NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

BASIC DIMENSIONS OF FINANCIAL CONDITION WITHIN THE DEFENSE INDUSTRY

by

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September 1998

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REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE September 1998	3. REPORT TYPE AND DATES COVERED Master's Thesis

4. TITLE AND SUBTITLE
BASIC DIMENSIONS OF FINANCIAL CONDITION WITHIN THE DEFENSE INDUSTRY

5. FUNDING NUMBERS

6. AUTHOR(S)
Bowden, Craig T.

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Postgraduate School
Monterey, CA 93943-5000

8. PERFORMING ORGANIZATION REPORT NUMBER

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

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT *(maximum 200 words)*

In the current economic climate of fiscally constrained resources, the Department of Defense (DoD) has become extremely sensitive to the ways in which it spends money in support of its mission of providing national security. Before awarding contracts to defense industry firms, the DoD routinely performs financial analysis on these defense contractors in order to assess their financial condition. The primary purpose of this thesis was to analyze financial data from a sample of defense industry firms in order to determine the basic dimensions of financial condition in the defense industry. A related objective was to compare these results with previous studies. This analysis is particularly relevant due to the recent and numerous changes, particularly mergers, that have reshaped the economic landscape for defense industry firms during the mid-1990s. The research covered fifty of the top one-hundred defense contractors. Fifty-one different financial ratios for these companies were calculated and analyzed. Factor analysis was the primary statistical method employed. The analysis concluded that were nine distinct dimensions of financial condition within the defense industry. Future financial analyses of the defense industry should cover these distinct dimensions of financial condition.

14. SUBJECT TERMS
Defense Industry, Financial Ratios of Financial Condition, Factor Analysis, Indicators of Defense Industry Economic Health

15. NUMBER OF PAGES
62

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFI- CATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

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BASIC DIMENSIONS OF FINANCIAL CONDITION WITHIN THE DEFENSE INDUSTRY

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Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
September 1998

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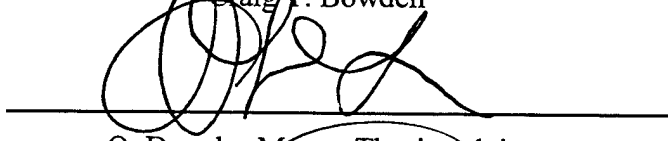
Approved by: 

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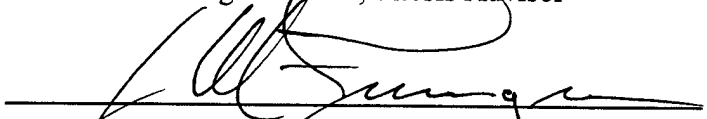

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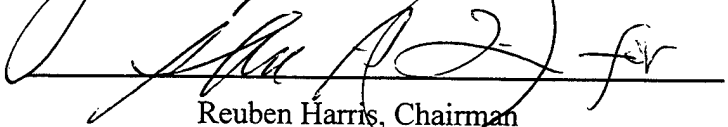

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ABSTRACT

In the current economic climate of fiscally constrained resources, the Department of Defense (DoD) has become extremely sensitive to the ways in which it spends money in support of its mission of providing national security. Before awarding contracts to defense industry firms, the DoD routinely performs financial analysis on these defense contractors in order to assess their financial condition. The primary purpose of this thesis was to analyze financial data from a sample of defense industry firms in order to determine the basic dimensions of financial condition in the defense industry. A related objective was to compare these results with previous studies. This analysis is particularly relevant due to the recent and numerous changes, particularly mergers, that have reshaped the economic landscape for defense industry firms during the mid-1990s. The research covered fifty of the top one-hundred defense contractors. Fifty-one different financial ratios for these companies were calculated and analyzed. Factor analysis was the primary statistical method employed. The analysis concluded that were nine distinct dimensions of financial condition within the defense industry. Future financial analyses of the defense industry should cover these distinct dimensions of financial condition.

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I. INTRODUCTION

A. BACKGROUND

The Department of Defense (DoD) is primarily responsible for protecting this country's national interests both at home and throughout the world. In order to guarantee the successful accomplishment of this mission, the DoD must ensure that it supplies its military forces with the most modern weapons that can be provided by the nation's defense industry. Consequently, in order to fulfill its mission, the DoD must ensure that it has the support of a stable and economically healthy defense industry. A strong, stable, and health defense industry will help to ensure that the DoD can carry out its mission with the best possible chances for success.

In the current economic climate of fiscally restrained resources and an ever-growing list of requirements, the DoD has become extremely sensitive to the ways in which it spends money in support of its missions. Before awarding lucrative contracts to defense industry firms, the DoD routinely performs financial analysis on these perspective contract winners in order to assess their financial stability. One of the primary methods employed by DoD agencies in this assessment is through the use of financial ratios;

> All activities are concerned with assessing the health/stability/capability of defense firms; all tend to rely heavily on financial information reported on in financial statements; all tend to construct a set of financial ratios from the financial statement information.[Ref.1]

Previous studies have indicated that financial ratios reflect fundamental dimensions of financial condition within the defense industry. In earlier studies, it was determined that financial ratios for commercial firms in general could be classified into seven distinct areas which included; Return on Investment, Capital Turnover, Inventory Turnover, Financial Leverage, Receivable Turnover, Short-Term Liquidity, and Cash Position [Ref.2]. More recent studies have indicated that there are actually eight basic dimensions of financial condition that underlie financial ratios within the defense industry [Ref.1]. Through an analysis of financial ratios, this study will investigate a sample of defense industry firms to determine whether the industry's financial condition can be effectively and accurately measured along stable financial dimensions.

In recent years, the defense industry has experienced numerous changes that have drastically reshaped the economic landscape within the industry. The primary change has been experienced in the form of mergers. The principal reason for the increase in the number of mergers can be traced to the reduction in defense and military expenditures. Prior to the collapse of the Soviet Union, the U.S. government routinely picked two defense producers to share the production of an important defense program. Recently, however, the shrinking defense budget has forced the government to reduce the volume of its orders which makes it impossible to support two contractors sharing production for a single program. [Ref. 3]

Instead of sharing production, the government is now interested in using a single contractor in order to reduce costs and ensure optimal performance of its procurement

process. This new procurement strategy has had a direct impact on the defense industry; The U.S. government has become openly receptive to mergers among military suppliers, especially those in direct competition with one another [Ref. 3]. As a result of these changes there has been a dramatic increase in the number of mergers within the defense industry. Examples of recent defense industry mergers include, Boeing and McDonnell Douglas, Lockheed Martin and Northrop Grumman, Raytheon and Hughes Electronics. There are numerous other examples of mergers that have taken place in recent years that further display the changing landscape of the defense industry. This thesis will also explore the validity of prior studies' findings concerning defense industry financial dimensions in the context of the new defense industry economic landscape.

B. OBJECTIVES AND RESEARCH QUESTIONS

The primary objective of this thesis will be to determine the principal dimensions of financial condition in the defense industry. This determination will be accomplished through statistical analysis using financial ratios in conjunction with a factor analysis computer program. Financial ratios will be calculated for a group of fifty defense industry firms from their most recent financial statements including balance sheets, income statements, and statements of cash flow. The selection of the fifty firms will be discussed in detail in Chapter II. Related objectives will be to determine which individual ratios are most highly associated with each particular dimension of financial condition.

The thesis intends to answer the following primary and secondary questions:

1. Primary Question

What are the primary dimensions of financial condition for defense industry firms?

2. Secondary Questions

1.What individual ratios are most highly associated with each dimension of financial condition?

2. Are the dimensions of financial condition and representative ratios consistent with those identified in earlier studies?

C. METHODOLOGY

This thesis will be accomplished under the following guidelines:

1. Determine a relevant definition of the defense industry.
2. Identify a sample of fifty firms that comprise the best overall representation of the defense industry as a whole.
3. Collect the most recent financial information on these firms.
4. Identify a set of financial ratios for analysis and compute each ratio for each defense industry firm.
5. Use Factor Analysis to determine the existence of financial dimensions within the defense industry.
6. Compare the current results to previous studies to determine if patterns exist.

7. Complete research conclusions.

D. SCOPE, LIMITATIONS, AND ASSUMPTIONS

The main purpose of this thesis is to analyze current financial data of the defense industry firms to determine what are the dimensions of financial condition. To accomplish this task, a database comprised of the most recent financial statements of fifty defense industry firms will be used. Statistical analysis via a factor analysis program will be the primary method employed to analyze the financial data. The output from the factor analysis will be a description of systematic patterns exhibited by measures of financial condition within the defense industry. This output will be compared to the output from a previous study of the defense industry. Thus, this thesis is a study of aspects of financial condition and characteristics of financial ratios within the defense industry as a whole. It is not an analysis of the financial condition of individual firms within the defense industry [Ref. 4].

E. LITERATURE REVIEW

A literature review was conducted prior to initiating the analysis portion of this thesis. The review focused on prior studies conducted by Pinches, Mingo and Cauther [Ref. 5], Pinches, Eubank, Ming and Cauthers [Ref. 2], Chen and Shimerda [Ref. 6], and Moses [Ref.1]. These studies laid the foundation for understanding the fundamental dimensions of financial condition and their relationship with financial ratios. These studies will be discussed in greater detail in Chapter II and Chapter III.

F. ORGANIZATION OF STUDY

The remainder of this thesis will include Chapters II through V. Chapter II will provide the necessary background information for this study via a literature review of several previously conducted studies. Chapter III will provide a detailed description of the methodology involved in this study. This chapter will also discuss the selection of defense industry firms and the financial ratios that will be calculated and analyzed. Chapter IV will discuss the factor analysis technique and provide a framework for the actual empirical analysis. Chapter V will conclude the study with a discussion on the results and a comparison with findings from previous studies.

II. LITERATURE REVIEW

A. OBJECTIVES

The objective of this chapter is to provide a background on five studies that concentrated on using financial ratios to determine the economic health of various sectors of industry. The five studies discussed in this chapter are The Stability of Financial Patterns in Industrial Organizations by Pinches, Mingo, and Caruthers, The Hierarchical Classification of Financial Ratios by Pinches, Mingo, Caruthers, and Eubank, An Empirical Analysis of Useful Financial Ratios, by Chen and Shimerda, , A Cross-Industry Analysis of Financial Ratios by Edward Ketz, Rajib Doogar and David E. Jensen, and finally the Basic Dimensions of Financial Condition within the Defense Industry by Douglas Moses. This study addresses each study separately and it provides the reader with a fundamental understanding of the usefulness of financial ratios in analyzing the financial condition of companies within all sectors of private and public industry.

B. ANALYSIS OF PREVIOUS STUDIES

1. Background

Financial ratios have long been used extensively as predictors of an individual company's financial condition. Investors on Wall Street study and compare financial ratios among companies to assess which company would be the wisest choice to invest in.

Additionally, the Department of Defense conducts its own studies of financial ratios to determine which defense industry firms possess strong and stable financial conditions.

Currently, there are numerous useful financial ratios that can be constructed and used to determine the financial condition of a particular company. The problem lies in determining which financial ratios need to be used in order to provide the optimum prediction of relevant financial condition?

> There is only one reoccurring question with the use of financial ratios: which ratios, among the hundreds that can be computed easily from the available financial data, should be analyzed to obtain information for the task at hand.[Ref. 6]

In order to deal with this problem, researchers have developed a method to help organize financial ratios into specific classifications. Classifications, or taxonomies, reflect a common theme, such as liquidity or cash position, that is shared by that particular grouping of financial ratios. These classifications better help researchers to define the proper dimensions of financial condition for a particular company. The primary method for achieving a classification of financial ratios is through the use of a mathematical procedure called factor analysis. This procedure will be discussed in greater detail in Chapter III.

1. Analysis of Prior Studies

a. Pinches, Mingo, and Caruthers

There were two primary goals that this study by Pinches, Mingo and Caruthers achieved. The first goal was to develop empirically based classifications, or taxonomies, of financial ratios. This was accomplished through the use of factor analysis which identified seven classifications, to include: (1) return on investment; (2) capital intensiveness; (3) inventory intensiveness; (4) financial leverage; (5) receivables intensiveness; (6) short-term liquidity; and (7) cash position. The data used for this study included financial information from two hundred and twenty-one industrial firms from which forty-eight financial ratios were calculated and used. The data was organized into four separate matrices which, when combined, covered the period from 1951 to 1969. The second goal was to measure long term stability of these financial classifications during this period. This study concluded that the seven noted financial classifications were generally stable throughout the designated time period, with financial leverage being the most stable and capital intensiveness being the least stable.[Ref. 5]

b. Pinches, Eubank, Mingo, and Caruthers

This particular study closely followed the study conducted by Pinches, Mingo, and Caruthers, covering the 1951 to 1969 time period. The primary purpose of this study was to examine the short-term vice long-term stability of empirically-based

financial ratio classifications. The period covered during this study was 1966 through 1969. The same two hundred and twenty-one firms were used, as well as the same forty-eight financial ratios. Factor analysis was the mathematical program employed to determine the financial ratio classifications, which fell into seven distinct classifications: (1) return on investment; (2) capital turnover; (3) inventory turnover; (4) financial leverage; (5) receivables turnover; (6) short term liquidity and (7) cash position. These seven classifications were basically the same as those identified in the previous study. [Ref. 2]

In addition, this study focused on the stability of the dimensions across time. The data was correlated into separate matrices for each of the following time periods: 1966-1967, 1967-1968, 1968-1969, and 1966-1969. Factor analysis was performed and yielded a correlation coefficient for each matrix. The results of the factor analysis concluded that the occurrence of these dimensions was not a random occurrence, hence the dimensions are stable across time.[Ref. 4]

c. Chen and Shimerda

The primary purpose of this study was to define the optimum composition of the financial ratio set used in determining financial classifications. This study was partly based on the findings presented in references 2 and 5, which both concluded the existence of seven common ratio classifications for grouping financial ratios.

Chen and Shimerda analyzed several previous studies and determined that there were thirty-four financial ratios which seemed to be significant predictors of firms' future behavior. Chen and Shimerda applied the seven-factor classification base from references 2 and 5, as the relevant factor space for classifying the financial ratios. In doing so, there were ten out of the thirty-four ratios that were not included in the set of ratios investigated by Pinches, Mingo, and Caruthers and Pinches, Eubank, Mingo, and Caruthers and thus not included in their classification scheme. The ten unclassified financial ratios were as follows:

1. Quick Assets / Inventory
2. Net Income / Common Equity
3. Quick Flow Ratio
4. Funds Flow / Current Liabilities
5. Net Income / Sales
6. Funds Flow / Total Debt
7. Working Capital / Total Assets
8. Long term Debt / Current Assets
9. No-Credit Interval
10. Retained Earnings / Total Assets

The focal point of the Chen and Shimerda study was to perform factor analysis on these ten unclassified ratios in order to determine their relationship with the other factor space

ratios and the seven financial classifications. The study was based on 1977 financial data obtained from one thousand and fifty-three firms. The results indicated that the ten ratios had high correlations with ratios in each classification identified in the studies of references 2 and 5. This result led Chen and Shimerda to conclude that all thirty-four ratios were highly correlated in their respective classifications. Consequently, each group of ratios basically presented the same information, which allowed researchers to further reduce the number of required financial ratios when performing data analysis. [Ref. 6]

d. Ketz, Doogar and Jensen

This study was primarily concerned with determining the comparability of financial ratios across several different industries by assessing the similarity or dissimilarity among industry ratio classifications:

> Evaluating financial ratios across industries assumes that the numbers are comparable. The presumption is that the financial ratios are comparable; that is, the financial ratios of one industry are measuring the same underlying concepts as the financial ratios of another industry. If the underlying concepts are different, then the evaluation of financial ratios across industries- especially when utilizing such mathematical relations as "equal to" or "greater than" - are potentially meaningless. [Ref. 8]

This study incorporated financial data from a sample of four hundred and seventy-six firms, from which thirty-two financial ratios were calculated across the time period 1978 - 1987. The collection of firms was grouped into seven distinct industries: (1) automotive and aerospace; (2) chemical, rubber, and oil; (3) electronics; (4) food; (5) retail; (6) steel; and (7) textiles. Factor analysis determined that the financial ratios were correlated

across each industry into seven areas: (1) return; (2) cash flow; (3) cash position; (4) debt; (5) sales; (6) inventory; and (7) liquidity. These seven areas are similar to those determined in the previous studies done by Pinches, Mingo, and Caruthers, and Pinches, Eubank, Mingo, and Caruthers. This study concludes that the same seven financial classifications exist not only across time, but they exist across separate industries as well.

e. Moses

The final study to be reviewed was conducted by Moses [Ref. 1]. This study is primarily concerned with identifying the basic dimensions of financial condition specifically within defense industry firms. As with the previous studies noted, this study uses factor analysis to examine the correlation of financial ratios across the defense industry. Moses' study concluded that there are eight basic dimensions of financial condition in defense industry firms. The eight dimensions are: (1) profitability; (2) liquidity; (3) cash flow; (4) turnover; (5) cash position; (6) asset composition; (7) leverage; and (8) inventory. This study found six, of the seven, factors discovered in the earlier noted studies. One of the differences is that the Moses' study did not find a receivables factor, which indicates that this factor is not significant in defense industry firms. The most significant difference between this study and its predecessors is the identification of an additional eighth factor- asset composition. This indicates that defense industry firms differ significantly from other industries in how they assemble

their assets. Table 1 lists the different taxonomies used in all five of the studies in this literature review. [Ref.1]

As was previously noted, there have been significant changes in the economic structure and composition of the defense industry, primarily from mergers. One of the primary purposes of this study will be to assess the impact of these structural changes from mergers on the stability of these financial dimensions in the defense industry.

C. CONCLUSIONS

The studies in this chapter identified that there are seven basic classifications of financial condition in the industry as a whole. Within each of these classifications there exist a group of highly correlated financial ratios that reflect relevant information regarding their respective classification. The studies also indicated that a reduction in the number of financial ratios employed in studies is feasible because multiple ratios are representative of the same factors and hence contain redundant information. This is highly beneficial to researchers who can employ fewer ratios and still obtain accurate analysis results in regards to a firm's financial condition.

TAXONOMY	STUDY	*PMC*	*PEMC*	*C&S*	*KDJ*	*Moses*
Return on Investment		X	X	X	X	X
Capital Intensiveness		X	X	X	X	X
Inventory Intensiveness		X	X	X	X	X
Financial Leverage		X	X	X	X	X
Receivables Intensiveness		X	X	X	X	
Short-Term Liquidity		X	X	X	X	X
Cash position		X	X	X	X	X
Asset Composition						X
Cash Flow						X

Table 1: Taxonomies By Study

III. METHODOLOGY

A. OBJECTIVES

The objective of this chapter is to provide the methodology used to conduct the analysis of the financial ratios of defense industry firms. The first step in this chapter will be to provide a relevant definition of the nation's defense industry. The definition will include the methodology used to choose a sample of fifty firms representing the defense industry. The second step will explain the selection of financial ratios and display the financial ratios used in the analysis. The final step in this chapter will describe the factor analysis technique used to analyze the financial ratios of the defense industry firms and identify the underlying dimensions of financial condition in the industry. This step will include background information on factor analysis and a general description of the expected results of this empirical analysis.

B. DEFINITION/SELECTION OF THE DEFENSE INDUSTRY SAMPLE FIRMS

National Defense of the United States is a multi-billion dollar yearly industry, incorporating a wide variety of companies which produce a multitude of end products. The defense industry can best be characterized as providing equipment and services to three distinct customer groups: governments and military organizations, civilian transportation companies, and telecommunications and information services providers.

All three groups are related through the technology that is produced by the defense industry companies. [Ref. 3]

As was previously noted, this study selects a group of fifty defense industry firms to be analyzed. These fifty firms were chosen from the top 100 defense contractors that were listed in the Defense 97 Almanac [Ref.7], which ranks the contractors according to the largest dollar volume of prime contracts awarded by the DoD during 1996. The Defense 97 Almanac also provides a breakdown of the defense industry firms in regards to their common areas of production. There are nine broad categories of production for defense industry firms: (1) aircraft/aircraft engines, (2) tanks and automotive, (3) ships, (4) electronics and communications, (5) missiles, (6) weapons and ammunition, (7) training systems and services, (8) construction, and (9) medical supplies/services.

The selection of the fifty firms was based upon two criteria: (1) the total largest dollar volume of prime contracts awarded by the DoD and (2) company diversification across the nine general areas of production. The first group of thirty firms chosen represented the top thirty firms in regards to the largest dollar volume of contracts. The second group of twenty firms was chosen to provide the greatest degree of diversification across all nine production categories in the defense industry. Table 2 provides a listing of all fifty firms used in this study. The firms are listed in order of largest to smallest prime contract dollar volume.

Financial statement information for all fifty firms was collected from Moody's Industrial Manuals [Ref. 9]. The financial information was extracted from each firm's

annual reports for 1996. The financial information primarily includes information contained on the balance sheet, income statement, and statement of cash flows. This information will be used in the calculation of specific financial ratios in order to analyze the financial condition of defense industry firms.

C. FINANCIAL RATIO SELECTION

1. Ratio Background

As was discussed earlier, this study compares its findings against results from a previous study in regards to the dimensions of financial condition within the defense industry. The primary reason for this is to determine the extent to which the mid-1990's defense industry mergers, acquisitions, and bankruptcies have changed the financial condition of the industry as a whole. In order to complete an accurate comparison between these studies, this study must use the same financial ratios that were employed in reference 1. This study uses financial data from financial statements in 1996/1997 and compare its results against reference 1, which used financial data from the period covering 1983 through 1992.

2. Methodology For Ratio Selection

In accordance with reference 1, the following approach is outlined to provide guidance in determining which financial ratios are relevant to this study. The first step was to identify a population of potential ratios. Second, the ratios chosen were grouped into three distinct categories: risk, return, and structure. These categories will be

discussed in greater depth in the next paragraph. Lastly, a grouping of representative ratios from each category was chosen in order to ensure diversification across all areas of financial condition. [Ref .1]

Financial ratios reflect three basic categories of financial statement information, which are Return, Risk, and Structure. Return ratios generally compare a company's generated resources against its available resources during a specified period of operations. Return ratios are generally broken down into three subcatagories return, margin and turnover. Margin relates income against revenues, turnover relates revenues to investment, and return is the product of both margin and turnover. Risk ratios are used to compare required resources with resources available in order to satisfy a particular claim against the company. Risk is normally divided into term lengths or periods, which are referred to as either short-term or long-term. Lastly, Structure ratios are used to compare the amount of one resource/claim with the amount of another resource/claim. This type of ratio generally portrays a composition of assets or a composition of equities. Table 3 provides a listing of the fifty-one financial ratios that were used in this study. When interpreting all of the ratios in Table 3, the following example should be applied: CISE actually equates to CI / SE. [Ref .1]

D. DISCUSSION ON FACTOR ANALYSIS

1. Relevance of Factor Analysis

The primary method employed in this thesis for identifying financial ratio dimensions or categories is through the use of factor analysis. Factor analysis is a

mathematical program that attempts to categorize the variations within a very large data set so that a smaller, more manageable representation of that data set can be identified. This type of mathematical reduction is possible because many variables have a tendency to measure similar, if not the same, factors. Thus, factor analysis provides an advantage because it can reduce a relatively large number of variables into only a few variables that are related by a common factor [Ref. 8]. In regards to this study, these common factors will equate to being the basic dimensions of financial condition.

The reduction of the number of variables is important to this study due to the large and complex data set afforded by each of the fifty company's financial statements. As was previously discussed, financial ratios tend to cover three major areas: risk , return, and structure. Within these areas there are countless ratios that provide variations on measures of financial performance. Factor analysis will group together variables that measure the same underlying construct, but it will also not group together variables that are dissimilar [Ref. 8]. In this manner, factor analysis provides a convenient method for classifying or grouping data around a common factor.

2. Theoretical Mathematical Assumptions Regarding Factor Analysis

Factor Analysis is based upon a mathematical program that uses matrix algebra to manipulate a data set in order to present statistical information in the most effective manner. There are several different types of factor analysis that are available for statistical use and all differ in the ways in which the program "rotates" data in matrix form.

During factor analysis, the original data set is placed in the form of a matrix described below:

$$Z = \begin{vmatrix} z_{11} & z_{12} & \cdots & z_{1N} \\ z_{21} & z_{22} & \cdots & z_{2N} \\ \vdots & \vdots & \vdots & \vdots \\ z_{n1} & z_{n2} & \cdots & z_{nN} \end{vmatrix}$$

Zij denotes the value of the j^{th} standardized variable of the i^{th} observation, n denotes the number of variables, and N is the number of observations. The term "standardized" refers to subtracting the mean from the variable's value and then dividing by its standard deviation [Ref. 8]. The correlation matrix R is computed as follows:

$$R = \frac{Z \times Z'}{N}$$

Z' is the transposition matrix of Z and N is the number of observations. The ultimate goal of factor analysis is to calculate factors that can be used to most accurately approximate R [Ref. 8].

Common Factor Analysis applies a linear transformation, or rotation, to the matrix data set, which results in a size reduction of the data set. The equation for the common factor model is:

$$Zj = a_{j1}F_1 + a_{j2}F_2 + \ldots + a_{jn}F_n + d_jU_j$$

Here *a* is the coefficient, *F* is referred to as a common factor, and *U* is called a unique factor [Ref 8]. Rotation of data refers to applying a nonsingular linear transformation, so

that all its coefficients are close to 0 or +/- 1 and the optimum number of common factors is computed. This rotation presents the data in a manner which makes interpretation of numerous data points easier for an analyst [Ref 8].

Factor Analysis ceases rotating the matrix when the level of variance explained by any new factor is less than the variance associated with an individual variable. The level of variance is determined by the eigenvalues associated with each factor. An eigenvalue is a measurement of the amount of variance for its associated factor in the data set. Eigenvalues greater than one mean a factor explains more variance than exists in any single variable [Ref.1].

E. SUMMARY

This chapter was intended to provide the reader with an understanding of the methodology employed in conducting the analysis on the financial ratios of defense industry firms. A Factor Analysis program was used in this study to provide the statistical analysis for determining the relevant dimensions, or factors, of financial condition of defense industry firms. This technique allows the researcher to reduce a large and complex data set, with numerous financial ratios, into a smaller more concentrated data set that is broken down by common factors. Chapter IV will provide the findings and results from the analysis performed on the defense industry financial information.

Rank	COMPANY	Prime Contract $thousands	Rank	COMPANY	Prime Contract $thousands
1	Lockheed Martin	11,998,430	26	BDM International	407,467
2	McDonnell Douglas	9,938,973	27	Olin Corp	398,459
3	General Motors	3,240,326	28	Unisys	381,588
4	Raytheon	3,011,905	29	Dyncorp	379,994
5	General Dynamics	2,670,030	30	Logicon	332,440
6	Northrop Grumman	2,604,705	31	Avondale Industries	328,065
7	United Technologies	2,257,695	32	Chrysler	300,080
8	Boeing	1,724,044	33	Motorola	290,091
9	Litton Industries	1,709,112	34	IBM	280,096
10	General Electric	1,530,029	35	Worldcorp	270,884
11	Westinghouse Electric	1,440,714	36	Harris Corp	268,894
12	Textron	1.193,762	37	Honeywell	263,609
13	Science Applications Intl	1,066,291	38	UNC Inc	252,317
14	TRW	786,749	39	Johnson Controls	245,390
15	Computer Sciences Corp	711,956	40	OHM	233,611
16	ITT Industries	670,969	41	Phillip Morris Inc	231,775
17	GTE	599,073	42	Gencorp	217,711
18	Tracor	580,599	43	Humana	188,183
19	Halliburton Energy Svcs	573,635	44	Oshkosh Truck	187,788
20	AT&T	529,037	45	Kaman	180,233
21	Texas Instruments	528,569	46	CSX Corp	158,872
22	Allied Signal	511,804	47	International Tech	144,574
23	Alliant Techsystems	456,551	48	Jacobs Engineering	139,721
24	Black & Decker	452,589	49	Sequa Corp	124,854
25	Exxon	446,735	50	Bergen Brunswig	124,412

Table 2: Defense Industry Firms

RATIO NOTATION	*RATIOS*
INCOME STATEMENT & CASHFLOW ITEMS CI = Income from Continuing Operations NI = Net Income CF = Cashflow from Operations GP = Gross Profit SA = Sales IE = Interest Expense BALANCE SHEET ITEMS CH = Cash and Marketable Securities AR = Accounts and Notes Receivable IN = Inventory QA = Quick Assets CA = Current Assets WC = Working Capital FA = Fixed (Noncurrent) Assets TA = Total Assets CL = Current Liabilities NL = Noncurrent Liabilities TL = Total Liabilities CP = Invested Capital SE = Stockholders Equity	**RETURN** CISE CITA CICP NISE NITA NICP CFSE CFTA CFCP *MARGIN* GPSA CISA NISA CFSA *TURNOVER* SASE SATA SACP SACH SAAR SAIN SAQA SACA SAFA **RISK** *SHORT TERM* *INTEREST COV* CHCL QACL CACL CHIE CFIE CFCL CICL SACL CIIE NIIE *LONG TERM* TLTA TASE NLCP NLFA CPFA CFTL CITL NITL CHTL **STRUCTURE** *ASSETS COMPOSITION* INCA WCIN QAIN ARIN CHTA QATA CATA WCTA *EQUITY COMPOSITION* CLTL CLSE

(Adopted from Ref 1)

Table 3: List of Financial Ratios

IV. ANALYSIS

A. OBJECTIVES

The primary objective of this chapter will be to present the results of the factor analysis and to answer the primary and secondary research questions. This chapter will begin by discussing several special procedures used to ensure that suitable financial data was used in the factor analysis program. This chapter will also include a detailed discussion explaining the expected outputs from the factor analysis procedure, which will include the factor loading pattern, variance values for each factor, and the final communality estimates. Finally, this chapter will discuss the results of the factor analysis procedure.

B. PROCEDURES

1. Data Input and Transformations

As was previously noted, financial information from fifty separate defense industry firms was used to calculate fifty-one different financial ratios. A complete listing of the firms and financial ratios can be found in Chapter III. Before the financial data could be used in the factor analysis program, several "cleaning" procedures had to be performed on the data to ensure that factor analysis calculations could be carried out.

a. Division by Zero in the Ratios

The first procedure performed on the financial data was to ensure that none of the financial ratio denominators were equal to zero, because dividing any number by zero is mathematically impossible. Additionally, the factor analysis program requires that all data inputs are real numbers. If a company has any ratio that is calculated to be zero, then the program "throws out" that company's ratio from the analysis, hence reducing the number of observations in the data set. Consequently, it is crucial that all ratios have appropriate values in order for the factor analysis program to run effectively with the chosen set of fifty companies.

Data taken from the financial statements indicated three groups of companies that possessed certain values in their financial statements which would lead to division by zero. The first company was Lockheed Martin. Lockheed Martin possessed a zero value for its cash and marketable securities variable, which would result in the SACH ratio being eliminated. The second group of companies all reported zero interest expense in their financial statements, therefore, it was impossible to calculate the CHIE, CFIE, CIIE, and NIIE ratios. This group was comprised of General Dynamics, Allied Signal, and Logicon. The third group was comprised of Westinghouse Electric, Computer Sciences Corp, AT&T, BDM International, Worldcorp, CSX Corp, International Tech, Jacobs Engineering, and Humana. All these companies possessed financial statements that reflected a value of zero for inventory, which made it impossible to calculate the SAIN, WCIN, QAIN, and ARIN ratios.

b. Solving Division by Zero

Solving the division by zero problems for each of the three different groups of companies was handled in a similar manner. In the case of Lockheed Martin, its cash and marketable securities value for 1997 was reported in the financial statements to be zero. While mathematically the value for the SACH ratio is undefined when CH (cash) is zero, conceptually it can be argued that the value for the SACH ratio should actually be very high. The SACH ratio indicates the relationship of sales to the current assets of cash and marketable securities. Since Lockheed had significant sales coupled with essentially zero cash it can be interpreted that Lockheed had the highest degree of sales to cash/marketable securities out of all the companies in the sample. Therefore, Lockheed Martin was arbitrarily assigned the highest SACH ratio value of all the companies in the sample. This was accomplished by ranking all other firms in terms of SACH and identifying the highest value. Before adjusting the value for Lockheed, Tracor had the highest SACH value, at 7533.33. Consequently, Lockheed was assigned a higher value of 8000. This value made Lockheed's SACH ratio the highest value and, more importantly, the highest ranked ratio of all companies in the data set. This ranking is important because ratio ranks rather than actual ratio values were ultimately used in the factor analysis. This will be discussed in a later section.

In the case of the second group of companies (General Dynamics, Logicon, and Allied Signal), all their financial statements indicated that interest expense was zero. This value would make it impossible to calculate the four ratios noted

previously. The same method was applied to address this problem that was used in Lockheed Martin's case. The highest actual value in the sample for each ratio with interest expense in the denominator (CHIE, CFIE, CIIE, NIIE) was identified. Next the three firms were assigned a ratio value just marginally higher. The affect of this is that the three firms were ranked highest in the sample on these four ratios.

The same procedure was applied to the last group of companies, which possessed financial statements that indicated a value of zero for inventory. Values for SAIN, WCIN, QAIN, and ARIN were assigned such that the firms that had zero inventory were assigned the highest values for the ratios.

c. Ratios with Negative Stockholders Equity

A negative value for stockholder's equity results in several ratios being uninterpretable. Stockholder's equity is used to calculate several financial ratios, which include CISE, NISE, CFSE, SASE, and CLSE. Using a negative value for stockholder's equity in any one of these ratios would render a result that would not make any sense. For example, a negative value for SE would make the SASE ratio negative, implying that a firm had a negative "turnover" on equity. This is not meaningful. There were two companies which reported negative stockholder's equity on their financial statements; Worldcorp and Dynacorp. To solve this problem, these two companies were assigned a value of zero for their stockholder's equity. A zero value in the denominator makes each of the four ratios undefined mathematically, and the practical effect is that the SE ratios

are dropped from the analysis. Consequently, the factor analysis program eliminates these four ratio values for Worldcorp and Dynacorp. The total number of observations for each of these ratios dropped from fifty down to forty-eight.

d. Non Normal, Skewed Ratio Distributions

There were numerous ratio distributions that were not normal and highly skewed. These types of distributions are commonly caused by small values for a ratio's denominator, with extremely high values for the ratio. Extreme outlier values for ratios can significantly influence the end result of the analysis. In order to prevent these types of extreme values from driving the results, a two-step process was used to adjust the data. The first step was to rank the ratio values ordinally. This was accomplished using the RANK procedure in reference 10. The next step was to normalize the ratio values to ensure that each ratio had a normal distribution. This two-step process resulted in values for all ratio variables being normally distributed. The practical impact of these transformations was to reduce the impact of extreme ratio values on the results, while still retaining these observations in the sample. [Ref 1.]

C. FACTOR ANALYSIS STRUCTURE

Factor analysis is the primary statistical method employed to determine the basic dimensions of financial condition within this sample of defense industry firms. Factor analysis determines a common smaller set of similar variables from the overall larger set

of variables. Similar variables are variables that measure or reflect the same end item, and factor analysis groups similar variables along a common factor. If variables are not similar and measure two different items, then they are grouped or associated with different factors. This method of grouping similar variables is beneficial because it can reduce a large set of seemingly unrelated variables and group them along a set of factors into a smaller, more manageable subset. Therefore, the first important output from the factor analysis are the factors, which can be defined as the basic dimensions inherent in the original set of variables.[Ref 1.]

There are other important outputs from the factor analysis program that are relevant to this study. Factor analysis produces eigenvalues that are associated with each factor. Eigenvalues are measurements of the amount of variance in the set of related financial ratios that can be explained by a particular factor. If a factor has an eigenvalue that is greater than one, then that factor is said to explain more variance than exists in any single variable. Another important output from the factor analysis procedure is the factor loading. A factor loading represents the correlation between an individual ratio and its related factor. These loadings display which ratios are most highly correlated with each respective factor or dimension. A third statistic associated with the factor analysis is a Communality Estimate. Communality reflects the degree (0 to 100%) to which variance in an individual variable is explained by the set of identified factors. A high degree of communality indicates that the variable's information is accurately reflected by the set of determined factors. [Ref 1.]

D. ANALYSIS RESULTS

Factor analysis yielded four important statistical outputs that are relevant to this study. These outputs are common factors or dimensions, eigenvalues, factor loadings, and communality. All four of these outputs will be instrumental in answering the research questions proposed in this study.

1. Primary Dimensions of Financial Condition

Factor analysis was conducted on the full sample of fifty defense industry firms. Table 4 displays the results of the factor analysis. Across the top of Table 4 there are nine distinct factors (FA1,...FA9) which were identified in the analysis. These factors are sorted in order from highest to lowest eigenvalue. Eigenvalues display the amount of variance that is explained by a particular factor, and each eigenvalue is listed at the bottom of the table. The values comprising the columns under each factor in Table 4 are the factor loadings. Factor loadings represent the correlations that exist between the factor and each one of the fifty-one financial ratios. The factor loadings have all been multiplied by one-hundred for mathematical simplification. The SAS factor analysis program denotes loadings reflecting a correlation value in excess of .324886. with an asterisk (*).

Table 4 simply displays the factor patterns. It is the researcher's task to specify what each factor conceptually represents. The approach used was to view the ratios which have high loadings on a factor and identify what conceptual similarity exists among those factors.

Factor 1 is most heavily loaded with the first nineteen ratios. These ratios primarily measure Income from Continuing Operations (CI) and Net Income (NI), which are both measures of income or profitability. Therefore, Profitability is the dimension reflected in this factor.

Factor 2 is loaded with a set of ratios that reflect a relationship between Liquidity and Assets. The seven highest loading ratios compare some measure of current assets (CA, QA, AR, or WC) with some other balance sheet component. These ratios are all sensitive to the firm's investments in liquid current assets, and thus conceptually reflect the dimension of Liquidity.

Factor 3 is loaded with ratios that generally describe a dimension regarding sales. All seven of the most significant loaded ratios have Sales in their numerator. Sales are related to either assets (SATA, SACA, SAFA, SAQA) or investments (SACP, SASE). All of these ratios are sensitive to the degree to which the firm generates sales on its investments, which describes the dimension of Turnover.

Factor 4 contained five ratios that all included the asset Cash in either the numerator or denominator (CHTA, CHCL, CHTL, CHIE, SACH). All of these ratios are sensitive to the amount of cash held by a firm. This suggests that these ratios all reflect the dimension of Cash Position.

Factor 5 is composed of several ratios (CLSE, TASE, CFSE, TLTA) that are sensitive to the amount of a firm's stockholder's equity. These ratios reflect the amount

of stockholder's equity relative to assets or liabilities and thus conceptually reflect Leverage.

Factor 6 is composed of five ratios that have inventory in either the numerator or the denominator (QAIN, SAIN, ARIN, WCIN, INCA). This factor describes the dimension of Inventory.

Three ratios NLCP, NLFA, and CLTL load most heavily on factor 7. Each is sensitive to the amount of noncurrent liabilities for a firm , or the firm's debt structure. For this reason these ratios seem to reflect the dimension of Debt.

Factor 8 has a single ratio that loads significantly, GPSA. This ratio is indicative of the existence of Gross Profit as a separate dimension of financial condition.

Factor 9 loads most heavily with four ratios, CFCP, CFTA, CFTL, and CFCL. All of these ratios have cash flow in the numerator, which indicates the presence of financial dimension reflecting Cash Flow.

Table 5 displays the communality values for all fifty-one financial ratios. As noted previously, communality is a measurement of the proportion of each ratio's variance that can be explained by all nine factors. The majority of communality values exceed 90 percent and all exceed 80 percent, which is indicative that the nine factors explain a large degree of the variance in all fifty-one ratios. In total, the communality values add up to 48.42, which indicates that all nine factors can explain 94.9% (48.42/51) of the variance in the ratios. The implication is that the nine dimensions provide a

reasonably complete representation of the information contained in all fifty-one ratios. [Ref.1]

2. Ratios Representative of the Dimensions of Financial Condition

Table 4 represents a listing of all the financial ratios and how they loaded with each of the nine dimensions of financial condition. Table 6 displays the ratios judged to be most representative of the dimensions of financial condition. There were three criteria used to determine the single most representative financial ratio for each dimension. (1) The ratio had a high loading value, (2) the ratios were all common/familiar ratios, and (3) the ratios were concurrent with representative ratios identified in previous studies.

3. Correlation Analysis with Moses' Study

A correlation analysis was used to make a comparison between the dimensions in this study and the study conducted by Moses in 1995. This was accomplished by correlating this study's factor loading values for each dimension against the values found in Moses' study. Table 7 displays the correlation values between the two studies for each factor. In Table 7, this study's factors are listed horizontally across the top, and Moses' factors are listed vertically down the side of the table. The most correlated factors have shaded values. In addition to the eight factors identified in Moses' study, there is an additional factor, Gross Profit. Gross Profit would have been listed in Moses' study if factor analysis had been permitted to extract additional factors [Ref 1].

The correlation values range from a high value of .87658 for Debt to low value of .58617 for Leverage. The profitability factors between both studies correlated with a value of .85116. This study's second factor was determined to be Liquidity, which correlated at .63560 with Moses' factor called Asset Composition. Both these factors compare the firm's investment in current assets with some other balance sheet component, such as current liabilities. The third factor, Turnover, correlates at a value of .71156 with Moses' turnover factor. The fourth factor, Cash Position, also correlates well with Moses' cash position factor with a value of -.72362. The fifth factor, Leverage, reflects a relationship between stockholder's equity relative to assets or liabilities. This factor correlates highest with Moses' asset composition factor, with a value of .58617. The next highest correlating factor with Moses' study is leverage with a value of .45262. Both studies' inventory factors correlate at .61763. The seventh factor in this study, Debt, correlates the highest with Moses' leverage factor at a value of .87658. The eighth factor, Gross Profit, correlates with Moses' gross profit factor with a significant value of .8493. The ninth factor, Cash Flow, correlates with Moses' cash flow factor at .79469. The relatively high correlation values suggest that the dimensions noted between the two studies are very similar in structure and are important measurements of financial condition.

E. CONCLUSIONS

The factor analysis procedure results indicated that there were nine primary dimensions of financial condition within the sample of defense industry firms. The high communality values were indicative that the nine factors are a good representation of the total variance contained in the data set. These results are consistent with results tabulated from previous studies, with a few exceptions. A comparison of these results and the results from Moses' study will be further addressed in detail in Chapter V.

RATIO	FA1	FA2	FA3	FA4	FA5	FA6	FA7	FA8	FA9
CITA	95*	5	14	5	0	-9	-5	3	-8
CICP	95*	7	15	4	-1	-9	-5	3	-11
NITA	95*	6	-2	6	-14	-4	-2	-2	-3
NICP	94*	7	-1	5	-14	-4	-3	-2	-6
CITL	93*	12	16	8	-14	-5	-13	4	-6
CICL	92*	1	9	0	-14	-1	18	12	-3
NITL	92*	13	3	8	-26	0	-11	-1	-4
CFCP	89*	-5	7	-1	0	3	-8	15	39*
NIIE	87*	0	1	15	-9	13	-25	-23	-10
CIIE	87*	2	9	15	0	11	-26	-18	-11
CFTA	87*	-7	7	1	2	3	-8	16	42*
CFTL	86*	7	5	6	-16	4	-18	11	39*
CFCL	83*	-12	-6	-5	-21	5	26	13	37*
CFIE	80*	-6	9	20	0	16	-34*	-20	17
NISE	78*	-13	-14	-6	41*	-11	26	2	-7
CISA	78*	-12	-37*	-7	23	-10	11	21	-13
CISE	77*	-14	-4	-10	48*	-14	24	6	-11
NISA	71*	-13	-56*	-13	-4	-1	17	5	-11
CFSA	62*	-23	-60*	-9	18	-1	16	17	23
WCTA	6	86*	15	20	-38*	8	7	-7	-5
CATA	2	85*	31	26	0	0	-30	-4	-6
CACL	1	84*	11	14	-47*	3	12	-6	-1
CPFA	0	83*	32	29	5	1	-26	-5	-4
QACL	0	76*	5	11	-37*	45*	-7	-7	-4
QATA	-3	76*	25	19	3	43*	-32	4	-4
SAAR	-2	-72*	20	28	5	-27	-8	-4	-32
SATA	10	27	89*	12	-6	7	-30	-2	-1
SACP	10	28	89*	12	-7	8	-30	-2	-2
SASE	-9	3	76*	-2	60*	-4	5	-6	3
SAFA	4	53*	74*	20	-7	7	-31	-5	-3
SACA	18	-53*	73*	-14	1	25	10	-5	7
SACL	17	27	73*	6	-51*	23	11	-5	-4
SAQA	17	-56*	64*	-14	5	-39*	14	-6	7
CHTA	0	15	13	97*	-6	3	-10	-1	-1
CHCL	7	16	8	96*	-16	5	0	2	2
CHTL	7	21	12	93*	-19	2	-18	0	1
CHIE	28	10	13	84*	-15	6	-26	-16	-1
SACH	3	-6	18	-97*	-1	-1	-1	-11	3
CLSE	-21	-17	8	-9	92*	-18	-9	6	-6
TASE	-20	-25	-10	-23	80*	-14	38*	6	-5

Table 4: Factor Loading Pattern

RATIO	FA1	FA2	FA3	FA4	FA5	FA6	FA7	FA8	FA9
TLTA	-19	-28	-10	-23	80*	-14	36*	9	1
CFSE	57*	-28	-8	-17	60*	-9	20	12	29
QAIN	-6	16	-5	5	-7	97*	-10	-4	-1
SAIN	0	-8	19	6	-7	96*	-5	-1	0
ARIN	0	25	11	-8	-13	91*	3	-6	10
WCIN	3	46*	18	16	-41*	57*	9	-29	-11
INCA	7	-14	6	-3	10	-96*	8	6	2
NLCP	-13	-32	-31	-26	29	-9	77*	8	5
NLFA	-14	25	-1	-7	46*	-12	76*	4	-11
CLTL	8	29	34*	24	5	2	-84*	-3	-6
GPSA	21	-10	-16	4	17	-20	10	86*	-5

FA1 = PROFITABILITY FA2 = LIQUIDITY FA3 = TURNOVER
FA4 = CASH POSITION FA5 = LEVERAGE FA6 = INVENTORY
FA7 = DEBT FA8 = GROSS PROFIT FA9 = CASH FLOW

Variance Explained by Each Factor

FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5
14.722313	6.759045	5.888158	5.267957	4.971636

FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9
4.970837	3.551501	1.243687	1.072602

Table 4: Factor Loading Pattern (Continued)

CISE	NISE	CFSE	CITA	NITA	CFTA	CICP	NICP
.943259	.895650	.958623	.953262	.931393	976635	955078	925474
CFCP	GPSA	NISA	CISA	CFSA	SASE	SACH	SAQA
.976117	.906890	.897455	.892636	.947178	.961229	.981668	.956652
SATA	SAAR	SACA	SACP	SAIN	SAFA	CFCL	CHCL
.984425	.820849	.961994	.982633	.969471	.969795	.972746	.983634
QACL	CICL	CACL	SACL	TLTA	NLFA	CITL	TASE
.952648	.928568	.968762	.960932	.963386	.898873	.952990	.970089
CPFA	NITL	NLCP	CFTL	CHTL	CHIE	CIIE	CFIE
.950491	.951950	.966961	.974342	.990592	.926723	.910888	.907317
NIIE	INCA	ARIN	CATA	WCIN	CHTA	WCTA	QAIN
.927595	.980024	.948865	.986221	.860171	.986140	.972614	.982630
QATA	CLTL	CLSE					
.961200	.972479	.989542					

Table 5: Final Communality Estimates

FACTOR	*DIMENSION*	*RATIO*	*COMMON NAME*
1	Profitability	NICP	Return on Capital
2	Liquidity	CACL	Current ratio
3	Turnover	SACP	Capital Turnover
4	Cash Position	CHTA	Cash to Total Assets
5	Leverage	CLSE	Current Liabilities to SE
6	Inventory	INCA	Inventory to Current Assets
7	Debt	NLCP	Long-Term Debt Ratio
8	Gross Profit	GPSA	Gross Profit to Sales
9	Cash Flow	CFTA	CashFlow to Total Assets

Table 6: Ratios Representative of Dimensions of Financial Condition

	Profit	Liquidity	Turnover	Cash Position	Leverage	Inventory	Debt	Gross Profit	Cash Flow
Profit	.8511	-0.1784	-0.2199	-0.1295	-0.1778	-0.2464	-0.2125	-0.0420	-0.2031
Liquidity	.4106	.4933	-0.4810	-0.0541	-0.0027	-0.5197	-0.0236	-0.1722	-0.0191
Cash Flow	.5155	-0.2950	-0.1992	.0114	-0.3245	.0129	-0.0507	.1826	.7946
Turnover	-0.011	.2250	.7115	.4536	-0.2770	-0.2915	-0.2528	-0.2870	.0113
Cash Position	.2851	.3760	-0.1267	-0.7236	-0.2669	.4116	-0.2841	-0.0852	-0.0535
Asset Comp	-0.058	.6356	.0105	-0.1742	.5861	.0461	-0.3717	-0.2087	-0.2784
Leverage	-0.6523	-0.3265	-0.1143	.1256	.4526	.2544	.8765	.1441	-0.0137
Inventory	.0045	.3040	-0.5197	.3930	-0.2355	.6176	-0.0847	-0.0532	.0168
Gross Profit	-0.013	-0.1729	-0.2437	-0.1499	.2221	.0180	.2082	.8493	.1143

Table 7: Correlation Analysis with Moses' Study

V. CONCLUSIONS

A. OBJECTIVES

The primary objective of this chapter is to provide a summary of the results obtained from the research. In summarizing the results, both the primary and secondary research questions will be answered in detail.

B. FINDINGS OF ANALYSIS

1. Dimensions of Financial Condition within Defense Industry Firms

The factor analysis procedure was instrumental in reducing the number of original ratios, fifty-one, down to a representative group of nine factors. The results of the analysis revealed that there are nine separate dimensions, which account for roughly 95% of the total variance that existed in the original set of fifty-one ratios. The nine primary dimensions of financial condition are as follows: (1) profitability, (2) liquidity, (3) turnover, (4) cash position, (5) leverage, (6) inventory, (7) debt, (8) gross profit, (9) cash flow.

2. Representative Ratios of the Dimensions of Financial Condition

Table 4 provided a summary of the strength of every ratio's correlation with each particular dimension of financial condition. Table 8 provides a list of the most representative ratio for each dimension, using the criteria established in Chapter IV.

FACTOR	DIMENSION	RATIO
1	Profitability	NICP
2	Liquidity	CACL
3	Turnover	SACP
4	Cash Position	CHTA
5	Leverage	CLSE
6	Turnover	INCA
7	Debt	NLCP
8	Gross Profit	GPSA
9	Cash Flow	CFTA

Table 8: Representative Ratios for Each Factor

3. Comparison of Results to Moses' Study

a. Similarities

Moses' study concluded that there were eight basic dimensions of financial condition for defense industry firms. Of the eight dimensions that were noted, six are substantially the same dimensions that were noted in the results of this study. The six dimensions that are substantially the same between the two studies are: (1) profitability, (2) turnover, (3) cash position, (4) cash flow, (5) inventory, and (6) leverage. Additionally, both these groups of dimensions had relatively the same financial ratio loading patterns and values.

b. Differences

The primary difference between the two studies is the number of dimensions discovered. As was previously noted, Moses' study noted eight dimensions of financial condition, which included: (1) Profitability, (2) Liquidity, (3) Cash Flow, (4) Turnover, (5) Cash Position, (6) Asset Composition, (7) Leverage, and (8) Inventory. The results from this study indicate that there is a ninth factor, reflecting a dimension of gross profit, as well. It should be noted that Moses' study did identify the dimension of gross profit when the factor analysis was not limited in the number of extractable factors. In his study, the gross profit factor had an eigenvalue that was slightly less than one. This was indicative that the variance explained by the gross profit factor was less than the variance within a single individual variable. Hence, the gross profit factor in Moses' study was not included as a significant dimension of financial condition.

Another difference between the two studies is composition of the dimensions of financial condition. This study identified a dimension designated as debt, which correlated highly with Moses' leverage factor at a value of .8765. This correlation shows that these two factors are essentially the same and differ only in their names. In addition to debt, this study identified two factors, liquidity and leverage, which are not strongly and unambiguously identifiable with a factor in Moses' study. This study's liquidity and leverage factors are associated with Moses' asset composition factor by the somewhat weak correlations of .6356 and .5861 respectively. Also, this study's liquidity factor is weakly associated with Moses' liquidity factor at a value of .4933.

c. Reasons for the Differences between the Studies

This thesis used financial data for fifty of the top one hundred defense firms that were noted in reference 7. The financial data for each company was extracted from a single year's financial statements, either 1996 or 1997, in order to compute the necessary financial ratios. The primary motivation for using these years' financial data was that they would be reflective of the changes that have occurred in the defense industry due to mergers, acquisitions, and bankruptcies during the early to mid 1990s.

On the other hand, Moses' study focused on an entirely different period of observations. Moses' study focused on a ten year period from 1983 through 1992. Additionally, the firms used in Moses' study were not identical to those used in this study. The primary reason for this, as previously mentioned, is that numerous mergers, acquisitions, and bankruptcies have changed the composition of companies comprising the defense industry.

Finally, not only were different firms used in the two studies, but also the composition of firms used was different. In both studies, companies were grouped into the same three categories that reflected the type of end product provided to the military. The three separate categories were platforms, parts/components, and others. The first two categories are self-explanatory, while the third, others, refers to services provided by the companies in areas such as medical, engineering, or transportation. In Moses' study, the platforms subgroup was produced by thirteen companies, the parts/components subgroup was produced by seventeen companies, and others subgroup was produced by eighteen

companies. This study used seventeen companies for the platform subgroup, eighteen companies for the parts/components subgroup, and fifteen companies for the others subgroup.

C. CONCLUSIONS

The results of this study indicate that a number of dimensions of financial condition are prevalent within the defense industry. This implies that many ratios that are used for defense industry financial analysis are relatively similar measurements. This study indicated that financial ratios for defense industry firms tend to be grouped along a framework of nine separate dimensions. Future defense industry analysis could focus on a subset of ratios that are reflective of these dimensions. Such a subset of ratios would then be both comprehensive and sufficient in indicating factors of financial condition within defense industry firms.

LIST OF REFERENCES

1. Moses, O. Douglas R.M., Basic Dimensions of Financial Condition within the Defense Industry, Technical Report, Naval Post Graduate School, Monterey , CA, November 1995.

2. Pinches, G., A. Eurbank, K. Mingo, and J. Caruthers, "The Hierarchical Classification of Financial ratios," Journal of Business Research, October 1975, pp. 295-310.

3. "Aerospace and Defense," Standard & Poor's Industrial Surveys, January 29, 1998.

4. Katz, Robert, "Primary Dimensions of Change in the Financial Conditions of Defense Industry Firms," unpublished Masters Thesis, Naval Postgraduate School, Monterey, CA, June 1995.

5. Pinches, G., K. Mingo, and J. Caruthers, "The Stability of Financial Patterns in Industrial Organizations," The Journal of Finance, 1973, pp.389-395.

6. Chen, K. and T. Shimerda, "An Empirical Analysis of Useful Financial Ratios," Financial Management, Spring1981, pp.51-60.

7. Defense 97 Almanac, DoD, U.S. Government Printing Office, Washington, D.C., 1997.

8. Ketz, Edward J., Rajib K. Doogar and David E. Jensen, A Cross-Industry Analysis of Financial Ratios, Quorum Books, 1990.

9. Moody's Company Data. [CD-ROM]. Moody's Industrial Manuals. 1998.

10. SAS/STAT User's Guide, Version 6, Fourth Edition, Vol 1, SAS Institute, North Carolina, 1998.

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