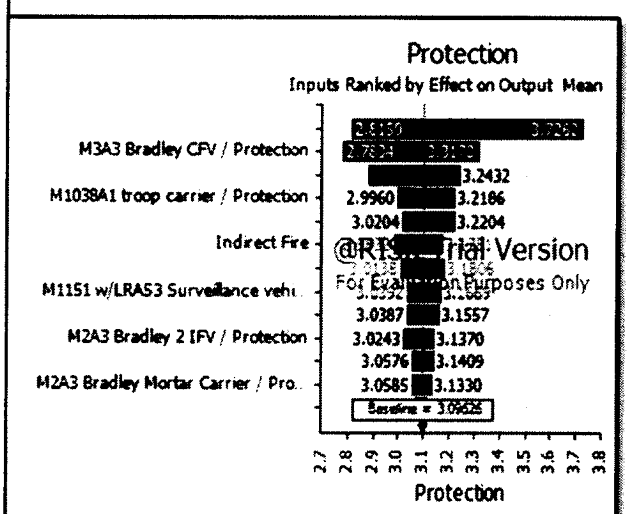


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Protection

Statistics		Percentile	
Minimum	2.076142132	5%	2.4342857
Maximum	4.523059618	10%	2.5391198
Mean	3.096264906	15%	2.6247401
Std Dev	0.450564586	20%	2.6920474
Variance	0.203008446	25%	2.7560976
Skewness	0.368488581	30%	2.8127018
Kurtosis	2.439031656	35%	2.864813
Median	3.036208733	40%	2.9208174
Mode	2.5	45%	2.9758149
Left X	2.434285714	50%	3.0362087
Left P	5%	55%	3.1004695
Right X	3.901052632	60%	3.171967
Right P	95%	65%	3.2444196
Diff X	1.466766917	70%	3.3302857
Diff P	90%	75%	3.4154303
#Errors	0	80%	3.5089606
Filter Min	Off	85%	3.6236906
Filter Max	Off	90%	3.7497062
#Filtered	0	95%	3.9010526



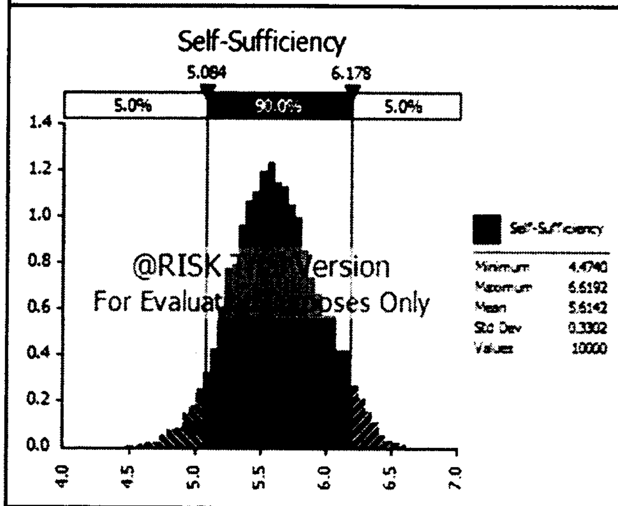
Change in Output Statistic for Protection

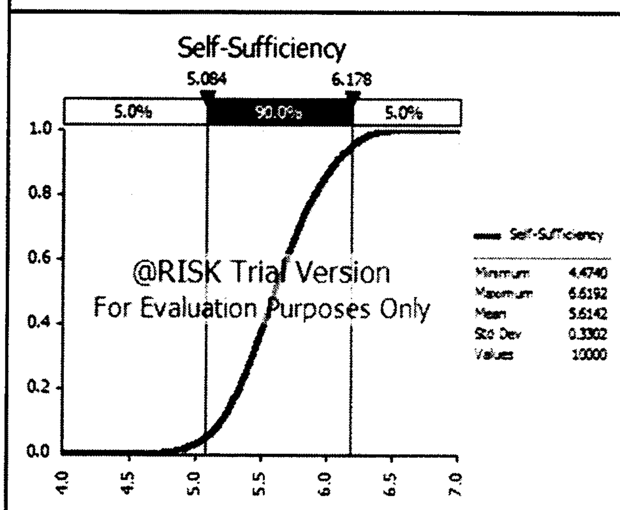
Rank	Name	Lower	Upper
1	Mounted Sniper	2.8159364	3.7261918
2	M3A3 Bradley CF	2.7834134	3.3169956
3	Fire Support	2.8851091	3.243196
4	M1038A1 troop c	2.9959613	3.2186174
5	Reconnaissance	3.020436	3.220408
6	Indirect Fire	2.9831853	3.1750787
7	M1A2 / Protectio	3.0137961	3.1806023
8	M1151 w/LRAS3	3.0391752	3.1669475
9	Fire Attack	3.0386871	3.1557156
10	M2A3 Bradley 2 I	3.0242555	3.1370435
11	M1A2-SEP / Prote	3.0576445	3.1408603
12	M2A3 Bradley Mo	3.0585054	3.1330132
13	M1109 Rec. Vehi	3.0698625	3.1137583

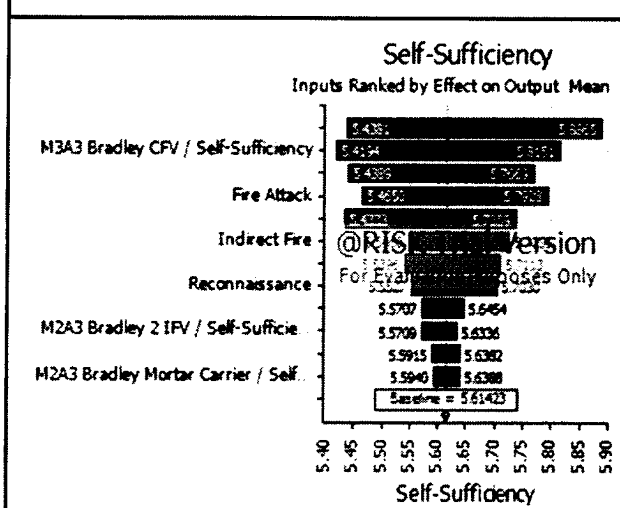
@RISK Output Report for Self-Sufficiency

Performed By: Metin

Date: Thursday, April 11, 2013 9:42:57 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Self-Sufficiency

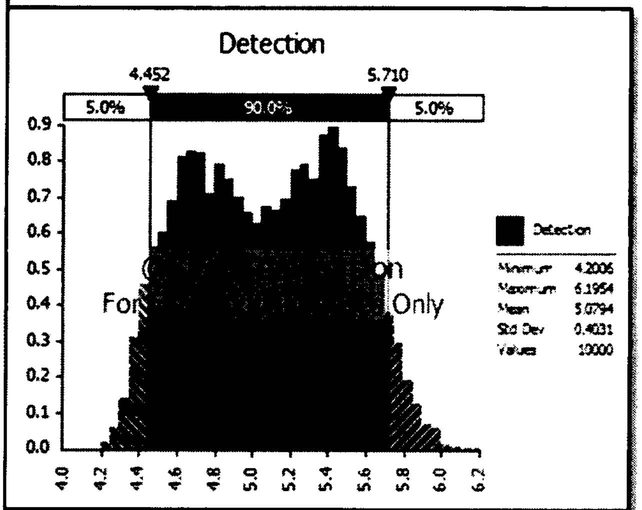
Statistics		Percentile	
Minimum	4.474009901	5%	5.0836197
Maximum	6.619242579	10%	5.1980088
Mean	5.614229089	15%	5.2694118
Std Dev	0.33017549	20%	5.3333333
Variance	0.109015854	25%	5.3840666
Skewness	0.061592287	30%	5.4305043
Kurtosis	2.72634573	35%	5.4763343
Median	5.60199005	40%	5.5189003
Mode	5.407496977	45%	5.5626976
Left X	5.083619702	50%	5.60199
Left P	5%	55%	5.6449704
Right X	6.178119349	60%	5.690583
Right P	95%	65%	5.7362894
Diff X	1.094499647	70%	5.7849687
Diff P	90%	75%	5.8374525
#Errors	0	80%	5.9005792
Filter Min	Off	85%	5.9748804
Filter Max	Off	90%	6.0600437
#Filtered	0	95%	6.1781193

Change in Output Statistic for Self-Sufficiency

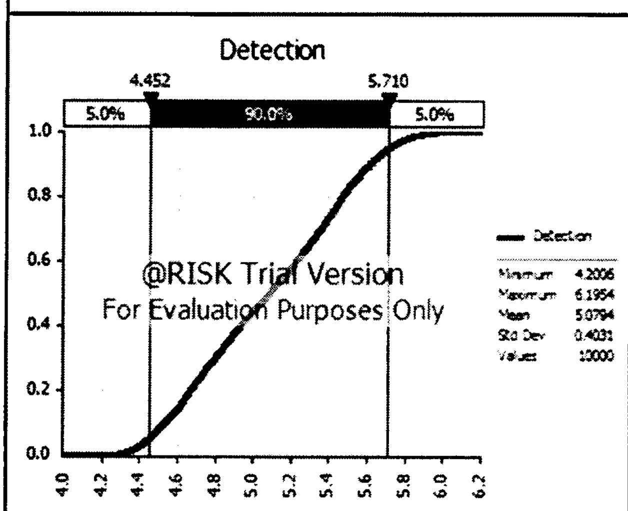
Rank	Name	Lower	Upper
1	Mounted Sniper	5.4380519	5.8865246
2	M3A3 Bradley CF	5.4194256	5.8150735
3	M1A2 / Self-Suffic	5.4389009	5.7669315
4	Fire Attack	5.4650399	5.7928279
5	Fire Support	5.4332578	5.7359158
6	Indirect Fire	5.5460313	5.7251007
7	M1038A1 troop c	5.5396187	5.7112956
8	Reconnaissance	5.5527479	5.7030477
9	M1151 w/LRAS3	5.5707316	5.6453954
10	M2A3 Bradley 2 I	5.5708768	5.6336005
11	M1A2-SEP / Self-S	5.5914798	5.6382237
12	M2A3 Bradley Mo	5.5939538	5.6387502
13	M1109 Rec. Vehi	5.5915708	5.6291379

@RISK Output Report for Detection

Performed By: Metin
Date: Thursday, April 11, 2013 9:43:05 PM



Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Detection

Statistics		Percentile	
Minimum	4.200604839	5%	4.452151
Maximum	6.195391705	10%	4.5375458
Mean	5.079425412	15%	4.6123188
Std Dev	0.403117005	20%	4.673029
Variance	0.16250332	25%	4.733871
Skewness	0.026407707	30%	4.7997812
Kurtosis	1.957359797	35%	4.8635438
Median	5.086345382	40%	4.9335828
Mode	5.217305801	45%	5.0086393
Left X	4.45215101	50%	5.0863454
Left P	5%	55%	5.1602497
Right X	5.709839357	60%	5.2285714
Right P	95%	65%	5.2921225
Diff X	1.257688348	70%	5.3578244
Diff P	90%	75%	5.4146608
#Errors	0	80%	5.4695912
Filter Min	Off	85%	5.5362694
Filter Max	Off	90%	5.6129032
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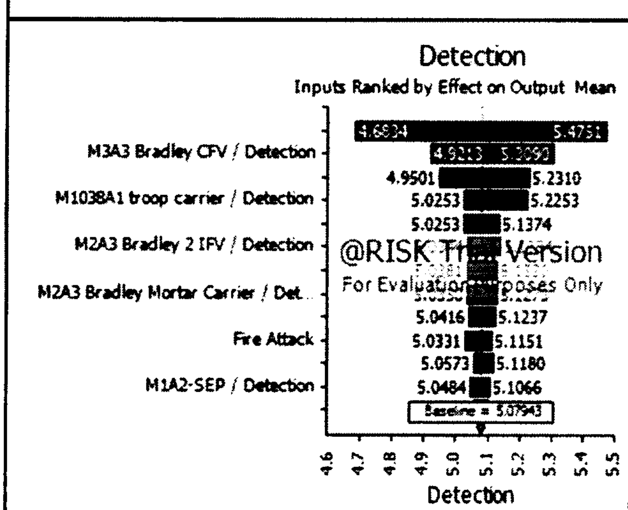


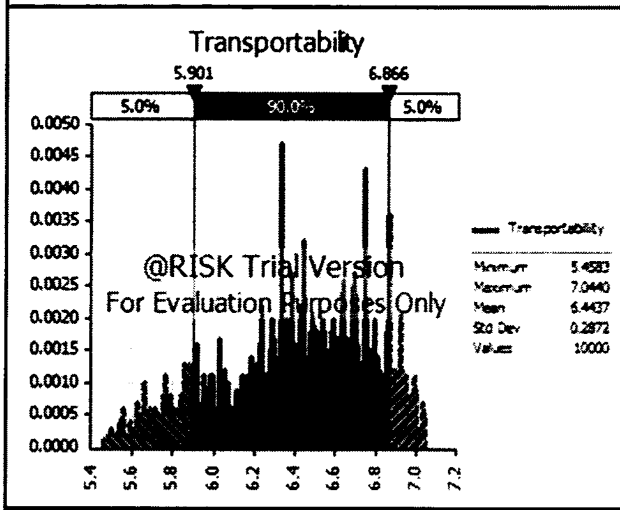
Change in Output Statistic for Detection

Rank	Name	Lower	Upper
1	Mounted Sniper	4.6834016	5.4751482
2	M3A3 Bradley CF	4.9212935	5.3089712
3	M1A2 / Detectio	4.950095	5.2309584
4	M1038A1 troop c	5.0252591	5.2252703
5	Indirect Fire	5.0252677	5.1374306
6	M2A3 Bradley 2 I	5.0343694	5.1384448
7	M1151 w/LRAS3	5.0380779	5.1320143
8	M2A3 Bradley M	5.0350415	5.1273218
9	Reconnaissance	5.0416205	5.1237174
10	Fire Attack	5.0330968	5.1150853
11	Fire Support	5.0572957	5.1180164
12	M1A2-SEP / Dete	5.0483579	5.1066226
13	M1109 Rec. Vehi	5.0605004	5.1041815

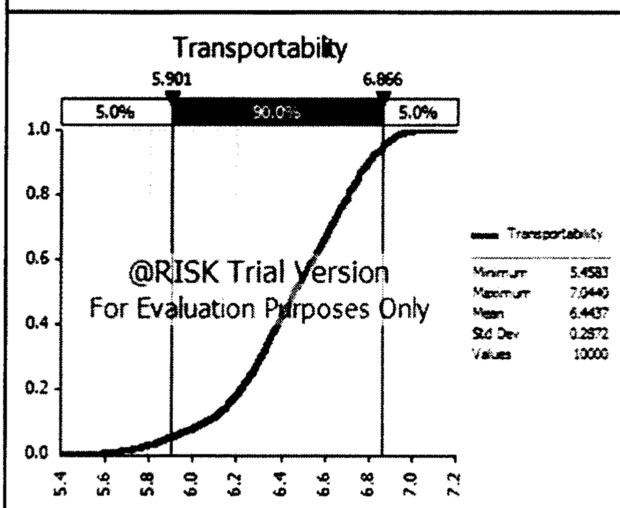
@RISK Output Report for Transportability

Performed By: Metin

Date: Thursday, April 11, 2013 9:43:13 PM

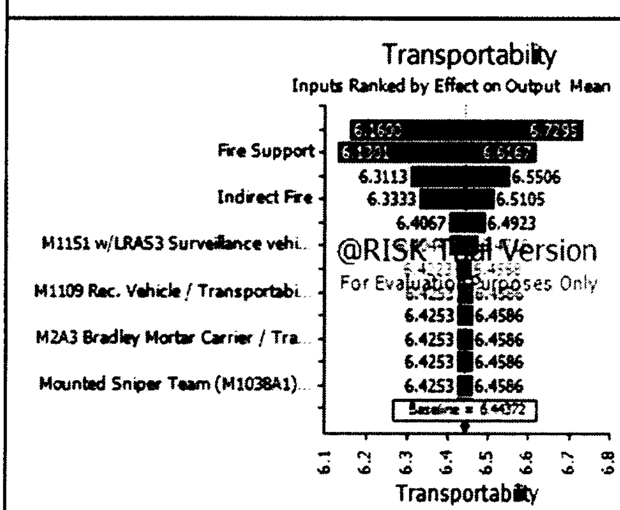


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Transportability

Statistics		Percentile	
Minimum	5.458272328	5%	5.9005525
Maximum	7.044038668	10%	6.0582121
Mean	6.443718391	15%	6.1588486
Std Dev	0.287192375	20%	6.2182741
Variance	0.08247946	25%	6.2684268
Skewness	-0.497109845	30%	6.3071809
Kurtosis	2.942306952	35%	6.3432574
Median	6.457687723	40%	6.3816667
Mode	6.332682927	45%	6.4242424
Left X	5.900552486	50%	6.4576877
Left P	5%	55%	6.5017626
Right X	6.865882353	60%	6.5441176
Right P	95%	65%	6.5849387
Diff X	0.965329867	70%	6.624424
Diff P	90%	75%	6.6635294
#Errors	0	80%	6.7038627
Filter Min	Off	85%	6.7474747
Filter Max	Off	90%	6.7966102
#Filtered	0	95%	6.8658824



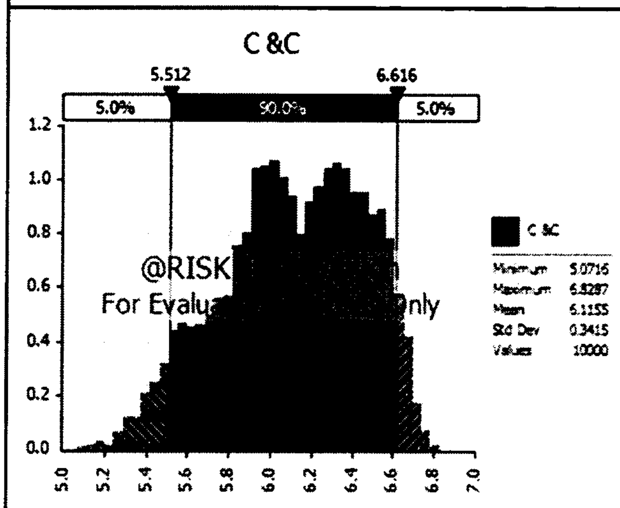
Change in Output Statistic for Transportability

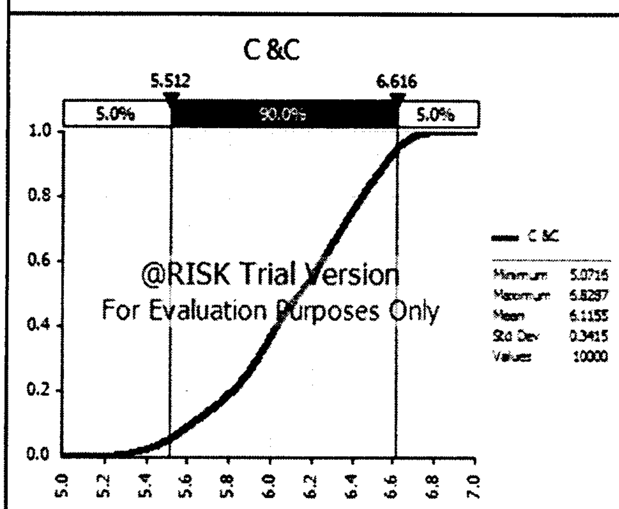
Rank	Name	Lower	Upper
1	Fire Attack	6.1599624	6.729511
2	Fire Support	6.1300651	6.6167096
3	Reconnaissance	6.3113032	6.5506311
4	Indirect Fire	6.333303	6.510536
5	M1A2 / Transpor	6.4066778	6.4923041
6	M1151 w/LRAS3	6.4043708	6.4717857
7	M1A2-SEP / Trans	6.4223374	6.4568491
8	M1109 Rec. Vehi	6.4252848	6.4586185
9	M1038A1 troop c	6.4252848	6.4586185
10	M2A3 Bradley M	6.4252848	6.4586185
11	M3A3 Bradley CF	6.4252848	6.4586185
12	Mounted Sniper	6.4252848	6.4586185
13	M2A3 Bradley 2	6.4252848	6.4586185

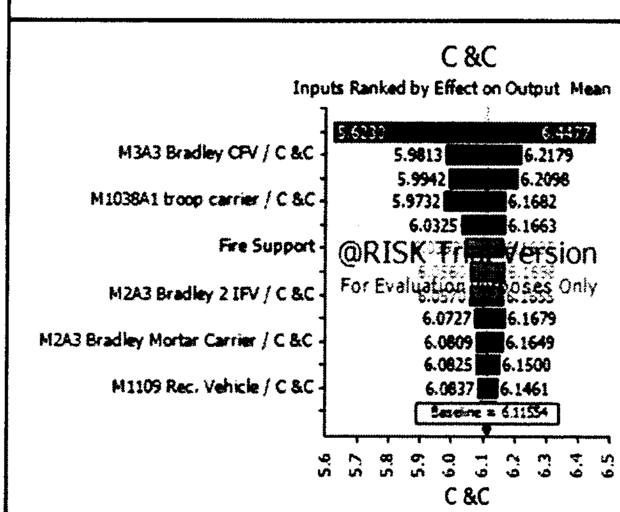
@RISK Output Report for C &C

Performed By: Metin

Date: Thursday, April 11, 2013 9:43:21 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for C &C

Statistics		Percentile	
Minimum	5.071559633	5%	5.5121339
Maximum	6.828657315	10%	5.6203072
Mean	6.115543546	15%	5.7291667
Std Dev	0.34151448	20%	5.8167442
Variance	0.11663214	25%	5.8824593
Skewness	-0.322309925	30%	5.9371125
Kurtosis	2.344367084	35%	5.9830827
Median	6.133534137	40%	6.0289449
Mode	6.121179039	45%	6.0792541
Left X	5.512133891	50%	6.1335341
Left P	5%	55%	6.1935829
Right X	6.615720524	60%	6.2456897
Right P	95%	65%	6.2944785
Diff X	1.103586633	70%	6.3415113
Diff P	90%	75%	6.3893557
#Errors	0	80%	6.4410646
Filter Min	Off	85%	6.496139
Filter Max	Off	90%	6.5524403
#Filtered	0	95%	6.6157205

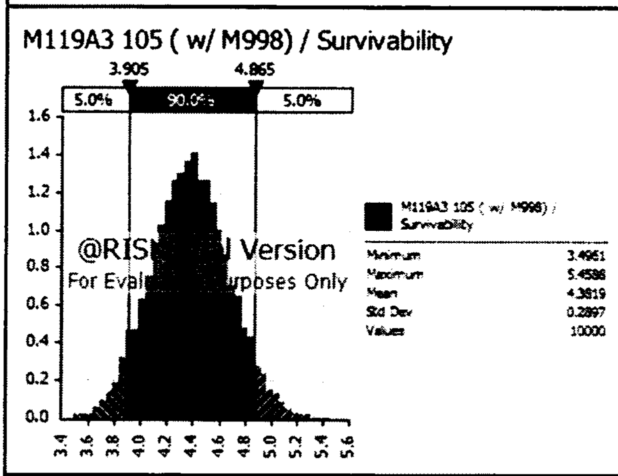
Change in Output Statistic for C &C

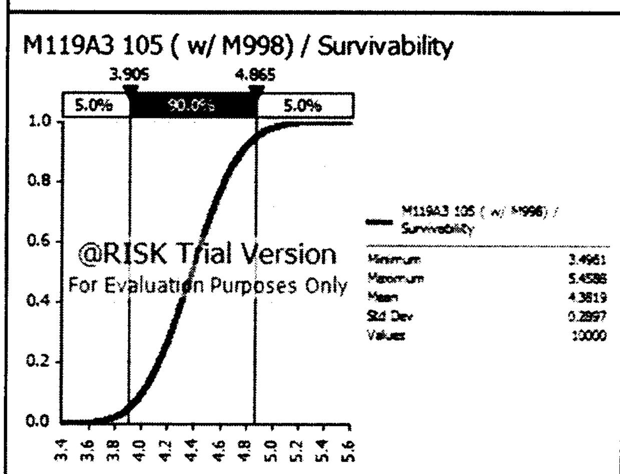
Rank	Name	Lower	Upper
1	Mounted Sniper	5.6230239	6.4476863
2	M3A3 Bradley CF	5.9812728	6.2178687
3	Fire Attack	5.9941856	6.2098352
4	M1038A1 troop c	5.9732099	6.1681609
5	M1A2 / C &C	6.032519	6.1663425
6	Fire Support	6.0391993	6.1635278
7	Indirect Fire	6.0559784	6.1697575
8	M2A3 Bradley 2 I	6.056974	6.1654569
9	M1151 w/LRAS3	6.0726709	6.1679413
10	M2A3 Bradley M	6.0809281	6.1649268
11	Reconnaissance	6.0825335	6.1500055
12	M1109 Rec. Vehi	6.0836665	6.146098
13	M1A2-SEP / C &C	6.0940518	6.1420598

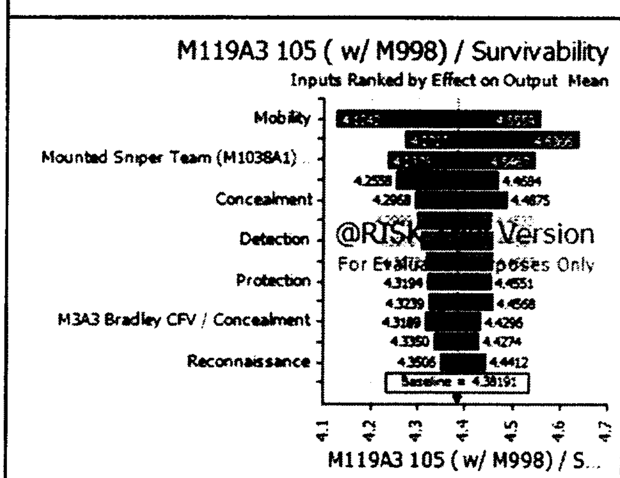
Motorized (inf)-Capabilities

@RISK Output Report for Survivability

Performed By: Metin
Date: Thursday, April 11, 2013 9:43:29 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for M119A3 105 (w/ M998) /

Statistics		Percentile	
Minimum	3.49614081	5%	3.9048914
Maximum	5.458842322	10%	4.0079635
Mean	4.381914423	15%	4.0773108
Std Dev	0.289723658	20%	4.1327048
Variance	0.083939798	25%	4.1815767
Skewness	0.080354702	30%	4.2260966
Kurtosis	2.827045356	35%	4.2661426
Median	4.378617424	40%	4.3038199
Mode	4.367435784	45%	4.341135
Left X	3.904891406	50%	4.3786174
Left P	5%	55%	4.4152313
Right X	4.864834648	60%	4.4521799
Right P	95%	65%	4.4924277
Diff X	0.959943243	70%	4.5311658
Diff P	90%	75%	4.5761537
#Errors	0	80%	4.6267829
Filter Min	Off	85%	4.6858209
Filter Max	Off	90%	4.7615183
#Filtered	0	95%	4.8648346

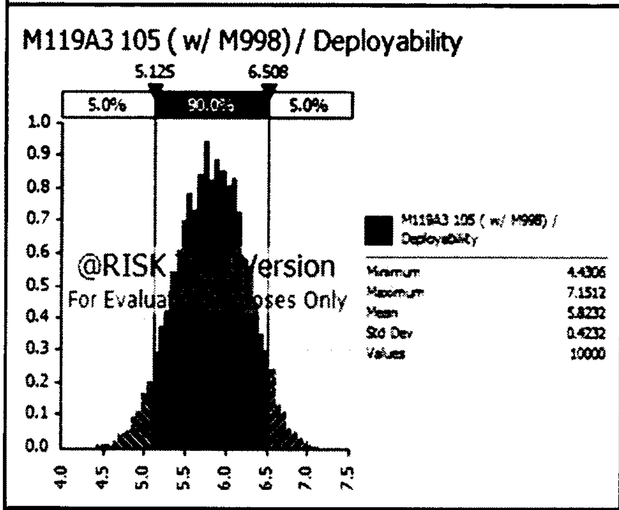
Change in Output Statistic for M119A3 105 (w/

Rank	Name	Lower	Upper
1	Mobility	4.1241791	4.5558628
2	Mounted Sniper	4.2725001	4.6366005
3	Mounted Sniper	4.2378346	4.5467396
4	M3A3 Bradley CF	4.2557601	4.4684199
5	Concealment	4.2967851	4.4874993
6	Fire Support	4.2999467	4.4532647
7	Detection	4.307018	4.4587446
8	Self-Sufficiency	4.3171767	4.4554673
9	Protection	4.3193586	4.4550621
10	Command & Con	4.3238574	4.4568037
11	M3A3 Bradley CF	4.3188738	4.429573
12	Indirect Fire	4.3349798	4.4274052
13	Reconnaissance	4.350555	4.4411732
14	M1038A1 troop c	4.3475896	4.435828

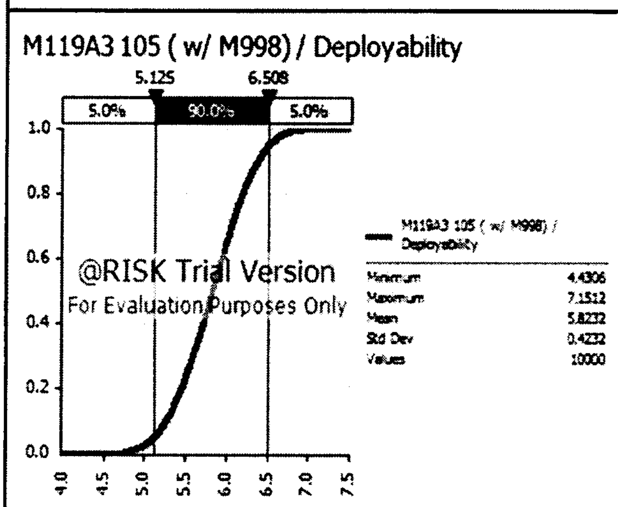
@RISK Output Report for Deployability

Performed By: Metin

Date: Thursday, April 11, 2013 9:43:43 PM

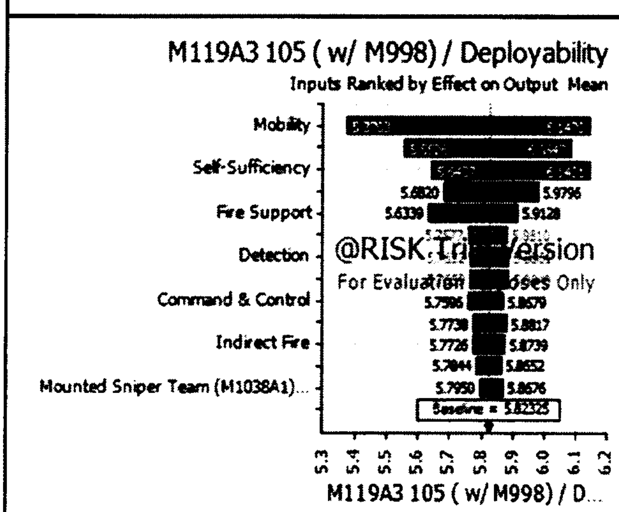


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for M119A3 105 (w/ M998) /

Statistics		Percentile	
Minimum	4.43055716	5%	5.1245656
Maximum	7.151167057	10%	5.2691294
Mean	5.823248268	15%	5.3669572
Std Dev	0.423226295	20%	5.4516296
Variance	0.179120497	25%	5.5228667
Skewness	-0.043656041	30%	5.5875319
Kurtosis	2.652909075	35%	5.6555109
Median	5.826350228	40%	5.7161128
Mode	5.743252852	45%	5.7675755
Left X	5.124565556	50%	5.8263502
Left P	5%	55%	5.884764
Right X	6.508267772	60%	5.9425346
Right P	95%	65%	6.00094
Diff X	1.383702216	70%	6.063028
Diff P	90%	75%	6.12277
#Errors	0	80%	6.1891392
Filter Min	Off	85%	6.2769717
Filter Max	Off	90%	6.3730657
#Filtered	0	95%	6.5082678



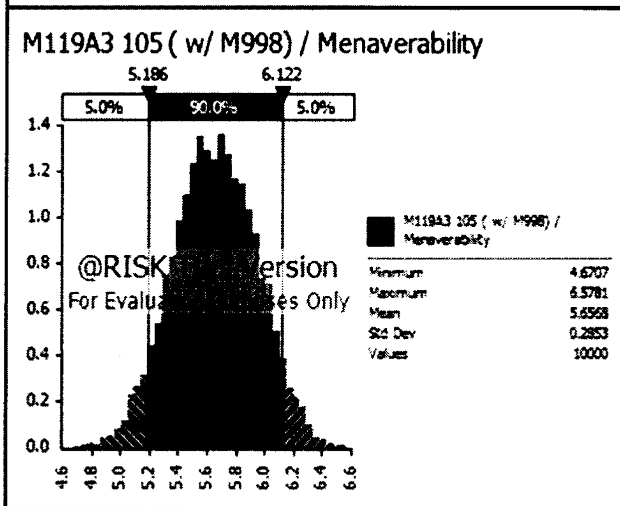
Change in Output Statistic for M119A3 105 (w/

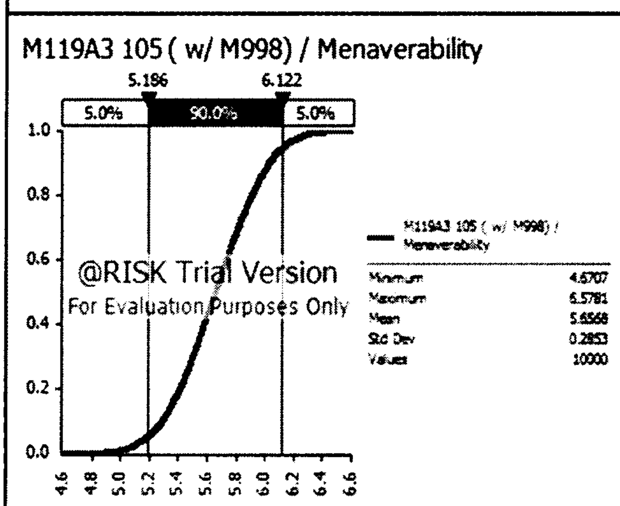
Rank	Name	Lower	Upper
1	Mobility	5.3703476	6.1469512
2	Transportability	5.5526108	6.084679
3	Self-Sufficiency	5.6437148	6.1420581
4	Fire Attack	5.6820029	5.979635
5	Fire Support	5.6339015	5.912819
6	Concealment	5.7576822	5.8810266
7	Detection	5.7631804	5.8861339
8	Reconnaissance	5.7658587	5.8840283
9	Command & Con	5.7595567	5.867887
10	Protection	5.7738054	5.8817048
11	Indirect Fire	5.7725788	5.8739426
12	M3A3 Bradley CF	5.7844348	5.8652456
13	Mounted Sniper	5.7950079	5.8676195
14	Reconnaissance	5.7890609	5.8605681

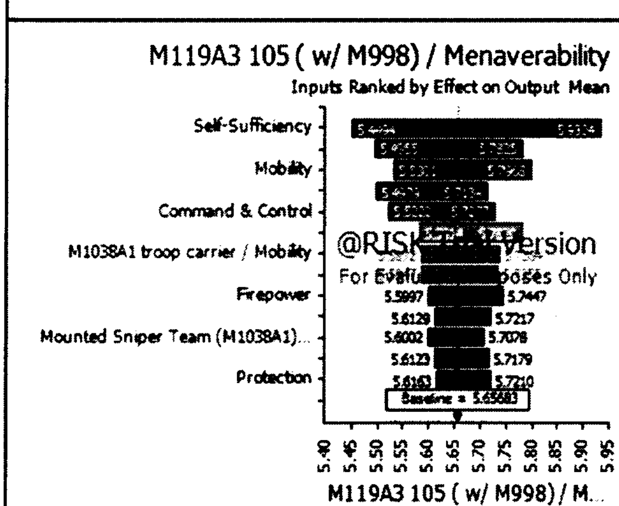
@RISK Output Report for Menaverability

Performed By: Metin

Date: Thursday, April 11, 2013 9:43:55 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for M119A3 105 (w/ M998) /

Statistics		Percentile	
Minimum	4.670691466	5%	5.1857352
Maximum	6.578085806	10%	5.2907238
Mean	5.656830328	15%	5.3561975
Std Dev	0.28527787	20%	5.4110718
Variance	0.081383463	25%	5.4592517
Skewness	-0.025168427	30%	5.5016671
Kurtosis	2.754563235	35%	5.5413822
Median	5.656805262	40%	5.5787763
Mode	5.690605967	45%	5.6177109
Left X	5.185735162	50%	5.6568053
Left P	5%	55%	5.6936897
Right X	6.122215876	60%	5.7326513
Right P	95%	65%	5.7711803
Diff X	0.936480714	70%	5.8146406
Diff P	90%	75%	5.8583284
#Errors	0	80%	5.906697
Filter Min	Off	85%	5.9606699
Filter Max	Off	90%	6.027585
#Filtered	0	95%	6.1222159

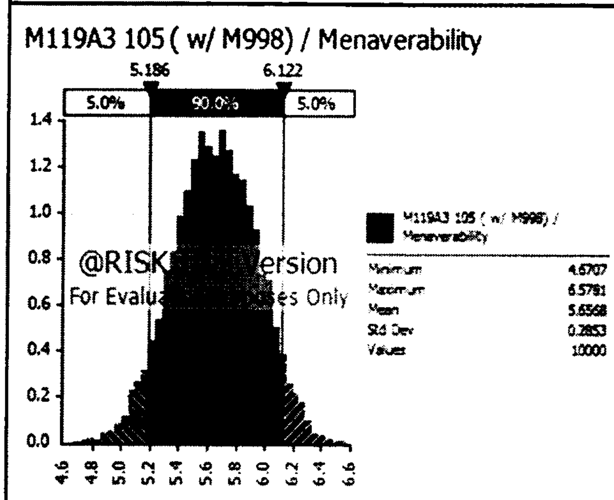
Change in Output Statistic for M119A3 105 (w/

Rank	Name	Lower	Upper
1	Self-Sufficiency	5.4494454	5.9324097
2	M3A3 Bradley CF	5.4954523	5.7824773
3	Mobility	5.5300683	5.7968046
4	Mounted Sniper T	5.4978994	5.7134099
5	Command & Con	5.5221985	5.7276542
6	Concealment	5.5813988	5.7820357
7	M1038A1 troop c	5.587155	5.7383713
8	Transportability	5.5847245	5.7354748
9	Firepower	5.5997237	5.7447386
10	Fire Support	5.6129489	5.7216565
11	Mounted Sniper T	5.6002414	5.7077862
12	Detection	5.6122607	5.7179078
13	Protection	5.616308	5.721028
14	M2A3 Bradley 2 I	5.6008338	5.6917367

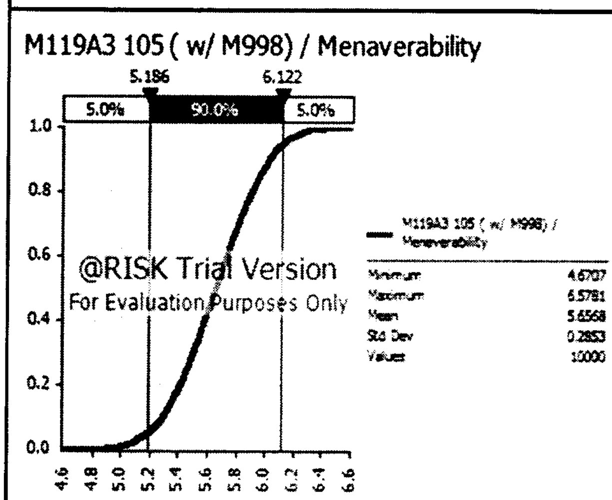
@RISK Output Report for Menaverability

Performed By: Metin

Date: Thursday, April 11, 2013 9:43:55 PM

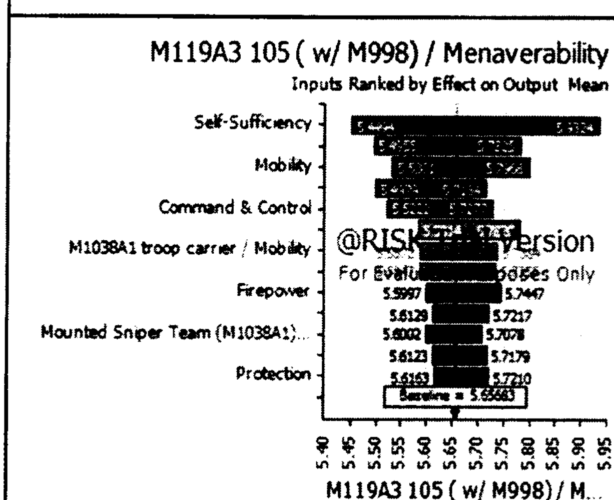


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for M119A3 105 (w/ M998) /

Statistics		Percentile	
Minimum	4.670691466	5%	5.1857352
Maximum	6.578085806	10%	5.2907238
Mean	5.656830328	15%	5.3561975
Std Dev	0.28527787	20%	5.4110718
Variance	0.081383463	25%	5.4592517
Skewness	-0.025168427	30%	5.5016671
Kurtosis	2.754563235	35%	5.5413822
Median	5.656805262	40%	5.5787763
Mode	5.690605967	45%	5.6177109
Left X	5.185735162	50%	5.6568053
Left P	5%	55%	5.6936897
Right X	6.122215876	60%	5.7326513
Right P	95%	65%	5.7711803
Diff X	0.936480714	70%	5.8146406
Diff P	90%	75%	5.8583284
#Errors	0	80%	5.906697
Filter Min	Off	85%	5.9606699
Filter Max	Off	90%	6.027585
#Filtered	0	95%	6.1222159



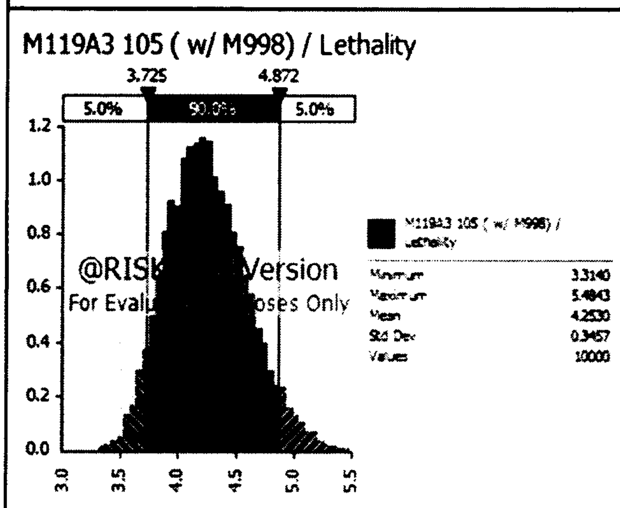
Change in Output Statistic for M119A3 105 (w/

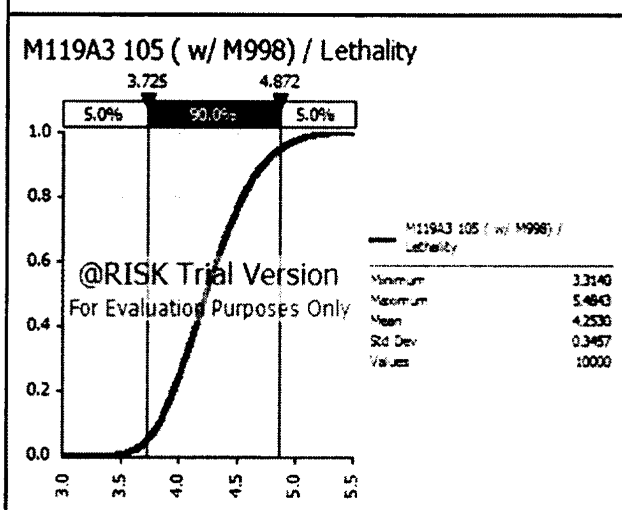
Rank	Name	Lower	Upper
1	Self-Sufficiency	5.4494454	5.9324097
2	M3A3 Bradley CF	5.4954523	5.7824773
3	Mobility	5.5300683	5.7968046
4	Mounted Sniper	5.4978994	5.7134099
5	Command & Con	5.5221985	5.7276542
6	Concealment	5.5813988	5.7820357
7	M1038A1 troop c	5.587155	5.7383713
8	Transportability	5.5847245	5.7354748
9	Firepower	5.5997237	5.7447386
10	Fire Support	5.6129489	5.7216565
11	Mounted Sniper	5.6002414	5.7077862
12	Detection	5.6122607	5.7179078
13	Protection	5.616308	5.721028
14	M2A3 Bradley 2 I	5.6008338	5.6917367

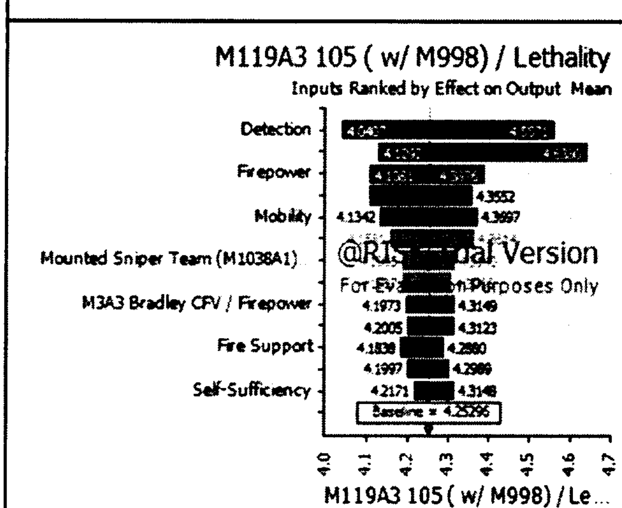
@RISK Output Report for Lethality

Performed By: Metin

Date: Thursday, April 11, 2013 9:44:19 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for M119A3 105 (w/ M998) /

Statistics		Percentile	
Minimum	3.313962515	5%	3.7254621
Maximum	5.484282837	10%	3.8264285
Mean	4.252956201	15%	3.8914368
Std Dev	0.345709776	20%	3.9468757
Variance	0.119515249	25%	4.0048284
Skewness	0.344103214	30%	4.0511262
Kurtosis	2.890745505	35%	4.0986001
Median	4.229073258	40%	4.1417134
Mode	4.188981918	45%	4.1853302
Left X	3.72546211	50%	4.2290733
Left P	5%	55%	4.2713323
Right X	4.87197719	60%	4.3197197
Right P	95%	65%	4.3697854
Diff X	1.146515081	70%	4.4220096
Diff P	90%	75%	4.4832731
#Errors	0	80%	4.5443756
Filter Min	Off	85%	4.6191835
Filter Max	Off	90%	4.7144141
#Filtered	0	95%	4.8719772

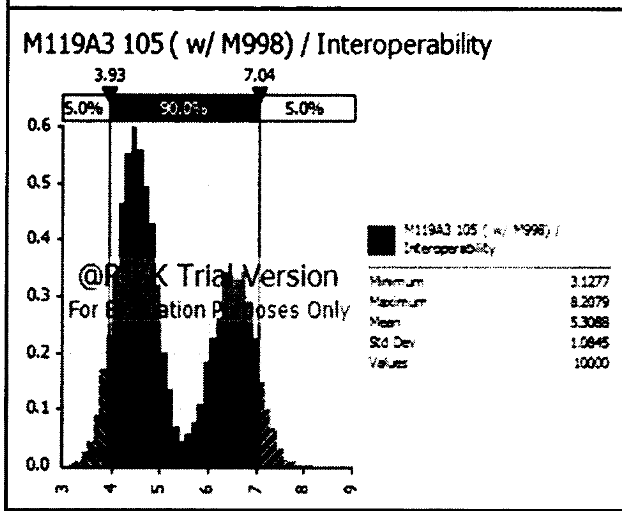
Change in Output Statistic for M119A3 105 (w/

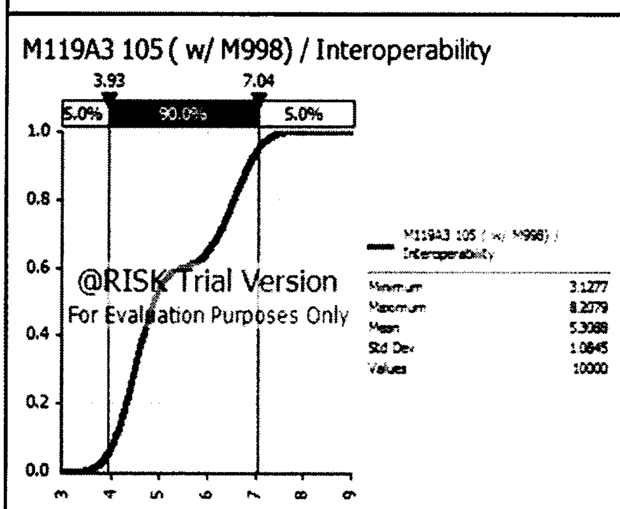
Rank	Name	Lower	Upper
1	Detection	4.0407285	4.5571473
2	Command & Con	4.1291626	4.6380401
3	Firepower	4.1081028	4.3876126
4	Mounted Sniper	4.1078591	4.3551994
5	Mobility	4.134166	4.3696617
6	M1038A1 troop c	4.1581402	4.3613885
7	Mounted Sniper	4.1904889	4.3140345
8	Reconnaissance	4.1886685	4.3065806
9	M3A3 Bradley CF	4.1972616	4.3148894
10	Concealment	4.2005205	4.3123373
11	Fire Support	4.1837772	4.2879815
12	Transportability	4.1997181	4.298912
13	Self-Sufficiency	4.2170682	4.3147626
14	Mounted Sniper	4.2002651	4.2948955

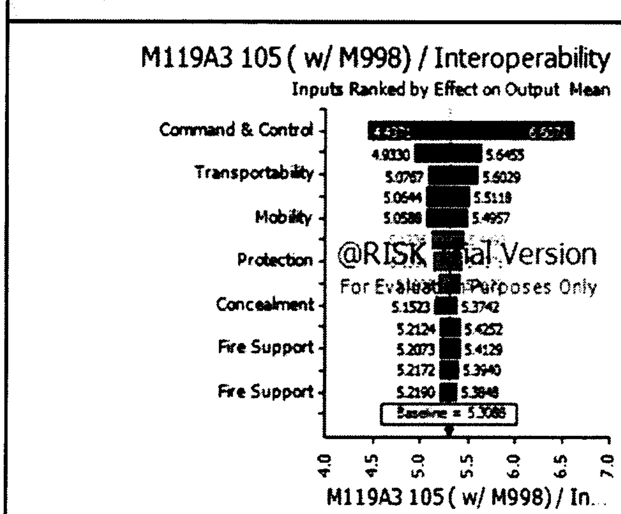
@RISK Output Report for Interoperability

Performed By: Metin

Date: Thursday, April 11, 2013 9:44:30 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

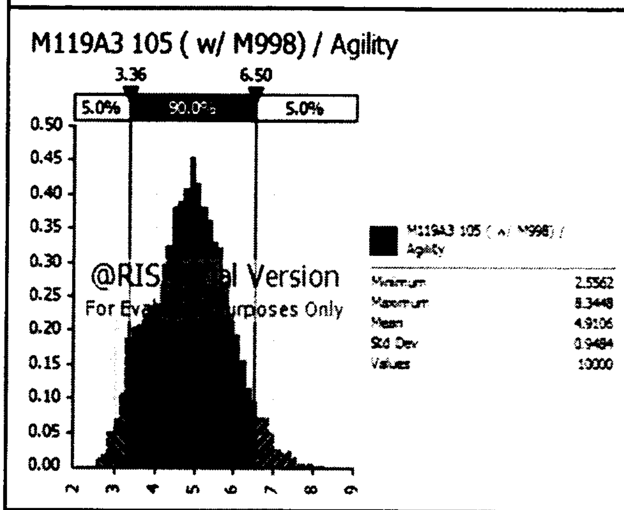
Summary Statistics for M119A3 105 (w/ M998) /

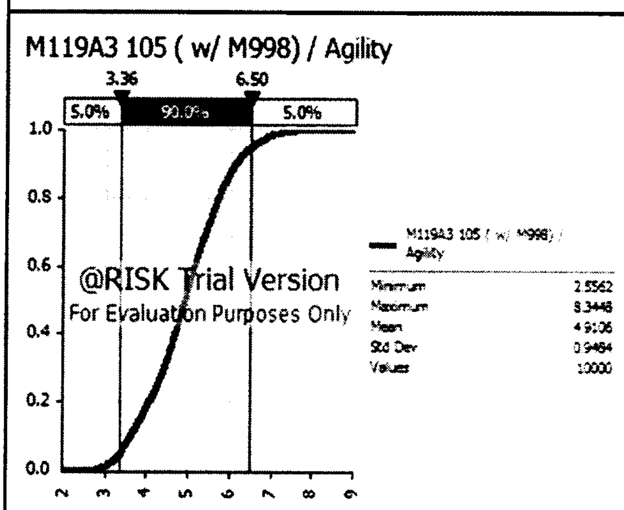
Statistics		Percentile	
Minimum	3.12770156	5%	3.9322056
Maximum	8.207858992	10%	4.1001275
Mean	5.308831299	15%	4.2247595
Std Dev	1.084544933	20%	4.3148603
Variance	1.176237712	25%	4.4062009
Skewness	0.359158737	30%	4.4923233
Kurtosis	1.69194197	35%	4.5769979
Median	4.886028269	40%	4.6694037
Mode	4.485033058	45%	4.7716979
Left X	3.932205565	50%	4.8860283
Left P	5%	55%	5.0406919
Right X	7.037508038	60%	5.4545369
Right P	95%	65%	6.0081007
Diff X	3.105302473	70%	6.2340687
Diff P	90%	75%	6.3968182
#Errors	0	80%	6.5389606
Filter Min	Off	85%	6.6919432
Filter Max	Off	90%	6.8470887
#Filtered	0	95%	7.037508

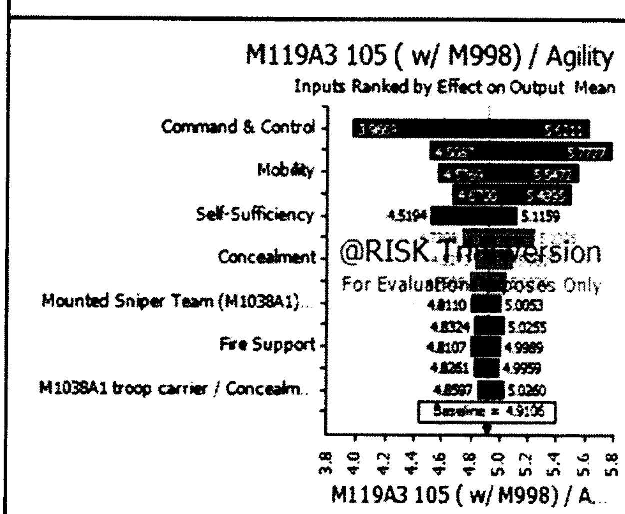
Change in Output Statistic for M119A3 105 (w/

Rank	Name	Lower	Upper
1	Command & Con	4.4370632	6.6071462
2	Detection	4.9330058	5.6455064
3	Transportability	5.0767078	5.6028586
4	Self-Sufficiency	5.064353	5.5117923
5	Mobility	5.0588265	5.4956939
6	Mounted Sniper	5.1235576	5.4493146
7	Protection	5.1391274	5.4276356
8	Firepower	5.1907544	5.4171537
9	Concealment	5.1523414	5.3741872
10	Mounted Sniper	5.2123599	5.4252019
11	Fire Support	5.2072853	5.412929
12	Mounted Sniper	5.2171518	5.3939725
13	Fire Support	5.2189901	5.3848303
14	M3A3 Bradley CF	5.2493108	5.4148152

Performed By: Metin
Date: Thursday, April 11, 2013 9:44:42 PM







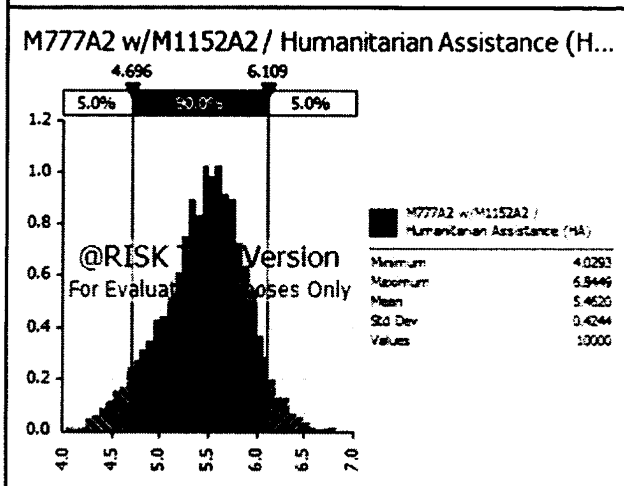
Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

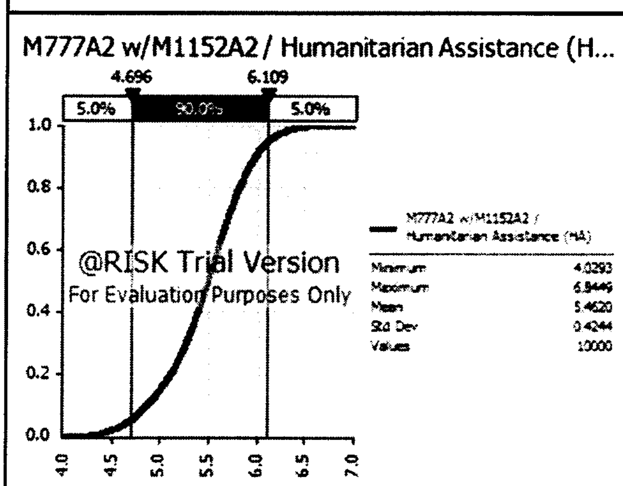
Summary Statistics for M119A3 105 (w/ M998) /			
Statistics		**Percentile**	
Minimum	2.556155166	5%	3.3638645
Maximum	8.344763454	10%	3.6033923
Mean	4.910606026	15%	3.8414561
Std Dev	0.948365232	20%	4.0493013
Variance	0.899396613	25%	4.2471725
Skewness	0.11510385	30%	4.4124533
Kurtosis	2.658555945	35%	4.5489563
Median	4.919609911	40%	4.6738396
Mode	4.930397064	45%	4.8007422
Left X	3.363864519	50%	4.9196099
Left P	5%	55%	5.0262246
Right X	6.502369372	60%	5.1438883
Right P	95%	65%	5.2783078
Diff X	3.138504853	70%	5.413561
Diff P	90%	75%	5.5626263
#Errors	0	80%	5.7156078
Filter Min	Off	85%	5.8983558
Filter Max	Off	90%	6.1352727
#Filtered	0	95%	6.5023694

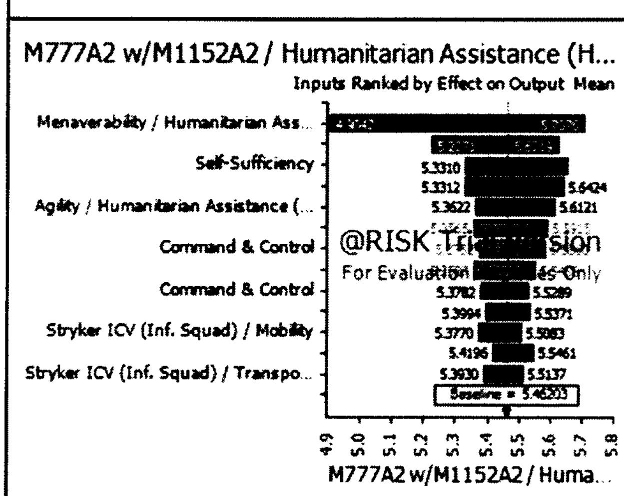
Change in Output Statistic for M119A3 105 (w/			
Rank	**Name**	**Lower**	**Upper**
1	Command & Con	3.9669113	5.6210624
2	Protection	4.508702	5.7776817
3	Mobility	4.5769437	5.5471596
4	Transportability	4.6700492	5.489455
5	Self-Sufficiency	4.5193692	5.1158697
6	Firepower	4.7398498	5.238472
7	Concealment	4.8270148	5.0827171
8	Mounted Sniper	4.7905259	5.0369859
9	Mounted Sniper	4.8110121	5.0052915
10	Mounted Sniper	4.8323624	5.0254854
11	Fire Support	4.8107481	4.9988736
12	M3A3 Bradley CF	4.8261018	4.9959341
13	M1038A1 troop c	4.8596873	5.0259573
14	Fire Support	4.8178387	4.9683179

Stryker Option- Missions

Performed By: Metin
Date: Thursday, April 11, 2013 9:44:54 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for M777A2 w/M1152A2 / H

Statistics		Percentile	
Minimum	4.029295799	5%	4.6959423
Maximum	6.844883098	10%	4.8681683
Mean	5.462034794	15%	4.9993858
Std Dev	0.424397171	20%	5.1155517
Variance	0.180112958	25%	5.2021834
Skewness	-0.308941531	30%	5.2735924
Kurtosis	2.938500262	35%	5.3346018
Median	5.496066988	40%	5.3927943
Mode	5.581492053	45%	5.4473691
Left X	4.695942264	50%	5.496067
Left P	5%	55%	5.5459195
Right X	6.109129721	60%	5.5956655
Right P	95%	65%	5.6460247
Diff X	1.413187457	70%	5.6987331
Diff P	90%	75%	5.7553101
#Errors	0	80%	5.8168112
Filter Min	Off	85%	5.8864193
Filter Max	Off	90%	5.9765601
#Filtered	0	95%	6.1091297

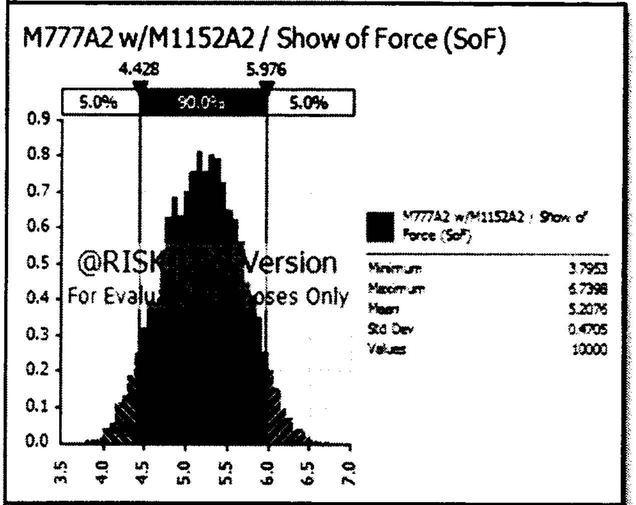
Change in Output Statistic for M777A2 w/M115

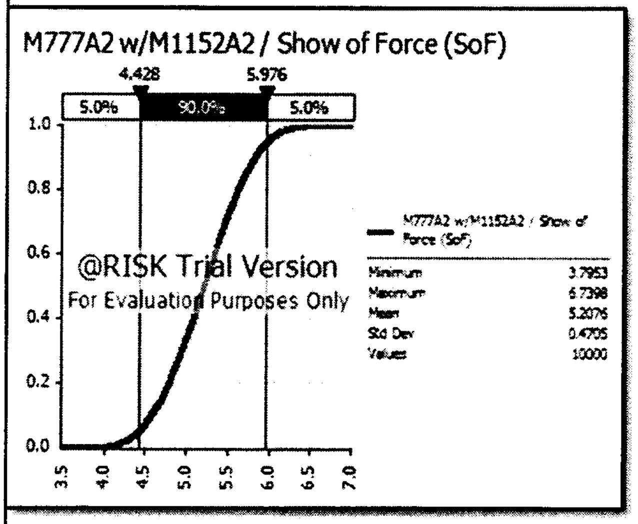
Rank	Name	Lower	Upper
1	Menaverability /	4.904152	5.7075774
2	Mobility	5.2270937	5.6219412
3	Self-Sufficiency	5.3309983	5.6484227
4	Deployability / H	5.3311816	5.6424433
5	Agility / Humanit	5.3621635	5.6120932
6	Interoperability /	5.3564628	5.5914832
7	Command & Con	5.3751724	5.5859903
8	Transportability	5.3586733	5.5488145
9	Command & Con	5.3782041	5.5289373
10	Self-Sufficiency	5.3994342	5.5371171
11	Stryker ICV (Inf. S	5.3769538	5.5083427
12	Stryker ICV (Inf. S	5.4196211	5.5460758
13	Stryker ICV (Inf. S	5.3929631	5.513711
14	Stryker ICV (Inf. S	5.4127785	5.524582

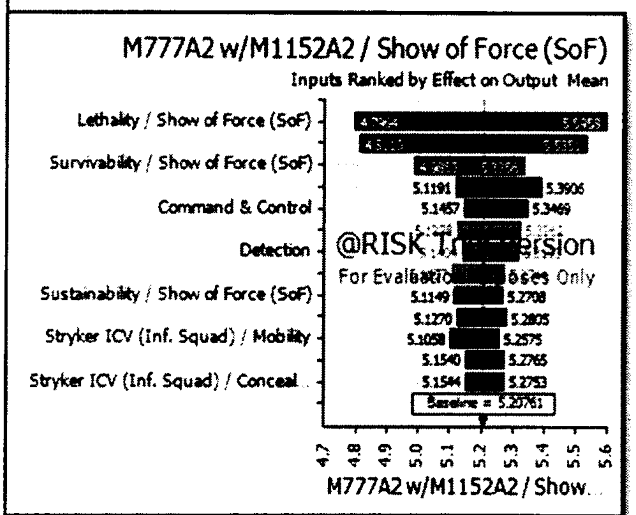
@RISK Output Report for Show of Force (SoF)

Performed By: Metin

Date: Thursday, April 11, 2013 9:45:08 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for M777A2 w/M1152A2 / Sh

Statistics		Percentile	
Minimum	3.795276962	5%	4.4283863
Maximum	6.739802553	10%	4.5799238
Mean	5.207606677	15%	4.7041748
Std Dev	0.470545033	20%	4.7933599
Variance	0.221412628	25%	4.866588
Skewness	0.001001406	30%	4.9391468
Kurtosis	2.56950407	35%	5.0144002
Median	5.20994018	40%	5.0811679
Mode	5.280440464	45%	5.1490777
Left X	4.42838626	50%	5.2099402
Left P	5%	55%	5.2751295
Right X	5.975789264	60%	5.3384186
Right P	95%	65%	5.4023129
Diff X	1.547403004	70%	5.4700705
Diff P	90%	75%	5.5438743
#Errors	0	80%	5.6232929
Filter Min	Off	85%	5.712746
Filter Max	Off	90%	5.8297106
#Filtered	0	95%	5.9757893

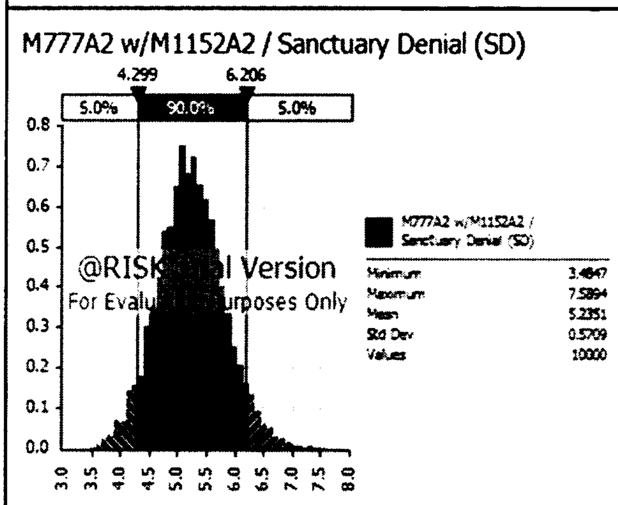
Change in Output Statistic for M777A2 w/M115

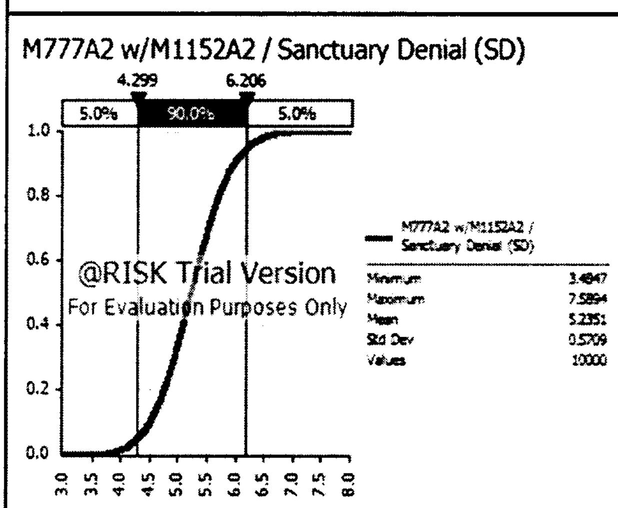
Rank	Name	Lower	Upper
1	Lethality / Show (	4.796437	5.5958362
2	Deployability / S	4.8109895	5.5351092
3	Survivability / Sh	4.9852757	5.3356249
4	Agility / Show of F	5.1190976	5.3906411
5	Command & Con	5.1457346	5.346939
6	Menaverability /	5.1278099	5.3262386
7	Detection	5.1403739	5.3193181
8	Mobility	5.1107464	5.2743954
9	Sustainability / S	5.1149315	5.2708379
10	Firepower	5.1269951	5.2805366
11	Stryker ICV (Inf. S	5.1057927	5.2574591
12	Self-Sufficiency	5.1539795	5.2764987
13	Stryker ICV (Inf. S	5.154411	5.2753462
14	Self-Sufficiency	5.1639711	5.283534

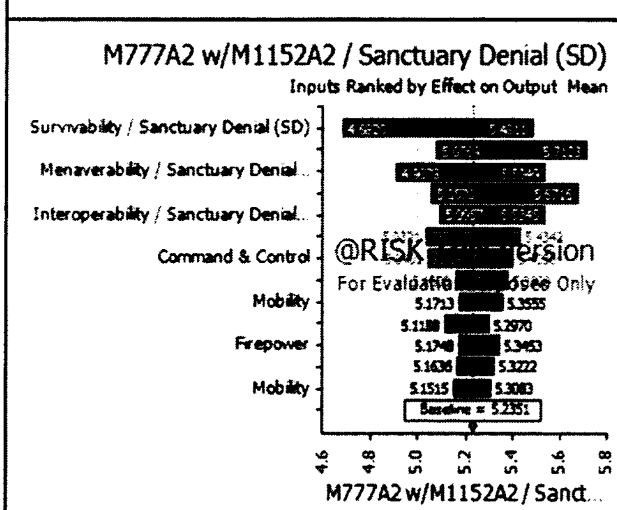
@RISK Output Report for Sanctuary Denial (SD)

Performed By: Metin

Date: Thursday, April 11, 2013 9:45:22 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for M777A2 w/M1152A2 / Sa

Statistics		Percentile	
Minimum	3.484749518	5%	4.2986335
Maximum	7.589398511	10%	4.510647
Mean	5.235143775	15%	4.648951
Std Dev	0.570861445	20%	4.7545907
Variance	0.325882789	25%	4.8472503
Skewness	0.14013595	30%	4.9351772
Kurtosis	3.03955269	35%	5.013026
Median	5.222568581	40%	5.0801643
Mode	5.074727819	45%	5.1464349
Left X	4.298633489	50%	5.2225686
Left P	5%	55%	5.2921348
Right X	6.205763772	60%	5.3683495
Right P	95%	65%	5.4415899
Diff X	1.907130283	70%	5.5234555
Diff P	90%	75%	5.6045246
#Errors	0	80%	5.702352
Filter Min	Off	85%	5.8193158
Filter Max	Off	90%	5.9702878
#Filtered	0	95%	6.2057638

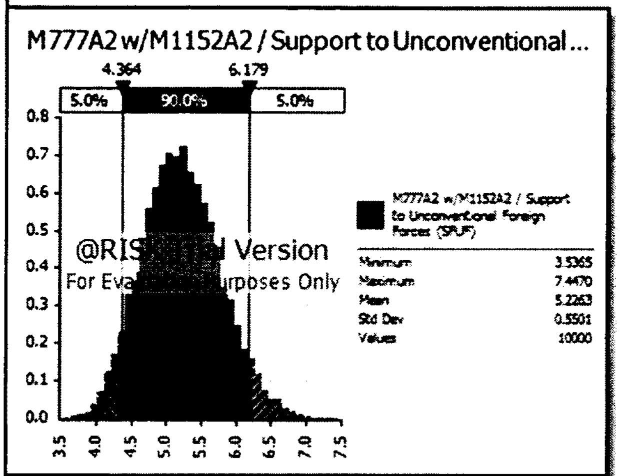
Change in Output Statistic for M777A2 w/M115

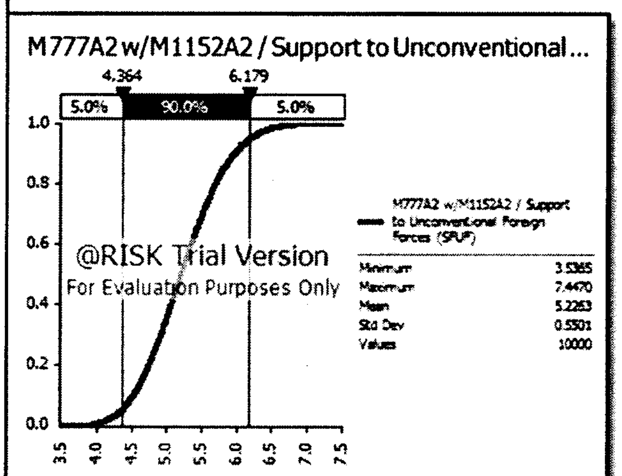
Rank	Name	Lower	Upper
1	Survivability / Sa	4.6819603	5.4810713
2	Sustainability / S	5.0769186	5.712315
3	Menaverability /	4.9077667	5.5348642
4	Deployability / Sa	5.0569652	5.6716485
5	Interoperability /	5.0957049	5.5344811
6	Agility / Sanctuar	5.0321022	5.4342493
7	Command & Con	5.0400597	5.4029908
8	Protection	5.1599903	5.3829307
9	Mobility	5.1713154	5.3555408
10	Self-Sufficiency	5.1188124	5.2969722
11	Firepower	5.174819	5.3453228
12	Stryker ICV (Inf. S	5.1635968	5.3221829
13	Mobility	5.151545	5.3083255
14	Command & Con	5.1737484	5.3210963

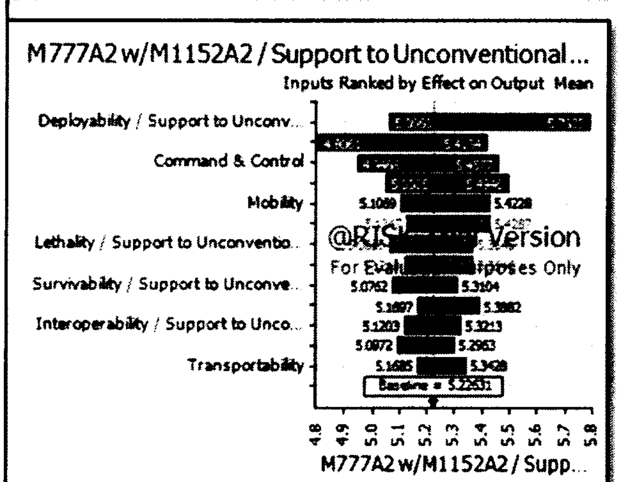
@RISK Output Report for Support to Unconventional Foreign Forces

Performed By: Metin

Date: Thursday, April 11, 2013 9:45:36 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for M777A2 w/M1152A2 / Su

Statistics		Percentile	
Minimum	3.536455411	5%	4.3637525
Maximum	7.446983988	10%	4.5256617
Mean	5.226305083	15%	4.649506
Std Dev	0.550141808	20%	4.7479106
Variance	0.302656009	25%	4.8358594
Skewness	0.222234616	30%	4.9165608
Kurtosis	2.833110307	35%	4.9891946
Median	5.203400429	40%	5.0637599
Mode	5.069242293	45%	5.1317831
Left X	4.363752459	50%	5.2034004
Left P	5%	55%	5.2716753
Right X	6.178914009	60%	5.3459114
Right P	95%	65%	5.4216657
Diff X	1.81516155	70%	5.5056449
Diff P	90%	75%	5.5955024
#Errors	0	80%	5.6923691
Filter Min	Off	85%	5.8037206
Filter Max	Off	90%	5.9540658
#Filtered	0	95%	6.178914

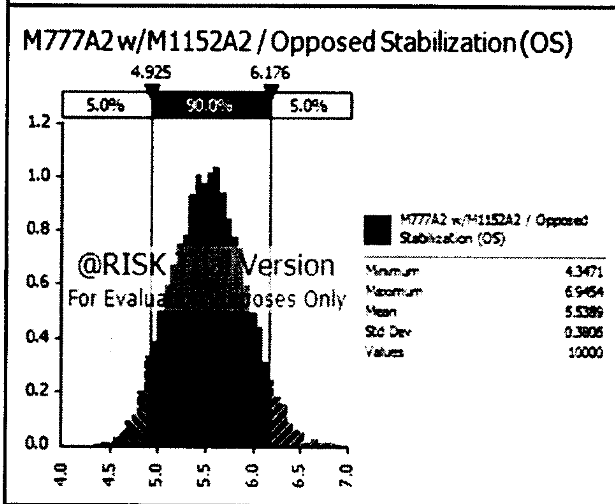
Change in Output Statistic for M777A2 w/M115

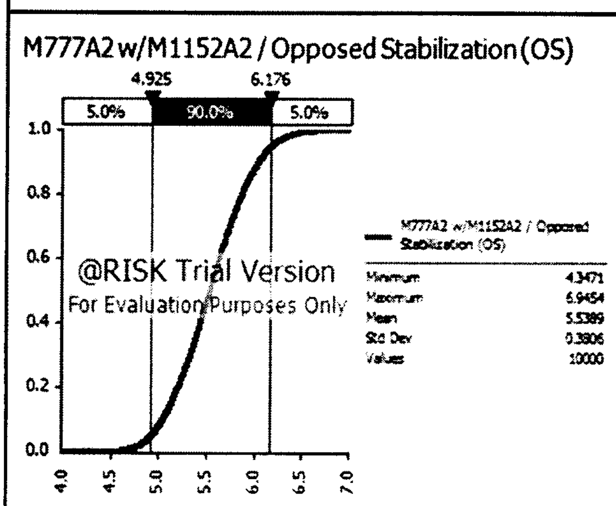
Rank	Name	Lower	Upper
1	Deployability / S	5.0660075	5.7885479
2	Agility / Support	4.8061324	5.4134292
3	Command & Con	4.9488248	5.4577045
4	Command & Con	5.0504501	5.4946477
5	Mobility	5.1069234	5.4228011
6	Protection	5.1246856	5.4287349
7	Lethality / Suppo	5.0664643	5.3648001
8	Sustainability / S	5.1217788	5.3646411
9	Survivability / Su	5.076155	5.310424
10	Firepower	5.1697045	5.3881935
11	Interoperability /	5.1202996	5.321263
12	Self-Sufficiency	5.0971818	5.296283
13	Transportability	5.1684718	5.342794
14	Stryker ICV (Inf. S	5.1734812	5.3255301

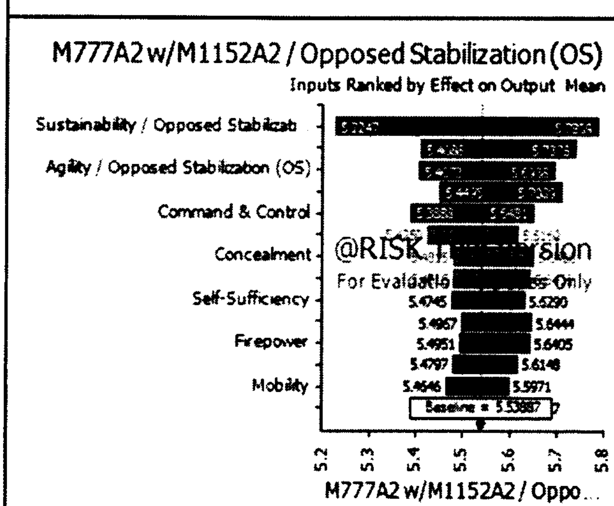
@RISK Output Report for Opposed Stabilization (OS)

Performed By: Metin

Date: Thursday, April 11, 2013 9:45:50 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for M777A2 w/M1152A2 / O

Statistics		Percentile	
Minimum	4.347081065	5%	4.9253822
Maximum	6.94535866	10%	5.0442207
Mean	5.538869161	15%	5.1285589
Std Dev	0.380571611	20%	5.2010899
Variance	0.144834751	25%	5.2687197
Skewness	0.111336815	30%	5.3322847
Kurtosis	2.763545318	35%	5.3841037
Median	5.533769107	40%	5.4334766
Mode	5.615550953	45%	5.4858021
Left X	4.925382237	50%	5.5337691
Left P	5%	55%	5.5840552
Right X	6.175563369	60%	5.6286142
Right P	95%	65%	5.685414
Diff X	1.250181131	70%	5.7414696
Diff P	90%	75%	5.8019155
#Errors	0	80%	5.8673735
Filter Min	Off	85%	5.9415479
Filter Max	Off	90%	6.0375182
#Filtered	0	95%	6.1755634

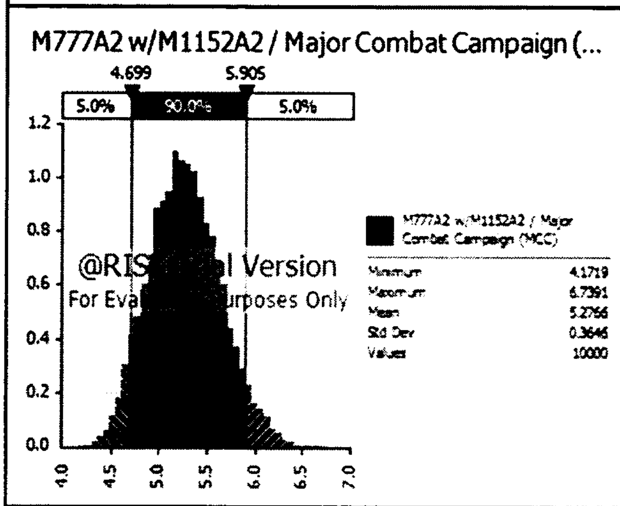
Change in Output Statistic for M777A2 w/M1152

Rank	Name	Lower	Upper
1	Sustainability / O	5.2246597	5.7859036
2	Command & Con	5.4088497	5.7378436
3	Agility / Opposed	5.4073441	5.6938276
4	Interoperability /	5.4494817	5.7089317
5	Command & Con	5.3887527	5.6480515
6	Menaverability /	5.4250079	5.6159667
7	Concealment	5.4815407	5.6487552
8	Mobility	5.4815105	5.6406059
9	Self-Sufficiency	5.4745321	5.6290303
10	Protection	5.4966713	5.6443563
11	Firepower	5.4951137	5.640527
12	Self-Sufficiency	5.479651	5.6147548
13	Mobility	5.4645959	5.5970677
14	Stryker ICV (Inf. S	5.4850659	5.6156858

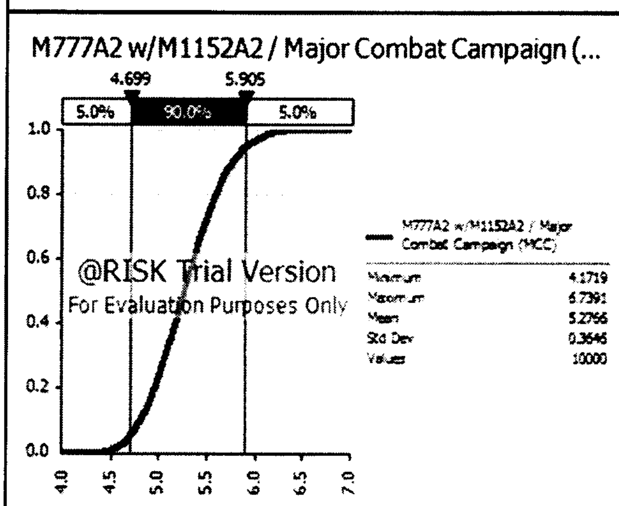
@RISK Output Report for Major Combat Campaign (MCC)

Performed By: Metin

Date: Thursday, April 11, 2013 9:46:04 PM

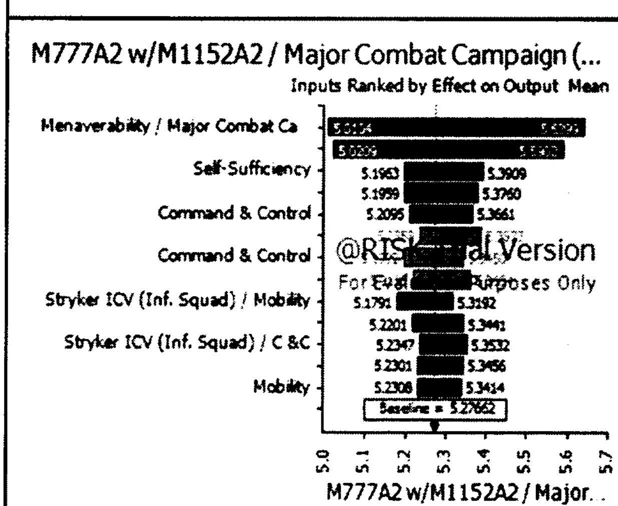


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for M777A2 w/M1152A2 / M

Statistics		Percentile	
Minimum	4.171935098	5%	4.698936
Maximum	6.739080585	10%	4.8097288
Mean	5.276622834	15%	4.8924937
Std Dev	0.364584842	20%	4.957666
Variance	0.132922107	25%	5.0131025
Skewness	0.222516027	30%	5.0686978
Kurtosis	2.793882643	35%	5.1214533
Median	5.262341466	40%	5.1693408
Mode	5.30421255	45%	5.2147639
Left X	4.698936045	50%	5.2623415
Left P	5%	55%	5.3077503
Right X	5.905156595	60%	5.3573799
Right P	95%	65%	5.4053427
Diff X	1.20622055	70%	5.4635238
Diff P	90%	75%	5.5230319
#Errors	0	80%	5.5873927
Filter Min	Off	85%	5.6617962
Filter Max	Off	90%	5.759378
#Filtered	0	95%	5.9051566



Change in Output Statistic for M777A2 w/M115

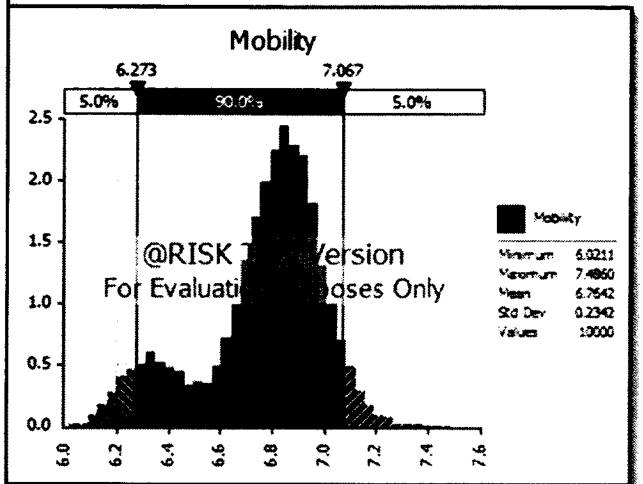
Rank	Name	Lower	Upper
1	Menaverability /	5.0104397	5.6399483
2	Lethality / Major	5.0208621	5.590162
3	Self-Sufficiency	5.1963339	5.390939
4	Survivability / Ma	5.1958527	5.376032
5	Command & Con	5.2094874	5.3661263
6	Command & Con	5.2357629	5.3872639
7	Command & Con	5.1991561	5.3449564
8	Interoperability /	5.2184673	5.3604036
9	Stryker ICV (Inf. S	5.1790739	5.3191891
10	Stryker ICV (Inf. S	5.2201068	5.3440774
11	Stryker ICV (Inf. S	5.2347456	5.3531621
12	Detection	5.2301273	5.3455965
13	Mobility	5.2308277	5.3413686
14	Firepower	5.2131692	5.3199731

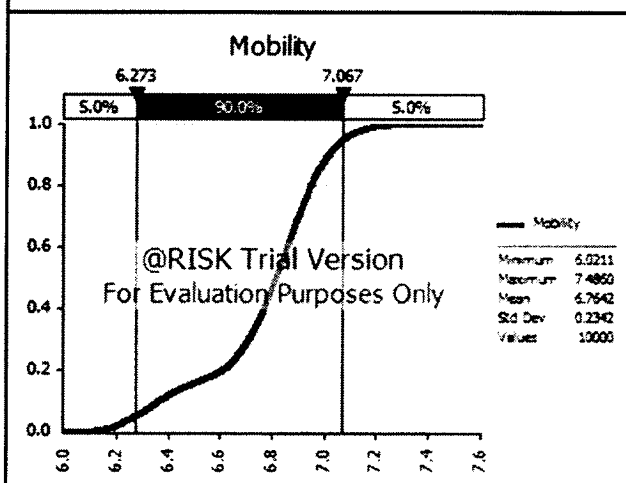
Stryker Option-Attributes

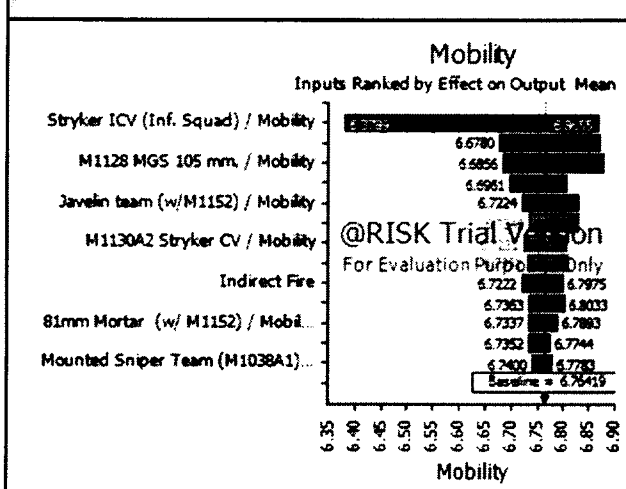
@RISK Output Report for Mobility

Performed By: Metin

Date: Thursday, April 11, 2013 9:46:18 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Mobility

Statistics		Percentile	
Minimum	6.021110242	5%	6.2728561
Maximum	7.485958486	10%	6.3632107
Mean	6.764186088	15%	6.4767932
Std Dev	0.234239888	20%	6.6076759
Variance	0.054868325	25%	6.6696987
Skewness	-0.826495214	30%	6.7085582
Kurtosis	3.200196935	35%	6.7397998
Median	6.81331293	40%	6.7671492
Mode	7	45%	6.7916355
Left X	6.27285613	50%	6.8133129
Left P	5%	55%	6.8357827
Right X	7.067169294	60%	6.8562049
Right P	95%	65%	6.8773163
Diff X	0.794313164	70%	6.899519
Diff P	90%	75%	6.9216167
#Errors	0	80%	6.946061
Filter Min	Off	85%	6.974212
Filter Max	Off	90%	7.0138782
#Filtered	0	95%	7.0671693

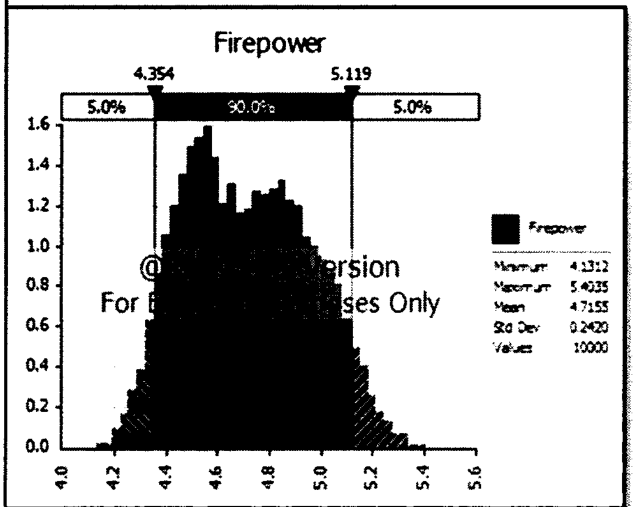
Change in Output Statistic for Mobility

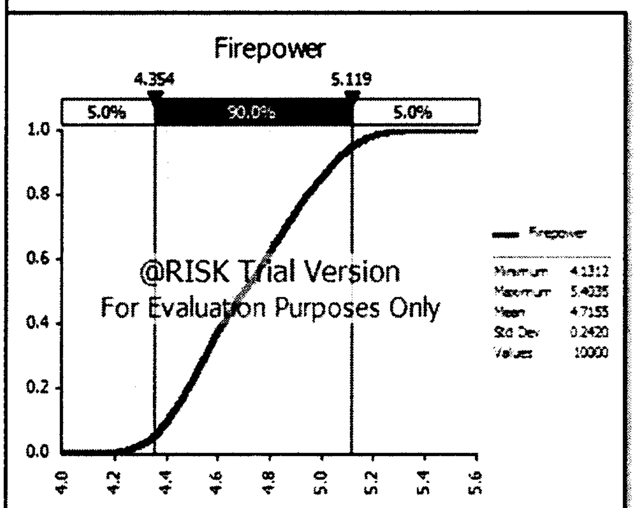
Rank	Name	Lower	Upper
1	Stryker ICV (Inf. S	6.3789446	6.8654993
2	M1134A2 Stryker	6.6779625	6.8680173
3	M1128 MGS 105	6.6856454	6.8753898
4	M777A2 w/M115	6.696131	6.8061534
5	Javelin team (w/	6.7223923	6.8298772
6	M1109 Rec. Vehi	6.7346491	6.8276906
7	M1130A2 Stryker	6.7230575	6.8062056
8	Fire Support	6.7300859	6.8103008
9	Indirect Fire	6.7222488	6.7974568
10	Stryker 120 mm.	6.7362597	6.8033354
11	81mm Mortar (w	6.7336843	6.7893447
12	Target Acquisitio	6.7351883	6.7744197
13	Mounted Sniper	6.7400216	6.7782549
14	Fire Attack	6.7392291	6.7767411

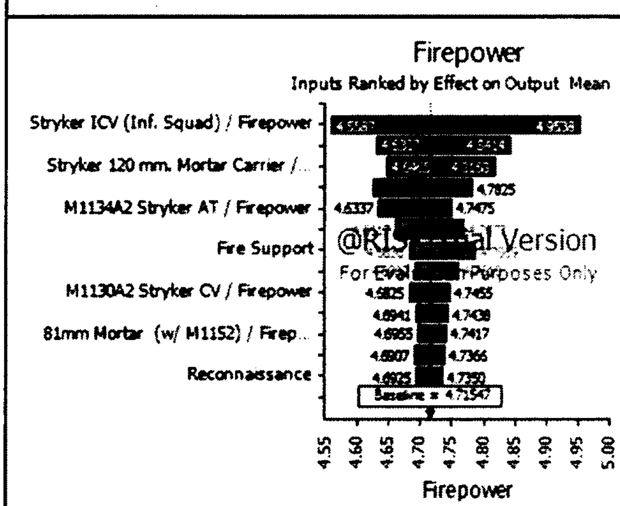
@RISK Output Report for Firepower

Performed By: Metin

Date: Thursday, April 11, 2013 9:46:26 PM







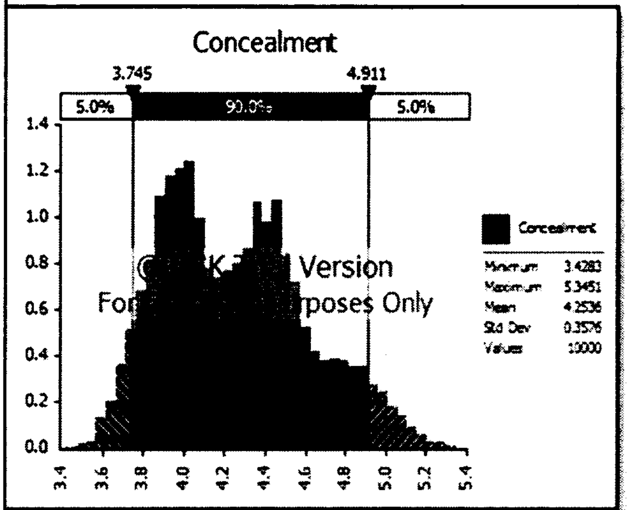
Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for Firepower			
Statistics		**Percentile**	
Minimum	4.131177829	**5%**	4.3535749
Maximum	5.403491756	**10%**	4.4071051
Mean	4.715467428	**15%**	4.4503311
Std Dev	0.241961744	**20%**	4.4866605
Variance	0.058545486	**25%**	4.5198218
Skewness	0.18257381	**30%**	4.5519399
Kurtosis	2.186042368	**35%**	4.5827781
Median	4.701433515	**40%**	4.621856
Mode	4.578456758	**45%**	4.6609995
Left X	4.353574927	**50%**	4.7014335
Left P	5%	**55%**	4.744113
Right X	5.118913378	**60%**	4.7838828
Right P	95%	**65%**	4.8222738
Diff X	0.765338451	**70%**	4.8609843
Diff P	90%	**75%**	4.9010633
#Errors	0	**80%**	4.9456674
Filter Min	Off	**85%**	4.996286
Filter Max	Off	**90%**	5.0498886
#Filtered	0	**95%**	5.1189134

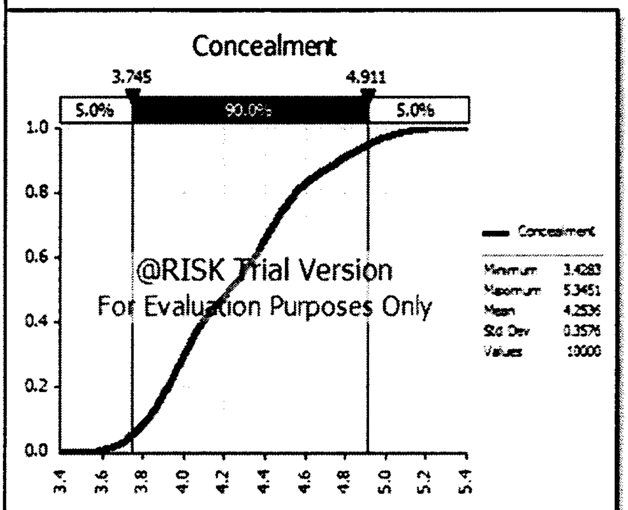
Change in Output Statistic for Firepower			
Rank	**Name**	**Lower**	**Upper**
1	Stryker ICV (Inf. S	4.5587363	4.953796
2	M1128 MGS 105	4.6306511	4.8414227
3	Stryker 120 mm.	4.6465336	4.8168063
4	Fire Attack	4.6234409	4.7824909
5	M1134A2 Stryker	4.6336939	4.7475196
6	Javelin team (w/	4.6616775	4.7676685
7	Fire Support	4.6836115	4.7868554
8	M777A2 w/M115	4.6902294	4.7609571
9	M1130A2 Stryker	4.6824914	4.7454768
10	Indirect Fire	4.6940522	4.7438257
11	81mm Mortar (w	4.6955255	4.7417364
12	Mounted Sniper	4.6906623	4.7365556
13	Reconnaissance	4.692544	4.7349752
14	M1109 Rec. Vehi	4.7001934	4.7324912

@RISK Output Report for Concealment

Performed By: Metin
Date: Thursday, April 11, 2013 9:46:34 PM

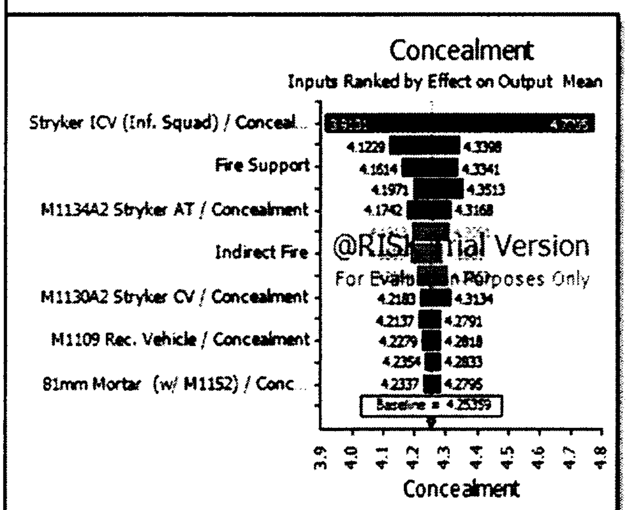


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Concealment

Statistics		Percentile	
Minimum	3.428336079	5%	3.7446458
Maximum	5.345110929	10%	3.822627
Mean	4.253585481	15%	3.8759232
Std Dev	0.357569438	20%	3.923588
Variance	0.127855903	25%	3.96337
Skewness	0.416658947	30%	4.0055594
Kurtosis	2.457485205	35%	4.0450523
Median	4.224637681	40%	4.0933977
Mode	4	45%	4.157161
Left X	3.744645799	50%	4.2246377
Left P	5%	55%	4.2880711
Right X	4.911290323	60%	4.3463855
Right P	95%	65%	4.3932003
Diff X	1.166644524	70%	4.4416544
Diff P	90%	75%	4.490785
#Errors	0	80%	4.5513768
Filter Min	Off	85%	4.6465364
Filter Max	Off	90%	4.7720639
#Filtered	0	95%	4.9112903



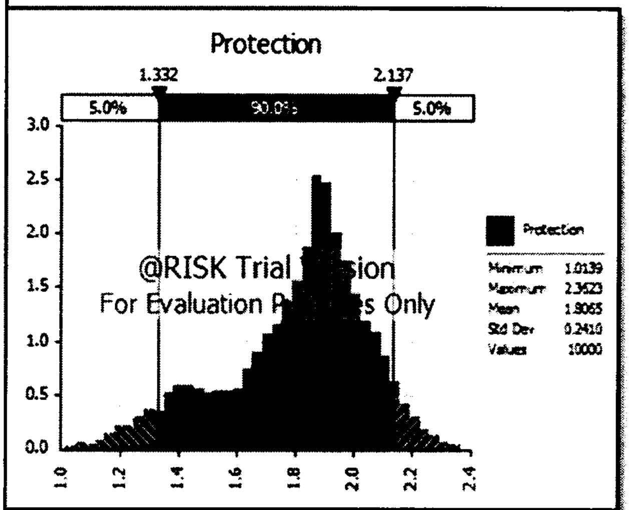
Change in Output Statistic for Concealment

Rank	Name	Lower	Upper
1	Stryker ICV (Inf. S	3.9101443	4.770476
2	M1128 MGS 105	4.122917	4.3398128
3	Fire Support	4.1614006	4.3340519
4	Fire Attack	4.1971444	4.3513078
5	M1134A2 Stryker	4.1742389	4.3167643
6	Javelin team (w/I	4.1912764	4.3091147
7	Indirect Fire	4.1888749	4.2884885
8	Mounted Sniper	4.2083919	4.3052669
9	M1130A2 Stryker	4.2182572	4.3134023
10	Stryker 120 mm.	4.2136768	4.2790923
11	M1109 Rec. Vehi	4.2278731	4.2817792
12	M777A2 w/M115	4.2354416	4.2832911
13	81mm Mortar (w	4.2336806	4.2795279
14	Target Acquisitio	4.2281819	4.2730551

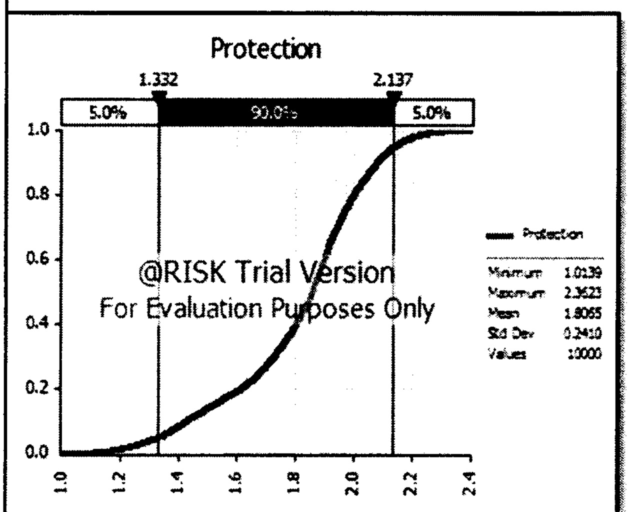
@RISK Output Report for Protection

Performed By: Metin

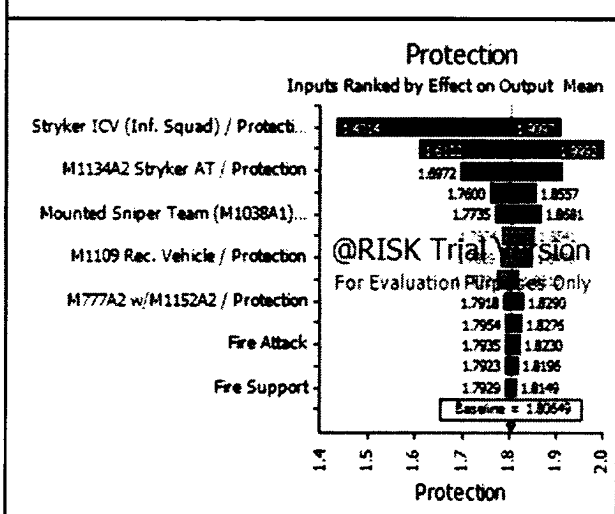
Date: Thursday, April 11, 2013 9:46:42 PM



Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Protection			
Statistics		Percentile	
Minimum	1.013917884	5%	1.3323077
Maximum	2.362260343	10%	1.427334
Mean	1.806487851	15%	1.5204945
Std Dev	0.241039368	20%	1.6138871
Variance	0.058099977	25%	1.6798337
Skewness	-0.701480107	30%	1.7280093
Kurtosis	3.057148157	35%	1.7687075
Median	1.858785942	40%	1.8029197
Mode	2	45%	1.8334281
Left X	1.332307692	50%	1.8587859
Left P	5%	55%	1.8778173
Right X	2.137001079	60%	1.8979592
Right P	95%	65%	1.9187192
Diff X	0.804693386	70%	1.9415385
Diff P	90%	75%	1.9678148
#Errors	0	80%	1.9992963
Filter Min	Off	85%	2.0359712
Filter Max	Off	90%	2.0790763
#Filtered	0	95%	2.1370011

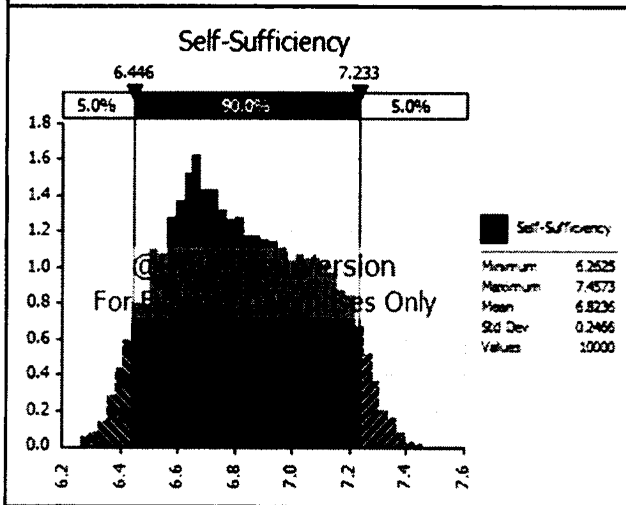


Change in Output Statistic for Protection			
Rank	Name	Lower	Upper
1	Stryker ICV (Inf. S	1.4314166	1.9097423
2	M1128 MGS 105	1.6102072	1.9992197
3	M1134A2 Stryker	1.6971928	1.9105679
4	M1130A2 Stryker	1.7599905	1.85572
5	Mounted Sniper	1.7734999	1.8681166
6	Javelin team (w/	1.7874248	1.854111
7	M1109 Rec. Vehi	1.7828592	1.8479271
8	Stryker 120 mm.	1.7771818	1.8212819
9	M777A2 w/M115	1.7918379	1.8289972
10	81mm Mortar (w	1.7954418	1.8275558
11	Fire Attack	1.7935397	1.8229625
12	Indirect Fire	1.7923213	1.8196416
13	Fire Support	1.7928895	1.814887
14	Reconnaissance	1.7955455	1.8163419

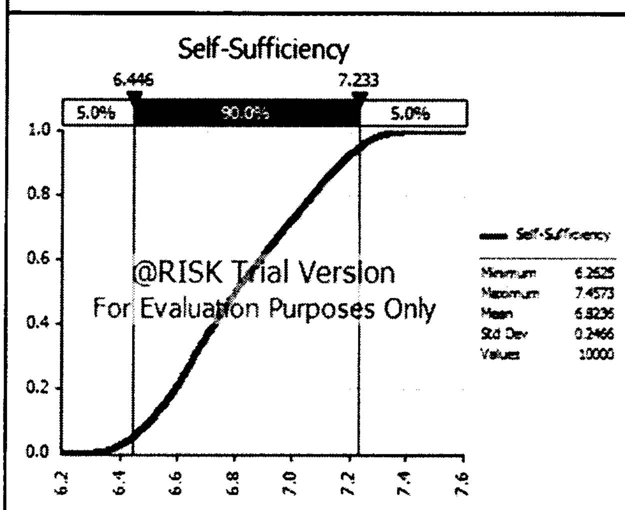
@RISK Output Report for Self-Sufficiency

Performed By: Metin

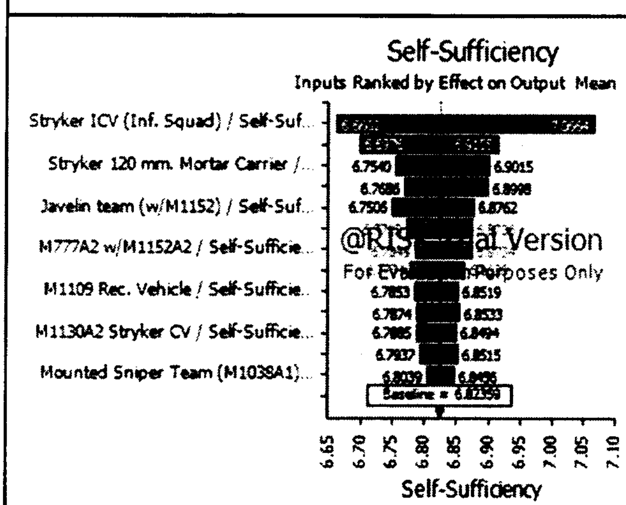
Date: Thursday, April 11, 2013 9:46:50 PM



Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Self-Sufficiency			
Statistics		**Percentile**	
Minimum	6.262482168	5%	6.4456959
Maximum	7.457317073	10%	6.5070064
Mean	6.823585791	15%	6.5535852
Std Dev	0.246625314	20%	6.5926966
Variance	0.060824046	25%	6.6292467
Skewness	0.145062175	30%	6.6601942
Kurtosis	2.094210845	35%	6.6934911
Median	6.804347826	40%	6.7293333
Mode	7	45%	6.7640449
Left X	6.445695897	50%	6.8043478
Left P	5%	55%	6.8455882
Right X	7.233194527	60%	6.887574
Right P	95%	65%	6.9313233
Diff X	0.78749863	70%	6.9754647
Diff P	90%	75%	7.0227001
#Errors	0	80%	7.0707965
Filter Min	Off	85%	7.1172996
Filter Max	Off	90%	7.1715818
#Filtered	0	95%	7.2331945

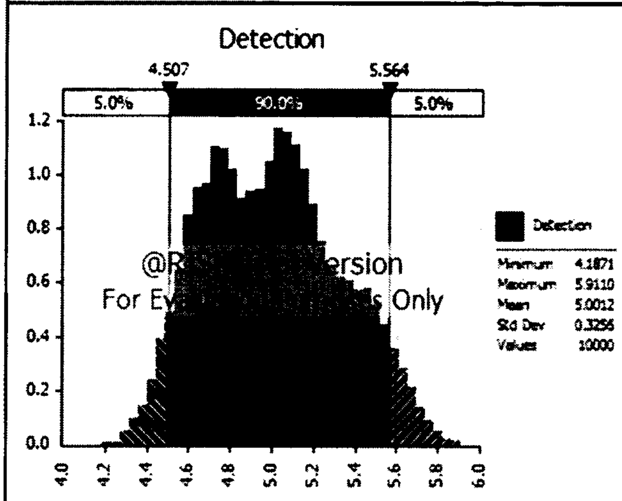


Change in Output Statistic for Self-Sufficiency			
Rank	**Name**	**Lower**	**Upper**
1	Stryker ICV (Inf. S	6.6602497	7.0663756
2	M1128 MGS 105	6.6975686	6.9155066
3	Stryker 120 mm.	6.7539612	6.901452
4	M1134A2 Stryker	6.7685637	6.8997655
5	Javelin team (w/	6.7505786	6.8762124
6	Fire Attack	6.7717841	6.8736151
7	M777A2 w/M115	6.7848697	6.8734265
8	Fire Support	6.7774338	6.8638237
9	M1109 Rec. Vehi	6.7853322	6.8518966
10	81mm Mortar (w	6.7873921	6.853278
11	M1130A2 Stryker	6.7884837	6.8494384
12	Indirect Fire	6.7936602	6.8514622
13	Mounted Sniper T	6.8038581	6.8456181
14	Target Acquisitio	6.8058498	6.8427781

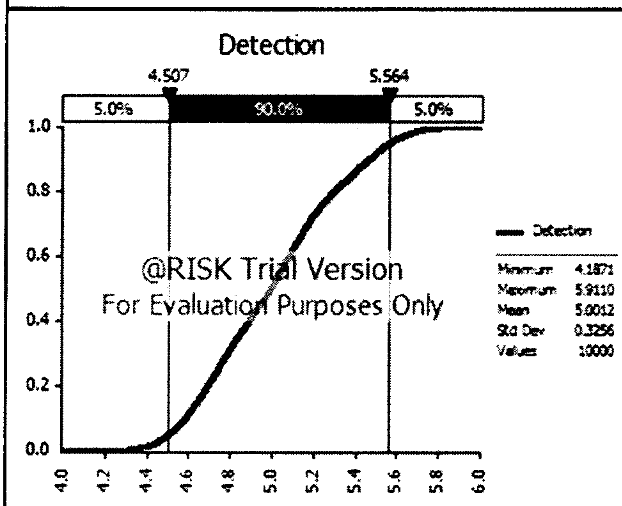
@RISK Output Report for Detection

Performed By: Metin

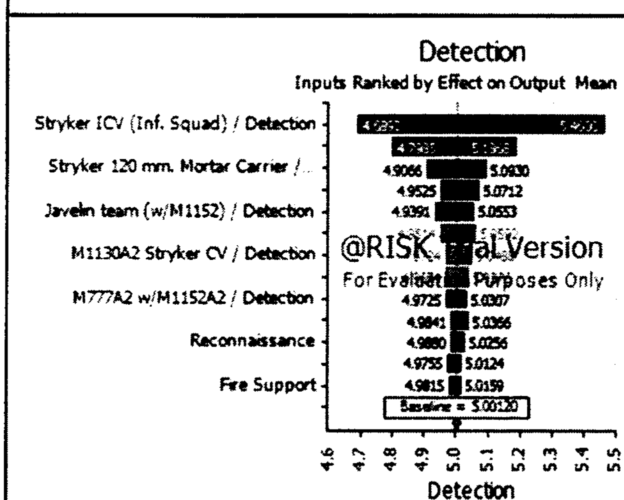
Date: Thursday, April 11, 2013 9:46:58 PM



Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Detection			
Statistics		**Percentile**	
Minimum	4.187096774	5%	4.5066387
Maximum	5.910967742	10%	4.5872679
Mean	5.00120266	15%	4.640869
Std Dev	0.325613563	20%	4.6941256
Variance	0.106024192	25%	4.7419558
Skewness	0.211256557	30%	4.7866824
Kurtosis	2.312273817	35%	4.8353756
Median	4.995420721	40%	4.8901444
Mode	4.649903288	45%	4.9433962
Left X	4.506638714	50%	4.9954207
Left P	5%	55%	5.036941
Right X	5.5639413	60%	5.0821622
Right P	95%	65%	5.1237374
Diff X	1.057302586	70%	5.1732852
Diff P	90%	75%	5.2286432
#Errors	0	80%	5.2973568
Filter Min	Off	85%	5.3781407
Filter Max	Off	90%	5.4619918
#Filtered	0	95%	5.5639413

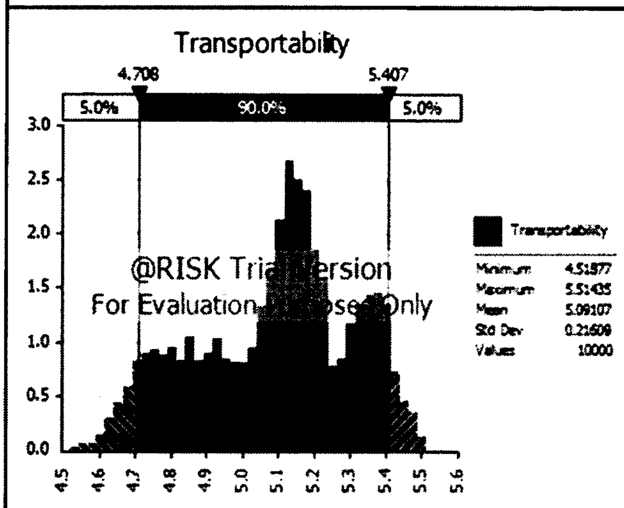


Change in Output Statistic for Detection			
Rank	**Name**	**Lower**	**Upper**
1	Stryker ICV (Inf. S	4.6891748	5.4599741
2	M1128 MGS 105	4.798498	5.1867946
3	Stryker 120 mm.	4.9066124	5.0930467
4	M1134A2 Stryker	4.9525021	5.0711703
5	Javelin team (w/	4.9391131	5.0553266
6	M1109 Rec. Vehi	4.9514417	5.0592139
7	M1130A2 Stryker	4.9723683	5.0487609
8	Mounted Sniper	4.9674488	5.0375936
9	M777A2 w/M115	4.9725435	5.0306599
10	81mm Mortar (w	4.9840683	5.0365731
11	Reconnaissance	4.988	5.0256465
12	Fire Attack	4.9755447	5.012423
13	Fire Support	4.9814811	5.0159151
14	Indirect Fire	4.9887767	5.0198487

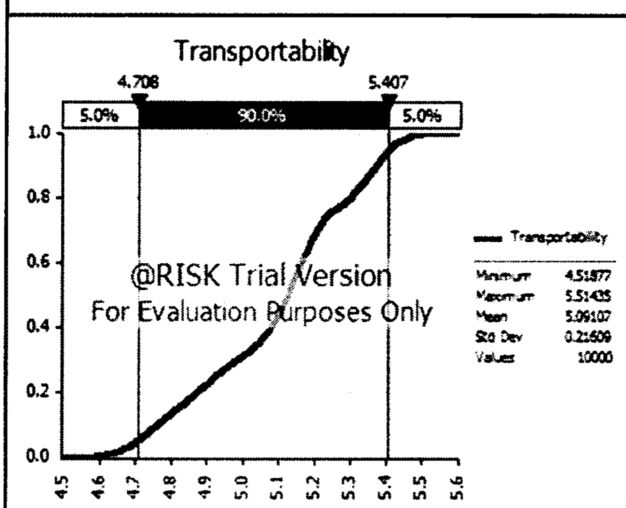
@RISK Output Report for Transportability

Performed By: Metin

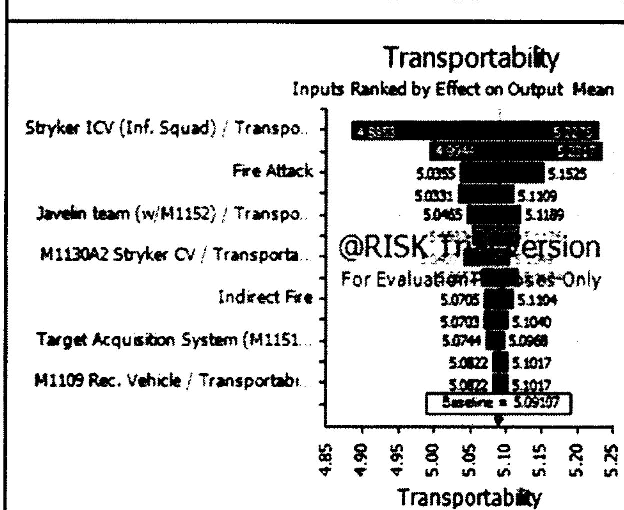
Date: Thursday, April 11, 2013 9:47:06 PM



Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for Transportability			
Statistics		Percentile	
Minimum	4.518773946	5%	4.7082324
Maximum	5.514352211	10%	4.7616099
Mean	5.091071992	15%	4.817734
Std Dev	0.216086957	20%	4.8712871
Variance	0.046693573	25%	4.9265306
Skewness	-0.338806007	30%	4.9841535
Kurtosis	2.257629818	35%	5.041977
Median	5.126600284	40%	5.0766501
Mode	4.842490842	45%	5.104142
Left X	4.708232446	50%	5.1266003
Left P	5%	55%	5.1439661
Right X	5.407274896	60%	5.1629013
Right P	95%	65%	5.1844215
Diff X	0.69904245	70%	5.2078708
Diff P	90%	75%	5.2383838
#Errors	0	80%	5.2987654
Filter Min	Off	85%	5.3366337
Filter Max	Off	90%	5.3715596
#Filtered	0	95%	5.4072749

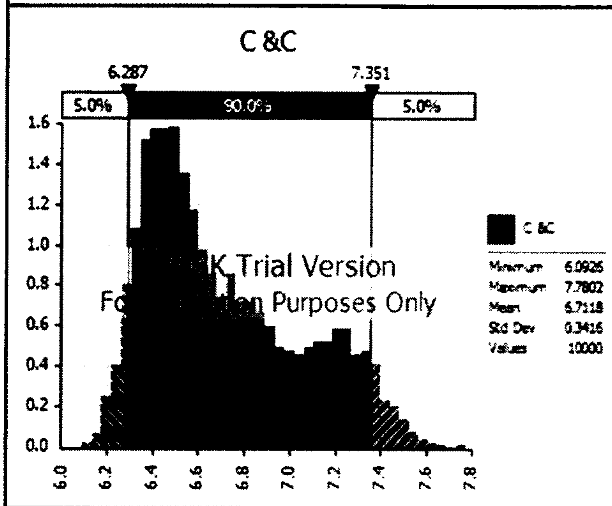


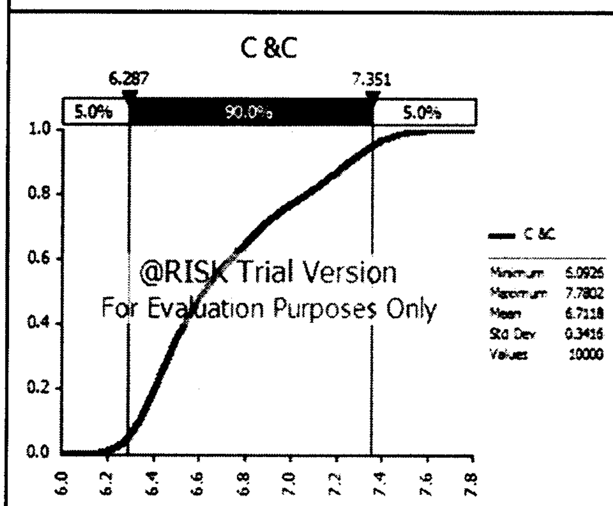
Change in Output Statistic for Transportability			
Rank	Name	Lower	Upper
1	Stryker ICV (Inf. S	4.885288	5.2274541
2	M1128 MGS 105	4.9943774	5.2317041
3	Fire Attack	5.0355122	5.1525295
4	Stryker 120 mm.	5.0330579	5.1109356
5	Javelin team (w/	5.0465117	5.1189096
6	M777A2 w/M115	5.0532564	5.1175626
7	M1130A2 Stryker	5.0406568	5.1049002
8	81mm Mortar (w	5.0652059	5.117406
9	Indirect Fire	5.0704817	5.1104348
10	Fire Support	5.0703227	5.1039514
11	Target Acquisitio	5.0743682	5.0967962
12	Mounted Sniper	5.0822294	5.1016682
13	M1109 Rec. Vehi	5.0822294	5.1016682
14	M1134A2 Stryker	5.0822294	5.1016682

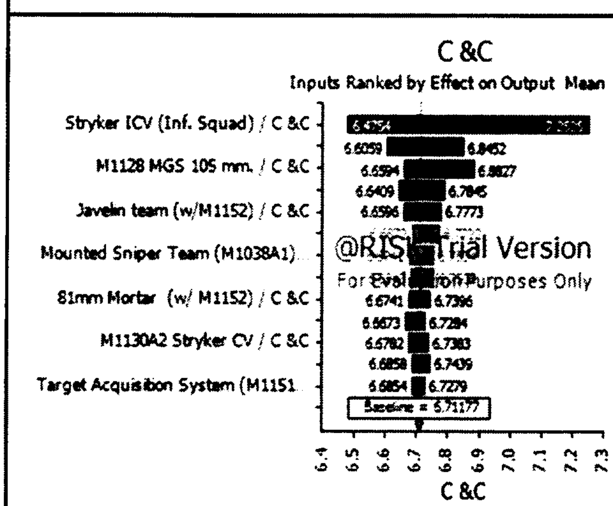
@RISK Output Report for C &C

Performed By: Metin

Date: Thursday, April 11, 2013 9:47:15 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for C &C

Statistics		Percentile	
Minimum	6.092592593	5%	6.2873923
Maximum	7.780208333	10%	6.3370044
Mean	6.711772595	15%	6.3720657
Std Dev	0.341577831	20%	6.4030023
Variance	0.116675415	25%	6.4350433
Skewness	0.62808631	30%	6.4679012
Kurtosis	2.321185487	35%	6.4981353
Median	6.619414484	40%	6.5334088
Mode	6.414864865	45%	6.5707196
Left X	6.287392326	50%	6.6194145
Left P	5%	55%	6.6722998
Right X	7.350617284	60%	6.7385079
Right P	95%	65%	6.801509
Diff X	1.063224958	70%	6.8707085
Diff P	90%	75%	6.9557522
#Errors	0	80%	7.0622568
Filter Min	Off	85%	7.1584446
Filter Max	Off	90%	7.2474708
#Filtered	0	95%	7.3506173

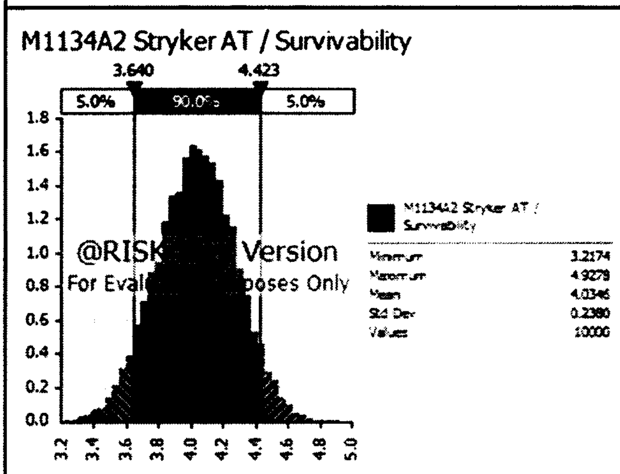
Change in Output Statistic for C &C

Rank	Name	Lower	Upper
1	Stryker ICV (Inf. S	6.4754256	7.2525314
2	M1134A2 Stryker	6.6059132	6.8451939
3	M1128 MGS 105	6.6593902	6.8827357
4	M1109 Rec. Vehi	6.6409288	6.78447
5	Javelin team (w/	6.6596054	6.7772508
6	Stryker 120 mm.	6.6871636	6.7721855
7	Mounted Sniper	6.6740958	6.7533806
8	Fire Attack	6.6843239	6.7506463
9	81mm Mortar (w	6.6741476	6.739604
10	M777A2 w/M115	6.6673159	6.7284224
11	M1130A2 Stryker	6.6781735	6.7383252
12	Fire Support	6.6857899	6.7439152
13	Target Acquisitio	6.685445	6.7279086
14	Indirect Fire	6.6959365	6.7361603

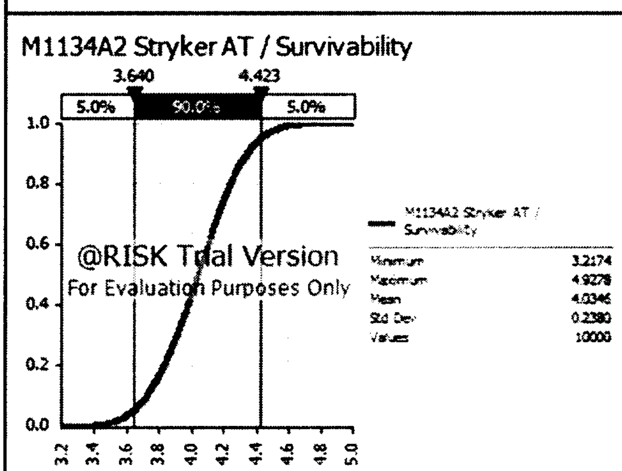
Stryker Option-Capabilities

@RISK Output Report for Stryker Survivability

Performed By: Meth
Date: Thursday, April 11, 2013 9:47:23 PM

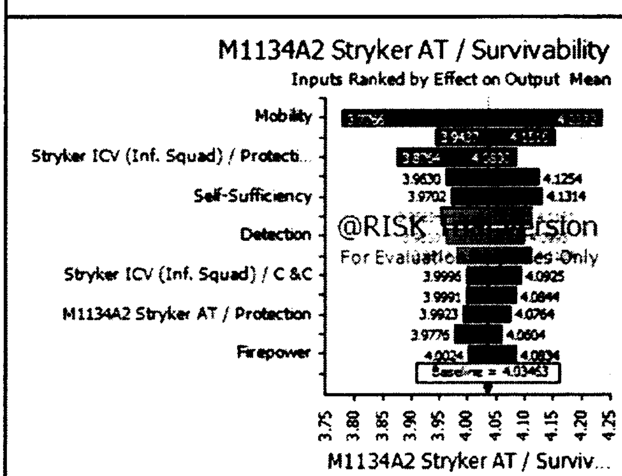


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for M1134A2 Stryker AT / Sur

Statistics		Percentile	
Minimum	3.217419479	5%	3.640051
Maximum	4.927843567	10%	3.7233647
Mean	4.03463132	15%	3.7816785
Std Dev	0.237993661	20%	3.8287356
Variance	0.056640983	25%	3.8691611
Skewness	-0.042132102	30%	3.9065027
Kurtosis	2.76023303	35%	3.9435321
Median	4.037977675	40%	3.9765931
Mode	4.040517865	45%	4.0067722
Left X	3.64005102	50%	4.0379777
Left P	5%	55%	4.0683927
Right X	4.422844362	60%	4.1016109
Right P	95%	65%	4.1313586
Diff X	0.782793343	70%	4.1658639
Diff P	90%	75%	4.2001188
#Errors	0	80%	4.2415642
Filter Min	Off	85%	4.2840299
Filter Max	Off	90%	4.3403193
#Filtered	0	95%	4.4228444



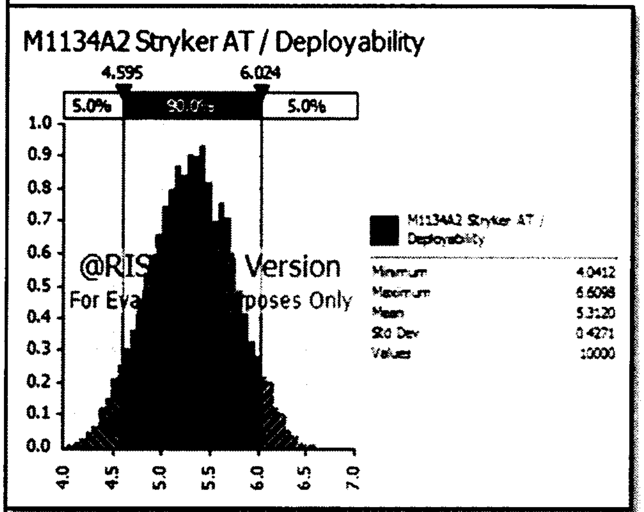
Change in Output Statistic for M1134A2 Stryker

Rank	Name	Lower	Upper
1	Mobility	3.7765721	4.2331617
2	Stryker ICV (Inf. S	3.943714	4.1515842
3	Stryker ICV (Inf. S	3.8764424	4.0830462
4	Concealment	3.9630249	4.125416
5	Self-Sufficiency	3.970172	4.131361
6	M1128 MGS 105	3.9528268	4.1121066
7	Detection	3.9630271	4.099268
8	Command & Con	3.9814141	4.1124105
9	Stryker ICV (Inf. S	3.9995685	4.0925467
10	Protection	3.9991029	4.0843983
11	M1134A2 Stryker	3.9922757	4.0764122
12	Stryker ICV (Inf. S	3.9776454	4.0604348
13	Firepower	4.0023881	4.0833594
14	M1128 MGS 105	3.9899857	4.0635597

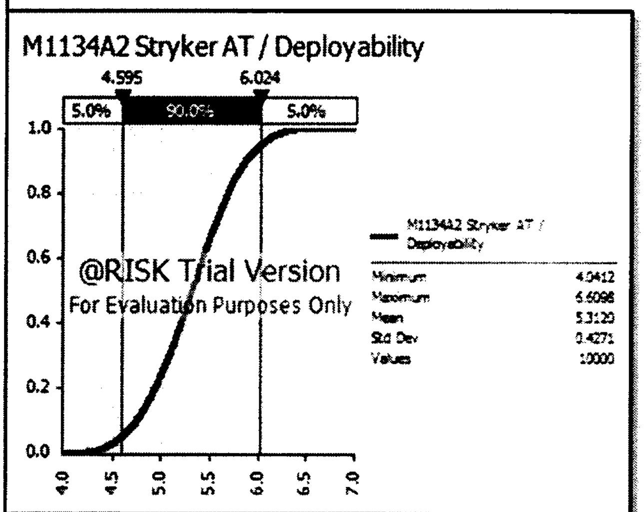
@RISK Output Report for Stryker Deployability

Performed By: Metin

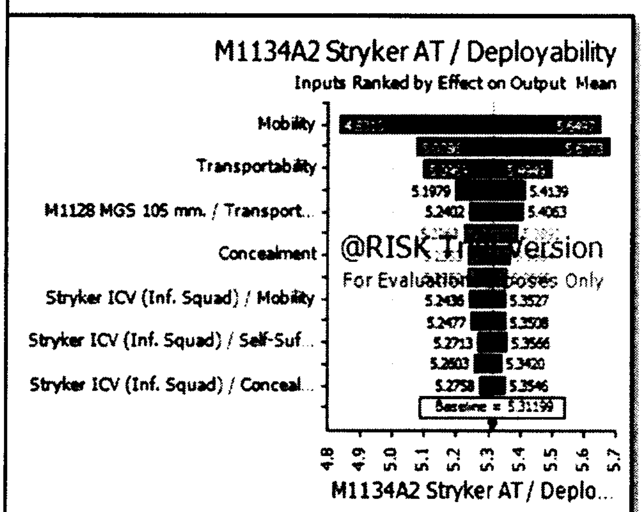
Date: Thursday, April 11, 2013 9:47:35 PM



Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for M1134A2 Stryker AT / De			
Statistics		**Percentile**	
Minimum	4.041168386	5%	4.5945489
Maximum	6.609781787	10%	4.7487425
Mean	5.311990842	15%	4.8527676
Std Dev	0.427142665	20%	4.9371236
Variance	0.182450856	25%	5.0130164
Skewness	-0.009059658	30%	5.0815379
Kurtosis	2.614917593	35%	5.1439103
Median	5.315058412	40%	5.1994219
Mode	5.407656987	45%	5.2593229
Left X	4.594548903	50%	5.3150584
Left P	5%	55%	5.3709628
Right X	6.023860801	60%	5.4230491
Right P	95%	65%	5.4826139
Diff X	1.429311898	70%	5.546953
Diff P	90%	75%	5.6156255
#Errors	0	80%	5.6849144
Filter Min	Off	85%	5.7628564
Filter Max	Off	90%	5.8657488
#Filtered	0	95%	6.0238608

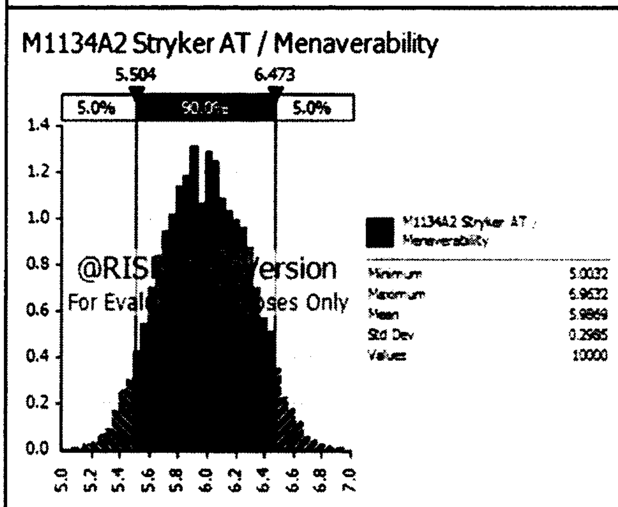


Change in Output Statistic for M1134A2 Stryker			
Rank	**Name**	**Lower**	**Upper**
1	Mobility	4.8310447	5.6497031
2	Self-Sufficiency	5.0785934	5.6772913
3	Transportability	5.0968672	5.4949184
4	Stryker ICV (Inf. S	5.1978604	5.413919
5	M1128 MGS 105	5.2402255	5.4063046
6	Detection	5.2262649	5.3892516
7	Concealment	5.2353071	5.3684313
8	Firepower	5.2351961	5.3564945
9	Stryker ICV (Inf. S	5.2435781	5.3526952
10	Command & Con	5.2476541	5.3507506
11	Stryker ICV (Inf. S	5.2713044	5.3566252
12	Javelin team (w/	5.2603103	5.3420069
13	Stryker ICV (Inf. S	5.2758164	5.3545779
14	M1130A2 Stryker	5.2738221	5.350616

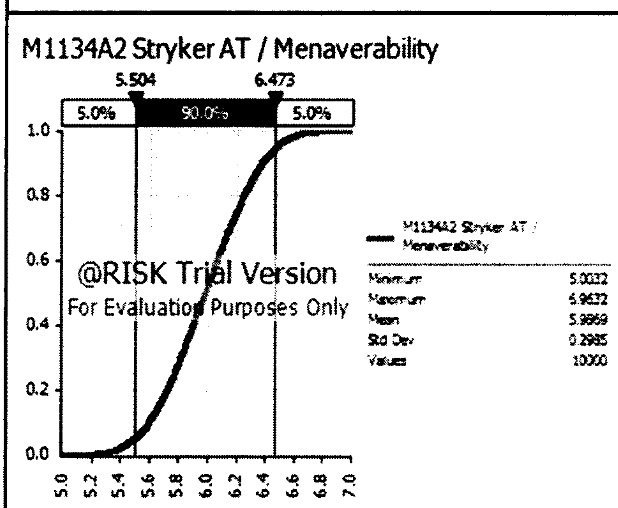
@RISK Output Report for Stryker Menaverability

Performed By: Metin

Date: Thursday, April 11, 2013 9:47:47 PM

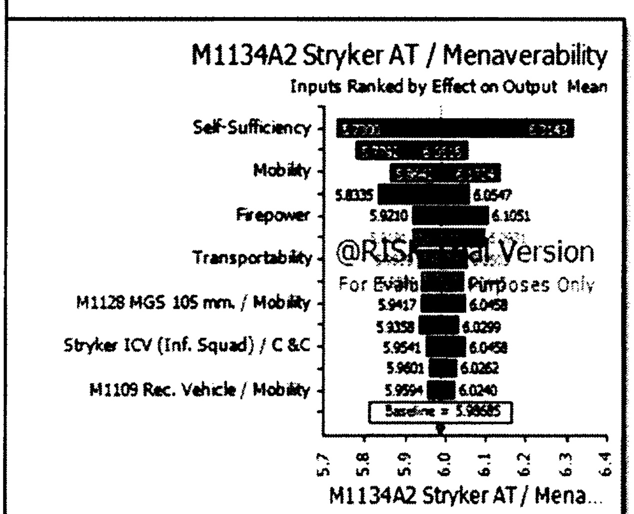


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for M1134A2 Stryker AT / Me

Statistics		Percentile	
Minimum	5.003244399	5%	5.5041956
Maximum	6.963221687	10%	5.5982346
Mean	5.986854318	15%	5.6668054
Std Dev	0.298488187	20%	5.7228576
Variance	0.089095198	25%	5.7716336
Skewness	0.019494505	30%	5.8169885
Kurtosis	2.590702259	35%	5.8596691
Median	5.986182787	40%	5.9021668
Mode	5.927316395	45%	5.9390053
Left X	5.504195602	50%	5.9861828
Left P	5%	55%	6.0243047
Right X	6.473049827	60%	6.0636381
Right P	95%	65%	6.1102471
Diff X	0.968854224	70%	6.1566838
Diff P	90%	75%	6.2046881
#Errors	0	80%	6.2543252
Filter Min	Off	85%	6.3103359
Filter Max	Off	90%	6.3792961
#Filtered	0	95%	6.4730498



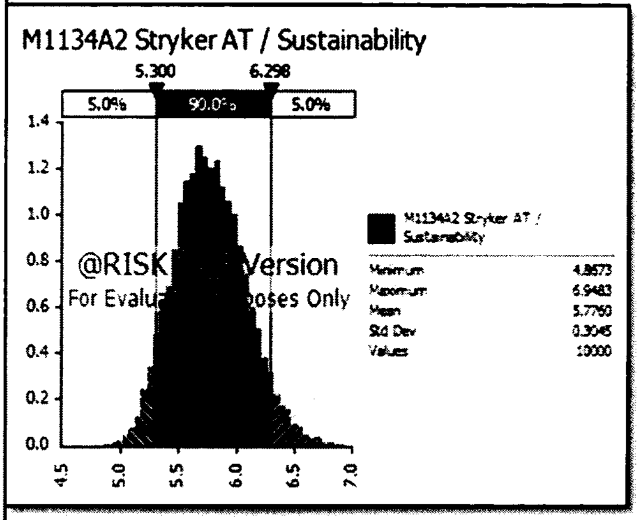
Change in Output Statistic for M1134A2 Stryker

Rank	Name	Lower	Upper
1	Self-Sufficiency	5.7300479	6.31427
2	Stryker ICV (Inf. S	5.7792408	6.0515237
3	Mobility	5.8641649	6.132386
4	Command & Con	5.8335473	6.0546581
5	Firepower	5.9210226	6.1051448
6	Concealment	5.918059	6.0930762
7	Transportability	5.9338977	6.0503062
8	M1134A2 Stryker	5.9388844	6.0444504
9	M1128 MGS 105	5.9416994	6.0458369
10	Detection	5.935824	6.0298502
11	Stryker ICV (Inf. S	5.9540929	6.0457987
12	Stryker ICV (Inf. S	5.9601315	6.0262268
13	M1109 Rec. Vehi	5.9594042	6.0239593
14	Javelin team (w/	5.9564078	6.0206336

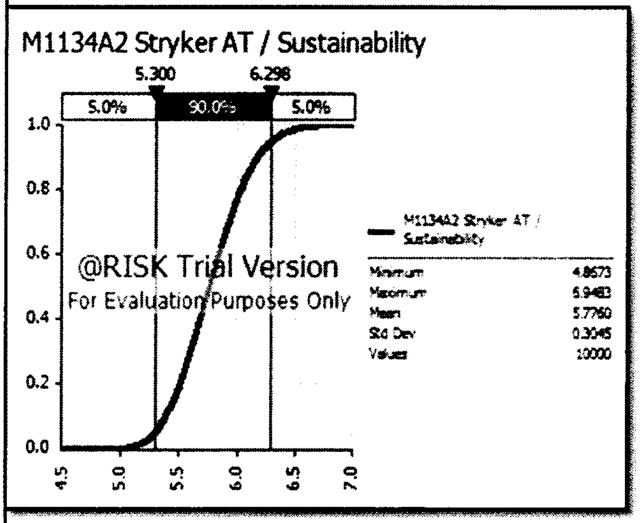
@RISK Output Report for Stryker Sustainability

Performed By: Metin

Date: Thursday, April 11, 2013 9:48:00 PM

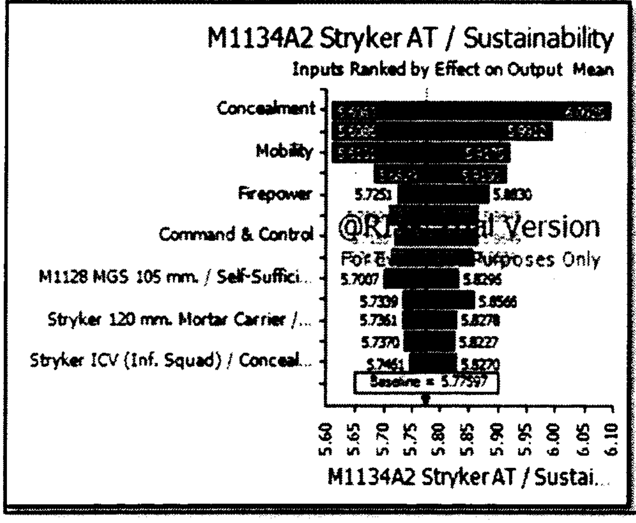


Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529



Summary Statistics for M1134A2 Stryker AT / Sus

Statistics		Percentile	
Minimum	4.86729304	5%	5.3004204
Maximum	6.94829979	10%	5.3860961
Mean	5.775967146	15%	5.4582349
Std Dev	0.304537552	20%	5.5114325
Variance	0.092743121	25%	5.5568941
Skewness	0.25279689	30%	5.599557
Kurtosis	2.863670488	35%	5.6420598
Median	5.762327242	40%	5.682813
Mode	5.662695795	45%	5.7224402
Left X	5.300420365	50%	5.7623272
Left P	5%	55%	5.802909
Right X	6.297705926	60%	5.8426727
Right P	95%	65%	5.8872185
Diff X	0.99728556	70%	5.932159
Diff P	90%	75%	5.9810134
#Errors	0	80%	6.0327981
Filter Min	Off	85%	6.0970556
Filter Max	Off	90%	6.1760888
#Filtered	0	95%	6.2977059



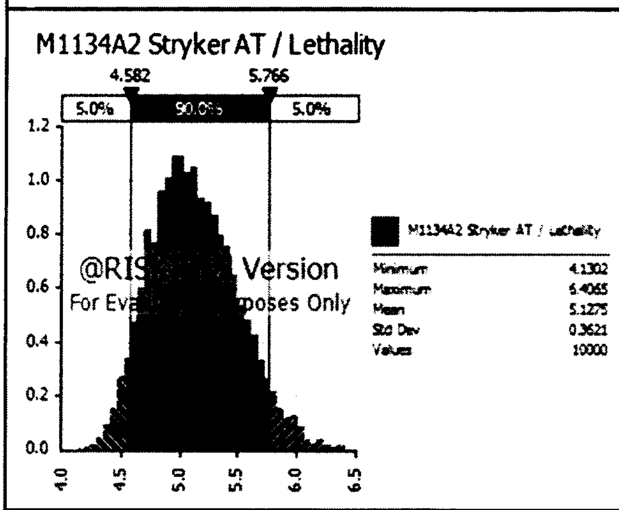
Change in Output Statistic for M1134A2 Stryker

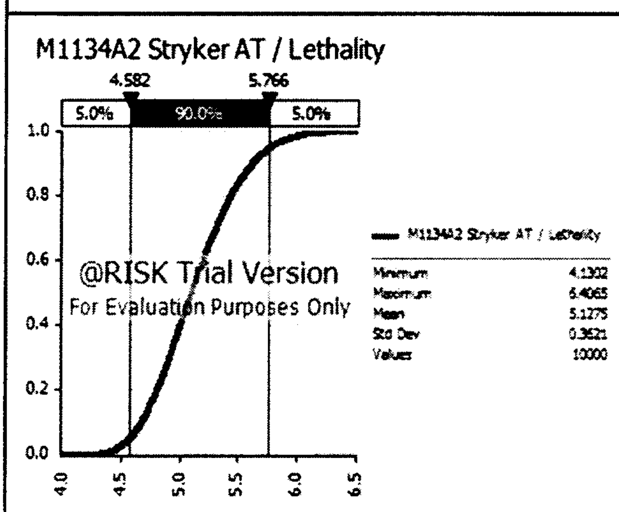
Rank	Name	Lower	Upper
1	Concealment	5.6082889	6.0924586
2	Self-Sufficiency	5.6085907	5.9912418
3	Mobility	5.6101226	5.9175383
4	Stryker ICV (Inf. S	5.6829457	5.9130209
5	Firepower	5.7250696	5.8830382
6	Protection	5.7098943	5.8644614
7	Command & Con	5.7184722	5.8649186
8	Detection	5.7121117	5.8534054
9	M1128 MGS 105	5.7006996	5.829622
10	Transportability	5.7339104	5.8565869
11	Stryker 120 mm.	5.7360771	5.8277945
12	M1134A2 Stryker	5.7370348	5.8226791
13	Stryker ICV (Inf. S	5.7461382	5.8270098
14	Fire Attack	5.7314264	5.8086799

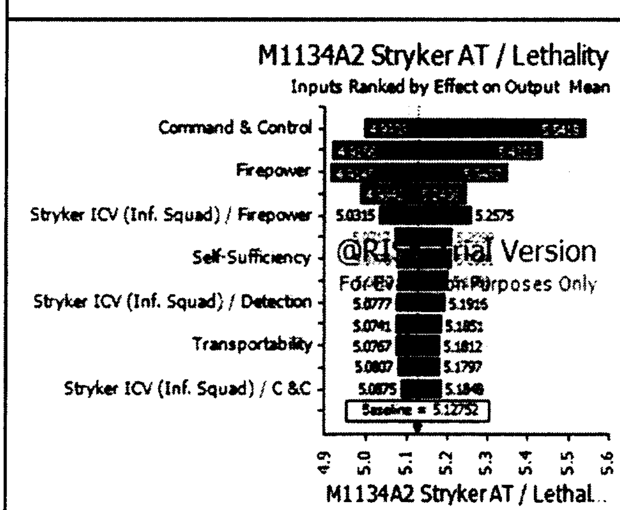
@RISK Output Report for Stryker Lethality

Performed By: Metin

Date: Thursday, April 11, 2013 9:48:12 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for M1134A2 Stryker AT / Le

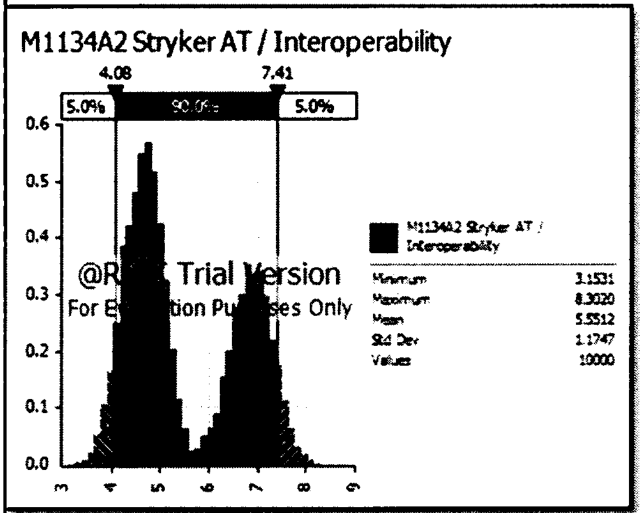
Statistics		Percentile	
Minimum	4.130158949	5%	4.5817412
Maximum	6.406478408	10%	4.6796592
Mean	5.127523023	15%	4.7445681
Std Dev	0.362097465	20%	4.8082261
Variance	0.131114574	25%	4.8616745
Skewness	0.361862658	30%	4.9122517
Kurtosis	2.818980459	35%	4.9577183
Median	5.098620375	40%	5.0033337
Mode	5.131422624	45%	5.0509827
Left X	4.581741173	50%	5.0986204
Left P	5%	55%	5.1465055
Right X	5.765615225	60%	5.200728
Right P	95%	65%	5.2497681
Diff X	1.183874052	70%	5.309963
Diff P	90%	75%	5.3716646
#Errors	0	80%	5.437569
Filter Min	Off	85%	5.5158165
Filter Max	Off	90%	5.6196708
#Filtered	0	95%	5.7656152

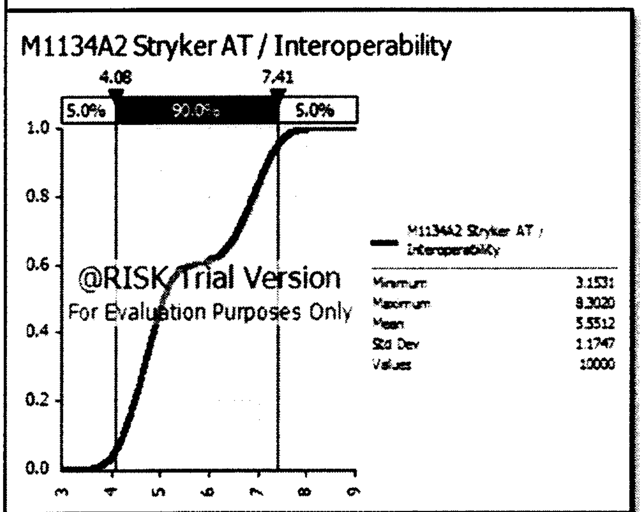
Change in Output Statistic for M1134A2 Stryker

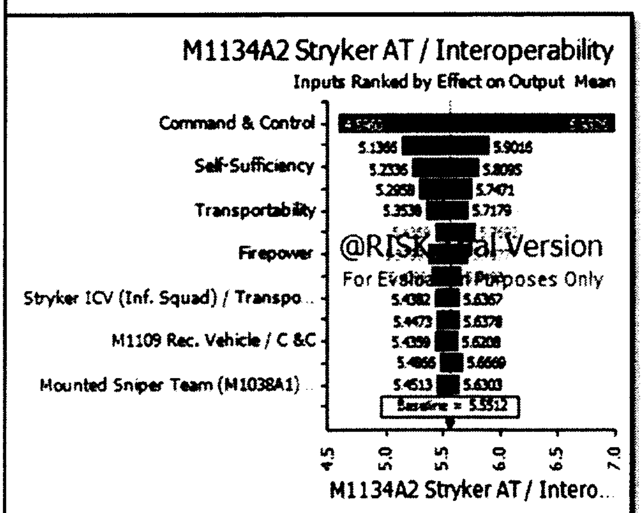
Rank	Name	Lower	Upper
1	Command & Con	4.9937892	5.5417845
2	Detection	4.9155977	5.4322979
3	Firepower	4.9144984	5.3486938
4	Mobility	4.984159	5.2435916
5	Stryker ICV (Inf. S	5.0314871	5.2575029
6	M1128 MGS 105	5.0717364	5.2098668
7	Self-Sufficiency	5.0778123	5.2081297
8	Concealment	5.0816937	5.1988331
9	Stryker ICV (Inf. S	5.0777071	5.1915596
10	Stryker 120 mm.	5.0740788	5.1851438
11	Transportability	5.0766674	5.1811877
12	Fire Attack	5.0806927	5.1797222
13	Stryker ICV (Inf. S	5.0874822	5.1847633
14	M1128 MGS 105	5.0875539	5.165755

@RISK Output Report for Stryker Interoperability

Performed By: Metin
Date: Thursday, April 11, 2013 9:48:24 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for M1134A2 Stryker AT / Int

Statistics		Percentile	
Minimum	3.153106704	5%	4.0764434
Maximum	8.301960493	10%	4.2440855
Mean	5.551209784	15%	4.370097
Std Dev	1.174702688	20%	4.4788859
Variance	1.379926405	25%	4.5791428
Skewness	0.355340723	30%	4.6688803
Kurtosis	1.632807962	35%	4.7635842
Median	5.064364717	40%	4.8552614
Mode	4.789562499	45%	4.9506736
Left X	4.076443376	50%	5.0643647
Left P	5%	55%	5.2150216
Right X	7.407325918	60%	5.672668
Right P	95%	65%	6.3722618
Diff X	3.330882542	70%	6.5914463
Diff P	90%	75%	6.7585113
#Errors	0	80%	6.9033469
Filter Min	Off	85%	7.0493921
Filter Max	Off	90%	7.2008555
#Filtered	0	95%	7.4073259

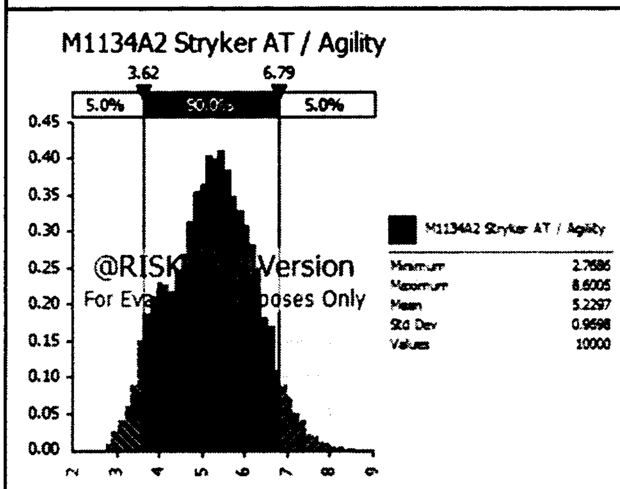
Change in Output Statistic for M1134A2 Stryker

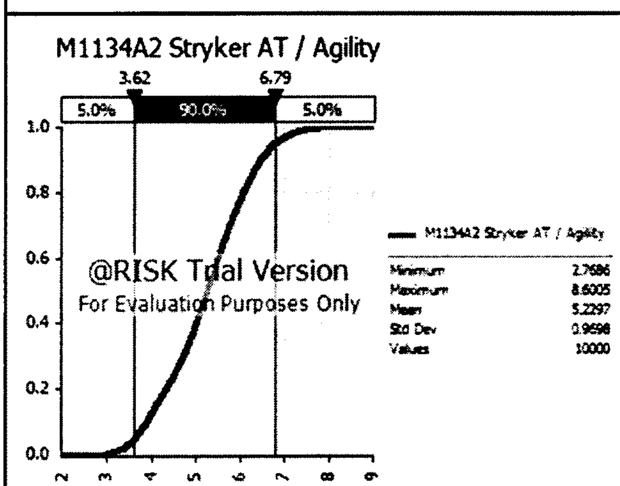
Rank	Name	Lower	Upper
1	Command & Con	4.5960309	6.9826271
2	Detection	5.1366083	5.9015559
3	Self-Sufficiency	5.2336453	5.809515
4	Mobility	5.2957871	5.7470512
5	Transportability	5.3537847	5.7179235
6	Stryker ICV (Inf. S	5.4359181	5.7691868
7	Firepower	5.3799191	5.7077417
8	Concealment	5.40904	5.6492777
9	Stryker ICV (Inf. S	5.4382056	5.6366835
10	Protection	5.4473357	5.6377864
11	M1109 Rec. Vehi	5.4358596	5.6207622
12	Stryker ICV (Inf. S	5.4865933	5.6669383
13	Mounted Sniper	5.4512632	5.6303187
14	Javelin team (w/	5.4835858	5.6612944

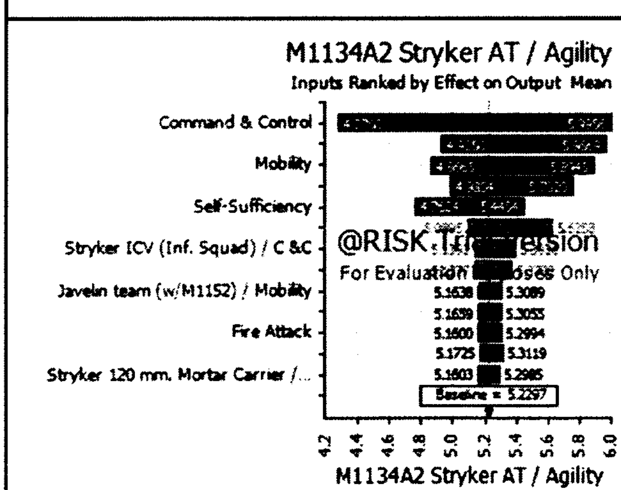
@RISK Output Report for Stryker Agility

Performed By: Metin

Date: Thursday, April 11, 2013 9:48:36 PM







Simulation Summary Information	
Workbook Name	aLTERNATIVES-4.xlsx
Number of Simulations	1
Number of Iterations	10000
Number of Inputs	1103
Number of Outputs	84
Sampling Type	Latin Hypercube
Simulation Start Time	4/11/2013 21:20
Simulation Duration	00:06:45
Random # Generator	Mersenne Twister
Random Seed	506905529

Summary Statistics for M1134A2 Stryker AT / Ag

Statistics		Percentile	
Minimum	2.768641667	5%	3.6240312
Maximum	8.600498064	10%	3.8907549
Mean	5.229710159	15%	4.1037334
Std Dev	0.969774617	20%	4.3251056
Variance	0.940462807	25%	4.5303812
Skewness	0.002221899	30%	4.7135997
Kurtosis	2.525238608	35%	4.8684718
Median	5.259880632	40%	5.0049082
Mode	5.398455891	45%	5.1395753
Left X	3.624031224	50%	5.2598806
Left P	5%	55%	5.3878643
Right X	6.791225518	60%	5.5053196
Right P	95%	65%	5.6316078
Diff X	3.167194293	70%	5.773933
Diff P	90%	75%	5.9240207
#Errors	0	80%	6.0787117
Filter Min	Off	85%	6.2531227
Filter Max	Off	90%	6.4644006
#Filtered	0	95%	6.7912255

Change in Output Statistic for M1134A2 Stryker

Rank	Name	Lower	Upper
1	Command & Con	4.2760183	5.9955547
2	Protection	4.9249897	5.9668939
3	Mobility	4.866481	5.8945356
4	Firepower	4.9853726	5.7520247
5	Self-Sufficiency	4.762366	5.4453835
6	Transportability	5.0894548	5.6258002
7	Stryker ICV (Inf. S	5.1392051	5.3925638
8	Concealment	5.1376915	5.3731848
9	Javelin team (w/	5.1637797	5.3089122
10	M1134A2 Stryker	5.1658662	5.3054762
11	Fire Attack	5.1599653	5.2993674
12	M1128 MGS 105	5.1724934	5.3118618
13	Stryker 120 mm.	5.1602706	5.2984511
14	M1134A2 Stryker	5.1573143	5.2925809

VITA

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M.S. in National and International Security Strategies Management & Leadership, Turkish Army War College, Istanbul, Turkey, 2008

M.S. in Operations Research, Defense Science Institute, Ankara, Turkey, 2003

B.S. in System Engineering, Turkish Military Academy, Ankara, Turkey, 1998

Professional Experience:

Supreme Allied Command Transformation HQ Norfolk/VA, NATO Operational Experimentation Staff Officer, 2010-2013

Brigade, Chief of Logistics Branch, 2008-2010

Brigade, Chief of Logistics Branch, 2007-2008

NATO KFOR Liaison and Monitor Team (LMT) Leader 2006

Tank Platoon/howitzer Leader and Company Commander, 1999-2006