why do you want to study this topic, what does existing scholarship say about this topic and what gaps are you hoping to fill, and what research questions are you hoping to answer.

military operation analysis

operations research

mathematics of armed conflict

Ph.D. Research Proposal Summary

Force Ratios and Relative Combat Power

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**CHAPTER 1: Introduction**

My intention is to work on relative combat power. I will collect information for the designated area wars and I will analyze these big data by the Python programming language which I gathered expertise after my military service, and I will try to reach meaningful conclusions whether our traditional belief of relative combat power 1/3 in order to plan attack operations is right or wrong based on scientific hypothesis testing. These results will be presented by Tableau, another powerful data visualization tool.

Overview of study

Explanation of project background

Briefly focus on primary issues

Why worth to attention

Present: research statement forms of hypothesis, goal statement or project statement

Rs:

* capture both essence and limitations of study
* follwed by clarification on the expected outcomes

Introduction: In the proposal introduction you should provide the following:

Research Questions: Explain the question/problem that the project intends to address to put the project in the proper context. You should develop a thesis statements that concisely sums up the question

Research approach: Explain in general the type of approach you will take and why

Significance: Explain why it is important to address the particular

Objectives: Briefly relate what you hope to accomplish through your research project

**CHAPTER 2**: **Literature Review**

+ Theory about this topic starts with Sun Tzu. He emphasizes “capturing enemy’s army intact rather than destroying”. According to him; “acme of the skill” is not winning 100 victories in 100 battle but to subdue the enemy without fighting.By this way the troops are not worn out. He terms this as the “art of offensive strategy”.

+ From this point Sun Tzu advises force ratios as; when the force ratio is 10:1 surround, 5:1 attack, 2:1 divide, 1:1 engage or elude, if force ratio is less then enemy, capable of withdraw**[[1]](#footnote-1)**.

+ **Clausewitz[[2]](#footnote-2)** refers to force ratio as “superiority of numbers” and he refers this as a most common element in victory. He specifies that it is not force ratio but strategy with deciding; time, place, and the forces of the engagement has considerable influence on engagement’s outcome.

+ Clausewitz emphasizes that if purpose and circumstances of the engagement, and the fighting value of the troops is disregarded, then distinguishing factor in battle will be the “number of troops”. In this understanding he points that “numbers” will determine victory. He further adds that when taking into consideration of circumstances, “superior numbers” may actually be contributing very “little”.

+ After this generalization, Clausewitz further goes and asserts that if superiority reach the point where it is overwhelming, superiority of numbers will be the most important factor in the outcome of an engagement, so long as it is great enough to counterbalance all other contributing circumstances. As a result of this assertion, he points out as a “first principle of strategy”: bringing as many troops as possible at the decisive point.

+ Clausewitz’s methodology on building this theory is “historical examples” (Napoleon and Frederick). He concludes that even the most talented general will find it very difficult to defeat an opponent twice his strength. He says that “when we observe that the skill of the greatest commanders may be counterbalanced by a two-to-one ratio in the fighting forces, in ordinary cases, a significant superiority in numbers (it does not have to be more than double) will suffice to assure victory, however adverse the other circumstances”.

+ **Lanchester** introduced totally new concept on subject with the N-Square Law[[3]](#footnote-3). He asserts that “the direct numerical comparison of the forces engaging in conflict is almost universal”. He further goes and asserts that “counting the pieces as of value, and to deny the more extended application of mathematical theory, is illogical and unintelligent.”

+His formulation is based on this phrase: the number of men knocked out per unit time will be directly proportional to the numerical strength of the opposing force and efficiency of weapon system and fighting value of the units (training, morale).

**+ From N-square law** he defines **the fighting strength of a force**: it is proportional to the square of its numerical strength multiplied by the fighting value of its individual units (N\*r²=M\*b²).

+ Where the component units differ among themselves, as in the case of a fleet that is not homogeneous, the measure of the total of fighting strength of a force will be the ***square of the sum of the square roots of the strengths of its individual units.***

+ Thus, he made conclusion of divided forces: sum of squares of two portions of the divided forces are for all values equal to the square of the other (not divided) force.

+ Example of this is an army of 50K giving battle in turn to two armies of 40K and 30K respectively, equally well armed; then the strengths are equal, since 50K²=40K²+30K². But if divided force fight in one part then the army of 50K will be overwhelmed.

**+ With** assumption of “machine-gun is 16 times effective than rifle”, he analyzes the number of men armed with machine-gun necessary to replace a battalion (1000 men strong) in the field. From n-square law he says 250 men needed (**16\*r²=1\*1000²).**

+ If two armies are successively brought into action their aggregate fighting strength of will be hypotenuse of a right-angle triangle.

+ The **n-square law** tells us at once the price or penalty that must be paid if elementary principles are outraged by the division of battle fleet into two or more isolated detachments. If battle fleet separated into 2 equal parts, increase would require to be fixed at approximately %40 percent – that is to say, in relation of 1 to √2; more generally the solution is given by a right-angled triangle.

+ **Nelson’s Tactical Scheme at Battle of Trafalgar (p.65-66):** Nelson planned to envelop the half of -23 ships- combined fleet with 32 ships. This, according to n² law would give him superiority of fighting strength of almost exactly 2 to 1[[4]](#footnote-4). He forced combined fleet to fight in two groups thus, inflicted √2 times their force in the beginning of fight. Thus, we are led to appreciate the commanding importance of a correct tactical scheme. If old-time method of attack had been adopted, British could not avert defeat.

+By the early 1960's, Soviet applied operations research theory to the problems of operational and tactical decision-making. One such application was the correlation of forces and means (COFM) [[5]](#footnote-5). The Soviet Dictionary of Military Terms defines correlation of forces and means as “an objective indicator of combat might/power of opposing sides which makes it possible to determine the degree of superiority of one side over another. This is determined by means of comparing the quantitative and qualitative characteristics of subunits, units, and formations and the armaments of one's own troops (forces) and those of the enemy.

+ Later Dupuy US Army Colonel and military historian developed Quantified Judgment Method, where the outcome of a battle is predicted using a fairly complicated multiplicative-additive formula in which various factors relating to the strength and firepower of the fighting parties as well as the circumstances are taken into account. Dupuy and his associates adjusted the parameters of his model by using known statistical facts of several recorded battles.

+ Depuy defined an equation in which he assesses combat power. In this equation Combat Power is defined as multiplication of Force Strength (number and types of weapons plus personnel), Operational Environmental Factor and Quality of Troops[[6]](#footnote-6) (P = S x OE x Q).

**The Calculus of War:** The Role and Use of Quantitative Decision Aids at the Tactical Level of War[[7]](#footnote-7)

The current command estimate process used by the U.S. Army is largely personality driven. The desires and vision of the commander serve as the primary focus of this process. While this relationship is functional for the U.S.Army, more attention needs to be given to the physical aspects of land warfare - most of which are quantifiable with simple decision aids. The thesis traces the use of quantitative decision aids through history to develop the schools of thought that impact on the issue. It then isolates several different quantitative decision aids, and then uses them in three case studies to demonstrate their utility to the tactical decision maker. Finally, the thesis explores some problems with the current contributions of Operations Research to tactical decision making.

Smith points out that there are two schools of thought--moral and quantitative--are not competitors. They are, in fact. complimentary. The main requirement for the decision maker and leader is to keep them in balance (p.139).

Smith says: If we cannot come to grips about the appropriate balance between the moral and quantitative schools, the Army will never realize its full combat potential. I do not argue for an adoption of a Soviet-style system of norms. Instead, the rational approach is one where the quantitative school builds the unassailable physical foundation upon which the moral school erects the tactical work of art (p.141).

Yigit, having analyzed the Force Ratio concept with the CDB90FT data set, concludes that as a gross measure for campaign planning, FR is useful and stands up quite well under historical scrutiny[[8]](#footnote-8). As a basis for forecasting battle outcomes, however, it seems to be more probabilistic than deterministic. As such, the FR is less reliable in terms of predicting the battle outcome. He also gives the formula for FR as A/D where A and D is total force strength of the attacker and defender in manpower(p.xii).

After analyzing 660 battles of CDB90FT data set which covers the period of Netherlands War of Independence in 1600 and Israel-Lebenon War in 1982 he concludes that even though it is more probabilistic than other battle outcome predictors, the FR is a valid estimator of battle outcome. His final conclusion is like that: “despite some slight differences among probability of winning values corresponding to specific FR values of the data set, the general trend remains applicable for the overall analysis of the campaigns, emphasizing that the P(Attacker wins given FR) value increases as the FR value increases (p.xv).

CDB90-CAA Database of Battles, Version 1990

**Predicting battle outcomes with classification trees[[9]](#footnote-9):**

COBAN, analyzed the same but updated data set of CDB90G with classification trees. He pre-selected three variables namely Objective, Relative and terrain and weather variables. FR together with, tank, artillery, cavalry ratio is analyzed in Objective Variables (p.xvii).

COBAN concludes that the descriptive statistics reveal that the objective variables are not highly correlated with victory. However, some of the relative variables, such as leadership, have a strong relationship with the battle outcome (p.xvii).

He got this same result when he conducted his first analysis with the model in which only Objective variables are used in classification analysis. Prediction with only Objective variables yielded high misclassification rates. And he concludes as “Objective variables alone are not sufficient to classify battle outcomes”. He tried second model with both Objective and Relative variables. The result classification models have relatively low misclassification rates (p.xvii).

The classification models in Chapter III reveal that the battle outcomes can be predicted by using classification tree models built by with historical combat data(p.93). However, classification models provide information on how the importance of variables changed thorough history and which factors have most affected the battle outcome(p.94).

**An Examination of Force Ratios[[10]](#footnote-10):**

Christian points out in his master’s thesis that US Army is currently undergoing a transition from focusing on counter insurgency operations to large scale combat operations. As it undergoes this transition, the organization should reflect on its current doctrine and the use of heuristics such as force ratios. Therefore, the primary research question asks whether force ratios and quantitative models are valid tools for commanders and planners going forward. The underlying thesis of this study argues that force ratios are invalid and their continued use may develop unwanted mental constraints. By understanding the origins of force ratios and their evolutions, this study identifies a complete lack of consensus about the applicability of force ratios at various levels of war as well as challenges with common planning tools often associated with force ratios (Report Documentation Page).

Christian refers to Force Ratio as “heuristics” (p.1, 2) and points out the most common force ratio as the 3:1 rule, stipulating that success when attacking a prepared defensive position requires an offensive force with three times more troops than the defenders. He also makes reference of USA Army Doctrine (US Army Field Manual 6-0) historical minimum planning ratios as below (p.2):

|  |  |  |
| --- | --- | --- |
| Friendly mission | Position | Friendly:Enemy |
| Delay |  | 1:6 |
| Defend | Prepared or fortified | 1:3 |
| Defend | Hasty | 1:2.5 |
| Attack | Prepared or fortified | 3:1 |
| Attack | Hasty | 2.5:1 |
| Counter-attack | Flank | 1:1 |

**Conclusion (32-34):** Acknowledging the role that chance plays in war, Clausewitz stated that “so-called mathematical, factors never find a firm basis in military calculations.”110 As the modern Army struggles to transition from counter-insurgency to large scale combat operations, it should encourage a debate over its practices, specifically the heuristic approaches that military planners rely on to save time during planning. Despite flaws, the prevalence of force ratios within Army doctrine and culture remains. Force ratios are a derivative of Lanchester’s early work on concentration and attrition but do not account for technological developments and the multiple domains of warfare that make up the modern battlefield. 111

The Army must differentiate force ratios from correlation of forces models. Force ratios should be abandoned as invalid heuristics. Correlation of forces models, with some effort, may provide utility to planners if they can be separated from force ratios and altered to present the results of its comparison in terms of anticipated effects and expenditures. By continuing to present results in the form of a force ratio that is not valid to begin with, the tool will lack utility. If altered, COFMs could be used to identify likely casualty numbers and expenditure rates for ammunition that would be required to achieve a desired effect (both the QJM and the TNDM support such applications).

As Kahneman cautioned, relying on heuristics may lead to prediction errors. Bradley observed this danger, observing that force ratios led commanders to constrain their options when assessing the battlefield. For this and other reasons previously identified, the US Army should abandon force ratios as a planning heuristic. Planners should focus on operational art and achieving surprise to give tactical commanders the best chance at success.

As the Army continues to expand simulations as cost-effective means of training, it should cultivate further debate into the quantitative analysis that they are built on. At a minimum, a renewed debate around force ratios could result in updating, centralizing, and publishing the analysis that goes into calculators such as the correlation of forces models. The debate could also settle on definitions and explanations, informing leaders at all echelons so that they will be better prepared for large-scale combat operations.

Finally, and not addressed previously in this monograph, is the opportunity that the study of force ratios affords the military. Studying other nations’ development and adherence to force ratios, such as Russian doctrine, may provide an advantage in the event of any future conflict. Just as understanding the bias within our own way of thinking and adherence to force ratios is a risk, understanding an adversary’s quantitative or scientific approach to warfare may provide an opportunity.

**Chapter 3 Research Objectives and Methodology**

Detailed account of how you intend to conduct your research.

Discuss equipment, tools, techniques and anything else that will be used in conducting project.

You won’t be expected to know precisely everything involved but you will need to demonstrate that you have given it serious thought.

U.S. Concepts Analysis Agency (CAA): updated version of the historical combat data set[[11]](#footnote-11)

**Chapter 4 Current Work & Initial Results**

**Chapter 5 Work Plan and Potential Implications**

outline of your proposed time frame with specific targets at certain intervals.

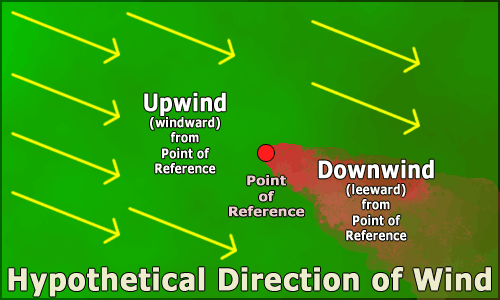
Make sure your proposed time frame fits within the programs schedule to complete a PhD.

This section isn’t always required or may be combined with the methodology section. Check with specific programs for their requirements.

**Chapter 6 Conclusion**

**References**

Bibliography: This is a page of all references that you have used, will use or think you might use in your research project including the literature review. The bibliography will be used to determine if you have a good background in the relevant literature and haven’t overlooked an important source. Use the citation style appropriate for your particular field.



1. TZU, Sun. The Art of War, Translated and with an Introduction by Samuel B.Griffith, Oxford University Press, p.77-80. [↑](#footnote-ref-1)
2. Clausewitz, Carl Von. On War, Edited and Translated by Michael Howard and Peter Paret, Princeton University Press, Princeton, New Jersey, 1984, p. 194-195. [↑](#footnote-ref-2)
3. LANCHESTER, F.W. Aircraft in Warfare, London, 1916, p.39-66. [↑](#footnote-ref-3)
4. Though explanation is given like this: 23\*√2=32.5, means since combined fleet is divided, they need √2 plus force to make equation with the UK fleet. I make this deduction to reach 2/1 force equation: 32²=23²+23², thus in the first battle would be fight with 32²=23² this portion. Equals to 1024 vs 529. [↑](#footnote-ref-4)
5. WOMACK, James K., “Soviet Correlation of Forces and Means: Quantifying Modern Operations”, Master’s Thesis, US Army Command and General Staff College, Fort Leavenworth, KS, 1990. [↑](#footnote-ref-5)
6. Dupuy, T.N., Numbers, Predictions & War: The Use of History to Evaluate and Predict the Outcome of Armed Conflict, Hero Books, 1985. [↑](#footnote-ref-6)
7. SMITH, Kevin B., “The Calculus of War: The Role and Use of Quantitative Decision Aids at the Tactical Level of War”, Master’s Thesis, US Army Command and General Staff College, Fort Leavenworth, KS, 1993. [↑](#footnote-ref-7)
8. YIGIT, Faruk. “Finding the Important Factors in Battle Outcomes: A Statistical Exploration of Data From Major Battles”, Master’s Thesis, Monterey, California. Naval Postgraduate School, 2000. [↑](#footnote-ref-8)
9. COBAN, Muzaffer. “Predicting battle outcomes with classification trees”, Master’s Thesis, Monterey, California. Naval Postgraduate School, 2001. [↑](#footnote-ref-9)
10. CHRISTIAN Jashua T., “An Examination of Force Ratios”, Master’s Thesis, US Army, School of Advanced Military Studies, US Army Command and General Staff College, Fort Leavenworth, KS, 2019. [↑](#footnote-ref-10)
11. Requirements and Resources Directorate, “Combat History Analysis Study Effort (CHASE): Progress Report for the Period August 1984-June 1985,” U.S. Army Concepts Analysis Agency, 1986. [↑](#footnote-ref-11)