CRANFIELD UNIVERSITY

GURKAN YESILYURT

EFFECTS OF LEADERSHIP AND MORALE ON THE OUTCOME OF THE BATTLE ALONGSIDE OTHER COMBAT POWER ELEMENTS INCLUDING FORCE RATIOS

CRANFIELD DEFENCE AND SECURITY

LEADERSHIP AND MANAGEMENT

PhD

Academic Year: 2021 - 2024

Supervisor: Dr. Iftikhar Zaidi

Associate Supervisor: Dr.Irfan Ansari

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Supervisor:  Dr. Iftikhar Zaidi

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This thesis is submitted in partial fulfilment of the requirements for the degree of Enter degree

***(NB. This section can be removed if the award of the degree is based solely on examination of the thesis)***

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ABSTRACT

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LIST OF ABBREVIATIONS

|  |  |
| --- | --- |
| IT | Information Technology |
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# INTRODUCTION

Human history is full of strife, struggles, fights, and ultimately wars that take place on a grand scale. What the reasons for these struggles are and which side's justifications are more satisfactory constitute the field of historical science. However, with the patterns of effects on the outcome are formed over years and they become the subject of both management science, military art, and operational research.

Military theorists and scientists have produced many works on the factors affecting the outcome of wars. Some of these works are based on personal experience like Sun Tzu, some others are based on both experience and philosophy like Clausewitz, while others based on quantification with mathematical formulas like Lancaster and others. While much have been said on the physical elements of the factors like force ratios, most of these studies excludes the qualitative characteristics or take them constant because of their qualitative nature.

Although the importance of leadership and morale is generally emphasized by all authors, it has not been treated within a rigorous, and systematic study. So, in this research, the factors affecting the outcome of the battle will be examined from the perspective of leadership and morale.

## Background

The first written organized thoughts on the subject belongs to Sun Tzu. He names five fundamental factors to evaluate the war. These factors, which Sun Tzu associates with the winning of the battle are moral influence, weather, terrain, command, and doctrine (Sun Tzu, n.d., p. 63-65). With these estimation factors is laid down as principles, he prescribes some force ratio rules with the heading “art of using troops” and says when ten to the enemy’s one, surround him”, “when five times his strength, attack him”, “if double his strength, divide him” (Sun Tzu, n.d., p. 79-80).

Clausewitz ’s approach to subject is comprehensive and covers qualitative nature of the subject as well. He conditions overcoming enemy with matching the efforts against his “power of resistance” which he says product of two inseparable factors, namely “total means at his disposal” and “strength of his will” (Clausewitz, 1832, p. 77). He recognizes the fighting as a trial of moral and physical forces through the medium of physical force and asserts that psychological forces exert a decisive influence on the elements involved in war (Clausewitz, 1832, p. 127). He specifies that, with deciding; time, place, and the force of the engagement, strategy, not force ratio, has considerable influence on engagement’s outcome. These reservations in mind, he explains “superiority of numbers” as most common element in victory with an important condition which is “if purpose, circumstances, and the fighting value of the troops is disregarded”. But he further argues 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 (Clausewitz, 1832, pp. 194–195).

In the 1900s, the subject attracted the attention of engineers like Lancaster. At this stage, mathematical formulas were used to explain the importance of the subject.

Lancaster contributed to the literature with two important concepts, one of which **differential explanation of the casualties** (the number of men knocked out per unit time will be directly proportional to the numerical strength of the opposing force, efficiency of weapons and unit value) and the other is **N-square law** as “the fighting strength of a force is proportional to the square of its numerical strength multiplied by the fighting value of individual units (Lanchester, 1916, pp. 39–66).

With the rapid development of technology, the subject has become the subject of operational research.

When we come to 1979, Depuy, former USA Army Officer, have examined the subject with the help of well-designed mathematical models. He had devoted himself to explain the factors effecting the outcome of the battle and use them in prediction of the future battles. He developed Quantified Judgment Method of Analysis (QJMA) of Historical Combat Data, where the outcome of a battle is predicted using a multiplicative-additive formula in which various factors relating to the strength and firepower of the fighting parties as well as the circumstances are considered. He defines Quantified Judgement Model (QJM) as a major component of the methodology and as a long but simple mathematical equation (Dupuy, 1979, p. ix).

His concept of “Combat Power Potential” is extracted from multiplication factors. These factors are calculated via 73 combat variables which is prepared by USA Historical Evaluation and Research Organization (Dupuy, 1979, pp. 30–50). These factors are summarized below:

Force Strength (S): The sum of the values of the weapons of a force (Operational Lethality Indices (OLI) – modified to reflect environmental variables. OLI factors were base of his research where he analysed the relationship between the weapons and the number of casualties. He added Operational Environmental Factors (OE) to the formula to better reflect the battlefield realities like effects of weather, terrain, season, mobility, and vulnerability factors. Force strength is calculated by multiplication of weapon effectiveness and environmental conditions.

Combat Power Potential (P): This value is calculated by applying (multiplying) all identifiable operational variables to the Force Strength (S) value. These variables are mobility factor, leadership, training and experience, morale, and logistic factors. Where applicable he gave mathematical weights to these variables. As an example, he gave values for the morale of the belligerents (excellent morale: 1.0, Panic: 0,2 and etc). Where he found solid proof, he multiplied these values with the Force Strength.

Where Power Potentials for the friendly force divided by the enemy force was greater than 1.0, he postulated that this meant that friendly side should have been successful.

In order to test this theory, he quantified the “actual results” of the battle, again with giving numerical values to mission accomplishment, holding ground, and comparing the casualties. He tested whether the “Combat Power Ratios” indicated the outcome of the battle or not (Dupuy, 1979, p. 42).

Conscious of the inconsistences in the system he developed, he further refined his system and reported the results in a totally new book named “Understanding the war: History and theory of Combat” in 1987.

In this book, he based all his analysis to the Clausewitz’s “Law of Numbers”. Clausewitz asserts that “if we strip the engagement of all variables arising from its purpose and circumstances, and disregard the fighting value of the troops, we are left with the bare concept of the engagement in which the only distinguishing factor is the number of the troops”(Clausewitz, 1832, p. 194). From this phrase he re-formulated his combat power of 1979. This time combat power is calculated by multiplying OLI factor (instead of number of troops he uses OLI factors) and environmental factors and quality of the troops (Dupuy, 1987, p. 30).

Most controversial point of his system was his approximation of troop quality by equating it to the actual battle results ratio divided by the theoretical combat power ratio. From 1960s to 1990s for almost three decades, Dupuy and his colleagues made comprehensive contributions to the subject, although his formula of assessing the “quality of the troops” (factors other than weapon effectiveness and environmental variables) is assessed to be “erroneous” in research which includes an interview with himself also (Ciano, 1988, p. 31).

By far the latest systematic treatment came from Biddle. His research methodology combines recent historiography with formal doctrinal theory, case method, statistical analysis, and simulation experimentation. He argued that material factors alone cannot explain capability and added force employment, which is a nonmaterial variable to his analysis. He defines modern system of force employment as “the doctrine and tactics by which armies use their materiel in the field” (Biddle, 2006, p. 2).

Modern system of force employment might be summarized as offensive and defensive operations and tactics. He discusses advantages and disadvantageous of offensive tactics such as breakthrough and exploit operations versus limited aim operations and bite and hold tactics under the effects of offensive tactics like cover and conceal, dispersion, combined arms, and independent small unit operations. If armies conduct these kinds of offensive operations with the requirements of these tactics, he argues, then these armies are conforming with the modern system of force employment. The same argument is made also for defensive operations and tactics (Biddle, 2006, pp. 28–51).

His key finding might be summarized as the effects of preponderance in the numbers and technology is mediated by “modern system of force employment”. He concludes that technology and preponderance’s effects are radically different as a function of force employment, it can be decisive or almost immaterial as a function of the implementation of the modern system force employment. The one who implements “force employment” better, will exploit advantageous of numerical superiority in numbers and technology (Biddle, 2006, pp. 60–77).

Other than Biddle, there are other works emphasizing and utilizing non-material factors on the outcome of the battle. One of them is UK Defence Doctrine which categorizes “fighting power” into three sections, namely conceptual, physical, and moral components(UK Ministry of Defence, 2014, p. 25).

One of them is a Rand Report which provided a detailed explanation of “will to fight” and a model designed to support assessment of forces (Connable et al., n.d., p. 10). They accept that morale, cohesion, and discipline is associated with the “will to fight” but they argue “morale” especially is ill-defined. Their model provides US army military planners an assessment tool for the “will to fight” dimension of the units.

## Area of Research

What will be studied?

In this research the factors affecting the outcome of the battle will be examined from the perspective of leadership and morale.

Why this research will be done?

Almost all contributors in this field agreed on material factors alone cannot explain the result in military conflict. Sun Tzu’s three out of five fundamental factors to be victorious (includes moral, command, and doctrine elements) relates with non-material factors(Sun Tzu, n.d., p. 63). Clausewitz puts morale factor “among the most important in war” (Clausewitz, 1832, p. 184). UK Defence Doctrine emphasizes none of fighting power elements should claim precedence and each mutually supports and informs the other (UK Ministry of Defence, 2014, p. 25).

So, there is a consensus among researchers on the importance of the leader’s role and morale in the battles. What is missing in the literature is lack of systematic research which includes these factors and explains the variance on the outcome of the battle.

This gap is problematic, because although the importance of these qualitative factors is recognized universally, research efforts has been limited so far to explore these factors because of their qualitative nature.

New text and data analysis tools presents powerful exploitation opportunities for new insights which in turn will facilitate the examination of this subject with the lenses of Leadership and Moral factors.

How it will be studied?

1st step: Literature review and case study will be conducted to identify the factors (variables) effecting the outcome of the battle.

2nd step:

Quantitative analysis will be conducted to explore the relationship between the factors effecting the outcome of the battle. In case correlation detected between the factors and the result of the battle than the relationship will be modelled with regression models.

Each factor’s contribution to variance will be analysed with Multiple Regression Analysis. This analysis is best suited since there exists multiple predictors which affect the result (James et al., n.d., p. 71).

To enable this analysis, data will be used from already in-place databases.

* One of these database is provided by “The Correlates of War Project” which was founded in 1963 by J.David Singer, a political scientist at the University of Michigan. This project consists of war data (inter-state, intra-state, extra-state, non-state war data) for the period between 1816-2007. Inter-state war data part will be utilized (Sarkees & Frank Wayman, 2010).
* Other database is U.S. Concepts Analysis Agency’s updated version of the historical combat data set which covers 660 battles for the periods between 1600-1982 (Historical Evaluation and Research Organization, 1988).

3rd step:

For the leadership and morale factors, “text analysis” will be conducted. Current level in text analysis allows to measure how important a word is to a document. It will be done in the steps summarized below:

* Named entities will be annotated.
  + This step includes locating and classifying key terms of the morale and the leadership into pre-defined categories. Examples are given below:
    - “Military spirit” term (named as the most important moral elements in war (Clausewitz, 1832, p. 189) will be classified in morale category,
    - “Intellectual powers and courage” of the commander (named as “soldiers first requirement” (Clausewitz, 1832, p. 101) will be classified in the leadership category.
  + Literature will be reviewed comprehensively to cover all possible important features associated with the effectiveness of these two variables (leadership and morale) to better represent the named entities.
* Named entity recognition (NER):
  + Once named entities annotated manually, recognition of all these entities from raw text will be conducted by Natural Language Processing (NLP).
  + Raw texts might be official battle reports, academic products, or memoirs of soldiers. In the methodology chapter it will be expressed which raw texts will be used as input to the model. It will be beneficial to use raw texts of the battles of which regression analysis is made.
* Relation Extraction (RE) models will be trained with the language representation techniques. New features will be created to build downstream deep learning models to find relations between the outcomes and leadership and morale factors.

4th step:

Case studies supported with strategic and operational perspective will be done to supplement the “Text Analysis” for the factors of leadership and morale.

5th step:

Results of the “Text Analysis” and “case study” will be integrated into the analysis made by Multiple Regression Analysis to conclude the nature of the relationship between leadership and morale and the outcome of the battle.

## Research Aim, Objectives, and Questions

### Research Aim:

This research will aim to explain effects of leadership and morale on the outcome of the battle alongside other combat power elements.

### Research Objectives:

To explain how far combat power elements explains the outcome of the battle.

To explain the relationship between leadership and morale and other combat power elements.

To identify the nature and the degree of the effects of leadership and morale on the outcome of the battle.

### Research Questions:

What factors relate with the outcome of the battle?

What are variances each factor has on the outcome of the battle?

What kind of effects leadership and morale have on the outcome of the battle?

How much the outcome of the battle effected with inclusion of leadership and morale as factors.

## Study Value

War theories clearly state the importance of non-materials in the battle. These theories are produced based on the battle experiences. Literature on this issue focused and tested material side so far.

Non-material factors of leadership and morale never analysed thoroughly because of their qualitative nature. Sophisticated analysis tools on the texts, developed so far, supported with artificial intelligence, gives researchers a leverage, which cannot be compared with even the start of this century.

This research will combine analysis methods of statistical reasoning, case study and artificial intelligence with text analysis feature.

With all these, it will significantly contribute to the literature.

## Limitations

The biggest limitation of this research is not coming from the nature of the subject, which is leadership and morale, but coming from the nature of the environment, which is battle. The factor of “chance”, which Clausewitz terms it as the most abundant thing in the battle(Clausewitz, 1832, p. 85), has a potential to prevent crystal clear understanding of the reasons of the outcome. Conscious of this fact, the focus will be on the patterns of leadership and morale in the battlefield.

This research is not aimed at quantifying the battle nor aimed at developing a theory to explain it. In line with Clausewitz’s conceptualization, who argues that “absolute, so called mathematical, factors never find a firm basis in military calculations” (Clausewitz, 1832, p. 86) this research will not calculate the winner based on mathematical formulas but will try to find the patterns of the winner side leadership and morale factors and their effects on the outcome of the battle.

The battles will be selected only from ones fought between state actors.

Since the factors might be better analysed for the battles which has a historical recording mechanism already in-place, only the battles fought after Napoleonic era will be analysed.

Although leader role might be best observed in the irregular warfare, it will be limited to the person who are given the role as commander, and hence leaders. Leader role in irregular warfare is the topic of other study.

The analysis will be made with the in-place databases. The details of the databases can be seen in the methodology part. This research has no intention to create a new battle database.

## Research outline

In this chapter (Chapter one) the general context has been set up. Questions has been so far responded with regard to what will be studied, why this research is being conducted, and how it will be conducted. Aim, objectives, questions, value, and limitations of the research has been articulated.

In Chapter two current literature will be summarized to explain what kind of approaches and models are being used so far.

In Chapter three theoretical framework will be presented to explain the factors effecting the outcome of the battle (variables) and their relationships, data collection and analysis methods.

In Chapter four how the research was carried out will be explained.

In Chapter five findings of research will be presented.

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REFERENCES

Biddle, S. (2006). *Military Power* (Fifth printing). Princeton University Press.

Ciano, J. F. (1988). *The Quantified Judgement Model and Historic Ground Combat*.

Clausewitz, C. von. (1832). *On War* (M. Howard & P. Paret, Eds.).

Connable, B., McNerney, M. J. (Michael J., Marcellino, W., Frank, A., Hargrove, H., Posard, M., Zimmerman, S. R., Lander, N., Castillo, J., Sladden, J., Arroyo Center. Strategy, D., Rand Corporation., & United States. Army. (n.d.). *Will to fight : analyzing, modeling, and simulating the will to fight of military units*.

Dupuy, N. T. (1979). *Numbers, prediction, and war*.

Dupuy, N. T. (1987). *Understanding War: History and Theory of Combat*.

Historical Evaluation and Research Organization. (1988). *Analysis of Factors That Have Influenced Outcomes of Battles and Wars: A Data Base of Battles and Engagements*.

James, G., Witten, D., Hastie, T., & Tibshirani, R. (n.d.). *Springer Texts in Statistics An Introduction to Statistical Learning*. http://www.springer.com/series/417

Lanchester, F. W. (1916). *Aircraft In War*.

Sarkees, M. R., & Frank Wayman. (2010). *COW War Data, 1816 - 2007 (v4.0)*. CQ Press.

Sun Tzu. (n.d.). *The Art Of War* (B. S. Griffith, Ed.). Oxford University Press.

UK Ministry of Defence. (2014). UK Defence Doctrine. In *0-01 (JDP 0-01): Vol. 5th Edition*.

APPENDICES

Whilst Heading 1 to Heading 6 can be used to number headings in the main body of the thesis, Heading styles 7–9 have been modified specifically for lettered appendix headings with Heading 7 having the ‘Appendix’ prefix as shown below.

Appendix Title (Use Heading 7)

Appendix Section (Use Heading 8)

Appendix Subsection (Use Heading 9)

Creating captions in Appendices

If you have chosen to include chapter numbers in your captions then follow the instructions given here to apply the same format to the captions in your appendices. This section explains how to caption the figures and tables in your Appendices, assuming that Heading 7 is numbered “Appendix A” and that the Figures and Tables are going to be labelled ‘Figure A-1’, ‘Figure A-2’, ‘Table B-1’ etc.

You will have to create new, separate labels that look like the ‘Figure’ and ‘Table’ labels you used in the main body of your thesis.

1. Select the **References** tab on the Ribbon then click on **Insert Caption**
2. Click **New Label**. Type **Figure\_Apx** then click **OK**
3. You now have two labels for figures, called **Figure** and **Figure\_Apx**  
   Repeat for table captions.
4. In the **Caption** box, type your caption text
5. Click **Numbering**. Tick **Include chapter numbering** and choose **Heading 7** from the drop-down list of styles and click **OK** twice
6. Your caption should look something like this:

**Figure\_Apx A‑1 This is the caption text for a Figure in the Appendix**

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   **Figure A‑1 This is the caption text for a Figure in the Appendix**  
   **TIP:** Instead of deleting each ‘\_Apx’ individually use **Find & Replace** to modify all the labels at once.

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This template already includes a List of Figures and a List of Tables, however you will have to create two new lists for the ‘Figure\_Apx’ and the ‘Table\_Apx’ labels.

1. Place the insertion point on a blank row after the existing List of Figures
2. Select the **Insert Table of Figures** command on the **References** tab of the Ribbon
3. Set the **Caption Label** box to ‘**Figure\_Apx**’ and click **OK**  
   **Note:** Word will put a single blank line between the original and new lists preventing it from appearing as one seamless list. However if you select the blank paragraph between the tables you can hide it by opening the Font dialog box from the Home tab and selecting **Hidden**.
4. Click after the List of Tables and repeat for the Caption Label ‘Table\_Apx’