Competitive edge manufacturing : incorporation of Sun Tzus The Art of War
by Qian Song

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Industrial and Management Engineering
Montana State University
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Abstract:
Although Sun Tzu's The Art of War has been successfully applied to military campaigns and marketing, there have been few attempts to apply it to manufacturing to assist business decision making. This research explores the possibilities of incorporating The Art of War to assist manufacturing executives in competitive edge decisions.

In this research, the difference between business competition and war is carefully compared. War guidelines from The Art of War, which can be applied to manufacturing decision-making, are transformed into seventeen applicable guidelines. These guidelines are structured as an IDEFO process, so that when combined with specific manufacturing techniques, are ready for application. An example is given to describe how to combine Analytic Hierarchy Process with the transformed guidelines to assist manufacturers in decision-making.

The following are major results of this research: 1. Based on ideas of The Art of War and the evolution of post-war manufacturing, it is concluded that the competitive edge is a moving target for all manufacturing companies.

2. With counter example method, and the manufacturing examples, it is concluded that the current successful manufacturing formats, like LEAN, JIT, Gradual Improvement, are not panaceas for competitive-edge manufacturing. Therefore, every business should strive to attain the competitive edge by shaping a format to its unique situation.

3. Real manufacturing companies that apply The Art of War in their decision processes are successful. Also, typical manufacturing examples are summarized to support and exemplify the essence of the book. With scientific method of knowledge acquisition, it is concluded that Sun Tzu's transformed guidelines are a useful aid for their strategic-decision making.

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May 1998

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APPROVAL

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Qian Song

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

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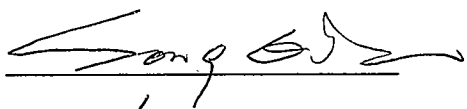
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ACKNOWLEDGEMENTS

The author gratefully acknowledges the support and the helpful suggestions of my graduate committee, Dr. Joel Troxler, Dr. Donald Boyd and Dr. Robert Marley, of the Department of Mechanical and Industrial Engineering, Montana State University-Bozeman.

Sincere appreciation is likewise expressed to my family and my friends for their support during the entire research process.

TABLE OF CONTENTS

CHAPTER Page

1. INTRODUCTION 1
   - Background 1
     - Following the Examples of Successful Companies and Being Aware of the Trends 1
     - Applying Practical Suggestions 3
     - Quantitative Decision Support Tools 4
   - Objectives 5

2. REVIEW OF HISTORICAL LITERATURE 7
   - Sun Tzu and His Influence 7
   - Introduction to The Art of War 9
   - Biography of Sun Tzu 10

3. SIGNIFICANCE 13

4. PREPARATION FOR THE INCORPORATION OF THE ART OF WAR 15
   - Selection of the Appropriate Translation 15
   - Comparison of Business Competition and War 21
     - The Dictionary Definitions of "War" and "Competition" .. 21
     - The Major Feature of War and Competition Are Summarized as 23
     - David T. Geaslin, An American Veteran, Summarizes 23
   - Guidelines Selected for Possible Application 24
     - Guidelines 24
   - Transformation of the Guidelines 27
     - Transformed Guidelines 27

5. THE MOVEMENT OF COMPETITIVE EDGE IN MANUFACTURING 30
   - Cutting Edge Variation 30
     - The Major Cutting Edge Changes with the Stages of the Product Life Cycle 30
   - Competitive Edge Is A Constantly Moving Target 31

There Is No Panacea for Manufacturing Companies 35
Japanese Method Is Not A Panacea 35
Big Leap instead of Gradual Improvement 37
Flexible without the FMS System 38
UPS (Uninterrupted Power Supply) Manufacturer Does Not Choose LEAN or JIT 38
Combination of JIT and Forecasting Production 40

6. CATCH THE COMPETITIVE EDGE WITH THE AID OF THE ART OF WAR 41
Methods by Which Guidelines from The Art of War Serve as A Decision-Support Tool 41
Exemplify the Application of the Art of War Guidelines 45
The Complete Victory 45
Tactical Dispositions 48
Gain Victory without Delays 51
Win with Clever Competition 56
Turn the Devious into Direct 59
Commands of the Sovereign 60
Attack the Weakness 63
Manufacturing Businesses that Applied The Art of War 65

7. ORGANIZED GUIDELINES FOR DECISION MAKING 67
Brief Introduction for IDEF0 67
Application of IDEF0 to the Transformed Guidelines 68

8. THE COMBINATION OF TRANSFORMED GUIDELINES WITH THE AHP DECISION SUPPORT SYSTEM 75
Concept of the Decision Support System 75
Expert Choice — A Typical DSS 76
Use ECPro to Incorporate Transformed Guidelines 79

9. CONCLUSIONS AND LIMITATIONS OF THE STUDY 83
Conclusions 83
Limitations of the Study 84

REFERENCES 85

LIST OF TABLES

Table Page

1. Comparison of Competition and War 23

LIST OF FIGURES

Figure Page

1. Product Life Cycle and the Relative Competitive Edge Desired 31
2. Method of Analysis Used on Examples in This Paper 43
3. Incorporation of the Guidelines 44
4. Similarity between Guidelines 44
5. The Research Process in Chapter 6 66
6. The Art of War as A Decision Support Process 68
7. Structured Contents of The Art of War 69
8. The Sub-processes of A0 71
9. Decision Structure for Strategic Planning, A0-1 73
10. Competition Tactics Selection, A0-2 74
11. Hierarchical Structure for Business Executive Selection 80
12: Hierarchical Structure with Two Candidates 81

ABSTRACT

Although Sun Tzu's The Art of War has been successfully applied to military campaigns and marketing, there have been few attempts to apply it to manufacturing to assist business decision making. This research explores the possibilities of incorporating The Art of War to assist manufacturing executives in competitive edge decisions.

In this research, the difference between business competition and war is carefully compared. War guidelines from The Art of War, which can be applied to manufacturing decision-making, are transformed into seventeen applicable guidelines. These guidelines are structured as an IDEF0 process, so that when combined with specific manufacturing techniques, are ready for application. An example is given to describe how to combine Analytic Hierarchy Process with the transformed guidelines to assist manufacturers in decision-making.

The following are major results of this research:

1. Based on ideas of The Art of War and the evolution of post-war manufacturing, it is concluded that the competitive edge is a moving target for all manufacturing companies.
2. With counter example method, and the manufacturing examples, it is concluded that the current successful manufacturing formats, like LEAN, JIT, Gradual Improvement, are not panaceas for competitive-edge manufacturing. Therefore, every business should strive to attain the competitive edge by shaping a format to its unique situation.
3. Real manufacturing companies that apply The Art of War in their decision processes are successful. Also, typical manufacturing examples are summarized to support and exemplify the essence of the book. With scientific method of knowledge acquisition, it is concluded that Sun Tzu's transformed guidelines are a useful aid for their strategic-decision making.

CHAPTER 1

INTRODUCTION

Background

In order to survive in today's competitive world, manufacturing businesses must frequently make changes in business and production methods. For many manufacturers, one of the most difficult tasks is maintaining a competitive edge. Basically, there are several important resources that can aid these companies in their decision-making to increase the competitiveness:

Following the Examples of Successful Companies and Being Aware of the Trends

In industry, new concepts, like Just-in-Time (JIT) manufacturing and Lean Production (LEAN), have been successfully applied, such as JIT in Toyota [1] and Lean Production in Chrysler [2]. Serope Kalpakjian [3] summarizes JIT manufacturing as:

> The purchase of supplies just in time to be used;
>
> The production of parts just in time to be made to sub-assemblies;
>
> The production of sub-assemblies just in time to be assembled into finished products;
>
> The production and delivery of finished products just in time to be sold.

The major advantages of JIT are low inventory carrying costs and the quick detecting of defects. Faizul Huq [4] simulates a JIT Kanban manufacturing process with short-term demand variation. He concludes that 2 WIPs (Work-in-Process) are the best choice for a company in such a situation.

Paul Kidd [5] delineates LEAN as:

> The ability to manufacture products with less of everything — less time to design, less inventory, fewer defects, etc.

Chester Richards [6] describes the following manufacturing trends:

> FLEXIBILITY: The ability to produce different products on the same production line.
>
> VIRTUAL COMPANY: A true company in that it carries out all the functions necessary to exploit a particular set of business opportunities. It is virtual in the sense that, such functions as marketing, design, manufacturing, legal, accounting, etc., are carried out by legally distinct units that have come together just for this opportunity, and will probably go their separate ways once it is over.
>
> GRADUAL IMPROVEMENT: A principle that the manufacturing processes and products must evolve by gradual improvement rather than radical changes.
>
> RE-ENGINEERING: A technique for improving the overall health of a system. It not only eliminates unnecessary activities from the current system, but also attacks and simplifies the company's underlying structure.
>
> AGILITY: The ability of an enterprise to thrive in a competitive environment of continuous and unanticipated change, to respond quickly to rapidly changing markets driven by customer valuation of products and services.

Chester also points out some relationships between these concepts. For example, agility might be the ability to switch rapidly among the various products of a flexible manufacturing system. Also, agility is one of the primary ways to measure a re-engineering technique. Chester understands that the virtual concept is not a panacea for manufacturers. Also, other literature summaries point out that manufacturing should be market-oriented and apply TQM (Total Quality Management) [7][8].

For many manufacturers, however, the question of whether the successful formats, like JIT manufacturing and Lean Production, could be a cure-all to fix manufacturing shortcomings remains a problem.

Applying Practical Suggestions

These suggestions come from business experience and studying of successful cases. Although these suggestions are everywhere, when decision-makers in manufacturing businesses must make critical decisions, they often feel that these suggestions are far from adequate in both quality and quantity.

Suggestions For Future Manufacturing Businesses

Nanua Singh [9] points out that successful manufacturing businesses must exhibit some or all of the following characteristics:

- Greater product customization
- Advanced interenterprise networking technology
- Rapid introduction of new or modified products
- Upgradable products
- Increased emphasis on knowledgeable, highly trained, empowered workers

- Interactive customer relationships
- Dynamic reconfiguration of production processes
- Greater use of flexible production technologies
- Rapid prototyping
- An open system information environment
- Innovative and flexible management structures
- Product pricing based on value to the customer
- Commitment to environmentally benign operations and product designs

Suggestions For Managers Of Manufacturing Enterprises

According to Nanua Singh [9], Goldman and Preiss suggest that managers have to unlearn many of the currently held truths, including:

- Cooperation is less desirable than succeeding on one's own
- Standards are constraining and their formulation dull work
- Labor — management relations must be adversarial
- Breakthroughs are the only targets worth aiming at
- Information is power and can be shared only to one's detriment

Quantitative Decision Support Tools

Quantitative decision support tools have been widely used, such as:

PROBABILITY AND STATISTICS: Useful tools for problems such as deciding insurance rates, risk analysis, etc. But this method usually needs a great deal of real or experimental data.

LINEAR PROGRAMMING: Helpful for problems concerning resource allocation, transportation plans, etc. However, it requires that problems be formulated as a linear model [10].

ANALYTICAL HIERARCHY PROCESS (AHP) [11][12]: Developed by Thomas Saaty. Its strength lies in its ability to support decision-making by structuring complex, multi-attribute problems hierarchically, including intangible factors. AHP is good at justifying multiple choices. Also, it provides a unique means of quantifying judgmental consistency. However, the method does not consider interactive effects among major influencing factors.

As all the major resources listed have capability limitations in assisting manufacturing company in decision-making, other feasible sources are consistently and aggressively sought by scholars and manufacturers. In this research, a book rarely noticed by manufacturers, guidelines from Sun Tzu's The Art of War are introduced as an aid for manufacturing companies to make decisions. Unique ideas are presented that outdistance the suggestions of Nanua Singh, Goldman and Preiss.

Objectives

The questions to be addressed by this research are:

1. The characteristic of the competitive edge, i.e., is it stable or moving?
2. Do successful manufacturing structures such as LEAN, JIT, and Gradual Improvement guarantee the cutting edge for manufacturing businesses?
3. Is it possible for manufacturers to apply the principles of Sun Tzu's The Art of War in their decision-making? This research explores the possibilities of using Sun Tzu's

guidelines in manufacturing business operations so that modern manufacturing may benefit from this profound ancient heritage.

CHAPTER 2

REVIEW OF HISTORICAL LITERATURE

Sun Tzu and His Influence

In the closing years of the sixth century B.C., Sun Tzu presented his The Art of War to He-lu, King of Wu, and was eventually made a general. In Sun Tzu's time, ancient China evolved from about one hundred independent states into "The Big Seven" states. Wu was a medium-sized state surrounded by larger states. Sun Tzu defeated the stronger state of Chiu to the west and entered its capital. To the north he intimidated Chi and Chin. To the south he defeated Yue. To the east of the Wu state is the China Sea. Though unbeatable, he suddenly disappeared from the political scene; however, The Art of War survived. [13]

According to British military strategist B. H. Liddell Hart [14]:

> "Sun Tzu's essays on The Art of War form the earliest known treatises on the subject, but have never been surpassed in comprehensiveness and depth of understanding. They might well be termed the concentrated essence of wisdom on the conduct of war. Among all the military thinkers of the past, only Clausewitz is comparable, and even he is more 'dated' than Sun Tzu, and in part antiquated, although he was writing more than two thousand years later. Sun Tzu has clearer vision, more profound insight, and eternal freshness."
>
> Civilization might have been spared much of the damage suffered in the world wars of this century if the influence of Clausewitz's monumental tomes On War, which

> molded European military thought in the era preceding the First World War, had been blended with and balanced by a knowledge of Sun Tzu's exposition on The Art of War."

The Art of War was first brought to the Western world by a Peking Jesuit missionary, Father J. J. M. Amiot, whose interpretation was published in Paris in 1772. As one Chinese editor has affirmed, possibly, it was read by Napoleon, for as a young officer the future emperor was an avid reader. Therefore, it is unlikely these unique essays would have escaped his attention. [15]

In the East, the book was first introduced to the Japanese islands by Kibi-no-makibi between A.D. 735 ~ 747, approximately one thousand years earlier than to the West. Kibi-no-Makibi visited China twice (A. D. 716 ~ 735 and A. D. 752 ~ 754) and brought a number of classical Chinese texts back to Japan.

The Chinese refer to Sun Tzu as "The military teacher for one hundred generations". Former Chinese leader Mao Tse-tung was strongly influenced by Sun Tzu's thought [15]. This is apparent in his works, for example, On Guerrilla War and On the Protracted War, that deal with military strategy and tactics. His followers had applied Sun Tzu's precepts to their anti-Japanese military operations in the Second World War which result in repeated defeats for the Japanese.

In 1988, President Richard Nixon [23] published a book, using Sun Tzu's guideline 'Victory Without War' as title; he successfully predicted the result of the Cold War. Later, during the Gulf War, it was reported that there were always two books on President Bush's table, The Art of War and The Biography of Caesar. President Bush's handling of the entire Gulf crisis verifies this. The war process was typical of Sun Tzu's way: "The highest form of generalship is to balk the enemy

with intelligence; the next is resort to foreign relation; the last in order is to attack the enemy's forts". "With direct method to engage, with indirect method to win" [17]. In 1961, former British Marshal Montgomery suggested The Art of War should be a required textbook for all the military schools in the world.

Introduction to The Art of War

After 2,500 years, there are numerous versions of The Art of War. In April 1972, Chinese archeologists unearthed some burial objects in the Han Dynasty Tomb (B. C. 206 ~ A. C. 25) of Yinqueshan (Silver Bird Mountain), 28.8 km north of present-day Lin-Yi City, Shandong Province, China. Among them were the remains of ancient books made up of 4,942 bamboo slats. More than 200 slats, containing 2,400 characters, were the remnants of an ancient version of Sun Tzu's The Art of War. Since then, the Lin Yi discovery has been a mandatory source for all Sun Tzu's studies [15]. More than ten translations have been published in several different languages, e. g., Russian, Japanese, English, and French.

Sun Tzu's The Art of War contains thirteen sections [13]:

- Estimates
- Waging War
- Offensive Strategy
- Dispositions
- Energy
- Weakness and Strengths

- Maneuvers
- The Nine Variables
- Marches
- Terrain
- The Nine Varieties of Ground
- Attack by Fire
- Employment of Secret Agents

In the beginning of the book Sun Tzu wrote:

> "War is a matter of vital importance to the state; the province of life or death; the road to survival or ruin. It is mandatory that it be thoroughly studied. Therefore, appraise it in terms of the five fundamental factors, and make comparisons with The Art of War, so you may assess its essentials. The first of these factors is morality; the second, weather; the third, position; the fourth, general; and the fifth, doctrine."[13][14][15] [16][17]

Biography of Sun Tzu

As a hero, Sun Tzu's legend was described in various stories. Two thousand years ago, Ssu-ma Ch`ien gave the following classic biography of Sun Tzu [19]:

> Sun Tzu Wu was a native of the Ch`i State. His The Art of War brought him to the notice of Ho Lu, King of Wu. Ho Lu said to him: "I have carefully perused your 13 sections. May I submit your theory of managing soldiers to a slight test?"
>
> Sun Tzu replied: "You may."
>
> Ho Lu asked: "May the test be applied to women?"
>
> The answer was again in the affirmative, so arrangements were made to bring 180 ladies out of the Palace. Sun Tzu divided them into two companies, and placed one of the King's favorite concubines at the head of each. He then bade them all take spears in their hands, and addressed them thus: "I presume you know the difference between front and back, right hand and left hand?"

The girls replied: "Yes."

Sun Tzu went on: "When I say 'Eyes front,' you must look straight ahead. When I say 'Left turn,' you must face towards your left hand. When I say 'Right turn,' you must face towards your right hand. When I say 'About turn,' you must face right round towards your back."

Again the girls assented. The words of command having been thus explained, he set up the halberds and battle-axes in order to begin the drill. Then, to the sound of drums, he gave the order "Right turn." But the girls only burst out laughing. Sun Tzu said: "If words of command are not clear and distinct, if orders are not thoroughly understood, then the general is to blame."

So he started drilling them again, and this time gave the order "Left turn," whereupon the girls once more burst into fits of laughter. Sun Tzu: "If words of command are not clear and distinct, if orders are not thoroughly understood, the general is to blame. But if his orders ARE clear, and the soldiers nevertheless disobey, then it is the fault of their officers."

So saying, he ordered the leaders of the two companies to be beheaded. Now the king of Wu was watching the scene from the top of a raised pavilion; and when he saw that his favorite concubines were about to be executed, he was greatly alarmed and hurriedly sent down the following message: "We are now quite satisfied as to our general's ability to handle troops. If we are bereft of these two concubines, our meat and drink will lose their savor. It is our wish that they shall not be beheaded."

Sun Tzu replied: "Having once received His Majesty's commission to be the general of his forces, there are certain commands of His Majesty which, acting in that capacity, I am unable to accept."

Accordingly, he had the two leaders beheaded, and straight away installed the pair next in order as leaders in their place. When this had been done, the drum was sounded for the drill once more; and the girls went through all the evolutions, turning to the right or to the left, marching ahead or wheeling back, kneeling or standing, with perfect accuracy and precision, not venturing to utter a sound. Then Sun Tzu sent a messenger to the King saying: "Your soldiers, Sire, are now properly drilled and disciplined, and ready for your majesty's inspection. They can be put to any use that their sovereign may desire; bid them go through fire and water, and they will not disobey."

But the King replied: "Let our general cease drilling and return to camp. As for us, we have no wish to come down and inspect the troops."

Thereupon Sun Tzu said: "The King is only fond of words, and cannot translate them into deeds."

After that, Ho Lu saw that Sun Tzu was one who knew how to handle an army, and finally appointed him general. In the west, he defeated the Chu State and forced his way into Ying, the capital; to the north he put fear into the States of Chi and Chin, and spread his fame abroad amongst the feudal princes. And Sun Tzu shared in the might of the King.

CHAPTER 3

SIGNIFICANCE

B. H. Liddell Hart suggests that studying The Art of War might spare civilizations great suffering and damage [14]. Sun Tzu's guidelines, such as "The supreme art of war is to subdue the enemy without fighting", provide an alternative to recent management theories. An advertisement posted at the New York La Guardia Airport says: "Does your consultant ever refer to The Art of War?", this shows that some consultants have noticed the importance of the book. Some manufacturing strategists also study Sun's book. For example, Chester Richards quoted Sun Tzu's, "According to my assessment, even if you have many more troops than others, how can that help you win." [6]. However, most sentences quoted by Richards do not capture the essence of The Art of War. Application of the book demands more accurate and profound knowledge of the author, the historical background, and the text.

Contemporary Japanese students of The Art of War have applied the strategy of the ancient classic to modern politics and business with alacrity. Indeed, some see in the success of post-war Japan an illustration of Sun Tzu's dictum "to win without fighting is best." [15].

Influenced by the Japanese application of The Art of War in business, a number of Chinese business leaders and scholars have been paying it more attention. Seminars are held almost every year. These seminars are attended by scholars and business leaders from the U.S., Japan, Europe, and countries all over the world [18][20][21].

However, The Art of War has seldom been used in manufacturers' decision-making, or to understand the situation of a business. The global competition of manufacturing is so keen that companies have invested millions of dollars and years of effort in order to gain the competitive edge. On the other hand, it takes only, a few days, to read The Art of War, and the book might be an excellent aid for the strategic decision making necessary to business survival. Therefore, it is an attractive idea to research the possible application of the essence of The Art of War.

The Art of War was written in ancient China. At that time, most Chinese works were written on bamboo slats instead of paper. The authors wrote as little as possible in order to cut down the size of "books". One Chinese character in these books could have many meanings. Therefore, it is difficult for scholars to understand and translate these abstruse books. Today, most Chinese people rely on modern editors' explanations of The Art of War. Since Kibi-no-Makibi, foreign translators have been striving to catch the essence of the book; however, their translations are far from perfect.

Because it is desirable to study the possible applications of the Sun Tzu's book to modern manufacturing business decisions, a profound understanding of The Art of War is critical.

CHAPTER 4

PREPARATION FOR THE INCORPORATION OF THE ART OF WAR

Selection of the Appropriate Translation

To find a good English translation of The Art of War, it is desirable to select a good Chinese version first. The original work has various Chinese versions. One of them can be dated back to Ts'ao Ts'ao (A. D. 220 ~ 265), a famous king in Chinese history, who wrote a commentary on Sun Tzu's work and published The Art of War [13]. Ts'ao Ts'ao lived in a time when China was separated into three countries (known as "Three Nations"); he was the king of one of them. Like Sun Tzu, Ts'ao Ts'ao's story is widely known throughout Asia today, especially in Japan. The Japanese recently produced a cartoon series about the history of the Three Nations; one major character was Ts'ao Ts'ao. The Three Nations Story is also translated into English from ancient Chinese as Romance of Three Kingdoms by Brewitt Taylor [22]. Ts'ao Ts'ao's commentary on The Art of War was written in ancient Chinese too. It provides one of the most prestigious commentaries on The Art of War and can be used as an aid for the selection of a modern Chinese version.

Among the Chinese versions, "Sun Tzu, The Art of War, Wuhan Publishing Co., September, 1994" is the best version, as it provides the following useful contents [13]:

1. Full contents of the original Sun Tzu's The Art of War in ancient Chinese, exactly the same as found at Lin Yi.
2. A translation of The Art of War into modern Chinese. This provides for a good understanding of the original work.
3. Thirteen military cases support the sections of The Art of War. This helps one catch the essence of the guidelines.
4. Ts'ao Ts'ao's and Ssu-Ma Ch'ien's commentaries on The Art of War.

The English translations are compared in a number of different ways, but the most important consideration is the accuracy of the translation. The background of authors, the format and the comments on these translations are also important factors.

There are a number of ways to acquire English translations of The Art of War. For example, the local Hasting's Store has four different versions for sale [14][15] [16][17]. There is also a translation by Samuel B. Griffith in Montana State University-Bozeman library that includes good information for Sun Tzu study. Samuel B. Griffith was a Ph.D. candidate in Oxford University. His translation of The Art of War is a considerably revised version of his thesis [14].

There are three different translations on the Internet at these following sites:

1. http://home.navisoft.com/entisoft/artofwar.htm. Sun Tzu on the Art of War, The Oldest Military Treatise in the World, Translated from the Chinese by Lionel Giles, M.A. (1910) [16].
2. http://www.mit.edu/people/dcctdw/AOW/toc.html. The Art of War, Sun Tzu, Translated by Thomas Cleary, Shambhala Pocket Classics, Boston, 1991 [17].
3. http://alf.nbi.dk/~jallberg/karate/art_of_war.html. The Art of War (The First Seven Sections). Translated from the Chinese by Anonymous.

One must first compare the accuracy of the table of contents translation in order to decide which translation gives the most accurate meaning of Sun Tzu's idea. Note the difference in the following:

(1) Lionel Giles's translation for content

1. Laying Plans
2. Waging War
3. Attack by Stratagem
4. Tactical Dispositions
5. Energy
6. Weak Points and Strong
7. Maneuvering
8. Variation in Tactics
9. The Army on the March
10. Terrain

11. The Nine Situations

12. The Attack by Fire

13. The Use of Spies

(2) Thomas Cleary's translation for content

1. Strategic Assessments

2. Doing Battle

3. Planning a Siege

4. Formation

5. Force

6. Emptiness and Fullness

7. Armed Struggle

8. Adaptations

9. Maneuvering Armies

10. Terrain

11. Nine Grounds

12. Fire Attack

13. On the Use of Spies

(3) Anonymous translations for content (There are no sections 8 ~ 13 in this translation.)

1. Estimates

2. Waging War

3. Offensive Strategy

4. Dispositions

5. Posture of Army

6. Void and Actuality

7. Maneuvering

(4) Samuel B. Griffith's translation for content

1. Estimates

2. Waging War

3. Offensive Strategy

4. Dispositions

5. Energy

6. Weakness and Strength

7. Maneuver

8. The Nine Variables

9. Marches

10. Terrain

11. The Nine Variables of Ground

12. Attack by fire

13. Employment of Secret Agents

By comparison with the Chinese table of contents [13], it can be seen that Lionel Giles's translation provides the most accurate translation of contents. The table of contents is the key part for most ancient Chinese books. It is understood as the second most important thing after the book title, to

attract the readers. So, the translation of this part can serve as the indicator for verifying the quality of the translation.

Lionel Giles's translation is written in a format that is familiar to the most Western readers. It is assembled in a format similar to the Bible's, sentences numbered sequentially. Therefore, this translation is selected as the best work for this research. Further review of the details reveals that Lionel Giles' 1910 edition is the most scholarly and presents the reader an incredible amount of information concerning Sun Tzu's text. Clearly, Lionel Giles's work established much of the groundwork used by later translators. He was a leading sinologist in his time and an assistant in the Department of Oriental Printed Books and Manuscripts in the British Museum.

On the other hand, Thomas Cleary's translation gives a full set of explanations about each sentence. He tells how and why these sentences are expressed. It is helpful for readers to understand the original meaning of The Art of War. Thomas Cleary uses, on the Internet, hyperlinks to give detailed comments without influencing the structure of the translated literature.

Sun Tzu's original work was written in a continuous format; its contents, like any other good book, are tightly inter-linked. So the Anonymous translation is best for reading, especially for first time reader, as it is appropriately paragraphed like the original work.

Comparison of Business Competition and War

For humans, real war is far fiercer and bloodier than business competition. There is significant difference between these two domains. Sun Tzu's work was originally written for war, not business competition. Not all of his guidelines can remain in the original form when being applied to modern business practice. Obviously, it would not be appropriate if the war guidelines used were applied to business competition without referring to law.

For example, in Section 12 of The Art of War Sun Tzu talked a great deal about "Attack by Fire". However, it is unlawful to set fire to the competitor's estate in order to gain advantage. Obviously, only those guidelines that can be applied in both domains can be considered in this research. Special attention should be paid to these guidelines having similarity and overlap between war and business concepts, and to exclude those that do not.

The Dictionary Definitions of "War" and "Competition".

Two typical dictionaries were referenced in order to find the exact meaning of the concept "war" and "competition". New Webster's Dictionary gives the definition in American English; the other, Longman Dictionary of Contemporary English, gives the definition in British English.

New Webster's Dictionary (U.S.A.)

War:

a) Armed conflict between nations, tribes of other groups or an instance of this.

b) A concerted effort to put down, reduce or exterminate.

c) A state of hostility without resort to arms.

Competition:

a) A contest in which people compete.

b) A competing.

Compete:

a) Try to win a contest.

b) Try to get what others also seek which all can not have.

Contest:

a) A struggle for domination.

Longman Dictionary of Contemporary English (Great Britain)

War:

a) Armed fighting between nations.

b) An example or period of this.

c) A struggle between opposing forces or for a particular purpose.

Competition:

a) The struggle between several people or groups to win something or gain an advantage.

The Major Feature of War and Competition Are Summarized as:

Table 1: Comparison of Competition and War

		War	Business Competition
Object	Occupy	Area	Market
	Gain	Everything	Profit
	Destroy or gain advantage over	Enemy	Competitor
Manner	Lawful	No	Yes
	Armed	Yes	No

David T. Geaslin, An American Veteran, Summarizes:

> "The only difference between war and commerce is that the law regulates the use of violence. Whether your business, your home, or your job and family security is taken by sale or at the point of a gun is of little consequence. You and your family are still standing in the cold and in danger's way. When I studied his (Sun Tzu's) plan, I realized that it could be the perfect organizational structure for competition in commerce. The parallel between commerce and war are very similar." [24]

The first eight sections of The Art of War — Estimates, Waging War, Offensive Strategy, Dispositions, Energy, Weakness and Strengths, Maneuver, and The Nine Variables — do not refer to war manners only, and do not concentrate on specific objects that could only be gained through war. Sun's weighting, planning and energy-gaining methods can also be applicable to business competition. The remaining five sections will not be considered in this study because they apply mainly to military techniques.

Guidelines Selected for Possible Application

The content of The Art of War is systematically organized. The guidelines are supported by facts and analysis. Sun Tzu was very careful that his book did not contain contradictions. The selection of the guidelines to be applied in this study is governed by two considerations:

- The guidelines selected should represent the unique ideas of Sun Tzu.
- The guidelines should be easy to be transformed to an applicable form for manufacturing business decision-making, without impairing their original essences.

In this research, the following guidelines are pulled from the Lionel Giles's translation [16] and applied to business competition. They are grouped according to their original sections and numbered according to the sequence number in their sections.

Guidelines

Section One.

1. Sun Tzu said: The art of war is of vital importance to the State.
2. It is a matter of life and death, a road either to safety or to ruin. Hence it is a subject of inquiry which can on no account be neglected.
3. The art of war, then, is governed by five constant factors, to be taken into account in One's deliberations, when seeking to determine the conditions obtained in the field.
4. These are:
    i. The Moral Law;
    ii. Heaven;
    iii. Earth;
    iv. The Commander;

v. Method and discipline.

9. The Commander stands for the virtues of wisdom, sincerity, benevolence, courage and strictness.

Section Two

5. Thus, although we have heard of stupid haste in war, cleverness has never been seen associated with long delays.

Section Three

1. Sun Tzu said: In the practical art of war, the best thing of all is to take the enemy's country whole and intact; to shatter and destroy it is not so good. So, too, it is better to recapture an army in its entirety than to destroy it, to capture a regiment, a detachment or a company in its entirety than to destroy them.
2. Hence to fight and conquer in all your battles is not supreme excellence; supreme excellence consists in breaking the enemy's resistance without fighting.
18. Hence the saying: If you know the enemy and know yourself, you need not fear the result of a hundred battles. If you know yourself but not the enemy, for every victory gained you will also suffer a defeat. If you know neither the enemy nor yourself, you will succumb in every battle.

Section Four

1. Sun Tzu said: The good fighter of old first puts himself beyond the possibility of defeat, and then waits for an opportunity to defeat the enemy.
13. He wins his battles by making no mistakes. Making no mistakes is what establishes the certainty of victory, for it means conquering an enemy that is already defeated.
15. Thus it is that in war the victorious strategist only seeks battle after the victory has been

won, whereas he who is destined to defeat first fights and afterwards looks for victory.

Section Five

5. In all fighting, the direct method may be used for joining battle, but indirect methods will be needed in order to secure victory.

21. The clever combatant looks to the effect of combined energy, and does not require too much from individuals. Hence his ability to pick out the right men and utilize combined energy.

Section Six

29. Military tactics are like water; for water, in its natural course, runs away from high places and hastens downwards.

30. So in war, the way is to avoid what is strong and to strike at what is weak.

31. Water shapes its course according to the nature of the ground over which it flows; the soldier works out his victory in relation to the foe whom he is facing.

Section Seven

2. After that, comes tactical maneuvering, than which there is nothing more difficult. The difficulty of tactical maneuvering consists in turning the devious into the direct, and misfortune into gain.

Section Eight

3. There are roads which must not be followed, armies which must be not attacked, towns which must not be besieged, positions which must not be contested, commands of the sovereign which must not be obeyed.

Transformation of the Guidelines

Obviously, the guidelines selected can be easily transformed into the following rules that are more appropriate for business competition. However, the essence of The Art of War must be maintained in this process.

Transformed Guidelines:

No. 1 The art of business competition is of vital importance to the Company. It is a matter of life and death, a road either to safety or to ruin. Hence it is a subject of inquiry which can on no account be neglected.

No. 2 The art of competition, then, is governed by five constant factors, to be taken into account in one's deliberations, when seeking to determine the conditions obtained in the field. These are:

i. Business ethics;

ii. Business environment;

iii. Mundane reality;

iv. The Manager;

v. Policies of the business.

No. 3 The Manager stands for the virtues of wisdom, sincerity, benevolence, courage and strictness.

No. 4 Thus, although we have heard of stupid haste in competition, cleverness has never been seen associated with long delays.

No. 5 In the practical art of competition, the best thing of all is to take the opponent's market whole and intact; to shatter and destroy it is not so good. So, too, it is better to recapture a market position in its entirety than to destroy it, to capture a segment, a product line or a product in its entirety than to replace them.

No. 6 Hence to fight and conquer in all your market skirmishes is not supreme excellence; supreme excellence consists in breaking the opponents competition without fighting.

No. 7 Hence the saying: If you know the opponent and know yourself, you need not fear the result of a hundred skirmishes. If you know yourself but not the competitor, for every victory gained you will also suffer a defeat. If you know neither the competitor nor yourself, you will succumb in every market skirmish.

No. 8 The good competitor first puts himself beyond the possibility of defeat, and then waits for an opportunity to defeat the opposing competitor.

No. 9 He wins his market battles by making no mistakes. Making no mistakes is what establishes the certainty of victory, for it means conquering a competitor that is already defeated.

No. 10 Thus it is that in business competition the victorious strategist only seeks battle after the victory has been won, whereas he who is destined to defeat first fights and afterwards looks for victory.

No. 11 In all market battles, the direct method may be used for direct competition, but indirect methods will be needed in order to secure victory.

No. 12 The clever competitor looks to the effect of combined energy, and does not require too much from individuals. Hence his ability to pick out the right men and utilize combined energy.

No. 13 Business tactics are like unto water; for water in its natural course runs away from high

places and hastens downwards.

No. 14 So in competition, the way is to avoid what is strong and to strike at what is weak.

No. 15 Water shapes its course according to the nature of the ground over which it flows; the competitor works out his victory in relation to the foe whom he is facing. Therefore, just as water retains no constant shape, so in competition there is no constant disposition.

No. 16 After that, comes tactical maneuvering, than which there is nothing more difficult. The difficulty of tactical maneuvering consists in turning the devious into the direct, and misfortune into gain.

No. 17 There are roads which must not be followed, competitors which must be not attacked, market areas which must be not besieged, market positions which must not be contested, commands of the manager which must not be obeyed.

CHAPTER 5

THE MOVEMENT OF COMPETITIVE EDGE IN MANUFACTURING

Cutting Edge Variation

The Major Cutting Edge Changes with the Stages of the Product Life Cycle

Theoretically, the cutting edge in product competition, or the relative advantage of a product, is somehow related to the product life cycle. The major competitive edge in different stages of a product life cycle are listed below and illustrated in Figure 1.

Phase 1: Product introduction speed. In the earliest stage, the company that first sells the special product will capture the market.

Phase 2: Quantity. The capability to produce the most products of the same quality becomes important as need increases.

Phase 3: Quality. As need is saturating because of more and more competitors in the market, quality emphasis becomes important for gaining advantage.

Phase 4: Capacity for variation. As the need declines, this becomes more important than other issues.

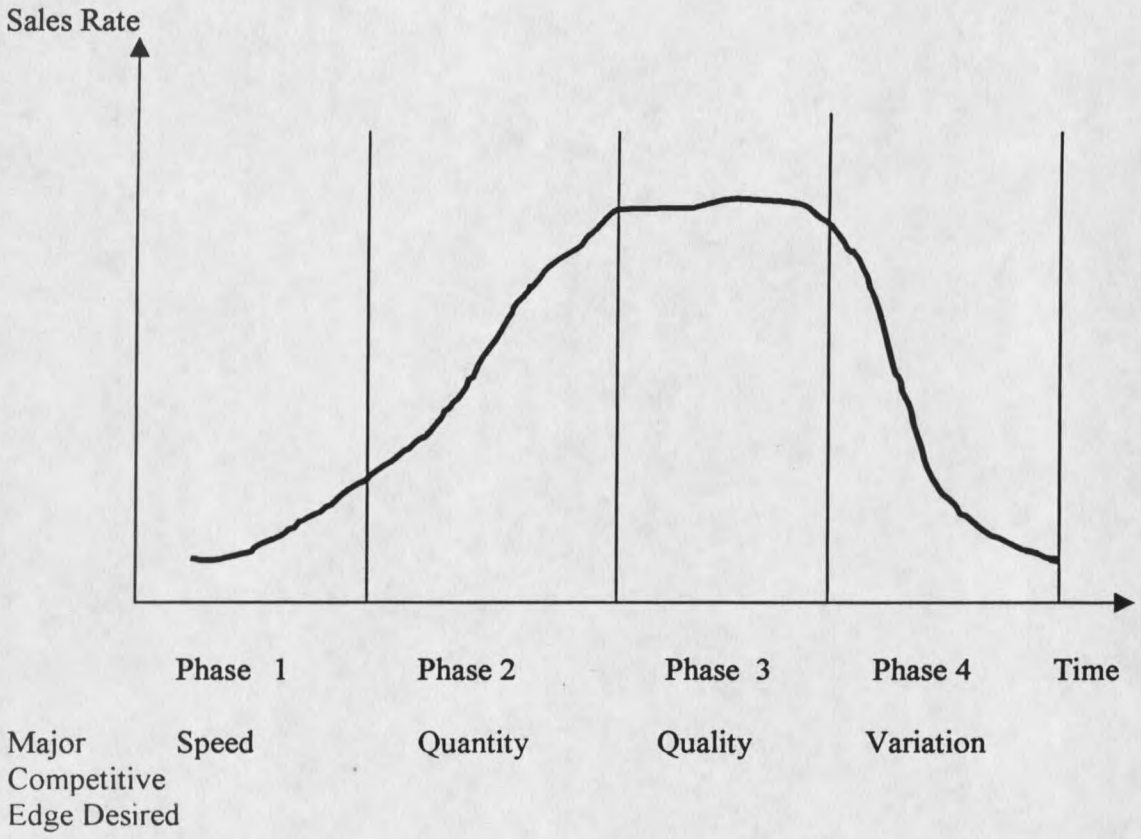


Figure 1: Product Life Cycle and the Relative Competitive Edge Desired

Competitive Edge Is A Constantly Moving Target

Manufacturing history shows that competitive edge is a constantly moving target. For manufacturing companies, the key is not to get stuck on a single notion of advantage. The best competitors know how to keep moving, and they always stay on the cutting edge of competition.

Post war Japanese manufacturing is a good example [25]. Since 1945, the Japanese have successfully shifted their cutting edge at least four times to gain advantage in world competition. Immediately after World War II, with its economy devastated, Japan concentrated on achieving a competitive edge through low labor costs. Since the yen was devaluated by 98.9% against the dollar, its labor costs were extraordinarily competitive.

The Japanese government set policies that favored industries with high labor content: textiles, shipbuilding, and steel. In these high labor content companies, the low labor rate was more than offset by low productivity rates. As a result, Japanese companies captured market share from their Western competition in these high labor content industries.

Later, rising wages, caused by high inflation, combined with fixed exchange rates, eroded the advantage. In many industries, manufacturers could not improve their productivity fast enough to offset escalating labor costs. By the early 1960s, the Japanese textile companies spiraled downward, first losing share, then volume, then profits, and finally position and prestige. In the early 1960s, the Japanese shifted their strategy, and began using capital investment to boost productivity. To achieve high productivity and low costs, they inaugurated the era of scale-based strategies by building the largest and most capital-intensive facilities that were technologically feasible. Japanese shipbuilders, for example, revolutionized the industry in their effort to raise labor productivity.

In the mid-1960s, Japanese companies moved to a new source of competitive advantage — the focused factory. Focused competitors manufactured products that were either made nowhere else

in the world or that were required by the high-volume segment of a market, often in the heart of their Western competitors' product lines. Focusing production allowed the Japanese to remain smaller than established broad-line producers, while still achieving higher productivity and lower costs. This gave them great competitive power.

In industries such as bearing manufacturing, where competition was fierce in the late 1960s, the Japanese fielded product lines with one-half to one-quarter the variety of their Western competitors. Targeting the high-volume segments of the bearing business — i.e., bearings for automobile applications was one — the Japanese used the low costs of their highly productive focused factories to undercut the prices of Western competitors. The Swedish company, SKF, was a major target for the Japanese. By adopting the Japanese strategy, however, SKF avoided business failure.

As the Japanese penetrated more markets, their narrow product lines began to pinch, limiting their ability to grow. Also, the focus strategy presented them with an unattractive choice: reduce variety further or accept the higher costs of broader product lines. Therefore, leading Japanese manufacturers began to move toward a new source of competitive advantage — the flexible factory. In a flexible factory system, variety-driven costs start low and increase slowly as variety grows. Scale costs remain unchanged. Thus, the optimum cost point for a flexible factory occurs at a higher volume and greater variety than for a traditional factory. It can be seen that there is a difference between the costs of flexible and the traditional factory: a cost variety gap, which represents the competitive advantage of a flexible factory, enjoys more variety with lower total costs than traditional factories.

Yanmar Diesel illustrates how this process works. In 1973, with the Japanese economy in recession, Yanmar Diesel was mired in red ink. As a Toyota supplier, Yanmar was impressed with the automaker's ability to go through the recession. Yanmer decided to install the Toyota procedure in its own factories. As a result, manufacturing costs declined 40% to 60%; factory break-even points dropped 50% to 80%; and total manufacturing labor productivity improved by more than 100%. During the re-construction, Yanmer quadrupled its product line.

The Toyota production system gave many Japanese manufacturers who adopted it in the mid-1970s a distinct competitive advantage. It was " born of the need to make many types of automobiles, in small quantities with the same manufacturing process"[1][25]. With its emphasis on Just-in-Time production, total quality control, employee decision-making, and close supplier relations, this system proved successful.

Other countries adopted similar strategies. Once Hong Kong focused on low capital, high labor cost apparel production. Now mainland China's apparel export plays an important role in the world apparel market, since it has cheap labor, and the apparel production does not require an intense amount of capital investment.

Based on the facts mentioned, it can be concluded that the competitive edge is a moving target. During the same time period, different manufacturing enterprises can shape their cutting edge according to their background. However, there is no panacea format for manufacturing companies.

There Is No Panacea for Manufacturing Companies

In manufacturing business, there are various concepts such as Lean Manufacturing, Just-in-Time, Gradual Improvement, etc. Which of these is better? It is tough to set a simple standard in order to answer this question. However, Sun Tzu's guideline No. 15 "Water shapes its course according to the nature of the ground over which it flows; the competitor works out his victory in relation to the foe whom he is facing. Therefore, just as water retains no constant shape, so in competition there is no constant disposition." provides a starting point for this discussion. Any business structure must adapt to the situation and conditions. For instance, Japanese auto companies developed their Just-in-Time method and the Kaban Method because of their close relations with vendors. In other countries, companies may select Virtual Manufacturing because the business itself is a virtual business.

Throughout the following inference process in this chapter, a counter-example method is applied. For each popular concept such as JIT, one or more real cases are introduced, where successful companies were unable to apply the concept. Therefore, it is concluded that the concept does not work in all situations: it is not a panacea.

Japanese Method Is Not A Panacea

Since the success of the Japanese automobile industry, the Toyota production organization model has come to be widely appreciated and accepted as the most advanced manufacturing management style. Toyota is identified with Japanese production. However, the Toyota model is not a cure-all. The following example illustrates this:

In Sweden, the labor market remained tight throughout the 1970s and 1980s. Unemployment rarely exceeded 3% (while most other European countries had rates of 10%), and union density remained high and stable. These factors, combined with the culture difference between Japan and Sweden, explain why Swedish companies persevered with their methods of work organization. While Volvo was introducing whole-car assembly at its plant at Uddevalla in 1989, many other European car makers were seeking to imitate Japanese auto industry working practices [27].

In early 1970s, there was widespread concern throughout the West about the quality of working life. It was believed that an increasingly well-educated workforce, with higher expectations than its predecessors, would demand greater satisfaction and fulfillment from working life. The answer to these problems was thought to be to redesign jobs to make fuller use of workers' capacities. Although there may appear to be similarities between the Japanese high employment commitment, and the Swedish desire to organize work so as to encourage high employee commitment, there are, in fact, tremendous differences between the two models. Japanese manufacturers and their imitators are able to choose from large numbers of applicants for the jobs in their plants, and can be very selective about whom they recruit. They prefer young, well-educated people with the "right attitudes". Once employed, workers in such plants have to cooperate with a demanding work-pace and ever-rising quality standards. Shop floor control methods make it difficult for employees not to contribute every ounce of effort and creativity to the enterprise. In Sweden, on the other hand, motor manufacturers have had difficulty filling jobs at all, and so have needed to make their jobs attractive both to the limited number of potential recruits and to existing workers.

When, Volvo's Kalmar factory opened in 1974, it was the world's first auto assembly plant without mechanically driven assembly lines. Teams performed its entire assembly on stationary carriers, in so-called docks. The further goal was to improve assembly **ergonomics**. The novelties in the building design and production flow became the basis for a team culture, extensive job rotation and a functional assembly, where each team was responsible for a clearly demarcated function, such as a dashboard. By 1985, the plant had become much more competitive. Assembly hours per car were 25% lower than other Volvo plants with consistent high quality and competitive overhead costs.

Kalmar, with its high efficiency and reliability, was Volvo Cars' "best-practice plant" in Sweden, and the company decided to set up another plant — at Uddevalla — which would depart from the principle of line assembly to an even greater extent. In contrast to Kalmar, the unions were involved on a full-time basis from the start. They took part in a 1987 joint labor-management study of Japanese methods at Nissan's U. K. plant. The study concluded that, given labor market pressures to provide attractive jobs, **Japanese methods were unworkable in Sweden, and that an alternative had to be found**. The new plant was opened in 1989. Its objectives were high personnel stability and a balanced workforce. By 1991, Uddevalla achieved the same productivity and higher quality output than Volvo's Swedish mass-production plant at Gothenburg.

Big Leap instead of Gradual Improvement

Due to inexpensive acquisition of facilities, manufacturing companies in developing countries can make major leaps in improving manufacturing technology. For example, Chinese Tianjin Yi-chu Motorcycle Company bought a German motorcycle company, including all the machinery and the entire technique file for a reasonable price in early '80s. So the Tianjin Yi-chu Motorcycle Company was able to greatly improve the technique level of its products [28].

Flexible without the FMS System [29]

Hong Kong watchmakers are selling watches for every occasion. Their philosophy is to convince consumers that a watch is a fashion statement and clothing accessory. This level of product variation is Hong Kong's trademark, and its production systems operate within this philosophy. As one manufacturer noted, "**The Japanese always talk about automation, but it [automation] also restricts flexibility and creativity that a labor force provides.** As watches become more accepted as fashion accessories, people will appreciate interesting hand-crafted items".

Hong Kong watch prices are extraordinarily low by world standards. Hong Kong dominates the low-end watch market segment. The nation has no rivals for market share in the price ranges in which the majority of its products compete. Prior to 1987 (when the yen was one-half its current value), Japanese producers made a foray into the low-priced end of the electronic watch industry. Anticipating an increased market share, two of the three major Japanese watchmakers set up assembly plants in Hong Kong to manufacture low-cost products. Even Japanese Seiko uses Hong Kong as a low-wage flexible labor location for the assembly of new products. This has become all the more important as the yen has continued to rise in value.

UPS (Uninterrupted Power Supply) Manufacturer Does Not Choose LEAN or JIT [30]

When the American Power Conversion Company was trying to get into the crowded low-tech business of uninterruptible power supplies (UPSs) for computers back in the mid-1980s, it seemed to make all the wrong moves.

It stayed in high-cost Rhode Island as the competition moved overseas. When others were leveraging up and cutting costs, American Power was giving equity and bonuses to employees, buying the latest equipment and investing in distribution. **While Lean Production was coming into fashion, the company was boldly running an inventory.**

"We target one to two months of finished goods in inventory and no backlog," said American Power Conversion's CEO, Rodger Dowdell Jr. "We were getting a lot of heat from the analysts." In 1988, its first year of trading, the market gave American Power a price/earnings multiple of eight.

Five years later, investors understood exactly what the company, which came out on top, was up to. "Every single penny that American Power is spending goes toward market share and improving the product" says Rick Martin of the brokerage Chicago Corp.

American Power also lavishes money on the latest manufacturing equipment so it can lower production costs. As a result, in 1993 the company generated $280,000 worth of business per employee, versus the competitor's $150,000 per employee.

With that kind of advantage, the company was able to cut prices 20% in 1990 and 12% in 1992, and still reward employees with bonuses. Indeed, American Power's employee ownership plan is so generous it has left one line worker with nearly $1 million in stock. The company has remained the dominant UPS supplier in the fast-changing computer business for a long time.

Combination of JIT and Forecasting Production

In the largest automobile factory in China, production has been changed from pure JIT to a combination of JIT and forecasting production. Under this system, customers can have two choices:

1. Pay for a car and get it immediately.
2. Order a car with a lead-time of one month, and pay a small deposit. The customer can select any choices that are available, including color and accessories. The sum paid is $200-$500 less than that paid for the car if available immediately. In the second situation, the special orders will be sent to each sub-division. A JIT production strategy will provide a plan. The customer's specific requirements will guide the entire manufacturing process, indicated by a special card with the customer's signature. The customer must accept the custom-made car since it is an order. If the customer does not take the final result, he will lose the deposit.

The factory always produces the sum of the quantity for both the lead-time orders and the number forecasted for distribution needs.

From the examples in this chapter, it can be seen that the advanced manufacturing formats, such as LEAN and JIT can not guarantee a competitive edge. Manufacturing companies need to catch the competitive edge with decisions relative to their own background, such as Toyota selecting JIT as its own format.

CHAPTER 6

CATCH THE COMPETITIVE EDGE WITH THE AID OF THE ART OF WAR

Methods by Which Guidelines from The Art of War Serve as A Decision-Support Tool

Several possible ways were explored to test applications of Sun Tzu's ideas

a. Experimental design: This statistical method requires good control over the factors influencing decision-making. Since real business situations vary, and the factors are difficult to control, this method is difficult to apply in this study.

b. Business case study: This is the ultimate form of theory application, but its five to ten year time frame goes beyond the researcher's time frame and scope of this thesis. A Chinese business leader was contacted; he provided good information for this study, but the major problems in his business were beyond the scope of this study.

c. Applied business examples: Manufacturing companies that use The Art of War and achieved success are excellent evidence to support author's idea that The Art of War can be aid a manufacturing company's decision-making.

d. Similar business examples: Real business decision processes have great potential to illustrate the application Sun Tzu's ideas to manufacturing companies. Although

examples are aftermath facts, a summary suggests the applicability of Sun Tzu's ideas. Note that statistical methods also work on aftermath facts. Although the conclusions based on this method are not as reliable as the conclusions based on statistical experimental design, many business-process analyses still use this method, as there is no better way to go. Therefore, a good summary of aftermath facts establishes a basis for a **posteriori** statistical analysis. Few people in decision-making positions would try something that cannot work effectively on aftermath facts. Methodology applied in this study is based on real-life examples.

Information about the real-life examples, as described in method (c) above, is very general. The method of part (d) is used to supplement and to further exemplify application of The Art of War.

In this study, the method used to illustrate that guidelines developed from The Art of War are applicable to aid decision-making in manufacturing businesses has a relatively special design. First, typical facts about different manufacturing businesses were selected. They included a completed decision, the situation prior to the decision (Pre-Decision Situation) and the situation after the decision (Post-Decision Situation) was realized. This method of analysis is shown in Figure 2.

Business decisions are often based on empirical guidelines developed from special business experience or a business leader's idea. The author's purpose is to find matches between those real ideas and those transformed guidelines from The Art of War. See Figures 3 and 4. Therefore, it is proposed that, if the real decision-maker was replaced by a new business leader with good decision-

making capability, it is very possible that the new leader could also make the same decision and get the same result with the aid of the transformed guidelines from The Art of War, and the given situation.

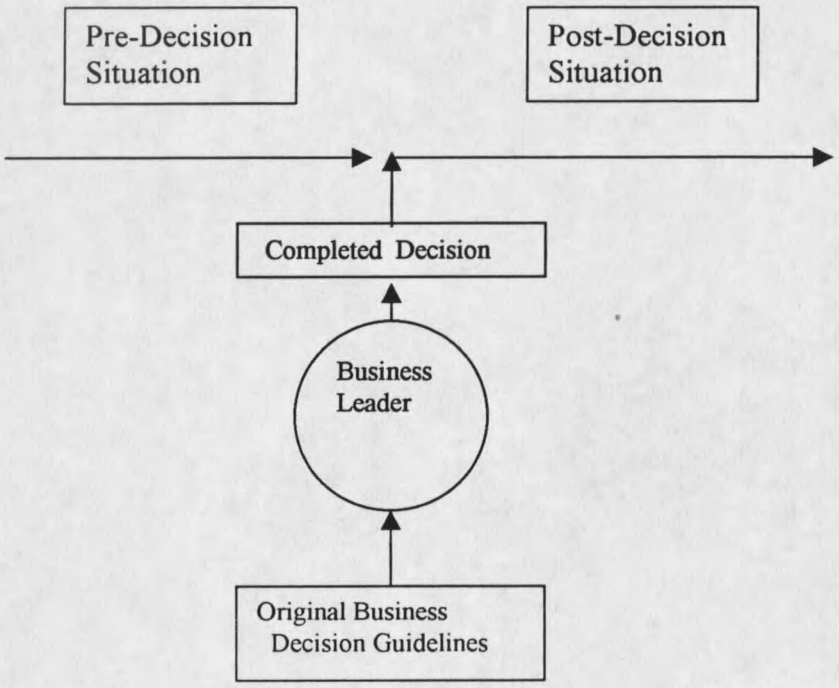


Figure 2: Method of Analysis Used on Examples in This Paper

In other words, if there is a good match between business decision making and the Sun Tzu's transformed guidelines, it is very possible that The Art of War could be incorporated as an aid for manufacturing decision-making, especially when the situation is a typical one and there are similar opportunities in the future.

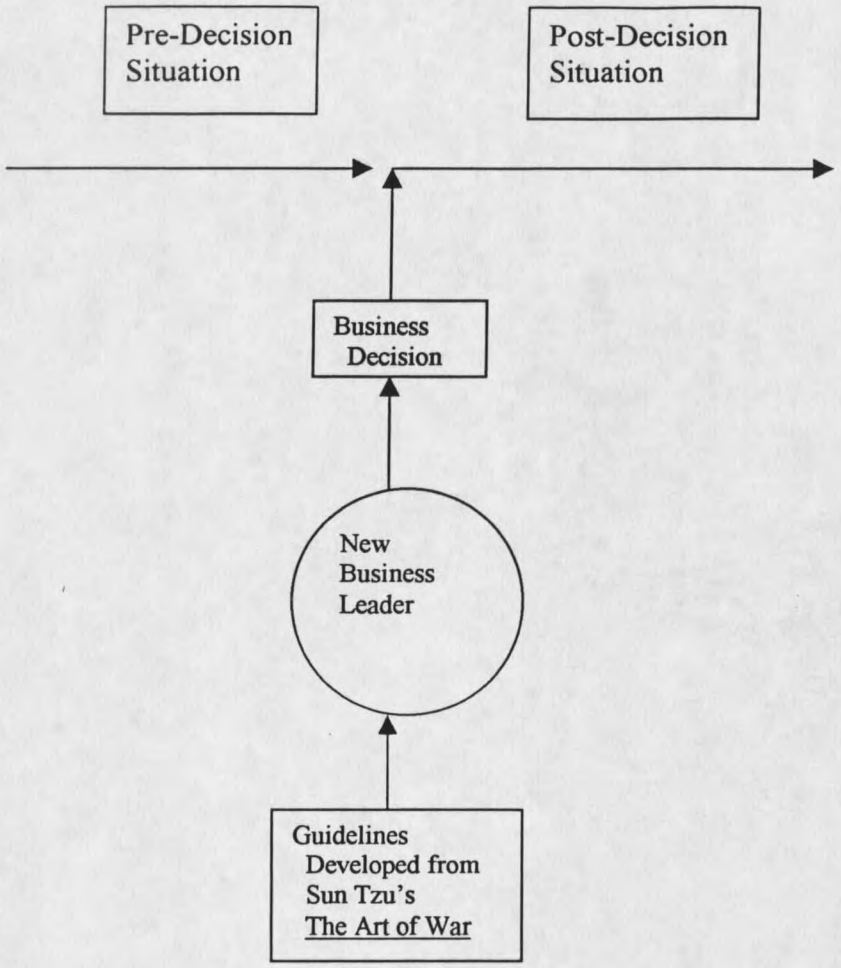


Figure 3: Incorporation of the Guidelines

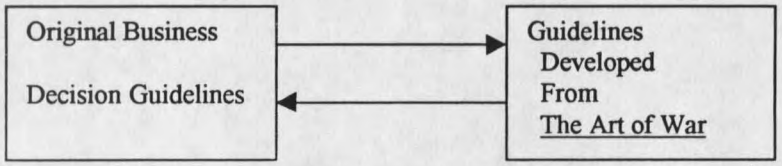


Fig. 4 Similarity between Guidelines

Also, the guidelines transformed from The Art of War are used to analyze some manufacturing business situations to provide the business another point of view. Sun Tzu had his own way of understanding the complicated situation of war. Because the guidelines developed from The Art of War are very well summarized, they can be applied to many situations. Likewise, the examples given in this paper can be used to better understand the guidelines.

The following examples show how Sun Tzu's ideas might serve as an aid to manufacturing decision making. Each example is carefully selected so that its primary business fits into the description for manufacturing industry in American Standard Industrial Classification (SIC) — SIC 20 ~ SIC 39.

Exemplify the Application of the Art of War Guidelines

The Complete Victory

Although it has been widely accepted that the best thing in competition is to fight and conquer in all situations, Sun Tzu's idea is different: "To fight and conquer in all skirmishes is not supreme excellence; supreme excellence consists in breaking the opponent's competition without fight" (Guideline No. 6). Therefore, he proposed another ultimate object for competition, complete victory. Section 3 "Attack by Stratagem", illustrates Sun Tzu's complete victory and can be understood as:

1. Take the competitor's company or market complete and intact.
2. With little cost as there was no direct conflict. The absence of direct conflict results in little cost.

Example 1: Nan-De Group, Shi-Chuan Province, P. R. China [28]

According to a United Nation's report, P. R. China's GNP growth in last ten years was among the highest in the world. The rapid development of private business was a major contributor to this success. Among these private companies, one of the most successful is Nan De Group, which is a typical **virtual manufacturing business** composed of various independent production factories.

The company started with a good idea, an idea that brought a complete victory in the late '80s. Mo Qi-zhong, now president of Nan-De Group, carefully studied the situation of China and Russia at that time. He found that Russia had developed excellent heavy industry (machine tool, automobile, train, airplane, and ship manufacturing, etc.) at a high pace and with a high-tech background. Their commercial airplanes were good quality, and the sale price was only about one third that of the similar Western products. On the other hand, Russia's light industry (food product, shoe, apparel production, etc.) did not develop at a relative pace. In the later '80s, Russians lined up in front of supermarkets for light industrial products and food. China started its economic modernization under open-door policies several years earlier than Russia. As a result, some light industrial products were overstocked. Chinese Airlines bought a large number of foreign airplanes, as there was little commercial airplane factories in China. Furthermore, there was not a local airline company in the province where Mo Qi-zhong lived, which had the largest provincial population in China (about 120 million). So, Mo Qi-zhong came up with the idea to trade those Chinese light industrial products for Russian T-154 airplanes, in order to help his province to build its commercial airline with T-154s.

Mo Qi-zhong went to Beijing, the capital of China, to hold a seminar with the experts from the Chinese Academy of Social Science to see if they agreed with the idea's feasibility. Then he went to Russia to persuade the president of an airplane factory to fly a T-154 to his province for a trial. The president was attracted to his idea, and sent a T-154 to China. That is exactly what Mo Qi-zhong wanted, as the bank agreed to loan funds only after they saw the T-154 airplane. After he got a loan from the bank, he immediately organized his Nan-De Group, to include several dozen relatively independent factories from all over the country, e.g.: The Second Tinned Fruit Factory of Guangxi Province, Jinang Textile Mill, Shangdong Province. Finally, he exchanged four T-154 airplanes for his light industrial products such as textiles and tinned fruits, and he helped set up the Southwestern Airlines of China. The deal was worth 240 million Swiss Francs. Nan-De Group gained a capital increase of about $25 million.

After the adoption of the Group, it continued its growth. Mo's idea constitutes "adding the last one degree centigrade to boiling the ninety nine degree centigrade water". His method matches the complete victory concept. That's important for the growth of the company. Also, under similar situations, the complete victory idea can work very well.

Example 2: Teva Pharmaceutical Industries, Israeli [31]

In 1985, the Israeli company Teva Pharmaceutical Industries moved aggressively into the United States by acquiring one of its American competitors, Lemmon Co., whose output of generic drugs was soaring at that time. With the help of the production and distribution system of Lemmon Co., Teva became a significant seller and manufacturer of generic drugs in the U. S. in 1994. In the first

nine months of 1993, its net income rocketed 92%, to $41.4 million, or 77 cents per American Depository Receipt. Sales surged 32% to $371 million.

Although takeovers happen everyday in the pharmaceutical industry around the world, such an international merger was key to Teva's success. Countries have different regulations on the sale and testing procedures of pharmaceutical products. For example in U. S., pharmaceutical products must go through prolonged and extremely expensive test procedures before being allowed to go on the market. Only a few, large, wealthy companies can get through these procedures. Small pharmaceutical companies can not survive the procedure. Also, unlike other products such as cars, shoes, or clothes, a new pharmaceutical product is not welcomed by customers: most people use products with which they are familiar in order to avoid unexpected side effects. Therefore, Teva's decision to buy the successful Lemmon Company was very helpful. This is another example of the complete victory, a win-win situation. Instead of competing with Lemmon Co., Teva choose to acquire Lemmon Co, and Lemmon's influence in market. It gained a competitive edge by incorporating Lemmon Company's entire system.

Tactical Dispositions

Guidelines:

No. 8 The good competitor first puts himself beyond the possibility of defeat, and then waits for an opportunity to defeat the competitor.

No. 9 He wins his market battles by making no mistakes. Making no mistakes is what establishes the certainty of victory, for it means conquering a competitor that is already defeated.

No. 10 Thus it is that in business competition the victorious strategist only seeks battle after the victory has been won, whereas he who is destined to defeat first fights and afterwards looks for victory.

During long-lasting competition, 100% attack or 100% defense is seldom the best choice. Sun Tzu's idea illustrates a relative steady path to success. It could be summarized as:

1. Whether gradually or with big leaps, first improve the company itself, technically, culturally, financially, etc. That is what a company can usually do itself, and this is relatively easier than changing the competitor and the business environment.
2. Wait until there is an opportunity to gain an advantage, and then, defeat the competitor.
3. "Improve the company" stands for "The opportunity to defeat the competitor". Former Chinese leader Mao, Tse-tung summarized Sun Tze's idea: "In the object of war, to destroy the enemy is the first, and to survive is the second. Because only through destroying the enemy can one effectively survive" [26].

Example 1: Motorola Co. [32]

In 1993, Motorola Co. announced the Total Customer Satisfaction (TCS) team competition within its organization. The teams saved the company $1.5 billion by reducing defects and production time in 1993, paving the way for $1 billion in profit out of sales of $17 billion. One Hi-Tech team saved the company $250,000 in 1993 by developing an implementation strategy that increased production and reduced cycle time, without additional equipment or labor expenses.

It can be seen that the company first put itself beyond failure by using TCS team competition. Motorola also gained because of the following aspect:

1. Any disappointment that came with a failure to advance in the competition (or win gold in the final) soon faded because of pride in the knowledge that the group had become better. Teams battled with each other, but these battles strengthened Motorola in the war against its competition.
2. Employees found solutions to their own problems.
3. Building a team with wide knowledge helped to solve systemic problems.
4. Some team members devoted as much as 400 hours a year of their personal time to working on team projects. No huge monetary rewards, only a few tokens such as plaques, shirts, jackets, and cordless phones, were given away.
5. Competition jump-started a push for quality by initiating six-sigma quality.

Without the effort in its own organization, 1993 would have been a deficit year for Motorola. Motorola strived to improve its own performance by team competition, and paved the way to success. This is an example of guideline No. 9 "first puts himself beyond the possibility of defeat".

Example 2: The Auto Market in U.S. in Early '80s.

Japan is a country with few natural resources, so they make cars that get good gas mileage and they strive for quality. That's the only way Japanese can survive. As the oil crisis formed, their products increased in the U.S. market share. This story is well known and has been repeated by many authors. Sun Tzu's guideline No. 9 provides another clear image of this situation. Japanese motor companies won by making no mistake; they could not afford to. They didn't start direct

competition (Guideline No. 11). What they did at that time was to conquer competitors that had already defeated themselves (Guideline No. 9).

Gain Victory without Delays

Guideline:

No. 4 Thus, although we have heard of stupid haste in competition, cleverness has never been seen associated with long delays.

In business competition, there are some critical moments. If the competitor moves with the highest speed in a short period of time, he will gain advantage for a relatively long period, especially when there is a potential energy difference that could be applied to gain the competitive edge. To be the first to take the initiative can be the key to successful business competition.

Example 1: Tianjin Yi-chu Motorcycle Company, P. R. China [28]

In China, because road and highway construction is far behind population growth, bicycles are more practical for commuting than are most other vehicles. The same applies to the motorcycle. In recent years, the motorcycle has become popular in China.

However, the products of most Chinese motorcycle factories in early '80s — products of Tianjin Yi-chu Motorcycle Company, for example — were way behind products from Western countries. Outdated facilities and designs generated poor products.

In September 1984, a member of a Chinese delegation visiting Germany learned some important information. A German motorcycle company, Nendap Company, was at the edge of bankruptcy. Nendap was a high-tech company and its product was high quality. Poor management had caused the company's difficult situation. The Chinese delegation member immediately reported the information to Tianjing City, and the local government decided to buy the entire company.

At the same time, other businessmen from Iran and India also showed strong interest in the company, the Iranian was the first to sign an agreement with the Germans. However, the contract also set a deadline for the payment. If the money hadn't been paid by 3:00 PM on October 24, the contract would be invalid.

As if in following guideline No. 4, the Tianjing government insisted on sending the delegates on October 22. The next day, fifteen Chinese arrived in Munich. By October 24, the Iranian's money hadn't arrived. The Chinese delegates rushed to Nendap Co. and initialized an agreement. On October 25, Chinese technical experts went to the factory to evaluate the facilities. On October 26, the final contract was signed. Tianjing bought the entire factory, including the 2,229 machines and the entire technique file, for 16-million German marks. Twelve months later, the factory was running on the other side of the earth. Its products, Yichu motorcycles, are very popular in China.

Example 2: Failure in Speed [20]

In 1983, another Chinese delegation in San Francisco received the information that a PCB manufacturing factory was about to be sold. The price asked was $3 million, only about a half of its value. The facility included a computerized testing system that was high tech, and most of its

facility could be easily updated. The night before the auction, the Chinese delegate reached an agreement to pay $1.433 million, provided that the money was paid before 10:00 AM the next day, the time the auction was to start. The delegate got help from the Chinese Embassy and gathered cash with the highest speed ever. However, it was two hours too later. The factory was sold for $1.9 million at the auction. Cleverness should have been substituted for haste.

The chances taken in the examples above are critical for the success of a manufacturing company in developing countries. While gradual improvement is a good way to achieve success, these kinds of opportunities can also help companies leap forward. In these situations, "cleverness has never been seen associated with long delays."

Example 3: The Famous Honda-Yamaha War [25][33]

In 1981, Yamaha ignited the Honda-Yamaha war by announcing the opening of a new factory, which would make it the world's largest motorcycle manufacturer, a position then held by Honda. Having been concentrating its corporate resources in the automobile business and away from its motorcycle operation, Honda chose to counterattack: "Yamaha wo tsubusu!" ("We will crush, squash, slaughter Yamaha!").

Honda cut prices, flooded distribution channels, and boosted advertising expenditures. Most important (and most impressive to the customers), Honda also rapidly increased the rate of change in its production line, using variety to bury Yahama. At the start of the war, Honda had 60 motorcycle models. Over the next 18 months, Honda introduced or replaced 113 models, effectively turning over its entire production line twice.

Average time for Honda to introduce a new model = 365×1.5/113 = 4.85 days/model.

Yamaha also began the war with 60 models; it was able to manage only 37 changes in its product line during those 18 months.

Average time for Yahama to introduce a new model = 365×1.5/37 = 14.80 days/model. While both of them had introduced new products tremendously fast, Honda was three times faster than Yamaha. Honda's new product introductions devastated Yamaha. Honda not only demonstrated its speed, but it also turned the motorcycle design into a matter of fashion. With its automobile technology, Honda raised the technical sophistication of its motorcycle products, introducing four-valve engines, composites, direct drive, and other new features. Next to Honda, Yamaha products were out-of-date, both in customer appeal and technology. Demand for Yamaha products dried up; in a desperate effort to move them, dealers were forced to price them below cost. But that didn't work either. At the most intense point in the Honda-Yamaha War, Yamaha had more than 12 months of inventory. Finally, Yamaha surrendered. In a public statement, Yamaha President Eguchi announced, "We want to end the Honda-Yamaha War. It is our fault. Of course there will be competition in the future but it will be based on a mutual recognition of our respective positions."

Honda didn't escape unscathed either. The company's sales and service network was severely disrupted and required additional investment, before it could return to stable footing. However, so decisive was its victory that Honda effectively had as much time as it wanted to recover.

George Stalk summarized, "Time — the next source of competitive advantage" [25]. He suggested managing time the way most companies manage costs, quality, or inventory. "Variety had won the war".

As the analysis has shown, it's not only the variety, but also the speed of variation, the technological improvements (which decides the acceleration and jerk of variation), and the indirect idea that turned motorcycle design into a fashion in the early '80s. That works.

If George Stalk had studied the example from a wider perspective, he would have found that not only the time, but also the timing of the Honda-Yamaha war was the best for Honda. To understand this, one can go through Sun Tzu's logic. In the beginning of the second section of The Art of War, Sun Tzu wrote [16]:

> "When the army engages in protracted campaigns, the resources of the state will fall short. When your weapons are dulled and ardor dampened, your strength exhausted and treasure spent, the chieftains of the neighboring states will take advantage of your crisis to act. In that case, no man, however wise, will be able to avert the disastrous consequences that ensue. Thus, though we have heard of stupid haste in competition, cleverness has never been seen associated with long delays (Guideline No. 5)."

The early '80s were a good time for Japanese automobile companies: their products were warmly welcomed and their world market share increased. That might have been the best time for Honda to allocate its resources to winning the decisive Honda-Yamaha war. However, Yamaha started the war with Honda while Honda silently faced the challenge of Yamaha for a long time. If Yamaha had selected another time to start the war, such as 1961, or 1997, for example, the situation might have been different, since the U.S.s Big Three had totally recovered and were waiting for the chance. Or if the Honda-Yamaha War had lasted longer, e.g., four or five years, Honda would also

have been exhausted. Neither Yamaha or Honda would have been a winner; they would have killed each other.

Win with Clever Competition

Guidelines:

No. 11 In all market battles, the direct method may be used for direct competition, but indirect methods will be needed in order to secure victory.

No. 12 The clever competitor looks to the effect of combined energy, and does not require too much from individuals. Hence his ability to pick out the right men and utilize combined energy.

George Stalk summarized that manufacturing companies have three strategic choices [25]:

1. Seeking coexistence with competitors. This choice is not stable, since most competitors refuse to cooperate.
2. Retreating in the face of competitors. Many companies choose this course by consolidating plants, focusing their operations, divesting business, pulling out of markets, or moving upscale.
3. Attacking either directly or indirectly. The direct attack involves the classic confrontation — cut price and add capacity, creating head-on competition. Indirect attack requires surprise. Opponents either do not understand the strategies being used against them or they do understand but cannot respond—sometimes because of the speed of the attack, sometimes because of their inability to mount a response.

George Stalk's idea of direct attacking and indirect attacking coincides with Sun Tzu's guideline

No. 11. The direct attack demands superior resources; it is always expensive and potentially disastrous. As in the Honda-Yamaha war, indirect methods promise the most gain from the least cost.

Example 1: Win by Indirect Method

From 1966-1976, P. R. China was engulfed by the so-called "Cultural Revolution". Private businesses were strictly controlled, and almost none of them were allowed in the cities. However, some of producers did survive in the cities.

They were private candy makers. Police detained the people who made and sold those products: most of the candies were made and sold by the same person. The reason is simple: candy packaging is so attractive to little boys that few children will report to police that there is someone selling candies. These candies were made of puffed rice. Although the puffed rice candies were made and sold by the state-owned factories and retailers, they were not as fresh as those made by the secret person appearing in the front of elementary schools. Those secret handworkers sold their product in a small package that can be afforded by every child, 3-5 Chinese cents (about 2-3 U.S. pennies).

However, the overwhelming attraction of the little candy packages was not from the candies themselves. It was the various tin animals used in little boys' games. The game is simple. Two boys (A and B) each offer a tin animal. Each of them uses his toy to aim and hit the other's toy in turn. If B's is hit and turns upside down, he looses the toy to A. In every class, the boy with the most tin animals becomes No. 1 in his class. The game and the No. 1 rule had prevailed for a long

time and the tin animal could only be purchased from these secret candy makers with the candy. Thus every boy had two ways to become No. 1:

1. to win in all the games, although he also had a good possibility of loosing those games.
2. to buy new candy with the little toys.

As the maximum number of tin animals is limitless and continues to increase, the candy was always a craze. If one candy person appeared at the corner of the school before classes began, the secret was passed to every boy in the class and most of them rushed to the candy person as soon as the class bell rang. Under such circumstances, few boys reported to the police, as some politicians required. If they did so, they would loose their chance to be No. 1 forever.

With the little toy added in their candy package, those private handworkers competed in a dangerous market and survived, though they were officially illegal at that time. Some of them were prestigious intellectuals before the Cultural Revolution, but were forced into manual labor as punishment. With such strategy, they survived and came back after this policy ended.

A number of candy and toy manufacturers created similar marketing techniques. For example, a Japanese company manufactures anger venting toys. Made with plastics, the toy's shape can be a policewoman, or a boss, which can withstand beating without deformation.

Example 2: Combined Energy [34]

Grupo Dina was a rapidly growing Mexican Truck and Bus Co. in the early '90s. It was bought from the government in late 1989 for $84 million. The company saw sales increase by more than 50% in 1993. By the end of the year, it had a $1 billion market value.

All these change would not have happened had the Mexican economy not taken off at the same time. From 1989-1993, the Mexican GDP grew an average of 3.5% annually. Furthermore, the growth in the country's construction sector was double the economic growth during the same period. The company had also taken advantage of the peculiarities in the Mexican transportation system — 97% of all passenger travel between cities was via inter-city busses and 85% of all domestic freight was transported by truck. The North American Free Trade Agreement lowered the price on many imported parts. This company successfully utilized the advantage of "combined energy".

Turn the Devious into Direct

Guideline:

No. 16 After that, comes tactical maneuvering, than which there is nothing more difficult. The difficulty of tactical maneuvering consists in turning the devious into the direct, and misfortune into gain.

The proverb "Quality is free" and Sun Tzu's guideline fit very well here.

Example: Camel Fan, Shanghai, P. R. China [20]

In the early '80s, there were a lot of electrical fan factories in China. Most stores were overstocked because of over production. But, in the largest city in China, Shanghai (with a population of 10 million), the Camel fan was always out of stock. Camel Fan Co. was a small factory of which people had never heard.

In February 1982, the end of winter, a fan started working on the counter of the largest department store in Shanghai. Every customer thought it was too early in the season. However, the fan continued its work day and night. After one or two months, some curious customers touched its motor. The fan's motor had not overheated after two-month's continuous work. Four months later, the continuously working fan became the best advertisement for its brand. Every customer looked for and bought a "Camel".

The manufacturer made a quality product, but it wisely demonstrated its quality, with an anti-seasonal effect. The sly way it demonstrated its quality was comparable to its trademark "Camel", the Chinese word for an honest hard-worker. Without such an idea, this small manufacturer might have failed to thrive, like many similar companies. In effect, the "Camel" worked as if it were guided by guideline No. 16 "The difficulty of tactical maneuvering consists in turning the devious into the direct, and misfortune into gain."

Commands of the Sovereign

Guideline:

No. 18 There are roads which must not be followed, competitors which must be not attacked, market areas which must be not besieged, market positions which must not be contested, commands of the manager which must not be obeyed.

Most people are familiar with a multi-choice decision, but the most difficult guideline here is the very last: " There are commands of the manager which must not be obeyed." This is especially important in a system filled with much bureaucracy.

Example 1: Failure of a good factory director [28]

Alhough Shen Lu was a successful factory director of Shanghai Huada Instrument Factory, there was a time at the Fall Guangzhou Trading Fair when he failed.

The leading product of his factory, X-140, was a short-line product. For a long time only their product was of good quality. But since 1983, many factories started to produce high quality X-140s.

At the trade fair, Shen Lu was about to sign an agreement when one of his competitors suddenly decreased their price by 10%. Soon some of Shen's potential customers came to him and told him the news. One of them said, "Your product has a higher quality, but they have better service. Well, if you can improve on your price, you still have the advantage." Shen Lu thought a while, "Please allow me one or two days, I need to discuss this with my supervisor"

Even though Chinese, he gave a typical Japanese response, not an American one. Most American representatives have more authority than their Eastern peers. Japanese reply in such a way because there is a good reason that the decision goes beyond their authority, or because they want to gain time to discuss it.

Shen was in the same predicament as the earlier Japanese; he had not the authority he should have had. He talked to his boss, and his supervisor refused him promptly. After Shen Lu explained that he would gain the same profit if he lowered the price and had more orders, his boss replied that he needed time to consider the proposal. Shen Lu instructed his subordinates to call his boss every three hours. Finally, he got his boss' response, "Write a report for my consideration". When he explained that his customers would not allow a long delay, he was told, "You are a win-win director. You should be able to deal with it."

The next day his opponents' order increased, and Shen Lu lost all his potential customers. But Shen Lu did not give up. He tried to find other opportunities. Finally, there came a good one. A famous German company wanted to cooperate with the Chinese to produce some products that were hot. They would provide the technique and capital investment. The Chinese would provide the land and the labor. The proposal was consistent with his factory's strategy. He immediately started the negotiation. The initial stage proved very successful. His factory had a long history of manufacturing instruments, large-scale production, enough capital, and good technology. The Germans preferred these qualifications.

As the negotiation came to the crucial part, Shen Lu reported his plan to his boss. However, his boss felt Shen Lu was too generous. He ordered Shen to stall with the Germans, so that they might milk more profit. Shen Lu reminded his boss, "Time is money. If you don't allow them to make money, they won't agree". His supervisor simply replied, "Don't be too generous when dealing with bourgeoisie."

In the next few days, the German company started contacting other Chinese factories and soon signed an agreement with a factory that had greater flexibility. After that, Shen Lu lost confidence in his work.

According to guideline No. 17, a good director or manager must have the bravery to make a decision according to correct analysis of the situation and make it work. However, to disobey and select the right choice is not easy. It requires a lot of responsible decision-making.

Attack the Weakness

Guidelines:

No. 13 Business tactics are like unto water; for water in its natural course runs away from high places and hastens downwards.

No. 14 So in competition, the way is to avoid what is strong and to strike at what is weak.

No. 15 Water shapes its course according to the nature of the ground over which it flows; the competitor works out his victory in relation to the foe whom he is facing.

Example 1: IBM Entered the Copy Machine Market [20]

Xerox is the No. 1 copy machine manufacturer, while IBM is the leading computer company. IBM entered the copy machine market by manufacturing and selling only one kind of copy machine with a lower price than Xerox. The IBM copier was the medium among the Xerox series, and was the most popular at the time.

IBM hit right at the Xerox weakness; while Xerox was busy defeating almost all its Japanese competitors with its service, Xerox lost its market to IBM. Because the Xerox series had a set price, the larger the copy machine, the less the copying cost. If Xerox lowered the price of the medium-sized copy machine to fight with IBM, the customer would loose interest in the large copy machine, and therefore, its entire sales would decrease significantly. Xerox had no choice. It had to allow IBM to cut into a piece of its favorite market.

Example 2: Beijing Rubber Factory [20]

Beijing Rubber factory is one of the largest rubber factories in China. It has a long history of manufacturing rubber products. In the last ten years when the number of private small factories increased quickly — these small factories hired cheaper farm labor and had a lower product price — Beijing Rubber Factory started to loose its market share. However, the Beijing Rubber Factory fought back with the following strategies:

1. Temporarily conceding its simple products market. These products can also be made by the small businesses.
2. Supporting important large projects, like the anti-fire transport belts. The need for this product is huge. It is a high-tech product that cannot be made by small factories.
3. After gaining energy, it fought back in the simple product market with higher quality products. Ten of its major products are honored as high quality products in nation wide competitions.

Actually this factory chose to focus on its strength (high-tech level) rather than its weakness (the price), and correctly used this principle to advance its competitive edge.

Both examples present a similar characteristic as described by guideline No. 14: "So in competition, the way is to avoid what is strong and to strike at what is weak."

Manufacturing Businesses that Applied The Art of War

Case 1: Nintendo Co., Japan [18]

During TV sales competition, the Japanese Nintendo Company switched its major product from playing cards to video games, and it has been very successful. The company has 800 employees. Sales are about 500 billion Japanese Yen. Their products flowed into the U. S.: there are 10 million of them, every three U. S. children has one Nintendo video game. The president of the company once said that his success comes from Sun Tzu's The Art of War: "The supreme excellence consists in breaking the opponents competition without fighting."

Case 2: Tokyo Precision Industrial Company [18]

Japanese businessman Dakaokusu was a captain in World War II. After World War II, he became president of Tokyo Precision Industrial Company. Using undisclosed guidelines from The Art of War, he successfully turned the business away from the edge of bankruptcy and into a very profitable endeavor.

Case 3: National Electrical Company [18]

The president of the National Electrical Co., Matsushita Kounosuke has been called 'The God of Management'. But he said, "The Ancient Chinese Sun Tzu is the number one God in the world. All our employees must show respect to him. Only through this way, our company can be prosperous."

"Repeat from memory his The Art of War, and apply with flexibility", seems to be the best way for application.

In summary, the research process in this chapter followed the scientific method of knowledge acquisition, as shown in Figure 5. Based on the successful cases that applied The Art of War, such as Nintendo Co. and National Co., an induction was made that Sun's ideas are helpful for manufacturers' decision-making. Then guidelines that represent the essence of the book were matched with guidelines of thirteen successful manufacturing businesses.

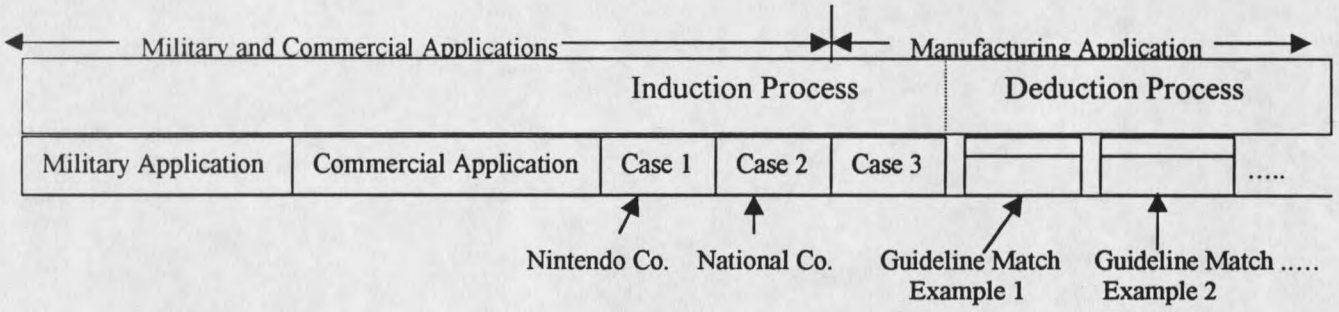


Figure 5: The Research Process in Chapter 6

Throughout the real cases and examples in this chapter, it can be seen that many manufacturing business decisions are supported or verified by Sun Tzu's guidelines. Therefore, Sun Tzu's ideas should be considered a decision-making aid and used to gain the competitive edge. As successfully applied to military and commerce, the essence of The Art of War is essential to manufacturing company management.

CHAPTER 7

ORGANIZED GUIDELINES IN DECISION MAKING

Brief Introduction for IDEF0

IDEF0 is one of the IDEF (Integrated DEFinition Methods) series. The original IDEF series were developed to enhance communication among people who used them to decide how their existing systems were to be integrated.

The entire IDEF modeling system is based on the Structural Analysis and Design Technique system (SADT) developed by Douglas T. Ross of the SofTech Corporation, Waltham, MA. It has been adopted and used by the U.S. Air Force Computer Aided Manufacturing Project, and again in the U.S. Air Force Integrated Computer Aided Manufacturing Project, widely known as ICAM. The IEDF modeling system is the systems analysis language defined and used in ICAM.

IDEF0 was designed to allow a graceful expansion of the description of a system function through the process of function decomposition (macro-to-micro) and categorization of the relations between functions (i.e., in terms of the input, output, control, and mechanism classification).

A number of high-level process descriptions of manufacturing processes are expressed with IDEF0. So, many high-level decision-makers in this area are familiar with the IDEF0. Because the structure is to be used in the manufacturing area, it would be efficient for decision-makers to apply The Art of War if it were to be structured in a manner similar to IDFE0.

Application of IDEF0 to the Transformed Guidelines

For ease in understanding and applying The Art of War to manufacturing business decision-making, the seemingly independent guidelines in this research are to be organized by IDEF0. In the last chapter, guidelines were exemplified independently. In this chapter, all the guidelines will be structured under IDEF0, to better illustrate how they might work together to support manufacturing decision-making, as shown in Figure 6.

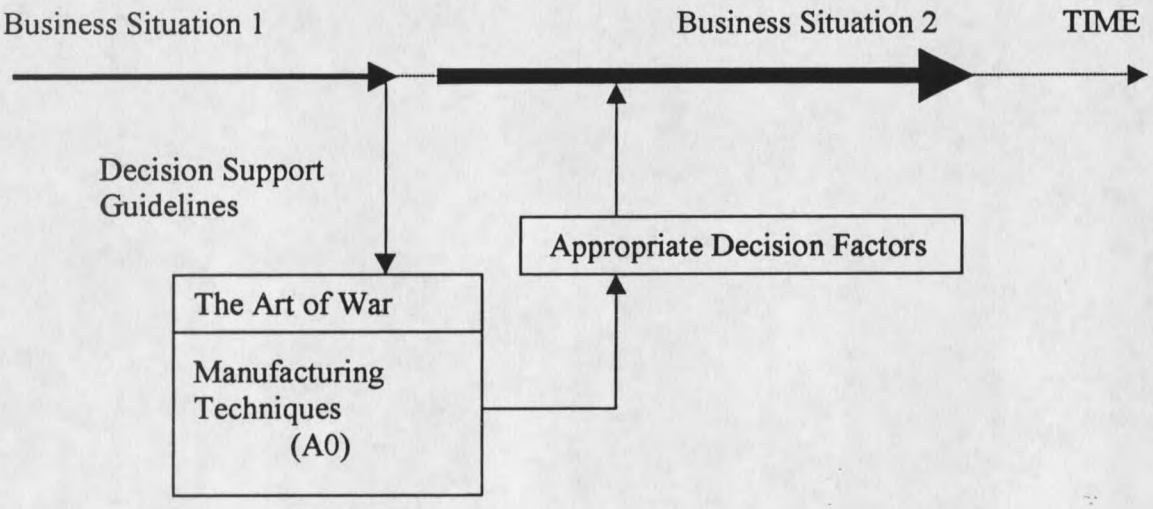


Figure 6: The Art of War as A Decision Support Process

When a manufacturing company comes to a point of decision, it can refer to The Art of War, expressed as process A0. Some of Sun's hints can be helpful for making decisions.

Contents of The Art of War are structured as in Figure 7:

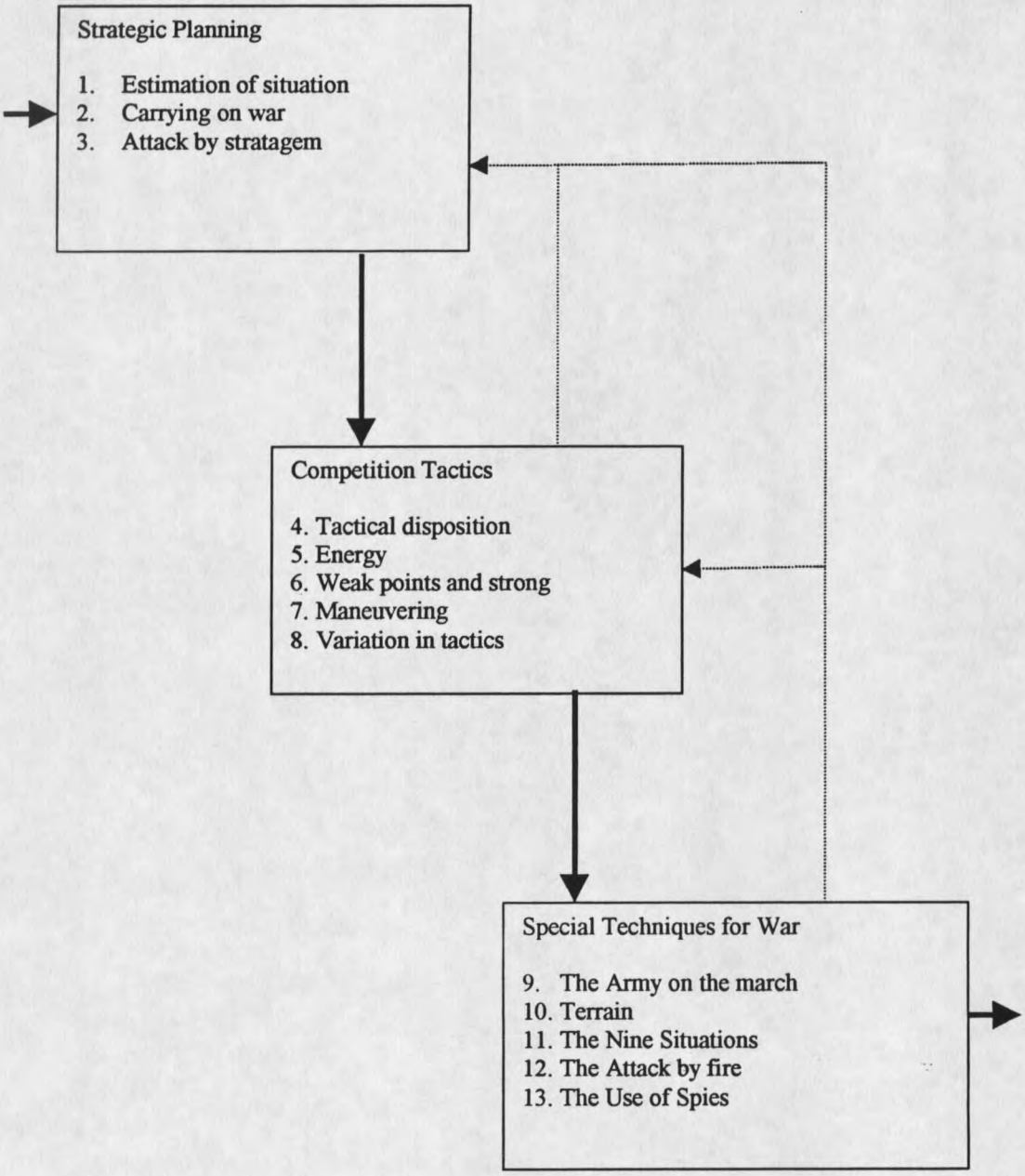


Figure 7: Structured Contents of The Art of War

Figure 7 helps to master the structure and to make application of The Art of War. The process A0 consists of three major sub-processes:

1. A0-1, Strategic Planning.
2. A0-2, Competition Tactics.
3. A0-3, Special Techniques for **War**.

A0-3, the third and the lowest block in Figure 7 can be substituted with any special manufacturing techniques, such as metal cutting, tooling, etc., and to make a systemized decision-support aid. As shown in Figure 8, these include:

1. A0-1, Strategic Planning.
2. A0-2, Competition Tactics.
3. A0-3, Special Techniques for **Manufacturing**.

Manufacturers can identify their special manufacturing skills as A0-3. However, structuring and application to manufacturing techniques with IDEF0 goes beyond the scope of this study.

For each sub-process, there are decision-making guidelines. These guidelines and the related concepts in The Art of War can support the decision-making in the following way:

1. Help in multiple-choice selection. For example, the rules in the first section govern the selection of a general.
2. Suggest a way for exploring possible choices. For example, "Use direct method to engage, use indirect method to win."
3. Suggest a course action. "Thus, what is of supreme importance in war is to attack the enemy's strategy. Next best is to disrupt his alliances by diplomacy. The next best is to attack his army. And the worst policy is to attack cities."

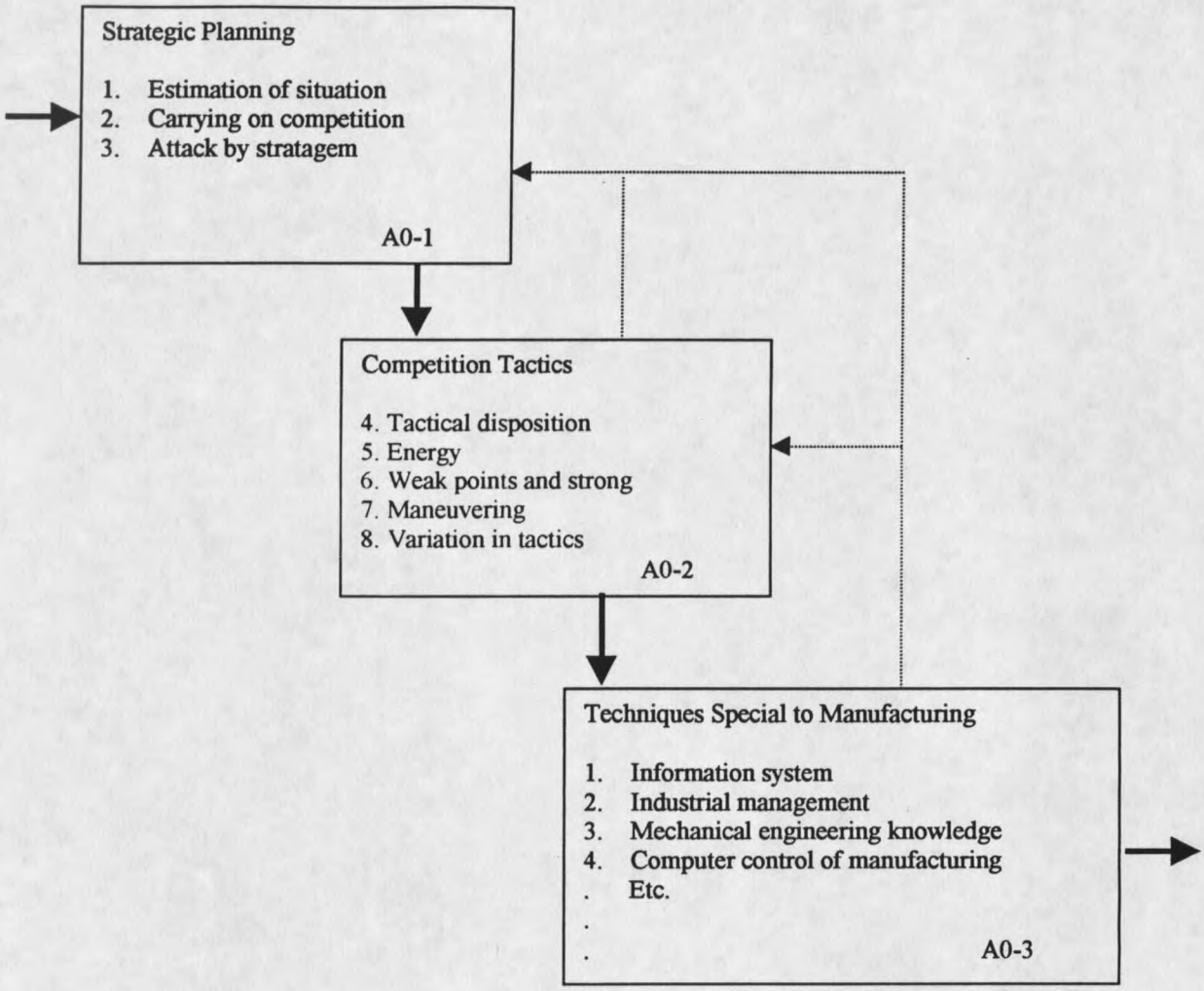


Figure 8: The Sub-processes of A0

Business people can select different parts or guidelines of the book and look for supporting ideas. The guidelines are referenced in a manner that is similar to processes structured by IDEF0 as in the Figures 7 or 8.

1. First, select an appropriate box with which to start. A decision-maker can choose that part of The Art of War which relates to his current business situation. For example,

during the early stage of the competition, he might find some useful hints by going through the first three sections of The Art of War. If it is the first time to refer to The Art of War, A0 is an appropriate starting point.

2. Following the macro-to-micro approach, go to next more specific level within starting box, such as from A0 (in Figure 7) to A0-1, A0-2, A0-3 (in Figures 8 and 9). Then, start from the top-left box, A0-1 or A0-1-1, for example, and look at guidelines in each box from the top-left to the bottom-right. If some guideline seems appropriate, take it to the next lower box at the right. Thus, boxes in Figures 8, 9 and 10 will be encountered.
3. In the subsequent boxes, check the feasibility or the consistency of the proposed guidelines with other guidelines and available factors, such as current manufacturing techniques, etc. If they are not feasible or consistent, go back to the starting box and begin again; if it is compatible, go further to the right and repeat the process. For example, if someone selects Guideline No. 9 "He wins his market battles by making no mistakes", he should check the idea with available manufacturing techniques to see if Guideline No. 9 is feasible. Furthermore, if some important technique is not reliable, he must solve the problem in order to "make no mistake". However, if the problem is too difficult to be solved, and might lead to serious quality problems, then "making no mistake" seems impossible. Therefore, he should go back to A0-2 to select another guideline, such as "To subdue the competitor without direct market skirmishes".

After going through the transformed guidelines, or reading the entire book, a qualified decision-maker will most likely get some hints from The Art of War. Sun Tzu has taken the "quality of wisdom", not "benevolence", as the most important character of a general in the application of his work. "One who ignores my counsel is certain to be defeated. Such a general should be dismissed".

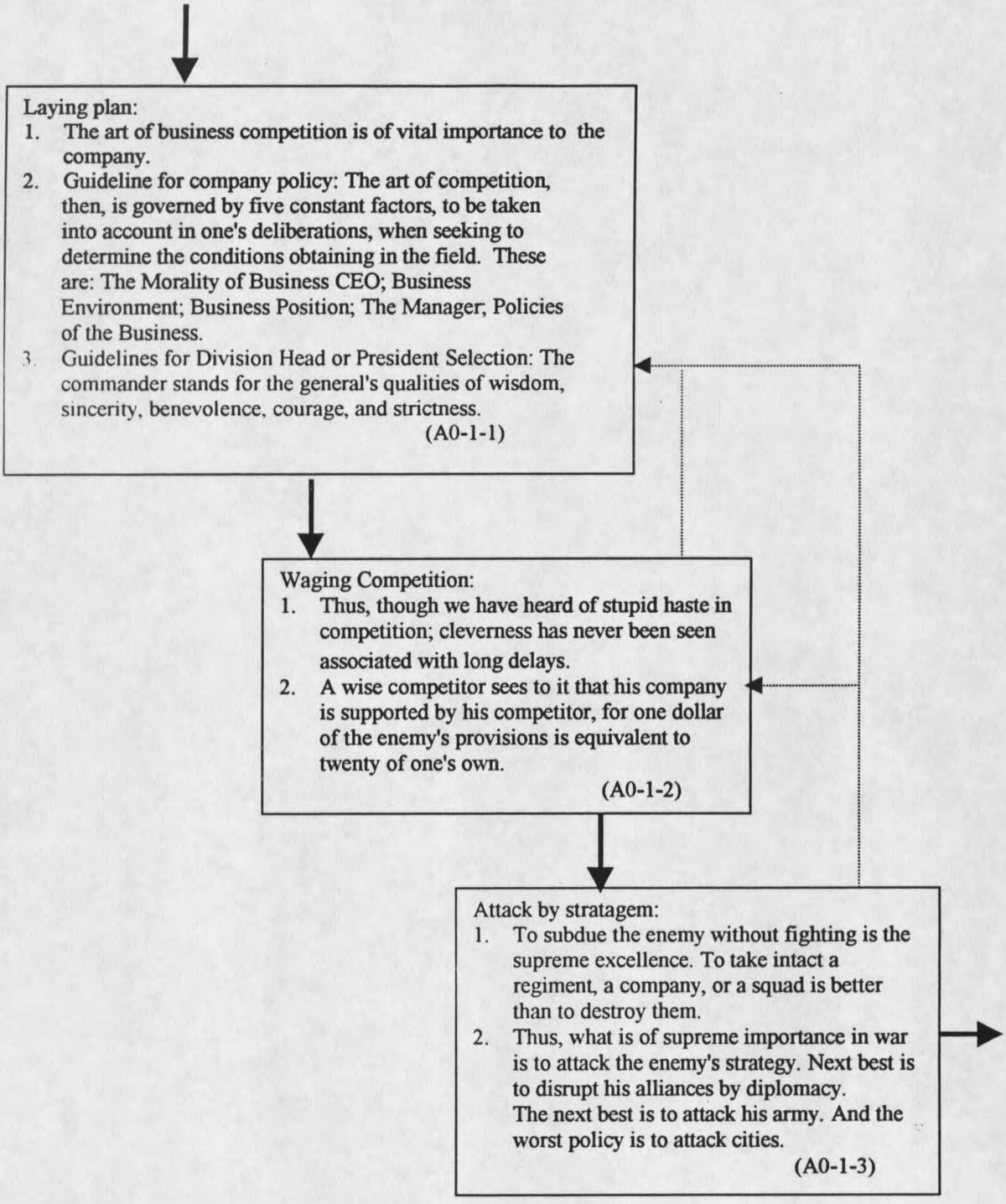


Figure 9: Decision Structure for Strategic Planning, A0-1

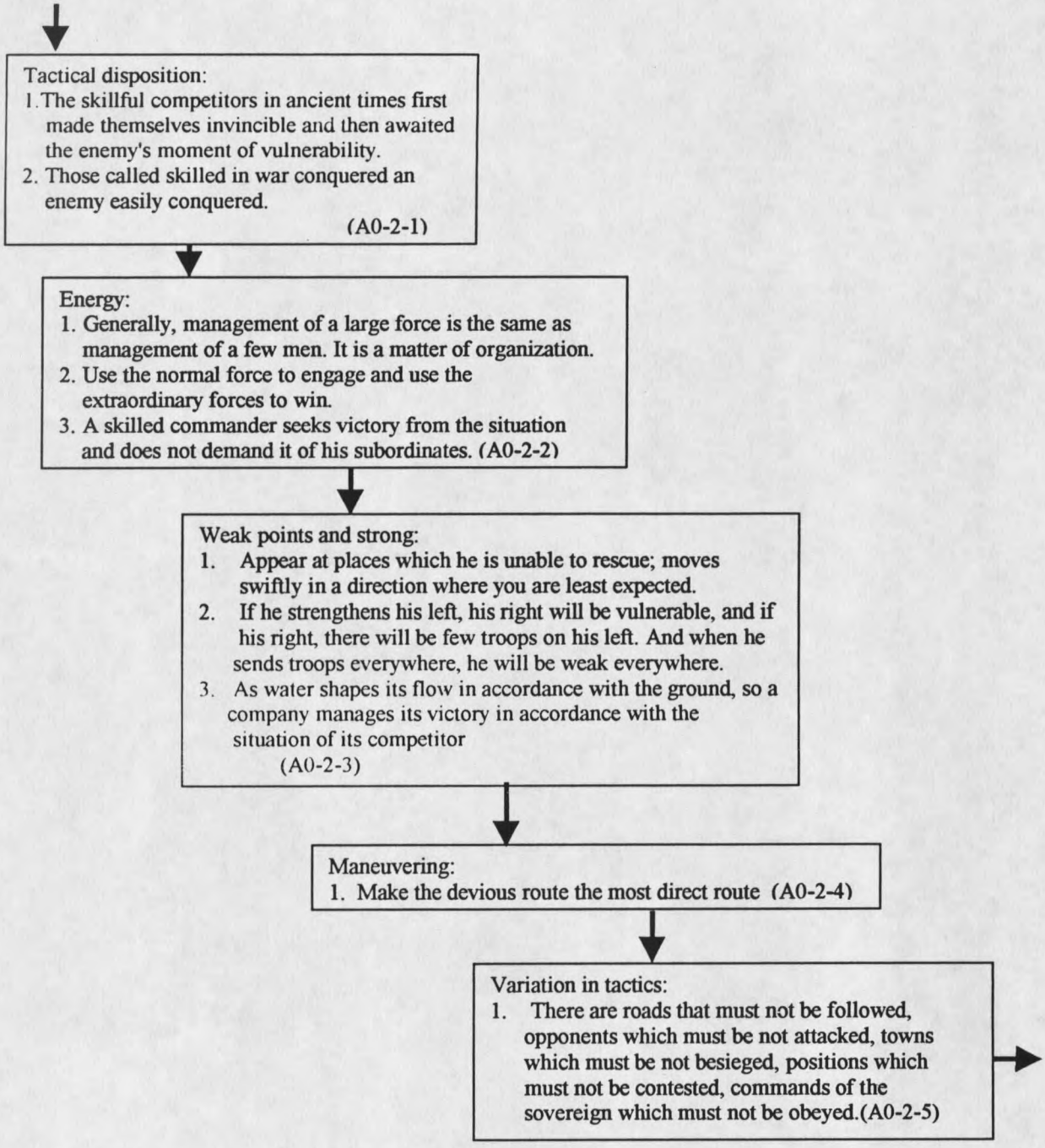


Figure 10: Competition Tactics Selection, A0-2

CHAPTER 8

THE COMBINATION OF TRANSFORMED GUIDELINES WITH THE AHP DECISION SUPPORT SYSTEM

Concept of the Decision Support System

Although the concept of Decision Support Systems (DSSs) has been widely used since 1970's, there is no single agreed-upon definition of DSS [35]. According to Andrew Sage [36], a DSS is a system that supports technological and managerial decision making by assisting in the organization of knowledge about ill-structured, semi-structured, or unstructured issues — a structured issue is one that has a framework with elements and relations between them that are understood.

Intuitively, DSSs are systems that help managers' decisions in situations where human judgment is an important contributor to the problem-solving process but human information-processing limitations impede decision making. DSSs are an adjunct to the decision-maker, extending his or her capabilities, but not replacing his or her judgment [35].

Expert Choice — A Typical DSS [38]

Expert Choice for Windows (ECPro) is based on the Analytic Hierarchy Process (AHP), a multi-criteria or multi-objective decision making process. It was developed by the mathematician Thomas L. Saaty at the Wharton School of the University of Pennsylvania.

The major objective of Expert Choice is to support decision making by structuring a complex and multi-attribute decision problem hierarchically, and finding measures for each decision alternatives with pair-wise comparisons of the decision elements (usually, alternatives and attributes). The software works on the Windows platform that is available for the majority of personal computers.

With ECPro, complex decision and evaluation problems involving multi-objective tradeoffs are arranged in a manageable structure of factors called a hierarchy. The hierarchy is similar to a family tree. Each element in a tree is called a node. The top level contains the goal node. Intermediate levels represent factors such as scenarios, players, objectives and sub-objectives. The bottom level of the hierarchy contains the alternatives of choice. Instead of assigning weights or priorities that are often arbitrary and difficult to justify, decision-makers can organize their data, thoughts, and intuition in a logical, hierarchical structure. They can express their understanding and experience with pair-wise comparisons about the relative importance and preference of likelihoods of all relevant factors. This arrangement makes it possible for decision-makers to focus on each and every part of the complex problem, and to derive priorities from simple pair-wise comparisons based on hard data, knowledge, and experience. Once the model has been pair-wise compared, it can be synthesized to obtain final results (suggestion for decisions).

The AHP used by ECPro makes it possible for decision-makers to deal with both tangible and intangible factors. It accommodates uncertainty and allows for revision so that individuals and groups can grapple with all their concerns. The results of an AHP evaluation are easily tested for sensitivities to changes in assumptions and judgments.

Expert Choice is being used by thousands of businesses and government organizations all over the world for a wide variety of applications including:

- selecting alternatives
- engineering design evaluations
- employee evaluation
- quality function deployment
- etc.

The major components of the ECPro can be seen from its main menu:

- Edit
- Assessment
- Synthesis
- Sensitivity Graphs
- Help/File/View/Utilities functions

The basic steps to apply ECPro for decision-making are:

- **Create the Decision Model with Edit Function:** The user first defines the decision problem as the goal, and then structures the problem as levels of criteria (or objectives)

within a framework. Once these factors have been determined, the alternatives are placed at the bottom level of the hierarchy under each lowest level sub-criterion. The flexibility of the hierarchical structure allows the user to build models specific to the problem.

- **Enter Judgments with Assessment Function**: Expert Choice leads the decision-maker through a series of judgments between the alternatives under each criterion (or objective), and then between the criteria (or objectives). The judgment process can be based on importance, preference, or likelihood. Expert Choice provides four types of comparison modes: Verbal, Numerical, Graphical, and Questionnaire, or lets the user enter direct data. The Verbal mode allows the user to pair-wise compare the elements on a nine-level scale with levels ranging from "equal" to "extreme".
- **Improve Consistency and Derive Priorities after the Pair-wise Comparison:** One of the most important features of Expert Choice is its flexibility in terms of consistency of judgments. The software allows the decision-maker to be inconsistent, but will guide him or her toward more consistent judgments if necessary. This consistency analysis feature is extremely valuable in working through complex decision problems that may require multiple iterations. Once inconsistency has been reduced to a reasonable level (generally below 10 percent), the user can calculate priorities for the current group of nodes. These priorities are later synthesized throughout the model to obtain priorities for the alternatives. The best alternative has the highest priority.
- **Synthesize to Get Results with Synthesis Function:** Expert Choice combines all of the priorities to arrive at an overall ranking of the alternatives.

- **Perform Sensitivity with Sensitivity Graph:** After synthesizing, sensitivity analysis can be performed to determine how changes made to one or more judgment weights affect the final priorities. ECPro offers five types of sensitivity analysis, a Windows clipboard editor, a facility for creating customized reports, a complete hierarchy generator, a questionnaire generator, and an enhanced information screen editor with multimedia support.

Use ECPro to Incorporate Transformed Guidelines

Since transformed guidelines from Sun Tzu's The Art of War can be a supporting tool for manufacturers' decision-making, it is desired to combine Sun's non-quantitative guidelines with some quantitative decision support systems, such as ECPro, to provide a convenient, quantitative application method.

Among the seventeen guidelines that have been transformed into applicable format for manufacturers' decision-making, two of them provide hierarchical structure that can easily be combined with the ECPro. They are:

Guideline No. 2 The art of competition, then, is governed by five constant factors, to be taken into account in one's deliberations, when seeking to determine the conditions obtained in the field. These are:

i. Business ethics;

ii. Business environment;

iii. Mundane reality;

iv. The manager;

v. Policies of the business.

Guideline No. 3 The manager stands for the virtues of wisdom, sincerity, benevolence, courage, and strictness.

With the second guideline listed above, a business executive selection process is developed with ECPro as following:

- Create the Decision Model:

  Goal: Business Executive Selection

  Let: A = Wisdom, B = Sincerity, C = Benevolence, D = Courage, E = Strictness.

  With ECPro, the decision hierarchy is structured as:

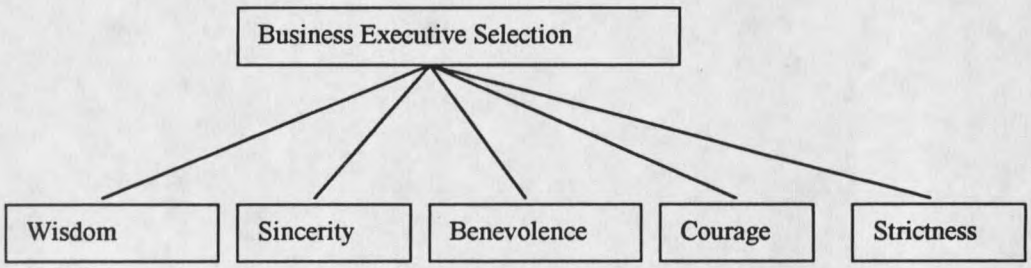


Figure 11: Hierarchical Structure for Business Executive Selection

- Pair-wise Compare: According to ancient Chinese custom, the most important factor comes first in the list, the least important is last. Therefore, pair-wise comparison result might be prioritized as:

						Priority weights
	A	B	C	D	E	
A	1	3	4	5	6	0.470
B		1	3	4	5	0.262
C			1	3	4	0.144
D				1	3	0.079
E					1	0.045

- Inconsistency Ratio as calculated with ECPro:

  Inconsistency Ratio = 0.07 (< 0.10)

  As the Inconsistency Ratio is less than 0.10, according to Satty, the pair-wise comparison result is consistent.

- Suppose there are two candidates for the selection, the hierarchical structure of the problem can be:

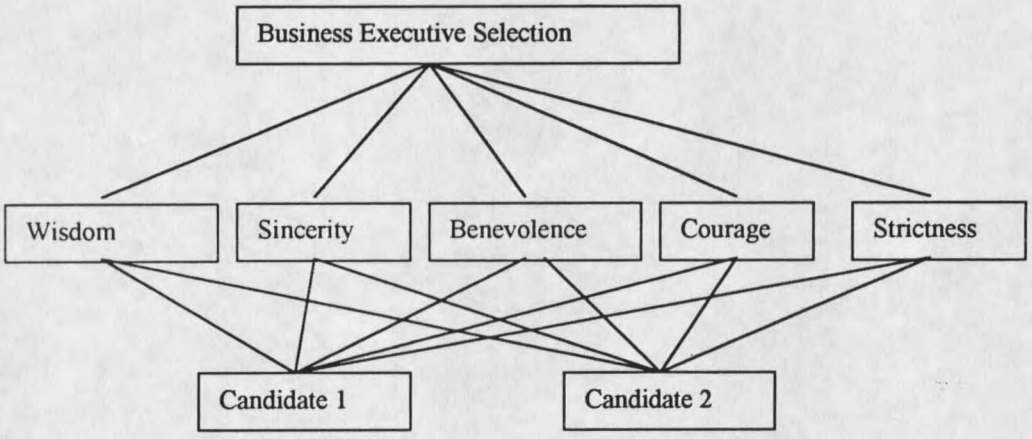


Figure 12: Hierarchical Structure with Two Candidates

	A	B	C	D	E	Measure
Candidate 1:	1	5	3	3	7	0.532
Candidate 2:	3	1	1	1	1	0.468

(1:1 = equally preferred; 3:1 = moderately more preferred; 5:1 = strongly more preferred; 7:1 = very strongly more preferred; 9:1 = extremely more preferred)

The pair-wise evaluations as illustrated can come from different sources such as statistical analysis or investigative reporting.

Given the evaluations, ECPro provides the measures for the candidates as above.

- Because Candidate 1 has a higher measure, it is superior according to the AHP method.
- Sensitivity Analysis: Suppose the pair-wise strictness evaluation varies from 7:1 to 3:1, then the measures become 0.529: 0.471. Candidate 1 remains a better choice.

Also, this method can be applied to situations with more than two candidates, as well as Sun Tzu's guideline No. 2.

It can be seen that the DSS software ECPro, based on AHP method, can incorporate guidelines from The Art of War and provide useful suggestions for manufacturers' decision making, such as executive selection and competition analysis.

CHAPTER 9

CONCLUSIONS AND LIMITATIONS OF THE STUDY

Conclusions

In this research, the difference between business competition and war was carefully compared. War guidelines from The Art of War, which can be applied to manufacturing decision-making, were transformed into applicable guidelines.

1. Based on ideas of The Art of War and the evolution of Japanese post-war manufacturing, it was concluded that the competitive edge is a moving target for all manufacturing companies.
2. The current successful manufacturing formats, such as Lean, JIT, Gradual Improvement, are not panaceas for competitive-edge manufacturing. The conclusion was supported by the experience of successful companies like Volvo Co. and Hong Kong watchmakers with a counter-example method. Therefore, every business should strive to gain the competitive edge by shaping a strategy according to its unique situation.
3. Manufacturing companies that apply The Art of War in their decision processes were successful. Also, typical manufacturing examples were summarized to support and

exemplify the essence of Sun's book. With scientific method of knowledge acquisition, it was concluded that the transformed guidelines are a useful aid for strategic-decision making.

Finally, guidelines from The Art of War were structured as an IDEF0 process which can be combined with specific manufacturing techniques, thus making readiness for application. An example was given to describe how to combine Analytic Hierarchy Process with the transformed guidelines to assist manufacturers in decision-making.

Limitations of the Study

Real practice requires a thorough understanding of the essence of The Art of War; it was only partly represented by the selected guidelines. However, the structure of The Art of War illustrated in this research can be an aid for further study of Sun Tzu's ideas. More real life applications in manufacturing will further enhance the idea that the book can be an aid for their decision-making.

Also, due to the author's limited skill in psychology, the detailed intuitive process by which decision-makers obtain hints from The Art of War cannot be delineated further. However, there may be another hindrance: the wisdom of human beings is not always transferable.

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