國 立 交 通 大 學

管理學院碩士在職專班管理科學組

碩 士 論 文

半導體設備產業之企業評價與經營績效分析
- 以 Lam Research Corporation 爲例

Business Valuation and Performance Review
Of Semiconductor Equipment Industry
- An Example on Lam Research Corporation

研 究 生：黃 國 強

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摘要

本研究主要是以經濟附加價值(Economic Value Added)理論對美國的兩家半導體設備供應商作經營績效分析，並求得其企業價值。

其中 Lam Research 爲一專攻於蝕刻設備之供應商。市場佔有率近年來大有提昇，並且於整體半導體設備銷售額排名中，也由2004, 2005的第七名，上升至第五名。而 Applied Materials 則是一跨足半導體設備各領域之全球最大供應商，其在本產業中的龍頭地位幾乎不容挑戰。

由於兩家公司皆爲美國上市公司，故可藉由公開之財務資訊，進行各項經營績效指標分析。整個研究分析過程以 Lam Research 爲主要個案公司，並輔以 Applied Materials 作爲標竿比較之企業。就各項營運績效之指標分析，探討Lam Research營運績效改進之原因。

研究結果發現Lam Research在ROIC-WACC差值及Invested Capital Turnover等衡量經營績效的參數上，均較Applied Materials爲優。評價結果顯示市場似乎有低估Lam Research股價的現象。Lam Research經營績效之好轉，則與其產品市佔率提升、良好之裝機及保固服務管理、稅務策略之最佳化、非核心業務之外包等有直接關係。本研究對於Lam Research之未來發展策略，則提出鄰近市場開拓、積極併購以提昇綜效、強化知識管理及保留人才和資本結構的最佳化等建言。

關鍵字：經濟附加價值，半導體設備，經營績效，企業評價，策略

Business Valuation and Performance Review
Of Semiconductor Equipment Industry
- An Example on Lam Research Corporation

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Abstract

This thesis is to do business valuation for two American semiconductor equipment suppliers by using the method of EVA (Economic Value Added).

Lam Research Corporation, a company mainly focusing on etch tools, has been gaining market shares for the past years. While Applied Materials, the biggest player in this industry since 1992, has been maintaining dominant positions in most of the segments.

Operation efficiency analysis and business valuation is conducted through the publicized information. We consider Lam Research as our main case while use Applied Materials for benchmarking purpose. Various operation efficiency parameters are compared to find out the cause of Lam Research's performance improvement.

The study finds that both ROIC-WACC spread and Invested Capital Turnover of Lam Research are better than those of Applied Material. It is also found that the market price of Lam Research stock seems to be undervalued. The causes of how Lam Research improved its operation include the market share gain, sound installation and warranty management, optimization of its tax strategy, outsourcing of

non-core activities. We also provides our recommendations for Lam Research's future strategies which include adjacent market engagement, aggressive merge and acquisition, improve knowledge management and people retention and optimization of its capital structure.

Keywords: Economic Value Added, Semiconductor equipment supplier, Operation Efficiency, Business Valuation, Strategy

Acknowledgements

Finally I am writing this, after these long years. MBA degree is always my dream. I was always hoping that it can open me the door to the exciting new world that probably can satisfy me more than what I am currently in. Although it takes me 5 years, this is really my own choice. I went through all these different concentrations from finance to entrepreneurship to organizational studies and then back to finance again. Throughout this journey, it did open my eyes, in a big way.

Thanks to Dr. Wang, my advisor, who is so excellent at transforming an engineering background student into one who can possibly complete this study.

Thanks to YR, my boss, who give me so much guidance and encouragement for my job. I would not be able to bring back my confidence and do what I am doing. Thanks to Joe, who is so considerate all the time and adamant to support me getting this last step, this thesis, done.

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I appreciate it so much that I have you. I will not be able to get this dream come true if it were not you. Thank you.

Best regards,

Kuo-chiang Huang

June, 2007

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Chapter One: Introduction

1.1 Research motivation and goals

High technology industry is full of vigor and energies. It helps to drive the advancement of mankind wealth fare and provides constant new excitement to us. Thanks to those numerous scientists, engineers, together with the entrepreneurs, and managers that work together and turn their wisdom and sweat into the sweet fruits that finally benefit all of us.

Certainly among these high tech arenas, semiconductor industry is one big chuck of it. Ever since integrated circuits were invented in 1959, each year so many new devices were invented and commercialized. The speed of growth is so astonishing that we suddenly enter a new era. As cited by Marry Bellis, Jack Kilby, the inventor of Integrated Circuits, puts it “What we didn’t realize then was that the integrated circuit would reduce the cost of electronic functions by a factor of a million to one, nothing had ever done that for anything before” Also from Moore's Law, the empirical observation made in 1965 that the number of transistors on an integrated circuit for minimum component cost doubles every 24 months. Both the capability of shrinking in its size and doing more complex circuitry design get us more and more power electronic appliances and gadgets. The applications are basically everywhere in our daily life. Mobiles phones, notebook computers, car electronics, stereos, TVs, digital cameras, computer servers, even the internet services boom is based on the maturity of IC industry in a way. Also there are some other businesses like thin film heads, MEMS (Micro-Electro-Mechanical System)and 3DIC packaging which are gaining their share of popularity. In 2007, the value of all these sectors totaled $267.3 billions. (Mark LaPedus)

Semiconductor equipment industry is part of the foundation of IC industry. It

enables the technologies to manufacture these IC chips and make it affordable to the folk people. It works hand in hand with the semiconductor fabs and provides the manufacturing equipments needed. Reviewing the history, it has went through the path from the original 5 inches, 6 inches, 8 inches and finally 12 inches wafers now.

Applied Materials, kept its championship since 1992, is the market share leader in this wafer fab equipment (WFE) industry. This giant is competing in almost every single module of this industry. Although of its glorious history and great success, profitability and operating efficiency were not so impressive in the past several years. Lam Research Corporation on the other hand, which has spent most of its years in etch business, was gaining momentum in the past several years. It seems that the management has been doing the right thing in converting this company from an ordinary to an extraordinary one. It is interesting to have a more in-depth analysis on how things were going on for these two companies and why this was happening.

The goals of this thesis consist of the following:

1. To analyze the operation effectiveness, efficiency and business valuation of these two companies through the EVA method.
2. Come out an analysis on how Lam Research went through the past five years and achieved the changes.
3. Based on the business valuation view point, formulate the recommended strategies of these two companies' future development.

1.2 Research Method

The research method this study adopts is Problem Resolution Research Method (朱浤源). This method is aiming at finding a solution to a problem raised. The procedure of this method is as the following:

1. Problem development
2. Define the range and boundary of the problem
3. Analyze the problem deeply
4. Search for a solution for the problem

This thesis is an analysis of Lam Research Corporation and Applied Materials based on EVA (Economic Value Added) and MVA (Market Value Added) theories so that the problems raised-the valuation of them, how these two companies changed for the past years and how to move on-could be answered. The data used were from the public financial reports (U.S SEC filings Form 10-K) from Fiscal Year 2002 to 2006. After obtaining the EVA values of these past years, a regression method is then used to forecast future years' EVA. Discounted cash flow concept is used to get MVA and then the stock price.

Based on the decomposition of EVA, a trend analysis could be conducted for Profit Margin and Invested Capital Turnover. These two indexes could then be further decomposed to get to the bottom and see exactly what items contributed the change of EVA. This helps to answer the question about what has caused the changes for these two companies.

Finally we can then propose our recommendations for the future development of these two companies based on our understanding of how they perform in each area of the operation and also the industry trend.

1.3 Research structure

This thesis is divided into six chapters. Please refer to the following and Figure 1-1 for a brief introduction:

Chapter One: Introduction

This is consisted with the research motivation, goals, research method and structures.

Chapter Two: EVA theories, literature survey and method

Firstly we will have an introduction of EVA theory. This is followed by a literature survey. Detailed definitions of the EVA constituents are given. These will include NOPAT, Invested Capital and WACC. The procedures of calculating MVA and Corporate Value via EVA is also discussed

Chapter Three: Industry Analysis and Introduction to companies discussed

A current status review of semiconductor equipment industry is presented together with the trend analysis. We will also give background information of the two companies involved in this study. This will hopefully enhance readers' understanding of these two companies and better facilitate the discussions going forward.

Chapter Four: Operation Effectiveness and Efficiency Analysis

EVA theory will be used to analyze these two companies. It is then followed by a side by side comparison. Comments on these different indexes will be given at the end.

Chapter Five: Business Valuation Analysis

A brief introduction of regression method will be given first followed by a discussion of some commonly used prediction methods for business valuation. Finally we proceed to do calculation on the business values, stock price, together with the sensitivity analysis on its dependent variables.

Chapter Six: Conclusion and Suggestions

A conclusion is made based on this study. The limitation and restrictions of this study is then discussed. Recommendation for future researchers will also be lay out.

The flow chart of this study

Formation of Research Problems and Goals

Research Method and Procedures

Literature review

Industry analysis and economic environment study

Introduced to the companies

EVA Calculation of the companies

Comment on the operation performance

Business Valuation

Conclusion and Recommendation

Source: from this study

Figure 1-1: Flow Chart of this study

Chapter Two: EVA theories and literature review

In this chapter, we will have an introduction of the EVA theory, review of literatures, EVA calculation, the concept of MVA and how to calculate company value with EVA via EVA theory.

2.1 Introduction to EVA theory

Economic Value Added (EVA) is used for measuring the excessive return that an investment or a company can generate over the opportunity cost of capital. This is the difference between the net operation profit after tax (NOPAT) and its weighted average cost of capital (WACC). This method has gaining its popularity recently. It is considered as an important index of companies' internal operation efficiency and a reference of managerial accounting decisions besides traditional accounting profit. It can also be used by the investment community to make investment decisions. Some people even suggest replacing the usage of accounting profit by EVA.

The method of EVA is proposed by a New York based global consulting company Stern Stewart & Co. in 1989 and registered as a trade mark. There are already more than 300 companies which are using it as an index of internal operating efficiency. It is advocated that the performance of these companies is better than that of other companies which did not implement this method. One of the benefits of using EVA is that it provides simple concepts for those who do not have a solid background on finance so that they can still easily utilize it.

The traditional method in measuring companies' performance is through indexes like Net Income or Earning Per Share (EPS) governed by General Accepted Accounting Principle (GAAP). But Net Income only considers interest cost of debts while neglecting the Cost of Equity which is the cost of shareholders'. On the contrary, EVA does get both considered. At the same time, due to that the accounting

principle has its restrictions on how to get depreciation, R&D expenses, and deferred income tax settled; this may affect the accuracy of deciding how the company is operated, and therefore cause the Principle-Agent Problem. While if EVA is used for the evaluation of company performance, via the adjustment of accounting items, the actual company profit can be calculated, and the value created is correctly reflected. This can be used to objectively manage employees' compensation package, too.

Actually, EVA is not a new concept. It is similar to what economists' long time thinking as "economic profit" or "economic surplus"(Stephen Keef). Economists think that company's net operational profit must exceeds its cost of capitals (including debts and equities), it is then worth the risk of this investment. By only having excessive profit, companies can then accumulate wealth, creating reasonable return to their shareholders. It is just that until recently, there is a way to measure economic value added, and then combine with the employee Incentive Compensation System. Since this concept is easy to understand, if companies can adopt this methodology accurately, it could then link the interests of managers and shareholders. The measurement of operation efficiency will then not get affected by the changes of accounting principles. It also leaves no room for manipulation. And the company performance measurement will then be based on real economic profit generated. This in term is to benefit the shareholders, which is in lined with the goal of the managers whose bonus is depending greatly on the economic values they help to create. Managers will hopefully no longer be interested in manipulating Earnings Per Share (EPS), Return On Net Asset (RONA), or Return On Investment (ROI). When managers are finally aligned with shareholders on their goals, the internal conflict inside companies can thus be greatly reduced, and hence eliminating the so called Principle-Agent Problem. For line managers, since it starts with the familiar operating profits and simply deducts a charge for the capital invested in the company as a whole,

in a business unit, or even in a single plant, office or assembly line. By assessing a charge for using capital, EVA makes managers care about managing assets as well as income, and helps them properly assess the tradeoffs between the two. This broader, more complete view of the economics of a business can make dramatic differences.

Hence, the concept of EVA could be applied to many areas, almost including all items in long term and short term planning and controlling especially the evaluation of long term and short term performance that relates to incentive compensation system.

That is why EVA has become so popular in today's business and finance community. *FORTUNE* magazine has called it "today's hottest financial idea," and Peter Drucker observed in the *Harvard Business Review* that EVA is a measure of "total factor productivity" Financial researches also support that the correlation between EVA and corporate value is higher than the that of other financial efficiency indexes like Earnings Per Share (EPS) or Return On Equity (ROE).)

So this research will target on decoupling the EVA into different items like NOPAT (Net Ooperation Profit After Tax), Invested Capital and WACC (Weighted Average Cost of Capital) Use these items to do analysis over the target companies. And eventually, do the business valuation, comment on the strategies of future company growth.

2.2 Review of EVA related literatures

1. Stern (1993)

Joe Stern from Stern Stewart constructed a system that claimed to correctly evaluate business performance. This system stressed that a business can only create value for its shareholders while it earns higher return than the cost of invested capital. So Economic Value added is a technique to measure whether a business could create higher value than its invested capital in a certain period of time. This is different from

the general accounting measures like Revenue, Cash flow or Dividends.

To avoid the distortion from GAAP rules, consultants from Stern Stewart & Co. have given recommendations to add back change in Equity Equivalents.

2. Tully (1993)

EVA correlates with stock price highly. Also there are three ways for business to increase its EVA:

(1) Increase operation profit while keeping the invested capital fixed.

(2) Try to maintain similar level of operation with lower invested capital.

(3) Invest capital to those projects that can earn higher returns than its cost.

3. Lehn & Makhija (1996)

A study using the 241 U.S. public companies' financial data of 1987, 1988, 1992 and 1993 showed that return on stock has higher correlation with EVA than other conventional performance evaluation indexes like ROA (Return on Asset), ROE (Return on Equity) and ROS (Return on Sales).

4. Chen and Dodd (1997)

A study using the 566 public companies' financial data of 1983 to 1992 showed that return on stock has higher correlation with EVA than other indexes like EPS (Earning per Share) and ROE (Return on Equity). But the R squared value of EVA is 0.202, is about comparable to that of Residual Income (0.194).

5. 張耿豪 (1997)

86 companies listed in the Taiwan Stock Exchange are used as research sample. The studying periods are from 1993 to 1997. The sample is further divided into several subgroups by their sizes and industries. The regular regression analysis is first applied to examine the explanatory power of each of the variables to the concurrent stock returns. Then the Information Coefficient Method is used to examine the information content of each of the variables. Results from the information coefficient analysis

strongly support the view that the EVA indeed carries more information content than that of CFO, Earnings, and RI. For the overall and every subgroup, the EVA outperforms other measures in predicting the performance of stock returns. However, the results from the regression analysis show that it is inferior to that of RI.

6. Robert Ferguson, Joel Rentzler, Susana Yu (2005)

This article uses event study methodology to investigate whether firms adopt EVA system leads to better stock performance (greater profitability). There is some evidence that EVA adopters experience increased profitability relative to their peers following adoption.

7. Chikashi Tsuji (2006)

EVA is compared with several other valuation measures including cash flow, operating income, and profit after tax from the viewpoint of both levels and changes. Also two different forms of EVA are examined by using the Weighted Cost of Capital (WACC) from the Capital Asset Pricing Model (CAPM) and the WACC from the Fama-French (1993) model. The results reveal that corporate market values in both levels and changes have stronger linkages with cash flow and other earnings measures than either form of EVA.

8. Wajeeh Elali (2006)

Two commonly used value-based performance metrics - namely, Total Shareholder Return (TSR) and Tobin's Q - were also considered to highlight the value-relevance of EVA vis-a-vis these measures in predicting shareholder wealth. Using a panel sample of about 1000 American firms over the period 1990-2002, the study found compelling evidence consistent with the notion that EVA outperforms other traditional performance measures in explaining shareholder wealth. Value-relevance tests reveal EVA to be more highly associated with shareholder wealth than TSR and Tobin's Q. The incremental value-relevance tests have also suggested that EVA possesses the

largest explanatory power over TSR and Tobin's Q. These results conclusively support the claims made by EVA proponents and further support the potential usefulness of EVA metric for internal and external performance measurement.

9. Ralph Palliam (2006)

108 companies were analyzed with data ranging from 1998 to 2002. Among them 75 are EVA users and 33 are non-EVA users). EVA corporations do not necessarily have superior stock returns. Simple correlation between accounting earnings provides a reasonable reliable guide to the movement of stock prices. Furthermore, the study found minimal evidence of a difference between the market returns of firms that use EVA compared to firms that do not use EVA.

From the review of these articles, it is found that there are some supporters (**Tully (1993), Lehn & Makhija (1996), Chen and Dodd (1997), 張耿豪 (1997), Elali (2006))** asserting that EVA is better than other indexes at predicting stock price movement; but there are also some other researchers (**Tsuji (2006), Palliam (2006))** found that this is not the case. Also there is study (**Ferguson, Rentzler & Yu (2005))** suggesting that the EVA adopters experience increased profitability relative to their peers following adoption.

So although it is remianed argumentative whether EVA is fully proven to be the best measurement of companies' capability of creating shareholders' wealth, but it seems that its advocators are gaining better position.

Here are some comments/questions for Tsuji's and Palliam's articles. For Tsuji's, is it possible that Japan's investment community is less aware of the concept of EVA so that they follow the old ways of investment, which is looking at the performance of conventional performance metrics? So it may be natural that they the conventional metrics can beat EVA. As far as Palliam's work is concerned, is it possible that it

contains one big incident which is the dot com bubble so that the stock price has deviates too far from the real value it should be?

So the author concludes EVA to be no worse than other measures and that is the reason why it is chosen as the method for this study.

2.3 EVA calculation and its standardization

2.3.1 EVA Calculation

EVA is the difference between the Net Operation Profit After Tax and Weighted Average Cost of Net Capitals used. The Equation used(Stewart) is:

$$= \frac{NOPAT_t \times InvestedCapital_{t-1}}{Invested\ Capital_{t-1}} - (WACC \times Invested\ Capital_{t-1})$$
$$= (ROIC_t \times Invested\ Capital_{t-1}) - (WACC \times Invested\ Capital_{t-1})$$
$$= (ROIC_t - WACC) \times Invested\ Capital_{t-1}$$

Among them

NOPATt: It is the abbreviation of Net Operating Profit After Taxes.Net means that various kinds of accounting distortion is deducted.

WACC: It is the abbreviation of Weighted Average Cost of Capital.

Invested Capitalt-1: This is the invested capital at the end of term (t-1) or the beginning of term t.

WACC x Invested Capitalt-1:This is the cost of invested capital at the beginning of term t.

ROICt： This is the abbreviation of Return on Invested Capital.

From the equation of EVAt = (ROICt–WACC) x Invested Capitalt-1, we learnt that business can only increase its value under the situation while ROIC is greater than WACC. That is to say, only under the circumstances of positive EVA can company generates excessive return and brings positive value to its shareholders. On

the contrary, negative EVA means that company can not even earn enough retune greater than the cost of its weighted capital, thus it actually brings negative value to its shareholders. In short, EVA provides information about whether the company is creating excessive return for its shareholders. So it is an explicit form of corporate values creation. The primary goal of the management team is to maximize its EVA to create biggest values for the company.

For line managers, since it starts with the familiar operating profits and simply deducts a charge for the capital invested in the company as a whole, in a business unit, or even in a single plant, office or assembly line. By assessing a charge for using capital, EVA makes managers care about managing assets as well as income, and helps them properly assess the tradeoffs between the two. This broader, more complete view of the economics of a business can make dramatic differences.

2.3.2 EVA Standardization

To eliminate the impact of company sizing on EVA value so that we can do a fair comparison between companies, we need to calculate standardized EVA. The equation is as the following:

Standardized EVAt = (ROICt – WACC) x Standardized Invested Capitalt-1

$$\text{Standardized Invested Capital}_{t-1} = \frac{\text{Invested Capital}_{t-1}}{\text{Invested Capital}_0} \times 100$$

Standardized Invested Capitalt-1 is the standardized invested capital at the end of term(t-1) or the beginning of term t.

Invested Capital_0 is the invested capital at term zero.

Standardized EVA_t= ($ROIC_t$-WACC) x Standardized Invested Capital_{t-1}

= ($ROIC_t$-WACC) x Invested Capital_{t-1}/ Invested Capital_0 x 100

= EVA_t/ Invested Capital_0 x 100

2.4 EVA constituents and the calculation method

2.4.1 Computation of NOPAT and Invested Capital

From the previous equation derived, EVA could be easily got from the simple equation. But actually NOPAT and Invested Capital are not readily available from the financial reports. From the book “The Quest for Value” by G. Bennett Stewart III, two methods were proposed:

1. Financing Approach

   This mainly comes from the Liabilities and Shareholders Equities of the Balance Sheet

2. Operating Approach

   This mainly comes from the Assets of the Balance Sheet

The NOPAT and Invested Capital derived from both approaches should be the same. Please refer to Table 2-1 and 2-2 from the details.

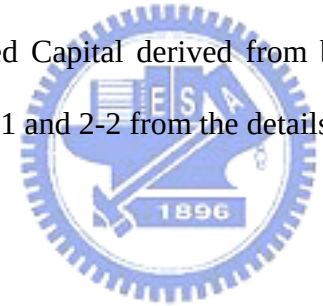


Table 2-1: NOPAT and Invested Capital (from Financing Approach)

NOPAT (by Financing Approach)	Invested Capiatl (by Financing Approach)
= GAPP Net Income	= Common Equity
+ Change in Equity Equivalents	+ Equity Equivalents
+ Capitalized R&D Expenses	+ Net Capitalized R&D Expenses
- R&D amortization	(Intangible assets)
+Capitalized Marketing expenses	+Net Cpaitalized Marketing expenses
- Market amortization	(Intangible assets)
+Non-Capitalized lease costs	+Present Value of Non-capitalized leases
+ Change in Bad Debt Reserve	+ Bad Debt Reserve
+Change in LIFO Reserve	+LIFO Reserve
+Goodwill Amortization	+Cummulative goodwill amortization
+ Unusual loss (Gain) after tax	+Culmulative unusual loss (Gain) after tax
+Change in deferred tax liabilities	+Deferred tax liabilities
+Dividend on Preferred Stock	+Preferred Stock
+Minority Interest Provision	+ Minority Interest
-Investment and Interest income	+ Short-Term Debt
+Tax paid on investment and interest income (effective tax x investment income)	+ Current Portion of Long-Term Debt
+ Interest expense	+Long-Term Debt
- Tax shield from interest expense (effective tax rate x interest expense)	- Marketing Securities & Construction in Progress

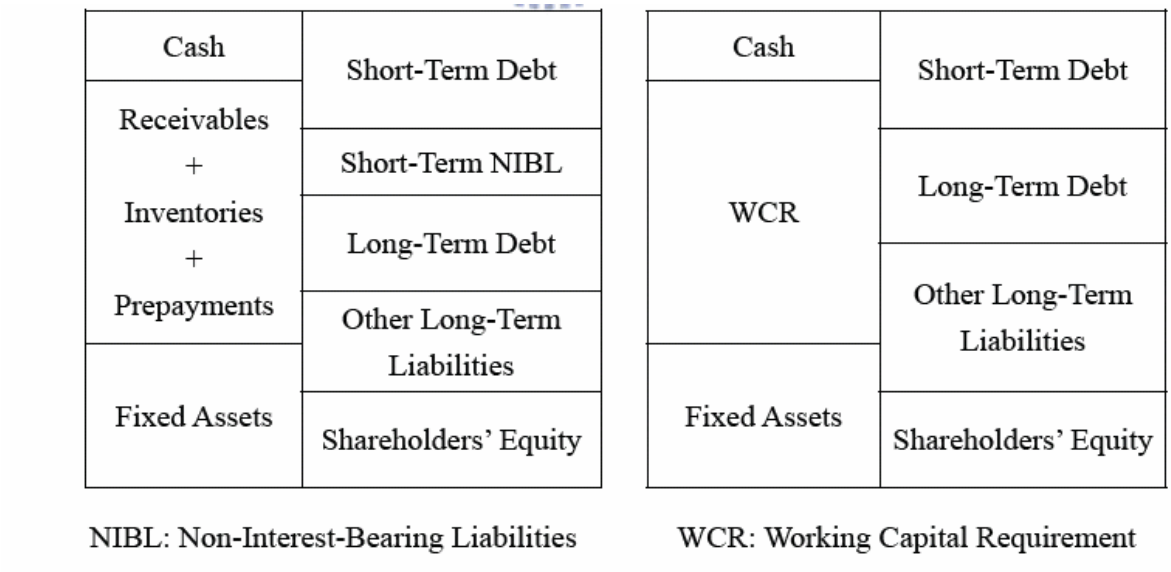
Source: G.Bennett Stewart,III.

Table 2-2: NOPAT (from Operating Approach)

NOPAT (by Operating Approach)	Calculation on Cash Operating Tax
= Sales Revenue - Cost of Goods Sold - Depreciation -Sellinng General & Administration + R&D Expenditures + Interest Expense on Non-Cpaital Lease +Change in LIFO Reserve + Other Income ---------- NOPBT (Net Operatin Profit before Tax) - Cash Operating Taxes ---------- = NOPAT	= Income tax provision - Change in deferred tax laibilities +Tax aving from Net Interest Expense (effective tax rate x net interest expense)

Source: G.Bennett Stewart,III.

Comparing the Regular Balance Sheet and EVA Balance Sheet below in Figure 2-1, we can find that the main difference between these two is that in EVA's Invested capital, NIBL (Non-Interest Bearing Liabilities) is not included. These Non-Interest Bearing Liabilities are accounts such as accounts payable and accrued expenses, that arises as spontaneous sources of financing in the nature course of business and which eliminate the need to raise permanent capital. The rationale for excluding them from capital is that the financing costs associated with paying suppliers and employees with some delay are incorporated in the cost of goods sold, and nothing is to be gained by extracting them from earnings.(G. Bennett Stewart, III)



Source: S. David Young, Stephen F. O'Byrne, EVA and Value-Based Management

Figure 2-1: Comparing the Regular Balance Sheet and EVA Balance Sheet

WCR (Working Capital Requirement) = Receivables + Inventories + Prepayments- Short-Term NIBL

Where Net Asset = Cash +Working Capital Requirement + Fixed Asstes

And Invested Capital = Short-Term Debt + Long Term Debt + Other Long Term Liabilities + Shareholders Equity

RONAt = NOPATt/ NetAssett-1

ROIC= NOPATt/ Invested Capital t-1

RONA=ROIC since Net Asset= Invested Capital

2.4.2 Computation of WACC

WACC (Weighted Average Cost of Capital) is the weighted average cost of all sorts of capitals that were used for a project (or a business). The importance includes the following:

1. It is used as the discount rate for future cash flow of a corporation for the purpose

of its evaluation. For the investors of this corporation including Bondholders and Shareholders, this is a Required Rate of Return that is a compensation for the risk they take for the investment. So naturally, this return rate will be different for different industries, different companies or even different projects within the same companies. So the cost of an investment is really dependent on the risk level of that project, or more specifically, on where the money is spent, in stead of where the money come from. So the overall cost of a company's capital is a reflection of the required return of its overall asset. So for a company that uses different sources of capitals that required different levels of return, the cost is computed by using their weighted average of all capitals.

2. The source of capitals

Since there are two forms of capital sources: debt and shreholders' equity, so the cost of capital is a function of the cost of each capital. The weighted averaged cost of capital (WACC) is thus defined:

WACC= D/(D+E) x Kd (1-Tc) + E/ (D+E) x Ke

Where Tc is the tax rate of the company, so debt has its effect of tax saving

D: the market value of interest baring debt. Usually it is estimated by the book value of the interest baring debt

E: the market value of a company's equity. E= Outstanding shares x Share price

Market Value of a company= E+D

Kd= cost of interest baring debt= interest expense / Average interest baring debt

= (interest expense x2)/ (interest baring debt at the beginning of a term + intrest baring debt at the end of a term)

Ke= cost of equity= Rf+ β (Rm-Rf) = risk free return rate + β x risk premium of the investment

From the calculation of WACC, it is observed that the weighting of each source of

capitals impact a lot to the magnitude of WACC. So the capital structure of a company (equity to debt ratio) is crucial and needs to be optimized for each specific company.

Each company has its own combination of debt, preferred stock and common stocks to get its WACC reaching the lowest and stock price reaching the highest. This combination is called the target capital structure. So a sensible company which is pursuing the maximum value will try to raise the capitals in a way that it won't deviate from the optimized capital.

2.5 The computation of MVA

The ultimate goal of a corporate operation is to increase its shareholders' wealth. This could only be achieved by increase the difference between a corporate's market value and its cost of capitals. The difference is called Market Value Added (MVA).

MVA= Market Value of a corporate- Total Invested Capital

So the higher the MVA is, the bigger the shareholders' wealth become. This is all about how to manage the limited resources within a company so that the EVA is optimized.

MVA= Outstanding shares x Stock Price + Market Value of Preferred Stock + Market Value of Debt – Invested Capital

Usually we assume that the market value of Preferred Stock and Debt equal to their book values for the purpose of simplicity. So the above equation becomes:

MVA= Outstanding Shares x Stock Price – Book Value of Equity

MVA per share = Stock Price – Book Value of Equity/ Outstanding Shares

So MVA, Stockholders' wealth and stock price change at the same direction. When MVA is positive, it means that the company is creating wealth for its shareholders so the stock price will go up. On the contrary, if the MVA is negative, shareholders' wealth is destroyed and thus the stock price will go down. But since stock price is

investors' expectation on company's future performance instead of current performance, so the correlation among these three parameters may not be that trivial in real case.

Stern Stewart & Co. considers EVA as a measure for company's stock price through empirical study. EVA is for only one term, while MVA is the accumulation of EVA under the assumption of continual operation. So

Expected MVA = Present Value of Future Expected EVAs.

If the EVA of a specific year is positive, it means that the company can continue to create economic profit after the cost of invested capital is deducted. So MVA gets increased also. If the EVA of a specific year is negative, it means that the company destroys economic profit through its operation. So the market value of the company decreases and MVA drops. This is to say that the changes in EVA have a strong correlation with the change of MVA.

2.6 Company Valuation through EVA computation

A company's value could be calculated by adding the original invested capital to all future EVA together with each term discounted to its present value by a discounted rate of WACC. This could be expressed by the following equation:

Company Value= Invested Capital + Present Value of future Expected EVAs

$$= \text{Invested Capital} + \sum_{j=1}^{j=\infty} \frac{EVA_j}{(1+WACC)^j}$$

Under the assumption of continual operation, usually a company can enjoy higher growth rate and profitability at the beginning several years. After this relatively higher speed of growth, the company may enter a more matured stage when the growth rate and the profitability is relatively stable. So we can use this kind of two stage concept for predicting a company's future EVA which are:

Stage one: During Explicit Forecast Period and

Stage two: After Explicit Forecast Period

Usually the first period lasts for 3 to 5 years, depending on different industry. But of course the duration of this period can also depend on the actual growth rate. For example, a higher growth rate may possibly extend the duration of this period.

Company Value = Invested Capital + Present Value of EVA During Explicit Forecast Period + Present Value after Explicit Forecast Period.

During Explicit Forecast Period

The financial reports like Balance Sheets and Income Statements should be forecasted explicitly and thus EVA of each year could be calculated explicitly. Then WACC could be used as the discounted rate to calculate the present values.

$$\sum_{j=1}^{j=T} \frac{EVA_j}{(1+WACC)^j}.$$

After Explicit Forecast Period

Continuing Value (CV, or Terminal Value or Residual Value) is firstly computed and then WACC is again used for its present value calculation. From the book Valuation by Copeland (2000), Continuing Value=

$(EVA_{t+1}/WACC)+ (NOPAT_{t+1} (IROIC-WACC) g)/ ((WACC (WACC-g) IROIC))$

Where t means the duration of the first stage

EVA_{t+1} means the EVA of the first term of the 2nd stage.

$NOPAT_{t+1}$ means the NOPAT of the first term of the 2nd stage.

g: growth rate of NOPAT

IROIC: The expected rate of return on Incremental Invested Capital

So from this we learn that we need the following conditions to have positive EVA in second stage:

1. IROIC-WACC>0
2. IR= g/IROIC>0

Chapter Three: Industry Analysis and Companies introduction

In this chapter, we will first have an introduction to the wafer fabrication equipment industry, and then the basic information, core competency and competitive strategy of the two companies, Lam Research and Applied Materials will be discussed.

3.1 Introduction to wafer fabrication equipment industry

Wafer fabrication equipment industry is an industry that builds tools for semiconductor manufacturing. The targeted customers includes INTEL, IBM, Samsung, TSMC or UMC……..etc.

3.1.1 Current Status of WFE industry and its trend.

The semiconductor and semiconductor equipment industry has enjoyed strong growth since its inception (Bob Johnson, Dean Freeman, 2005). From 1972 through the mid-1990s, the industry enjoyed revenue CAGR of 15 to 17 percent. The industry became a Wall Street darling, with very high price-to-earnings ratios as a result of the potential for strong growth. In the mid-1990s, however, there was an inflection in the growth curve. In the 1994-1995 timeframe, the long-term CAGR for semiconductor revenue dropped to a range of 10 to 12 percent. This has also affected the semiconductor equipment industry. It is found that this drop in revenue growth rate is probably related, in part, to the drop of average selling price of semiconductors. Several other issues that could also be contributing to this decline include:

- Consumerism;

Over time, and becoming more prevalent in the 1990s, the business environment for electronic products started to saturate and shifted to a market driven by replacement cycles. The industry has migrated from a supply 'push' to a demand 'pull' market, which is responding to an environment of increasing price sensitivity. Thus, the price premium segment of the market is shrinking on a

relative basis, ASPs are declining, and the long-term revenue growth trend is slowing.

- Increased competition;

In the early 1990s there was a significant increase in the number of fabless companies in the marketplace. The rise of the foundry model, with manufacturing capabilities less than a generation behind that of the IDMs (Integrated Device Manufactures), made it very simple for a company to design and then produce devices for the semiconductor market. This rapid rise of the fabless firms, along with a significant increase in the number of DRAM suppliers, led to increased competition in the marketplace, which in turn led to pricing wars for market-share dominance.

- Capital markets;

Much recent historical growth in the semiconductor market has resulted from new entrants -- mainly memory or foundry companies -- funded by offerings in the public capital markets or government incentives. However, the long down cycle has reduced the attraction of semiconductor ventures to capital markets. Thus, there probably will be few new major entrants into the industry.

- Fewer buying centers

As the industry continues to grow and mature, there are few buying centers that are available for semiconductor equipment manufactures to sell into. Foundries, the move to 300 mm, alliances and research consortiums have all led to fewer locations where semiconductor equipment can be tested out and then sold to

the market. 'Copy exact' or 'copy smartly' policies have created an environment where one toolset is sold not just to one company, but to any company associated with that consortium. Overall, these factors have in some ways made it easier to sell into the industry but have limited the number of opportunities to become a tool of record.

- The shift of semiconductor manufacturing to Asia

Since the 1980s the semiconductor manufacturing centers have been shifting. Cheap capital as a result of government incentives saw the industry move from the Americas and Europe to Japan, then Korea and Taiwan. Asia-Pacific market share based on location of production has increased dramatically, from nearly 5 percent in 1990 to approximately 30 percent in 2003.

- The pace of technology.

The pace of technology change seems to increase every year. The technology cycle moved from a three-year cycle to a two-year cycle. This has increased the pace at which the semiconductor equipment manufacturer must develop products and has extended the time period that a semiconductor equipment manufacturer must support its equipment. The industry now has 45 nm in development, 65 nm in pilot line production, 90 nm ramping, 130 nm ramping, 180 nm still running at full volume, and some capacity is still being added. Thus, an equipment manufacturer may need to support up to five different generations simultaneously with resources once needed to support only three generations of technology. This can be a significant drain on company resources.

Along with the faster-paced roadmap, semiconductor equipment manufactures are dealing with a significant number of material changes. Low-k, hi-k and metal gates along with new substrates are a few of the more significant challenges ahead. This process and product development will take a significant amount of resources to implement into the semiconductor process flow. Equipment firms will need to form alliances with the material suppliers as well as work closely with the semiconductor manufactures to succeed. Firms failing to get in on the leading edge at key semiconductor manufacturers or consortiums will fall farther behind on the technology curve.

Over the past five years the industry has been suffering from an overall lack of profitability, both for chip manufacturers and equipment manufactures. Data about net profit as a percentage of sales for the past 10 years for 32 semi-equipment makers (see Figure 3-1) shows that the industry has run a slight deficit of 1.8 percent. The total dollars picture is a bit brighter, with the industry running a slight profit of 3.3 percent from 1994 to 2003, but the industry has struggled since 1997, with 2000 being the only year with significant profits since 1997. The semiconductor equipment industry also needs to examine how to regain and then maintain profitability in the years to come.

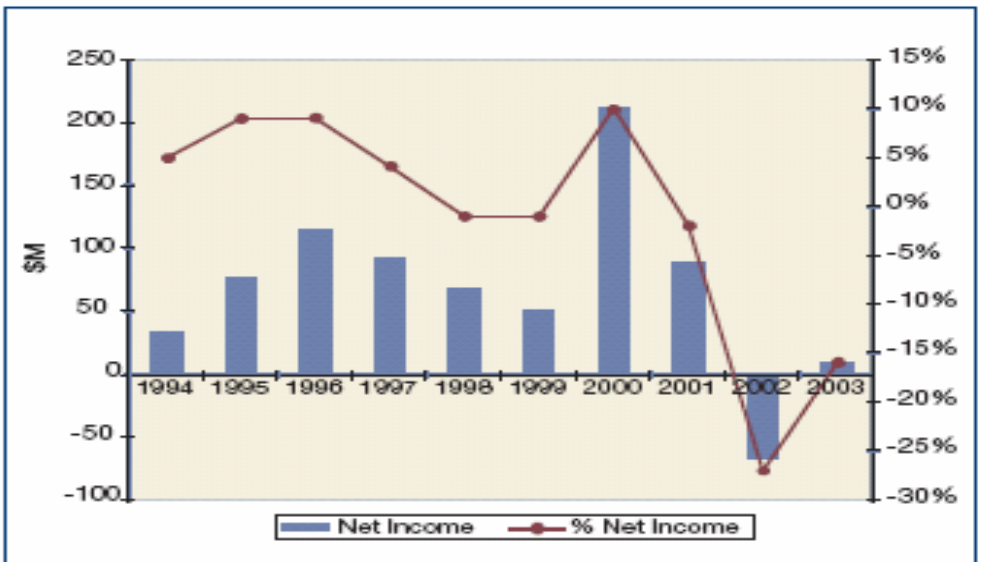


Figure 3-1: Semiconductor Equipment Companies Net Income (Bob Johnson)

As far as the revenue trend forecast, Dataquest has reported a study in Dec., 2006 for the worldwide semiconductor capital and equipment spending forecasts (See Table 3-1 below).

Table 3-1 Semiconductor Capital Spending Forecast. (Dataquest, Dec., 2006)

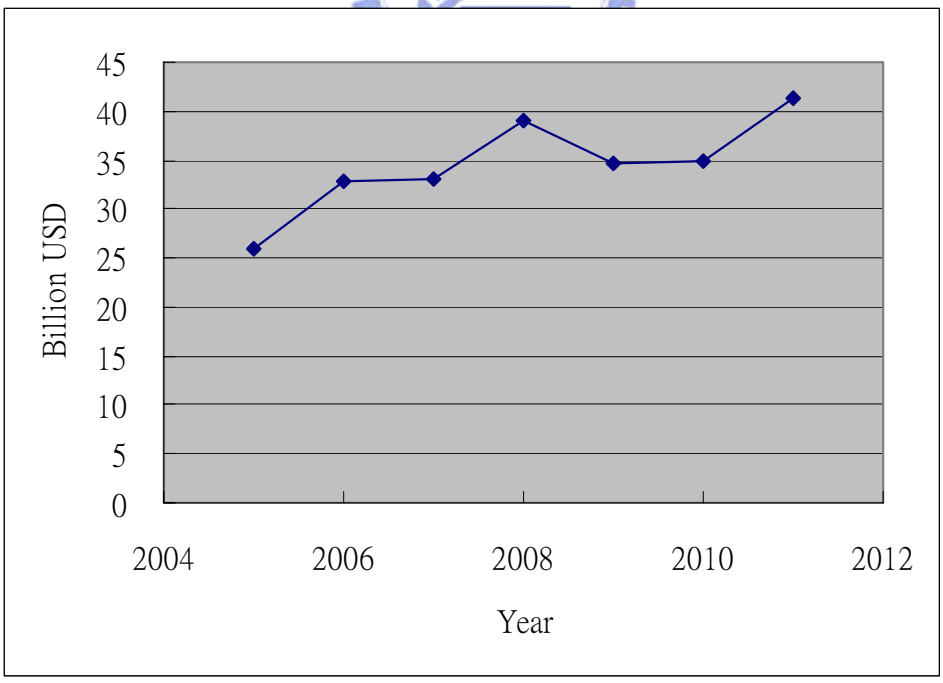
	2005	2006	2007	2008	2009	2010	2011
Semiconductor Capital Spending	47.2	56.1	56.6	65.7	60.3	58.7	68.3
Growth (%)	-3%	19%	1%	16%	-8%	-3%	16%
Capital Equipment	33.9	42.4	42.1	50.8	44.3	45.5	52.9
Growth (%)	-11%	25%	-1%	21%	-13%	3%	16%
Wafer Fab Equipment	26.0	32.8	33.0	39.1	34.7	34.9	41.4
Growth (%)	-8%	26%	1%	18%	-11%	1%	18%
Packaging and Assembly Equipment	4.20	4.83	4.56	5.74	4.83	5.10	5.79
Growth (%)	-12%	15%	-6%	26%	-16%	6%	13%
Automated Test Equipment	3.77	4.75	4.51	5.98	4.79	5.45	5.75
Growth (%)	-21%	26%	-5%	33%	-20%	14%	6%
Other Spending	13.3	13.7	14.5	14.9	16.0	13.2	15.4
Growth (%)	26%	3%	6%	3%	7%	-17%	17%

It clearly showed that Wafer Fab Equipment (WFE) is around 60% of the Semiconductor Capital Expense and almost 80% of the Capital Equipment expenditures (See Table 3-2). From this we can derive that the CAGR (compound annual growth rate) of WFE from 2005 to 2011 is 8.1% (see Figure 3-2), this is a further drops from the 10 to 12 percent in the past 10 years.

Table 3-2 Weighting of WFE expenditure as compared to total semiconductor capital Spending and Equipment Spending.

Year	2005	2006	2007	2008	2009	2010	2011
Semiconductor Capital Spending	47.2	56.1	56.6	65.7	60.3	58.7	68.3
Capital Equipment	33.9	42.4	42.1	50.8	44.3	45.5	52.9
Wafer Fab Equipment	26.0	32.8	33.0	39.1	34.7	34.9	41.4
Percentage of semiconductor CAPEX	55%	58%	58%	60%	58%	59%	61%
Percentage of Capital Equipment	77%	77%	78%	77%	78%	77%	78%

Source: From this study

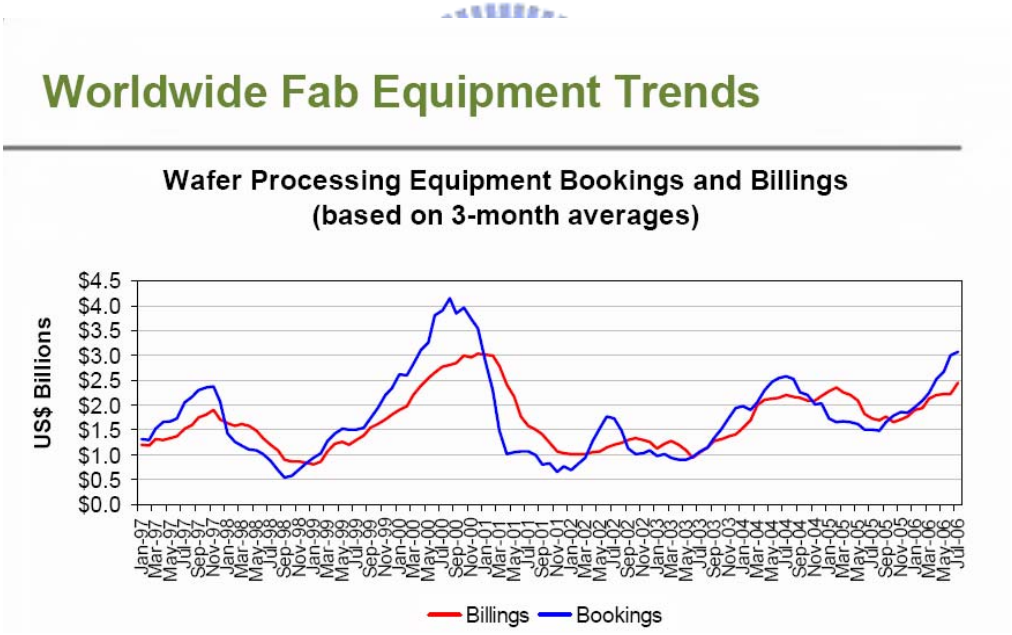


Source: From this study

Figure 3-2 WFE expenditure forecast and the linear fitting curve

So combining the two trends of decreasing profitability and slower annual growth, unfortunately we need to face the fact that this industry may not be as lucrative as before, which should be about right since this industry is around 35 years old as of today.

One other thing that worth noticing is the cyclical nature of this industry (see Figure 3-3 below). The swing of equipment booking and shipping is way bigger than that of semiconductor shipment and the peak to valley ratio can be as high as 8. So we can still conclude that this industry will continue to be exciting and risky. Proper forecasting must be made to survive this cyclical nature.



Source: Dan Tracy, SEMI Equipment and Materials Outlook, Sept. 2006

Figure 3-3: Worldwide Fab Equipment Trend

3.1.2 Targeted markets, shares and geographical distributions

The semiconductor equipment industry obviously has a global market. Worldwide billings totaled $40.47 billion in 2006(7), compared to $32.88 billion in sales posted

in 2005. "The worldwide semiconductor equipment industry resumed strong growth in 2006 as the robust memory chip market and continued transition to 300mm wafers fueled sales of manufacturing technology," said Stanley T. Myers, president and CEO of SEMI. "With double-digit gains in all market regions, the equipment industry posted annual sales second only to the extraordinary levels in 2000."

For the third year in a row, the Japanese market region spent the most on semiconductor equipment, growing almost 13 percent over 2005 to reach US$9.20 billion. N. America reclaimed the number two spot with $7.32 in equipment sales. Following closely behind N. America were the regions of Taiwan and S. Korea with spending of $7.31 billion and $7.01 billion respectively. After experiencing negative growth in 2005, the China market region grew the most in 2006, rising over 74 percent to US$2.3 billion. The Rest of World region, which aggregates Singapore, Malaysia, Philippines, other areas of Southeast Asia and smaller global markets, increased almost 30 percent. The equipment market in Europe increased 10 in 2006.

The global wafer processing equipment market segment increased 26 percent; the assembly and packaging segment grew 14 percent, the total test equipment sales increased 21 percent.

Table 3-3 2005-2006 Semiconductor Capital Equipment Market by World Region

2005-2006 Semiconductor Capital Equipment Market by World Region
(Dollars in U.S. Millions; Percentage Year-over-Year)

Region	2005	2006	% Change
China	1,327	2,315	74.4
Europe	3,262	3,595	10.2
Japan	8,183	9,209	12.5
Korea	5,826	7,014	20.4
North America	5,702	7,324	28.4
Taiwan	5,722	7,308	27.7
Rest of World	2,862	3,709	29.6
Total Regions	32,884	40,474	23.1
Source: SEMI-SEAJ			

3.1.3 WFE segments

The business of WFE market could be divided into different segments including new leading edge fab, new non-leading edge fab, new specialty fab, upgrades and end of life.(See Figure 3-4)

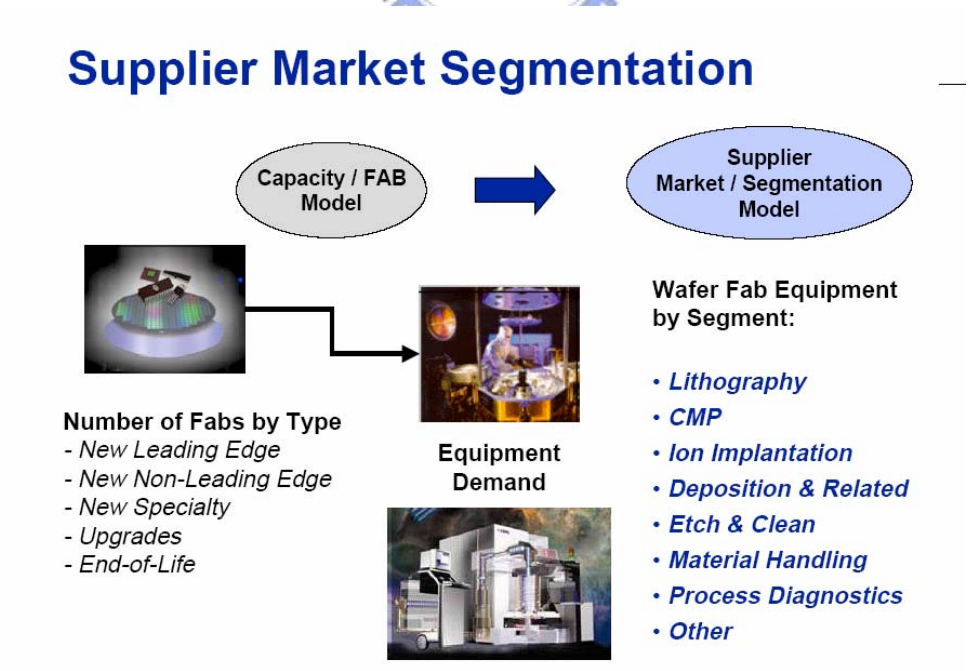
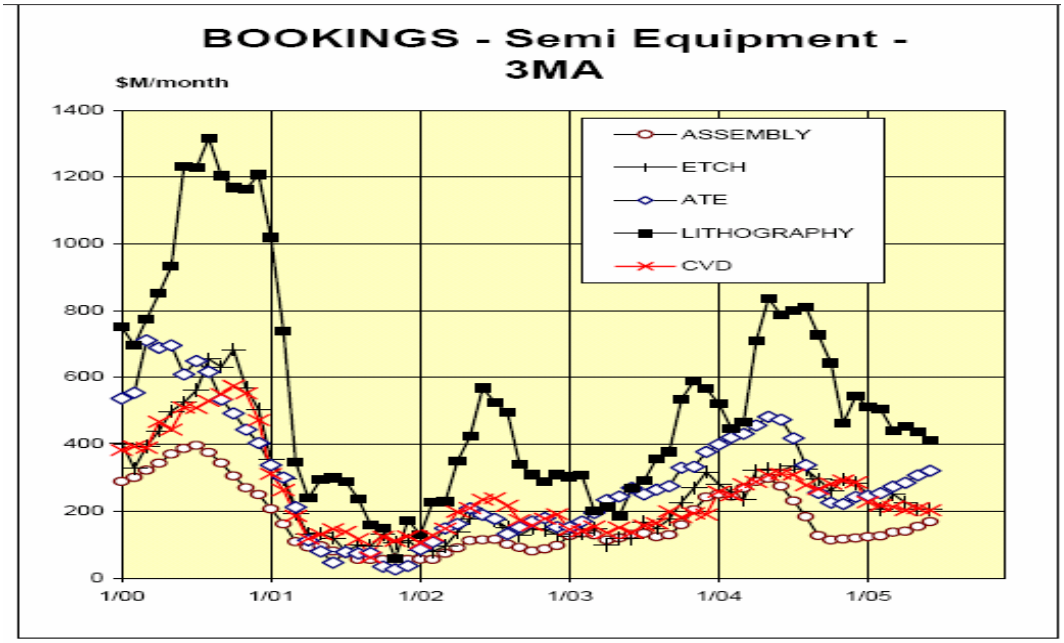


Figure 3-4 WFE market segmentation (David Anderson, International SEMATECH, Global Economic Symposium)

Among them, we can further break down the tools by into different production modules. That will include Lithography, CMP, Implant, Deposition, Etch and Clean, Diagnostics, Material Handling and others. See Figure 3-5 for billings trend and as it can be seen, the fluctuation is quite big. Find also Figure 3-6 for market share data in 1999.



Source: Advanced Forecasting, September 2005.

Figure 3-5: Bookings -Semi Equipment Billings:

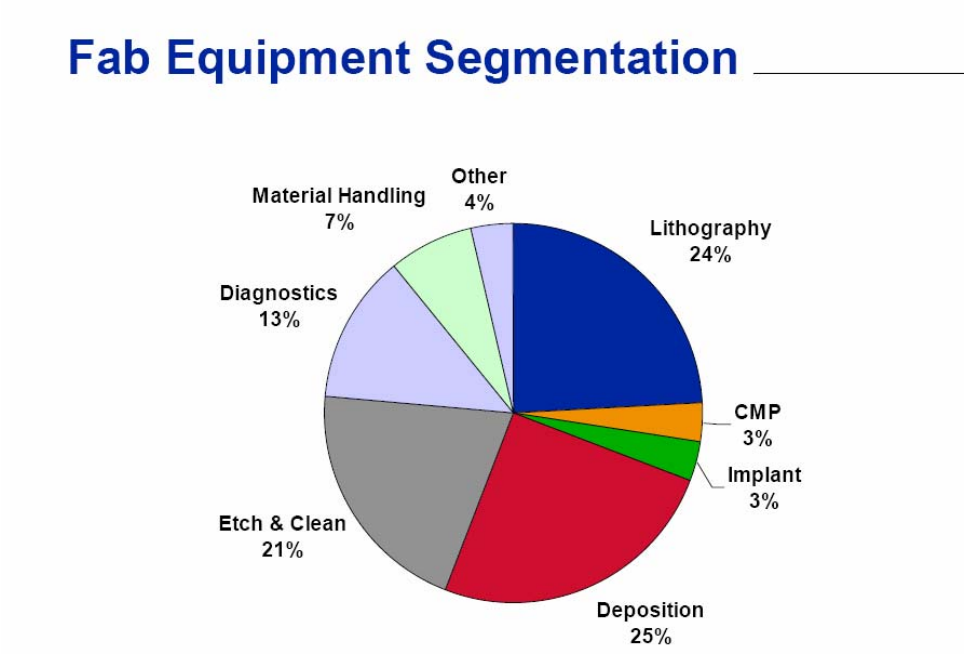


Figure 3-6: Fab Equipment segmentation by percentage (David Anderson)

3.2 Introduction to Lam Research Corporation

3.2.1 Basic data of Lam Research Co (www.lamrc.com)

Corporate Snapshot

• Founded in 1980

• Corporate offices in Fremont, CA, USA

• Approximately 2,250 employees worldwide

• 39 regional offices located in the United States, Europe, Japan, and Asia Pacific

Lam Research Corporation is a major supplier of wafer fabrication equipment and services to the world's semiconductor industry. The Company's innovative etch technologies empower customers to build the world's highest-performing integrated circuits. Lam's etch systems shape the microscopic conductive and dielectric layers into circuits that define a chip's final use and function. The Company also offers a next-generation wafer cleaning solution, which employs proprietary technology and can be used throughout the semiconductor manufacturing process. Headquartered in

Fremont, California, Lam maintains a network of facilities throughout the United States, Asia, and Europe to meet the complex and changing needs of its global customer base.

Lam is both the market share and technology leader for etch semiconductor processing equipment. Over the years, Lam has consistently provided innovative technologies to address the challenges of semiconductor manufacturing. The significance of several of these industry firsts has helped shape technology trends in the industry.

These innovations include:

- Being first to commercialize an inductively coupled plasma source technology with a planar coil
- Introducing Dual Frequency Confined™ (DFC™) technology for dielectric etch Developing the first 200/300 mm capable etch product line with a 200 mm comparable footprint
- Enhancing advanced process control (APC) capability in anticipation of future 300 mm requirements
- Decoupling of plasma density and bias power for conductor etch
- Providing unique technologies to control parameters that impact critical dimension (CD) uniformity
- Introducing an ***in situ*** clean strategy performed after each wafer is processed

As part of Lam's mission to provide innovative productivity solutions in etch, the Company's scientists and engineers strive to be first to introduce new capabilities to ensure customer competitiveness. Lam's core technologies include TCP high-density source technology for conductor (metal and silicon) etch and DFC medium-density

plasma source technology for dielectric etch processes.

Lam's systems employ these technologies to provide advanced solutions for the conductor and dielectric etch processes in the manufacture of integrated circuits.

Lam's innovative technologies position the Company to continue gaining market share in the emerging growth markets including back-end copper/low k interconnect processes and front-end gate processes involving new materials and approaches.

Below are the awards and rankings:

- Forbes Best Managed Companies in America list
- Business Ethics 100 Best Corporate Citizens list
- The Business Journal Top 25 Largest Semiconductor Equipment Manufacturers list
- Silicon Valley 150 list
- Semiconductor International Editor's Choice Best Product Awards for 2300 Exelan and 2300 Versys
- San Jose Magazine 50 Best Places to Work list

Financial Snapshots are listed as the following:

• Initial public offering in 1984

• Common stock trades on the NASDAQ National Market® under the symbol LRCX

• Member of the NASDAQ-100® Index and S&P 400 Mid-Cap Index

3.2.2 Core competency of Lam Research Co

The core competencies of Lam are Technology Innovation and Efficient customer support network.

Throughout its history, Lam has been the technology innovator in the semiconductor etch marketplace. It has consistently delivered technology breakthroughs that have advanced the state of the art for semiconductor etch and enabled leading semiconductor manufacturers to meet their technology roadmap goals.

Customers are many of the world's leading semiconductor manufacturers, including logic and memory producers as well as foundries. Due to changing manufacturing requirements, the selection of next-generation process equipment is a critical component of their future success. By addressing these challenges, Lam's differentiated products and services continue to drive market share gains. Besides that, its ValuePoint™ Optimized Productivity Services™ portfolio is designed to optimize customers' equipment sets and support services as needs change throughout their product cycles.

3.2.3 Competitive Strategy

New technology for process equipment can take 2-3 years to develop into a production-worthy system. Therefore, suppliers need to know customer requirements 3 years in advance. However, neither customers nor industry technology roadmaps can definitively identify requirements that far into the future. Consequently, these uncertainties can significantly add to equipment development costs, and strategies are needed to enable providing cost-effective equipment to semiconductor manufacturers now challenged by increasing costs and lower revenues. At Lam, three key strategies are employed to ensure providing timely, cost-effective solutions:

1. Consistent investment in technology development

Investment in research is based on development needs rather than a percent of revenue. At any given time, technology is in development at several stages -current technology transitioning to volume manufacturing, near-term technology in pilot lines, and next-generation technology at the R&D stage. In addition, product roadmaps with parallel development paths are maintained -based on a range of known viable options with the flexibility to implement new technologies that may emerge. This approach ensures a range of potential solutions to address a variety of customer requirements.

2. Pursuit of joint development relationships.

Relationships with leading-edge customers, supplier alliances, and consortia activities are actively pursued and developed to identify technology needs and define the focus. These activities ensure the right solutions are ready when customers need them.

3. Leveraging the Company's technology expertise

Lam leverages its core expertise in etch and cleaning to develop new technologies. Company engineers also evaluate related new technologies designed by other companies that can be developed into products quickly and at lower costs. Staying focused on the Company's technology expertise allows Lam to seize emerging opportunities quickly and provide cost-effective product solutions.

Lam has implemented a highly successful business model, with resources focused on core competencies-technology development and customer support. Recent Company achievements include:

• Higher cycle-to-cycle profitability with higher gross margins during periods of strong market share growth.

• Significantly improved cash generation, including strong free cash flow and a higher level of retained earnings.

• A stable employment environment in a cyclical industry, enhancing the ability to attract and retain world-class engineering talent

• An environment dedicated to building on core competencies, leading to:

- Executive management focused on strategic planning
- More expedient new product development
- Improved customer support
- Enhanced competitive differentiation

3.3 Introduction to Applied Materials

3.3.1 Basic data of Applied Materials

Applied Materials, Inc. (*NASDAQ: AMAT) is the global leader in nanomanufacturing technology solutions with a broad portfolio of innovative equipment, service and software products for the fabrication of semiconductor chips, flat panels, solar photovoltaic cells, flexible electronics and energy efficient glass.

Founded in 1967, Applied Materials creates and commercializes the nanomanufacturing technology that helps produce virtually every semiconductor chip and flat panel display in the world. The company recently entered the market for equipment to produce solar arrays and energy efficient glass.

Applied Materials service products improve yield enhancement and increase nanomanufacturing productivity.

To support its customers, Applied Materials employs approximately 14,000 people throughout the world. In fiscal year 2006, Applied Materials recorded net sales of U.S. $9.17 billion.

3.3.2 Core competency of Applied Materials

The core competency could be divided into several categories: (施純巧),

1. Tangible resources
    A. Healthy financial status. Like in 2004, its revenue reaches 8.013 Billion USD with 1.351 Billion net profit. The accumulated cash reaches 2.28 B Billion.
    B. It ranks 270th in Fortune top 500 and 5th in semiconductor electronics and devices companies.
2. Intangible resources
    A. Numerous patents. In 2004 alone it has got more than 400 patent in U.S.
    B. Superior image and public relation. It is in Business Ethics 100 Best Corporate Citizens list in 2004 and is the first semiconductor equipment supplier company that is ISO certified.
    C. It has five R&D engineering centers around the globe and more than 90 branch offices to facilitate fast response and service to its customers.
    D. Built long term relationship with customer and focus on customer satisfaction. Got numerous awards as best suppliers.
3. People capability

Former CEO James C. Morgan's achievement and its effort on stock return rate was compared to that of GE's Jack Welch. Business Week also comments that he is among the best CEOs in the U.S. He was considered as the most influential leaders in Silicon Valley together with former Intel President Andy Grove.

4. Organization capability
    A. The capability of innovation and integration: New product development and commercialization is Applied Materials' core competency. It has

developed and launched 75 products in 20 years. The R&D expenditure was as high as 15% since the 80s.

B. The capability of marketing and sales: It has broad product lines with average market share as high as 50%. It has great advantage of scale of economy. Its early into market strategy and diversified product portfolio makes it possible to have flexible sales tactics.

C. Sound knowledge management system and the culture of learning organization make the whole world as one big net. With systematic linkage, customer's need is easily satisfied.

D. Complete functional organization makes customized service possible. Total solution and one stop shopping concept could be deployed.

3.3.3 Competitive Strategy

Refer to May Ho (2002)'s study of "Strategy Analysis of the Success of Applied Materials Inc", we can summarized its competitive strategy in the three following categories:

Business and Markey strategies:

1. Carefully choose strategic customer, then aggressively invest to establish strong and early partnership (ex. Intel, TSMC)
2. Launch product earlier than competitor, even when product is not fully mature. Aiming to gain early presence in the market and "lock" customer's resource on performance enhancement activities in factory.
3. Flexible pricing strategies to leverage strong and weak products.
4. Differentiate by continuously providing new value to customers
    i. First in industry to guarantee process performance in early 90s.
    ii. First in industry to deploy account management and regular KSP (Key

Supplier Performance) meeting with key customers.

iii. First in industry to start parts consignment and TPM (total parts management), further anchoring partnership.

iv. First in industry to introduce “process module” solutions.

Technology development strategies:

1. Focus on core competence and targeted market
2. Leverage multi-product portfolio to achieve synergy and new value offer
3. Adopt M&A to achieve synergy

Infrastructure strategies:

1. Global infrastructure
    A. Aggressively invest in regional sales and service team to ensure best service level and high efficiency of technology performance improvement and enhancement activities.
    B. Industry-first to invest regional applications lab and training facility to facilitate “bring capability to customer” concept, and foster process development activities to strengthen technology partnership.
2. Organization is tailored to facilitate the most convenient communication channel and service quality for customers. (ex. Account management)
3. Focus best resources on core competence. Spend minimum resources to manage company’s non-core operations

Chapter Four: Operation effectiveness and efficiency analysis

While EVA is utilized as a measure of operation effectiveness, the corporate operation activities could be firmly combined with "value creation". In this chapter, we first discuss the key factor of value creation- EVA theory, and then its operation measurement indexes will be used to measure our companies- Lam Research Corporation, benchmarked with those of Applied Materials.

4.1 How Key Value Drivers are reflected by EVA terms

From Chapter 2, we have derived that

Company Value= Invested Capital + Present Value of future Expected EVAs

$$= \text{Invested Capital} + \sum_{j=1}^{j=\infty} \frac{EVA_j}{(1+WACC)^j}$$

$$= \text{Invested Capital} + \sum_{j=1}^{j=T} \frac{EVA_j}{(1+WACC)^j} + \text{Continuing Value}$$

Where Continuing Value=

$(EVA_{t+1}/WACC)+ (NOPAT_{t+1} (IROIC-WACC) g)/ ((WACC (WACC-g) IROIC))$

Also we had $EVA= NOPAT_t-(WACC \times Invested\ Capital_{t-1}$

$$= \frac{NOPAT_t \times InvestedCapital_{t-1}}{Invested\ Capital_{t-1}} - (WACC \times Invested\ Capital_{t-1})$$
$$= (ROIC_t \times Invested\ Capital_{t-1}) - (WACC \times Invested\ Capital_{t-1})$$
$$= (ROIC_t - WACC) \times Invested\ Capital_{t-1}$$

From the above equation, we know that the main parameters that impact business value are:

1. ROIC: Return on Invested Capital. The higher ROIC is, the better it can utilize the invested capital to create net profit.
2. WACC: Weighted average cost of capital. The lower WACC is the better for having positive net profit.

3. g: The growth rate of NOPAT. The high g is, if means the higher continuing value is under the assumption of IROIC> WACC.
4. IROIC: The expected rate of return on Incremental Invested Capital. The higher IROIC is, the better it can utilize the incremental invested capital to create new net profit. So the higher IROIC is the higher the business can grow to create higher value.
5. IR: Investment rate is the percentage of business earned each year used for new investment. Since business is looking for continual operation, so adequate IR can maintain certain growth and avoid aging.

So by using EVA for measuring operation efficiency, it encompasses all three Key Value Drivers below:

1. Profitability: this is reflected by the return of invested capital, namely ROIC.
2. Risk: this is reflected by the capital cost, namely WACC.
3. Growth: This is reflected by the growth of Net profit, how much the Incremental Invested Capital is and what the return is. These are g, IR and IROIC.

4.2 Profitability Analysis

From the equation

$EVA_t = (ROIC_t – WACC) \times Invested\ Capital_{t-1}$

ROIC-WACC spread is a measure to for business's capability of making profit. Only in the circumstance of ROIC>WACC does a business create value and increase shareholders wealth.

4.2.1 ROIC-WACC spread analysis

From Table 4-1, the spread of ROIC-WACC improves significantly from 2003 to 2005 although there is a slight drop in 2006. This is suggesting that Lam Research enjoys good return on its invested capital and thus should continue to adopt aggressive growth strategy by increasing investment to further maximizing its business value.

Table 4-1: EVA & Standardized EVA of Lam Research Corporation

Fiscal Year	06	05	04	03	02
Invested Capital	2,168.25	1,426.29	1,141.06	1,279.61	1,691.12
NOPAT	537.00	538.48	242.27	98.83	99.62
ROIC	38%	47%	19%	6%	NA
WACC	15.1%	15.9%	16.1%	14.7%	12.5%
ROIC-WACC	23%	31%	3%	-9%	NA
EVA	322	357	37	-150	NA
Standardized EVA	29	26	2	-7	NA

Unit of Invested Capital, NOPAT and EVA: Million USD,

Source: from this study

From Table 4-2, it shows that ROIC-WACC spread also gets improved from 2003 to 2006. This is showing that Applied also enjoys positive return from its invested capital. So a growth strategy should also be adopted to maximize its business value.

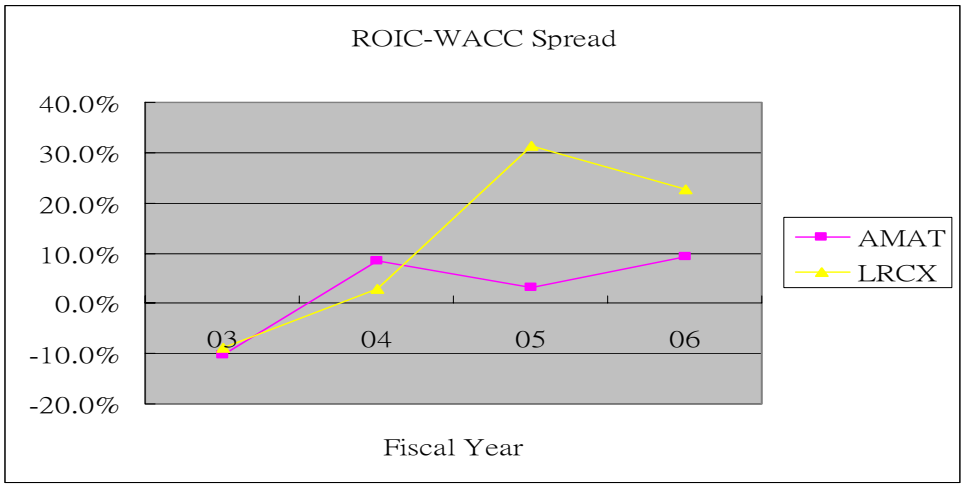
Table 4-2: EVA & Standardized EVA of Applied Materials

Fiscal Year	06	05	04	03	02
Invested Capital	9,192.57	11,095.20	11,594.82	10,176.22	10,526.79
NOPAT	2446.13	1870.37	2200.45	337.90	1339.86
ROIC	22%	16%	22%	3%	NA
WACC	13%	13%	13%	13%	13%
ROIC-WACC	9%	3%	8%	-10%	NA
EVA	1018	369	862	-1075	NA
Standardized EVA	8	3	9	-10	

Unit of Invested Capital, NOPAT and EVA: Million USD,

Source: from this study

A comparison between two companies is made in Figure 4-1. It is observed that a crossing of these two companies from 2004 to 2005. This is mainly caused by a big jump of Lam's performance improvement.



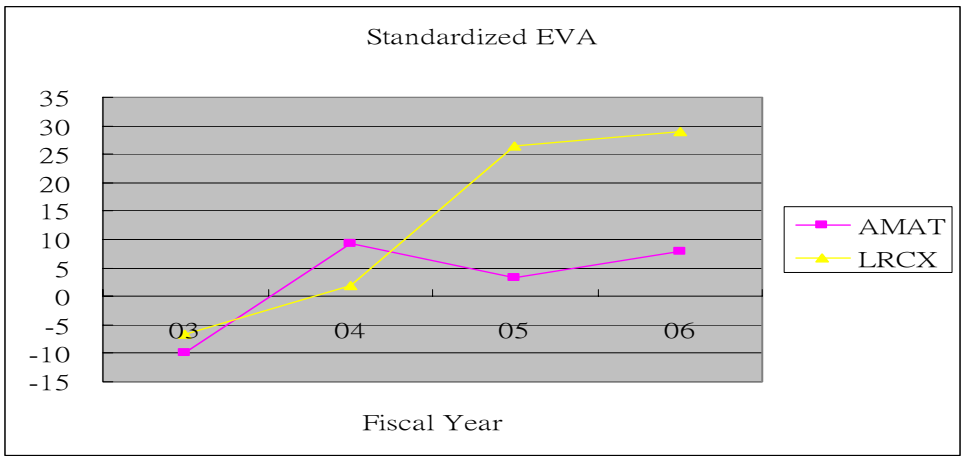
Source: from this study

Figure 4-1: ROIC-WACC spread comparison between Lam and Applied

4.2.2 Standardized EVA Analysis

As mentioned in section 2.3.2, objective comparison between companies using absolute values of EVA can not be made due to the difference in company sizes. In order to make fair comparison, we need to compute Standardized EVA. We use 2002's invested capital as the base and consider it as 100. From Table 4-1, it is observed that the standardized EVA of Lam Research increase monotonically from 2003 to 2006 and reaches an astonishing 29. While on the other hand, Applied's standardized EVA improved from 2003's -10 to a positive value but only fluctuate between 3 and 9 up to 2006. So we can conclude that the operation efficiency is quite different in terms of the standardized EVA comparison.

This can be also seen in Figure 4-2 below. It is suggested that Lam Research has a more promising future prospect.



Source: from this study

Figure 4-2: Standardized EVA comparison between Lam and Applied

4.3 Dupont Analysis

By decomposing ROIC with the introduction of Revenues, we can get

$ROIC_t = NOPAT_t / \text{Invested Capital}_{t-1}$

$= NOPAT_t / Revenues_t \quad x \quad Revenues_t / \text{Invested Capital}_{t-1}$

This decomposition is called Dupont Analysis.

$NOPAT_t / Revenues_t$ is called Profit Margin or Return on Sales, this is a way of measuring corporate's operation profitability. From the Operating Approach to derive NOPAT, we know that

$NOPAT_t / Revenues_t =$

(Revenues-COGS-Operation Expenses-Net non-operating income-Cash Operating Tax)/ Revenues

Where COGS stands for Cost of Goods Sold.

So from this further decomposition, we can learn exactly what are contributing to

the Profit Margin. These include Gross Margin, Net income as a percentage of Revenue, Net non-operating income as a percentage of Revenue and finally Cash Operating Tax as a percentage of Revenue.

Net non-Operating income

= Non-operating income (interest income is excluded)

- Non-operating expense (interest expense is excluded)

$Revenues_t$/ $Invested\ Capital_{t-1}$: Invested Capital Turnover. This is a measurement of the efficiency of utilizing invested capital.

From the DuPont Analysis, we can learn that a positive ROIC-WACC spread may come from two sources(吳啓銘):

1. Good business: Profitable because of correct product positioning or successful product differentiation. This is using Profit Margin as an index.
   A. The products or services provided meet customers' needs.
   B. It is difficult for competitor to imitate.
   C. Customer loyalty by good customer relationship, satisfaction and branding.
2. Good Manager: Profitable because of good operation efficiency. This is using Invested Capital Turnover as an index.
   A. The management has insights to create opportunities for higher efficiency.
   B. Cost could be reduced by continuous improvement in the business processes.
   C. WACC may be able to get reduced by optimizing its capital structure.
   D. Reduce to invested capital growth rate relative to revenue growth rate.

4.3.1 Profit Margin Analysis

Table 4-3 and 4-3 are the Profit Margin and Invested Capital Turnover of Lam Research and Applied Materials, respectively.

Table 4-3: Profit Margin and Invested Capital Turnover of Lam Research

Fiscal Year	06	05	04	03	02
Invested Capital	2,168.25	1,426.29	1,141.06	1,279.61	1,691.12
NOPAT	537.00	538.48	242.27	98.83	99.62
Revenues	1,642.17	1,502.45	935.95	755.23	943.11
Growth rate of Revenue	9%	61%	24%	-20%	NA
Growth rate of NOPAT	0%	122%	145%	-1%	NA
ROIC	38%	47%	19%	6%	NA
Profit Margin	33%	36%	26%	13%	11%
Invested Capital Turnover	115%	132%	73%	45%	NA

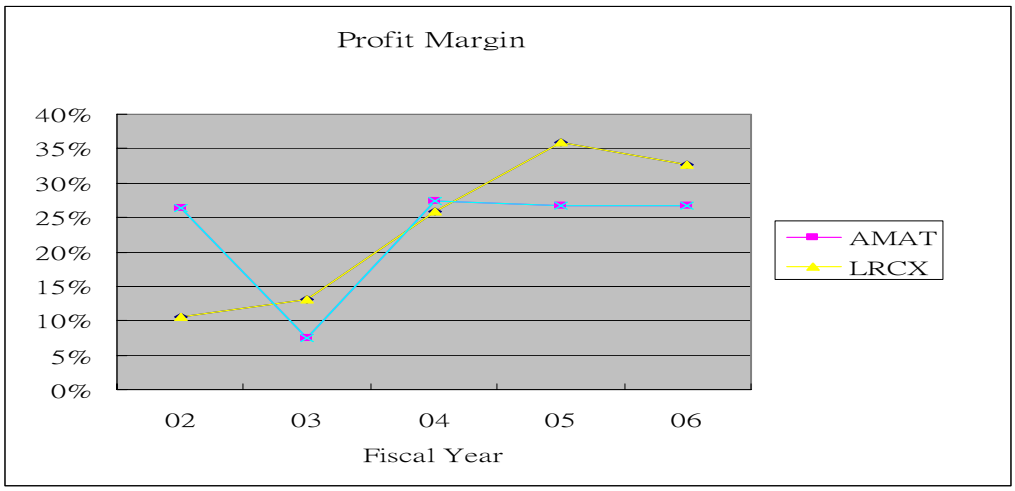
Source: from this study

Table 4-4: Profit Margin and Invested Capital Turnover of Applied Materials

Fiscal Year	06	05	04	03	02
Invested Capital	9,192.57	11,095.20	11,594.82	10,176.22	10,526.79
NOPAT	2446.13	1870.37	2200.45	337.90	1339.86
Revenues	9,167.01	6,991.82	8,013.05	4,477.29	5,062.31
Growth rate of Revenue	31%	-13%	79%	-12%	NA
Growth rate of NOPAT	31%	-15%	551%	-75%	NA
ROIC	22%	16%	22%	3%	NA
Profit Margin	27%	27%	27%	8%	26%
Invested Capital Turnover	83%	60%	79%	43%	NA

Source: from this study

By putting together the Profit Margins for comparison in Figure 4-3, it is observed that Lam Research has improved significantly since 2004 and surpassed Applied by 6 to 9% in the past two years.



Source: from this study

Figure 4-3: Profit Margin comparison between Lam and Applied

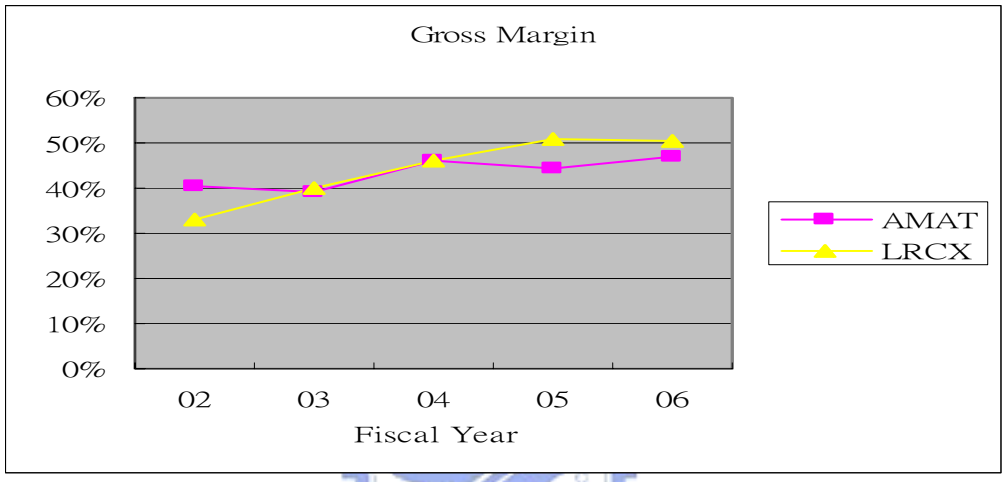
Since 2003, Lam’ s oxide etcher was widely accepted and gained market share. This helps to boost revenues and increase the profit margin. We can also consider both Lam’s oxide and conductor etchers meeting customers’ needs and thus they are both “*good businesses*”. Again, this may indicate:

1. The products or services provided meet customers’ needs.
2. It is difficult for competitor to imitate.
3. Strong customer loyalty by good customer relationship, satisfaction and branding.

This echoes that Lam wins Semiconductor International Editor’s Choice Best Product Awards for 2300 Exelan and 2300 Versys.

Using similar Operating Approach as computing NOPAT, we can further decompose Profit Margin and get each component’s percentage opposed to revenue so that we can learn exactly what are contributing to the Profit Margin. These items include the following: Cost of Goods Sold, Operation Expenses, Net non-operating

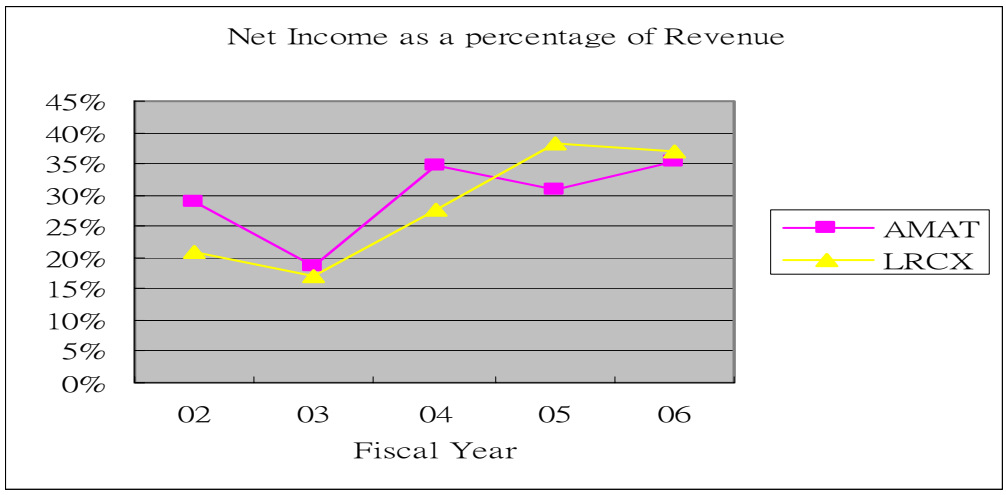
income and Cash Operating Tax. Two companies were compared as exhibited from Figure 4-4 to 4-7. And these are Gross Margin (Figure 4-4), Net income as a percentage of Revenue (Figure 4-5), Net non-operating income as a percentage of Revenue (Figure 4-6) and finally Cash Operating Tax as a percentage of Revenue (Figure 4-7).



Source: from this study

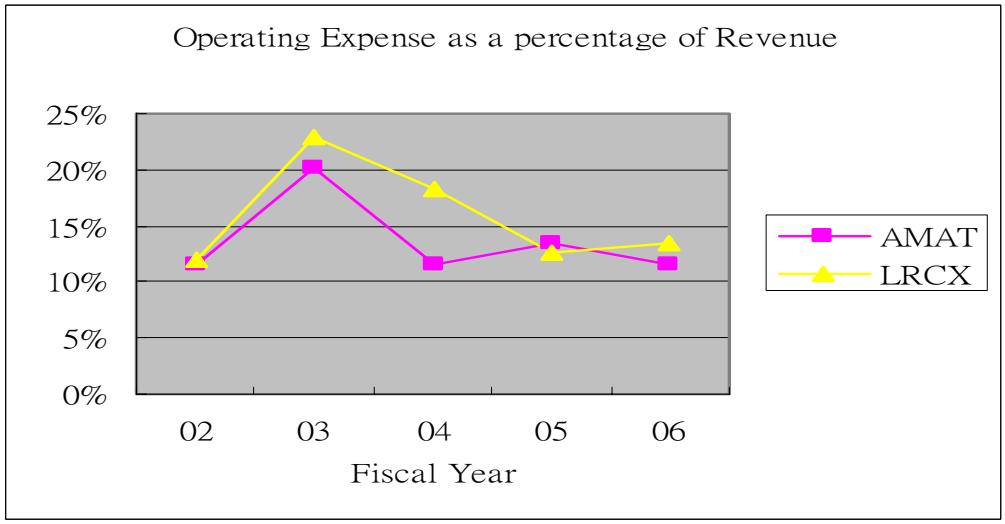
Figure 4-4: Gross Margin comparison between Lam Research and Applied Materials

Gross Margin of Lam Research surpassed that of Applied Materials starting from 2005. This is an indication of reduction of cost of goods sold as a percentage of revenue.



Source: from this study

Figure 4-5: Net Income as a percentage of Revenue comparison between Lam and Applied



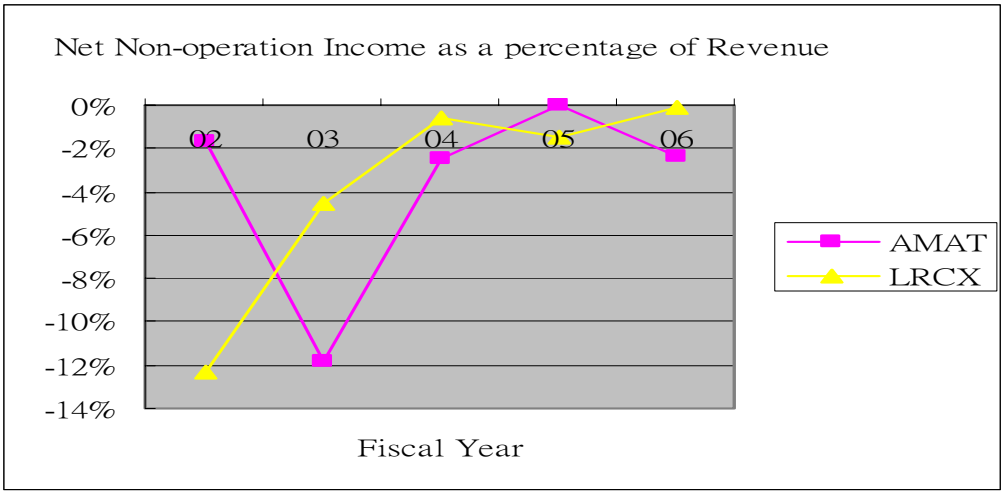
Source: from this study

Figure 4-5A: Operating Expense as a percentage of Revenue comparison between Lam Research and Applied Materials

By plotting out the operating expense as a percentage of revenue comparison between Lam and Applied as shown in Figure 4-5A, it is clear that Lam Research has improved to a similar level as that of Applied starting from 2005

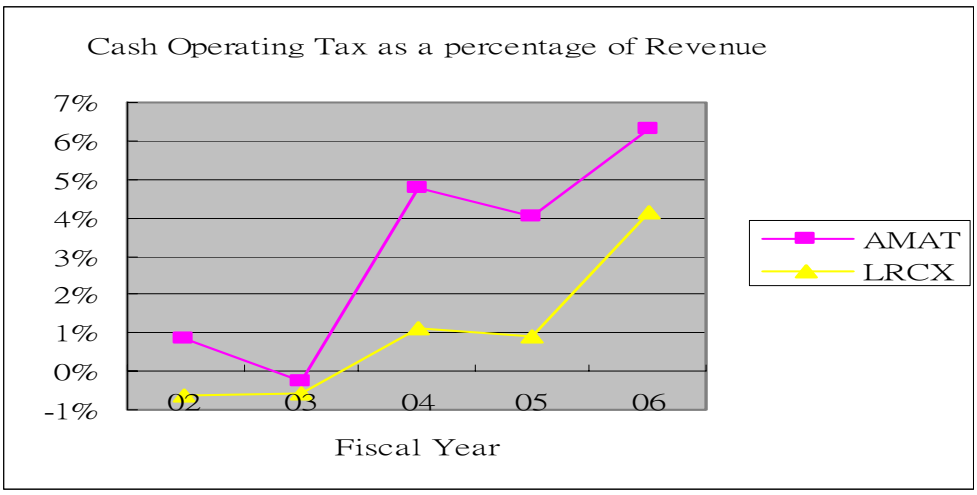
From Figure 4-6, it is observed that the net non-operating income as a percentage of revenue for both companies dropped to less than 3% since 2003. This indicates that both companies have clear focus on its operations and rely most of their revenues generating from the WFE related operation.

From Figure 4-7, it is observed that while both companies are making more profit since 2003, so do the tax as a percentage of revenue pick up to a higher level. One thing worth noticing is that since 2003, Applied's level was higher than that of Lam Research.



Source: from this study

Figure 4-6: Net Non-operation Income as a percentage of Revenue comparison between Lam and Applied

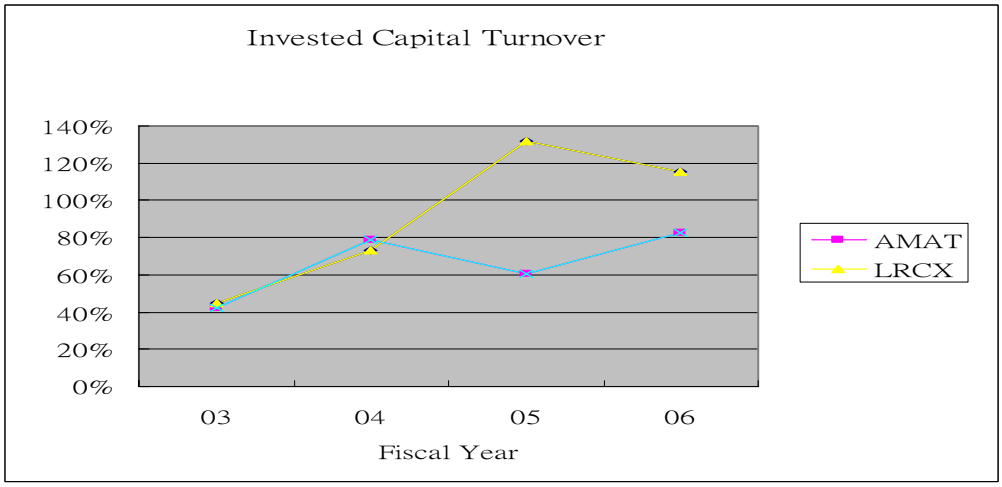


Source: from this study

Figure 4-7: Cash Operating Tax as a percentage of Revenue comparison between Lam and Applied

4.3.2 Invested Capital Turnover Analysis

Put Invested Capital turnover from Table 4-3's Lam data and Table 4-4's Applied data together into Figure 4-8, it is found that the rate is about the same between two companies from 2003 to 2004 while the Lam Research had a quantum jump in year 2005 and maintains at a relatively high level in 2005.



Source: from this study

Figure 4-8: Net Non-operation Income as a percentage of Revenue comparison between Lam and Applied

4.3.3 Operation Efficiency Indexes Analysis

This section deals with some commonly used activity ratios which measure how effectively management is utilizing its resources by relating the magnitude of various assets to revenues or expenses. Table 4-5 listed these ratios in two different forms.

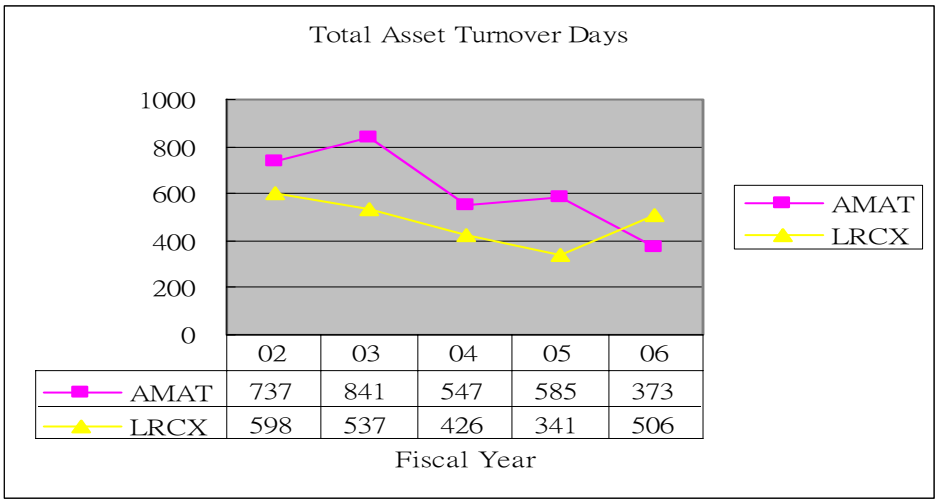
Table 4-5: Some common activity ratios

Efficiency Index	Equation	Unit
Total Asset Turnover	Revenue/ Total Asset	times/ per year
Fixed Asset Turnover	Revenue/ Fixed Asset	times/ per year
Accounts Receivable Turnover	Revenue/ Accounts Receivable	times/ per year
Inventory Turnover	Cost of Goods Sold/ Inventory	times/ per year
Alternative expression	Equation	Unit
Total Asset Turnover days	365 x(Total Asset/ Revenue)	days
Fixed Asset Turnover days	365 x (Fixed Asset/ Revenue)	days
Average collection Period	365 x (Accounts Receivable/ Revenue)	days
Average Inventory Period	365 x(Inventory/ Cost of Goods Sold)	days

Source: Wilbur G. Lewellen etc., Financial Management, an introduction to Principles and Practice

1. Total Asset Turnover Days

From Figure 4-9, it is found that the over the past several years expect 2006, the total asset turn over days of Lam is better than that of Applied. But both companies are showing improvement over time.



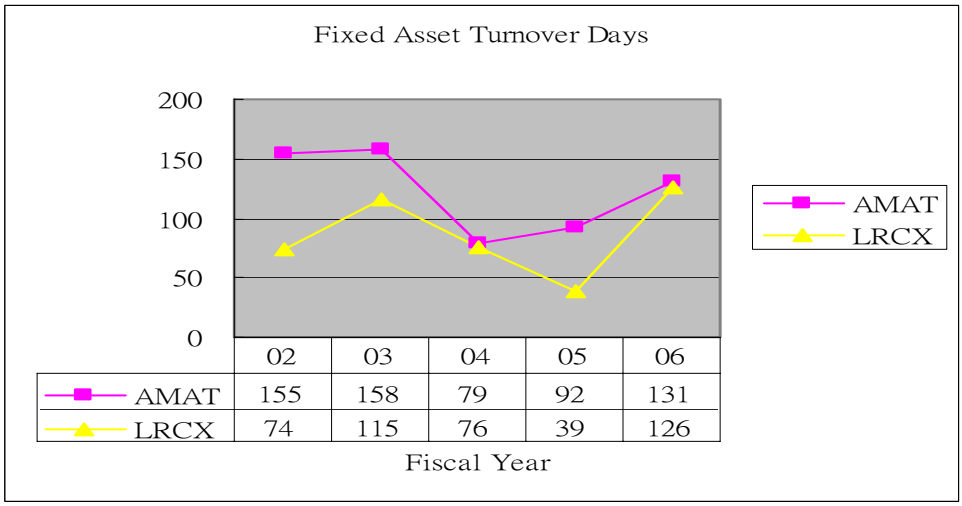
	02	03	04	05	06
AMAT	737	841	547	585	373
LRCX	598	537	426	341	506

Source: from this study

Figure 4-9: Total Asset Turnover Day comparison between Lam and Applied

2. Fixed Asset Turnover Days

From Figure 4-10, it is found that the over the past several years expect 2006, the fixed asset turn over days of Lam is better than that of Applied.



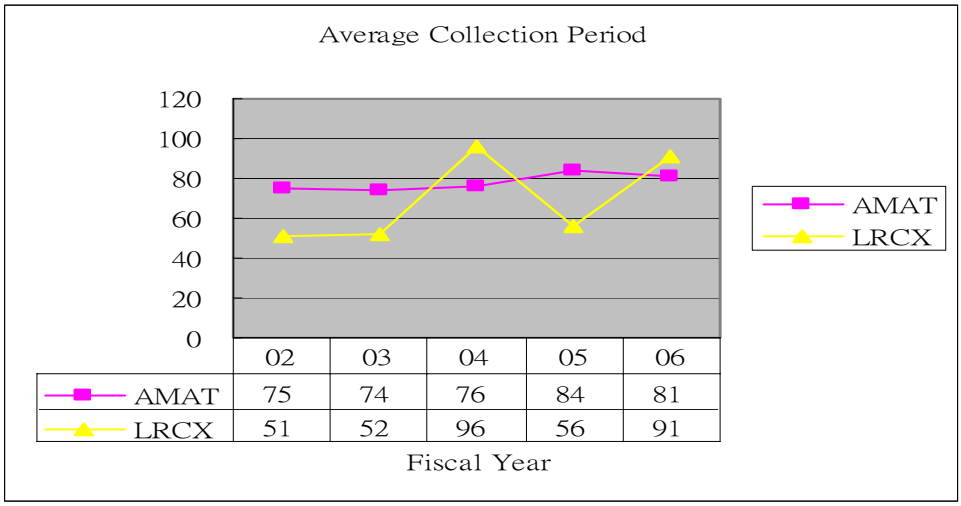
	02	03	04	05	06
AMAT	155	158	79	92	131
LRCX	74	115	76	39	126

Source: from this study

Figure 4-10: Fixed Asset Turnover Day comparison between Lam and Applied

3. Average Collection Period

From Figure 4-11, it is found that the over the past several years, there is no significant difference between Lam and Applied in terms of average collection period.



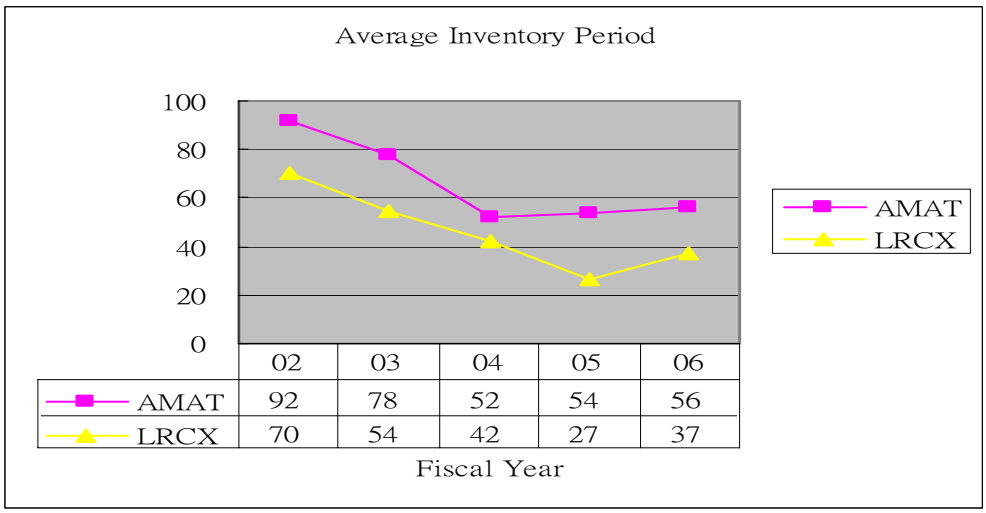
	02	03	04	05	06
AMAT	75	74	76	84	81
LRCX	51	52	96	56	91

Source: from this study

Figure 4-11: Average Collection Period comparison between Lam and Applied

4. Average Inventory Period

From Figure 4-12, it is found that the over the past several years, the average inventory period of Lam is better than that of Applied and the difference is somewhat significant (typically 30% difference) This may suggest that either Lam is doing a great job at limiting the level of inventory or that the hit rate may not be that good for its customers.



	02	03	04	05	06
AMAT	92	78	52	54	56
LRCX	70	54	42	27	37

Source: from this study

Figure 4-12: Average Inventory Period comparison between Lam and Applied

4.4 Growth Rate Analysis

4.4.1 Growth Theory of EVA

In order to discuss growth rate, let's define g, IROIC and IR first below:

1. g: The growth rate of NOPAT

   g_{t+2}= ($NOPAT_{t+2}$-$NOPAT_{t+1}$)/ $NOPAT_{t+1}$

   △ NOPAT: The change in NOPAT from term to term

2. IROIC: The return rate of incremental invested capital

   IROICt+2= ($NOPAT_{t+2}$-$NOPAT_{t+1}$)/ ($InvestedCapitalt_{+1}$-$InvestedCapital_t$)

3. IR: Investment Rate or called Net New Investment Rate or Re-investment rate

   IRt+1=△$InvestedCapital_{t+1}$/$NOPAT_{t+1}$

   =($InvestedCapital_{t+1}$-$InvestedCapital_t$)/$NOPAT_{t+1}$

4. △Invested Capital means the change in invested capital from term to term.

So we can derive g=IR x IROIC

Growth rate of NOPAT=Investment Rate x Return rate of incremental invested capital

This could be easily derived from the following:

g_{t+2}= ($NOPAT_{t+2}$-$NOPAT_{t+1}$)/ $NOPAT_{t+1}$

=(△$InvestedCapital_{t+1}$/$NOPAT_{t+1}$) x (△$NOPAT_{t+2}$/△$InvestedCapital_{t+1}$)

=(($InvestedCapital_{t+1}$-$InvestedCapital_t$)/$NOPAT_{t+1}$)

X ((($NOPAT_{t+2}$-$NOPAT_{t+1}$)/ ($InvestedCapitalt_{+1}$-$InvestedCapital_t$))

=IR_{t+1} x $IROIC_{t+2}$

This is saying that the growth rate of NOPAT in term (t+2) is really decided by the Investment Rate at the end of term (t+1) and the Return on Incremental Invested Capital of term (t+2). So high Investment Rate and high Return on Incremental Invested Capital naturally leads to high growth rate of NOPAT.

4.4.2 Analysis of the companies

Table 4-6 and 4-7 records the NOPAT growth rate of Lam Research and Applied Materials.

Table 4-6: NOPAT growth rate of Lam Research

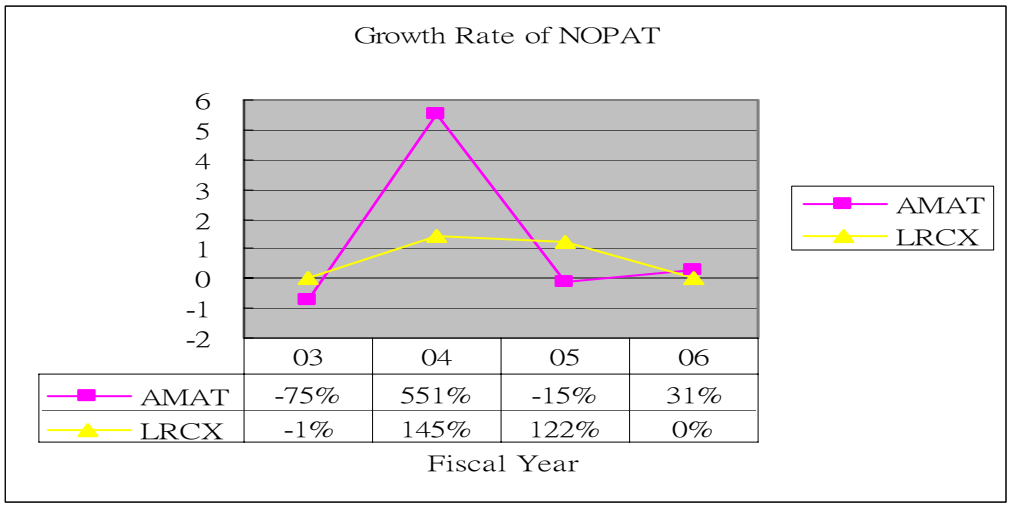
FY	06	05	04	03	02
New Invested Capital	741.96	285.227	-138.551	-411.504	NA
Increase in NOPAT	-1.48	296.21	143.43	-0.78	NA
IR	138%	53%	-57%	-416%	NA
IROIC	-1%	-214%	-35%	NA	NA
WACC	15%	16%	16%	15%	13%
IROIC-WACC	-16%	-230%	-51%	NA	NA
Growth Rate on NOPAT (gt= IRt-1 x IROICt)	0%	122%	145%	-1%	NA

Source: from this study

Table 4-7: NOPAT growth rate of Applied Materials

FY	06	05	04	03	02
New Invested Capital	-1902.633	-499.625	1418.601	-350.571	NA
Increase in NOPAT	575.75	-330.08	1862.55	-1001.96	NA
IR	-78%	-27%	64%	-104%	NA
IROIC	-115%	-23%	-531%	NA	NA
WACC	12.9%	13.0%	13.1%	13.4%	12.6%
IROIC-WACC	-128%	-36%	-544%	NA	NA
Growth Rate on NOPAT (gt= IRt-1 x IROICt)	31%	-15%	551%	-75%	NA

Source: from this study



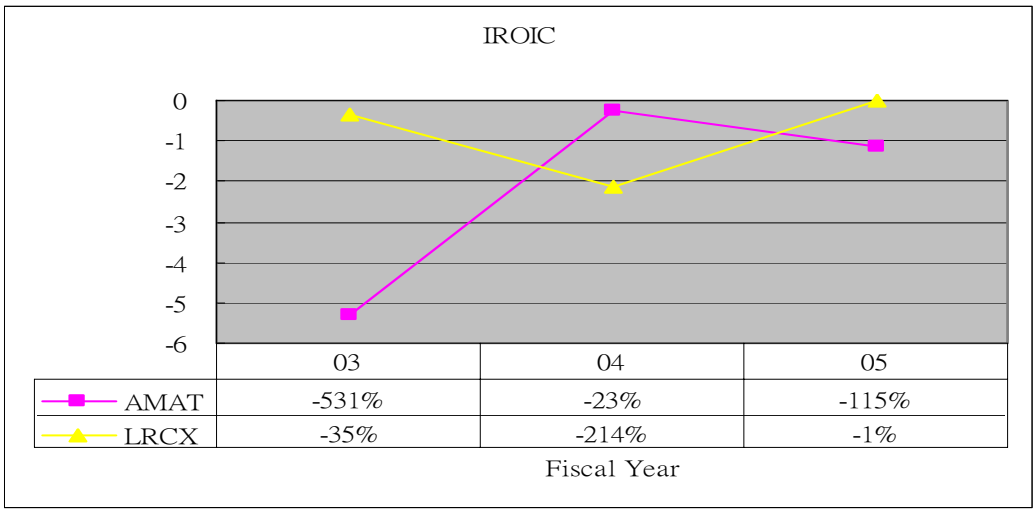
Source: from this study

Figure 4-13: Growth Rate of NOPAT comparison between Lam and Applied

Put them together for comparison in Figure 4-13 shows that both companies do not show clear trends except that Applied Material did have bigger fluctuation from year to year. By examining their CAGR (compound annual growth rate), we can found that Lam Research grows at an surprising high rate of 52% per year (NOPAT increases from 99.6 M in 2002 to 537.0 M in 2006) while Applied grows at an rate of 16% per year (NOPAT increases from 1339.9 M in 2002 to 2446.1 M in 2006)

This can also explain the strategy of Lam Research is to launch new products including 2300 Bevel Clean system, our 2300 Motif patterning system, and Deep Silicon Etch MEMS offering. This is trying to attack more segments of the whole WFE markets from current 13% to 25 to 26% by year 2010.

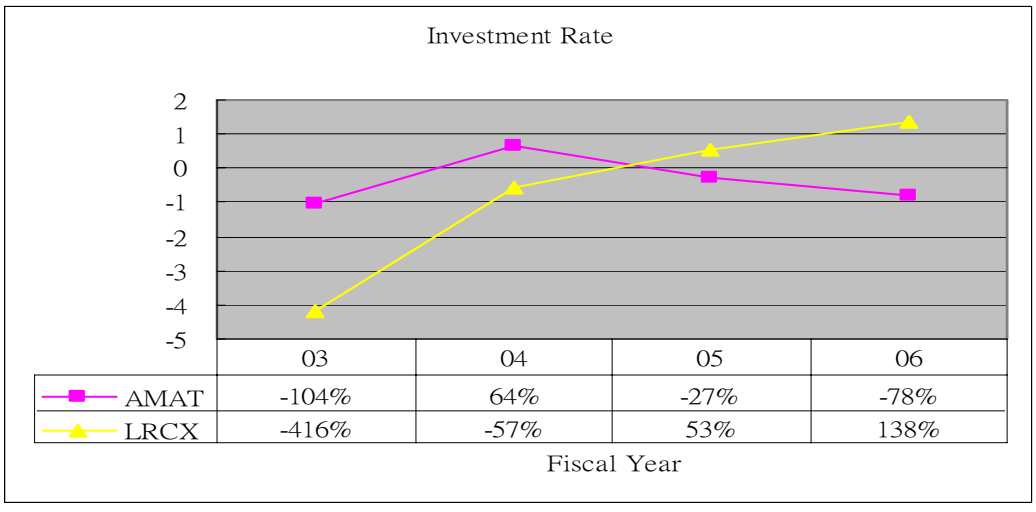
By decomposing g into IROIC and IR further and put them into Figure 4-14 and Figure 4-15 respectively, it is found that IROIC for both companies are not performing that well, actually all numbers for all years are negative. This may be attributed to the fact that typically in WFE industry, it takes more than 3 years to see the return of a specific investment. It simply takes that long from an alpha product (prototype product) to beta site testing (introducing to limited selected customer sites for real production environment testing) and finally get it released.



Source: from this study

Figure 4-14: Return on Incremental Invested Capital comparison between Lam and Applied

As for Investment Rate comparison, it is found that Lam is doing more and more aggressive re-investment compared while Applied Materials seems to be the opposite. This may related to the fact that these two companies are at two different positions of the market and stages of their lifecycles and thus they have different behaviors. As stated earlier, Lam decides to attack more market segment than Etch and Clean and is launching several new products to capture the 150 Billion opportunity from 2007 to 2010. (Martin Anstice, Steve Newberry, 2007)



Source: from this study

Figure 4-15: Investment Rate comparison between Lam and Applied

4.5 Summary of this chapter

Put all the performance indexes discussed above into Table 4-8 and summarized as below:

Table 4-8: Performance index comparison between Lam and Applied

Performance Index	Lam Research	Applied Materials
ROIC-WACC Spread	Upward trend Much higher	Upward trend Lower
Standardized EVA	Upward trend	Upward trend Lower
Profit Margin	Upward trend Higher	Flat Lower
Gross Margin	Upward trend Higher	Upward trend Lower
Net income as a percentage of Revenue	Significant improvement over years	Upward trend
Net non-operating income as a percentage of Revenue	Significantly reduced over years	Significantly reduced over years
Invested Capital Turnover	Upward trend Much higher	Upward trend Lower
Total Asset Turnover Days	Improvement over years Lower	Improvement over years Higher
Fixed Asset Turnover Days	No obvious trend Lower	No obvious trend Higher
Average Collection Period	Upward trend	Flat
Average Inventory Period	Improvement over years Lower	Improvement over years Higher
Growth Rate of NOPAT	Upward trend Higher	Upward trend Lower
Investment Rate	Upward trend	Flat
IROIC	No obvious trend Big fluctuation	No obvious trend Big fluctuation

Source: from this study

By comparing these indexes, it is found that almost all indexes of Lam Research

showed better performance than those of Applied Materials except for the Average Collection Period. Out of all of these, actually the (ROIC-WACC) Spread and Invested Capital Turnover are the most important measures of performance. It shows that both Lam Research and Applied Materials meet the criteria of having good businesses and good managers, the two most essential ingredients of a successful business since these two important measures are already good are showing good trend. Lam Research does show better performance than Applied's, one big turn around from its past years prior to 2002. Theses two indexes show that Lam catches up with Applied starting from 2003 to 2004 and surpassed it by a large magnitude in 2005 and 2006.

Besides that, since both companies' growth rate on NOPAT (CAGR, Lam 52% and Applied 16%) are still significant, it is recommend that they should both adopt the strategy of expansion and increase invested capital to gain more NOPAT, and lead to maximization of shareholders' wealth. There is in lined with Lam's practice for the past four years. It is not as clear why Applied was not practicing it since the IR was quite flat for the past four years. It is speculated that it is more difficult for Applied Materials to decide what the right areas to fund giving the following two facts:

1. It does not enjoy as high ROIC-WACC spread and Invested Capital Turnover for the markets that they are already engaged. So the strategy for these markets should be targeted at enhancing these performances in stead of increasing Investment Rate.
2. Applied has already set foot in quite some arenas including Flat Panel, Solar Photovoltaic Cell, Flexible Electronics and Energy Efficient Glass. It needs to consider its internal resources and capability before further attacking more markets.

Chapter Five: Business Valuation

In this chapter, we will start to compute the values of the companies. Before that, we will first explain the regression model and the method to do forecasting for the parameters.

5.1 Introduction to regression method used

Since we need NOPAT and Invested Capital for EVA's calculation, then we need to find a way to forecast these values for future years. Usually the procedure to get this done is as the following:

1. Firstly we consider the past years' data and come out regression models
2. Choose the best model that has highest R squared value
3. Use the chosen model to do forecasting

But for the purpose of simplicity, we choose liner regression model for our study.

5.2 Some commonly used methods for business valuation

From Gordon Growth Model, we can derive the following two methods:

1. Price Earning Multiple

   PERatio= P_0/EPS_0= (PayoutRatio x(1+g))/(r-g)

   Where P_0= Stock Price at term zero

   DPS_1: predicted dividend per share in term one

   EPS_0: Earning per share in term zero

   PayoutRatio: DPS/ EPS

   r: cost of equity

   g: growth rate of dividend

2. Price Book Value Multiple

PBVRatio= P_0/BV= ROE x PayoutRatio x(1+g)/(r-g)

The drawback of these methods is that usually EPS or BV can get impacted easily by corporate accounting decisions and having a fixed payout ratio is not common for all companies.

5.3 Model of business valuation

Remember that in Chapter two, we have that Company Value

= Invested Capital + Present Value of EVA During Explicit Forecast Period + Present Value after Explicit Forecast Period.

= Invested Capital + $\sum_{j=1}^{j=T} \frac{EVA_j}{(1+WACC)^j}$ +Continuing Value

Where Continuing Value= $(EVA_{t+1}/WACC)+ (NOPAT_{t+1} (IROIC-WACC) g)/ ((WACC (WACC-g) IROIC))$

And EVA_t

$= NOPAT_t\text{-}WACC \times Invested\ Capital_{t-1}$

$$= \frac{NOPAT_t \times Invested Capital_{t-1}}{Invested\ Capital_{t-1}} - (WACC \times Invested\ Capital_{t-1})$$
$$= (ROIC_t \times Invested\ Capital_{t-1}) - (WACC \times Invested\ Capital_{t-1})$$
$$= (ROIC_t - WACC) \times Invested\ Capital_{t-1}$$

5.4 Computation of Lam's value

5.4.1 NOPAT forecasting

By using linear regression, we can get the estimated NOPAT from year 2007 to 2012. See Table 5-1 for the calculated value.

Table 5-1: NOPAT Forecasting for Lam Research

FY	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
NOPAT(Actual)	100	99	242	538	537						
NOPAT(estimated)			128	260	392	524	655	787	919	1051	1183

Source: from this study

5.4.2 Invested Capital forecasting

By using linear regression, we can get the estimated Invested Capital from year 2007 to 2012. See Table 5-2 for the calculated value.

Table 5-2: Invested Capital Forecasting for Lam Research

FY	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Invested Capital(Actual)	1691	1280	1141	1426	2168						
Invested Capital(estimated)	1020	1108	1195	1283	1370	1458	1545	1633	1720	1808	1895

Source: from this study

5.4.3 Forecasting of WACC and stock price

Using the average value of Lam Research's past 5 years' WACC 14.85%, we can get the calculated stock price 46.05 USD in Table 5-3. Please refer to the computation details in Table 5-4.

Table 5-3: Assumptions made for stock price calculation for Lam Research

Timing of evaluation	2006.12
Method to forecast NOPAT	Linear regression
Method to forecast Invested Capital	Linear regression
Assumed WACC	14.85%
Stage one duration	5 years
Stage two will start from	2012
Assumption of Continuing Value computation	IROIC = WACC
Stock Price Per share	46.05

Source: from this study

Lam's annual report was filed on 8/17/2006. The stock price 10 days later was around 42.0 USD. This is about -8.8% different from the forecasted 46.05 USD. It seems that Lam's stock was undervalues at that time. But since then, the stock price has been going strong and reached 50 USD two months later.

Table 5-4: Computation Process of Lam Research's stock price

EVA Valuation Forecast						Stage one					Stage two
FY	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	after 2011
Invested Capital	1691.117	1279.613	1141.062	1426.289	2168.249	1457.682	1545.208	1632.734	1720.26	1807.786	1895.312
NOPAT	99.618137	98.83	242.27	538.48	537.00	523.6	655.4	787.2	919	1050.8	1182.6
ROIC	NA	5.84%	18.93%	47.19%	37.65%	24.15%	44.96%	50.94%	56.29%	61.08%	65.42%
WACC	12.51%	14.70%	16.06%	15.90%	15.07%	14.85%	14.85%	14.85%	14.85%	14.85%	14.85%
EVA per year	NA	-149.75	36.71	357.00	322.09	201.62	438.93	557.74	676.54	795.34	914.14
Continuing Value										2682.27	
EVA		-149.75	36.71	357.00	322.09	201.62	438.93	557.74	676.54	795.34	
Present Value of EVA						175.55	332.76	368.16	388.84	398.01	
Sum: PV of Total EVA	4345.59										
Plus: Invested Capital	2168.249										
Company Value	6513.84										
Less: Total Interest baring Debts	608.28										
Value for Common Equity	5905.56										
Number of Outstanding shares	128.253										
Value per share	**46.05**										

Source: from this study

5.5 Computation of Applied's value

5.5.1 NOPAT forecasting

By using linear regression, we can get the estimated NOPAT from year 2007 to 2012. See Table 5-5 for the calculated value.

Table 5-5: NOPAT Forecasting for Applied Materials

FY	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
NOPAT(Actual)	1340	338	2200	1870	2446						
NOPAT(estimated)	-25	376	777	1179	1580	1981	2382	2783	3184	3585	3986

Source: from this study

5.5.2 Invested Capital forecasting

By using linear regression, we can get the estimated Invested Capital from year 2007 to 2012. See Table 5-6 for the calculated value.

Table 5-6: Invested Capital Forecasting for Applied Materials

FY	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Invested Capital(Actual)	10527	10176	11595	11095	9193						
Invested Capital(estimated)	9253	9009	8765	8522	8278	8034	7791	7547	7303	7060	6816

Source: from this study

5.5.3 Forecasting of WACC and stock price

Using the average value of Applied Materials' past 5 years' WACC 13.01%, we can get the calculated stock price 17.77 USD in Table 5-7. Please refer to the computation details in Table 5-8.

Applied's annual report was filed on 12/14/2006. The stock price 10 days later was around 18.45 USD. This is quite close to the forecasted 17.77 USD, only around +3.7% difference.

Table 5-7: Assumptions made for stock price calculation for Applied Materials

Timing of evaluation	2006.12
Method to forecast NOPAT	Linear regression
Method to forecast Invested Capital	Linear regression
Assumed WACC	13.01%
Stage one duration	5 years
Stage two will start from	2012
Assumption of Continuing Value computation	IROIC = WACC
Stock Price Per share	17.77

Source: from this study

Table 5-8: Computation Process of Applied Materials' stock price

EVA Valuation Forecast						Stage one					Stage two
FY	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	After 2012
Invested Capital	10526.794	10176.223	11594.824	11095.199	9192.566	8034.38	7790.72	7547.06	7303.4	7059.74	6816.08
NOPAT	1339.8559	337.90036	2200.4513	1870.3723	2446.1272	1980.7	2381.8	2782.9	3184	3585.1	3986.2
ROIC	NA	3.21%	21.62%	16.13%	22.05%	21.55%	29.65%	35.72%	42.19%	49.09%	56.46%
WACC	12.64%	13.42%	13.15%	12.95%	12.87%	13.01%	13.01%	13.01%	13.01%	13.01%	13.01%
EVA per year	NA	-1074.94	862.45	368.54	1017.62	784.75	1336.53	1769.33	2202.13	2634.93	3067.73
Continuing Value										11319.79	
EVA		-1074.94	862.45	368.54	1017.62	784.75	1336.53	1769.33	2202.13	2634.93	
Present Value of EVA						694.41	1046.51	1225.91	1350.13	1429.50	
Sum: PV of Total EVA	17066.24										
Plus: Invested Capital	9192.566										
Company Value	26258.81										
Less: Total Interest baring Debts	1521.34										
Value for Common Equity	24737.47										
Number of Outstanding shares	1,392										
Value per share	**17.77**										

Source: from this study

5.6 Simple PE ratio multiple method

As discussed earlier in section 5.2, usually companies do not have a fixed payout ratio. An alternative simpler approach is used below. The historical EPS data is used for liner regression analysis. Both companies' 2007 FY EPS values are forecasted shown in Table 5-9 below.

Table 5-9: FY 2007 EPS forecasting by using linear regression method

FY	2006	2005	2004	2003	2002	2007 (forecasted)
LRCX	2.34	2.1	0.59	-0.06	-0.71	3.28
AMAT	0.97	0.73	0.78	-0.09	0.16	1.24

Source: from this study

Since the exact PE multiple for these two companies is unknown due to the lack of payout ratio information, we use 14.35 since it gives same AMAT stock forecasted price as the EVA method so that we do comparison between PE Ratio method and EVA method. The result is given in Table 5-10. EVA gives a slightly smaller difference from actual stock price than PE Ratio method does.

This result matches the EVA theory's claim that it is superior to traditional earning method to predict company' value.

Table 5-10: Forecasted stock price comparison between PE Ratio method and EVA

Valuation method	Company	PE Ratio Multiples	Forecasted Price	Actual Stock Price	Difference
PE Ratio	LRCX	14.35	47.10	42.00	-12%
	AMAT	14.35	17.77	18.45	3.7%
EVA	LRCX	NA	46.05	42.00	-10%
	AMAT	NA	17.77	18.45	3.7%

Source: from this study

5.7 Summary of this chapter

From this chapter's analysis, the stock price of Lam Research was higher than that

of Applied Materials at the end of 2006. This result is consistent with what we have been discussed in Chapter Four. That is to say, with better profitability and growth indexes, Lam's stock value is higher than Applied's.

Also by comparing to the market price, our forecasted prices are within +/- 10% range. EVA gives a slightly smaller difference from actual stock price than PE Ratio method does. But from both methods, LRCX seems to be undervalued at that time. The later on (two months later) stock price rise seems to support our valuation result.

Chapter Six: Conclusion and Recommendations

In this chapter, we will examine the result we derived in this study. We will also present our recommendations for these two companies' future development. At the last, we will discuss the limitation of this study and also recommendations for future study.

6.1 Conclusion and Recommendations toward companies in this case

Let us present this section by having a review of the goals set in Chapter One.

1. *To analyze the operation efficiency and business valuation of these two companies through the EVA method.*

   Operation efficiency has been discussed in Chapter Four. We get to understand the operation of these two companies from the EVA point of view. Since Applied Materials accounts for quite a big chunk of the whole WFE business, so it is suitable to be used for benchmarking purpose; while Lam Research on the other hand, has clearly set a higher bar for both indexes (ROIC-WACC spread and Invested Capital Turnover) in this industry.

   Business valuation has been covered in Chapter Five. The valuation result is compared to the market price and is confirmed to be within +/- 10% difference. This may be due to that these two companies are traced regularly by many analysts. It has been briefly discussed that Lam's stock price seems to be undervalued by -8.8 % in August, 2006 and was later recovered and even surpassed by +8.7% within two months.

2. *Come out an analysis of how Lam Research went through the past five years and achieved the changes.*

   For Lam Research, we have seen a continuous upward trend for both ROIC-WACC spread and also Invested Capital Turnover starting from

2003. Part of it is seems to be a natural result of the revenue increase due to economies of scale effect, but clearly the company has managed to keep the pace of invested capital growth slower than the revenue growth in order to get this achieved. We believe the following reasons are the foundation of these changes:

Strong engineering and service team: The revenue growth is mostly attributed to the success of Lam's Dielectric etcher product. Although relatively late to the market in the 300 mm arena, its intrinsic superiority in technology and productivity supported by the continuous improvement projects has proven to address customer's needs. This is the fruitful result of long term investment in technology development and joint development relationships. Combined with the original well performed Conductor etch product, Lam was pushed to the etch market share leader for the past 5 years.

"Respect the data" spirit: Particularly, Lam has an important spirit that is intrinsic to its big engineering community and other organizations: respecting the data. People are really concentrating on projects and make daily decisions based on the real engineering data. This nurtures the atmosphere of fantastic engineering environment and becomes the root of its engineering excellency. There is relatively less effort spent dealing with office politics. Combined with dedicated account structure to support its customers, Lam is able to provide speed to solutions.

Outsource non-core activities: Lam has outsourced several of the non-core activities like Legacy tool manufacturing, IT support function and also Spare parts management to save cost and boost efficiency.

Dedicated operation organization team: A dedicated CSBG (Customer

Satisfaction Business Group) organization has been formed to look at the operation efficiency of warranty tool performance. This kind of attention-to-details mindset helped to drive the best of breed FAST QUAL new tool installation and start-up and installation base performance. The weekly review includes both material and manpower resources allocation. This of course in term helps to accomplish the ultimate performance of Invested Capital Turnover. Basically, you get what you monitor. Also there is dedicated personnel for service and spares business operation. Back to about 5 years ago, Lam even bought a book "Lean Thinking" by James P. Womack for its middle managers trying to get this operation excellency rooted deep. I think this $26 dollar book is well paid off now.

Careful funding projects management: From strategic point of view, Lam has been cautious to pick up the most lucrative markets to attack. Before making a decision, the ROI (Return-on-Investment) analysis is carefully evaluated down to project level even the project is only one or two employee's effort. This is based on the understanding that any company resource is not only precious but also scarce. The power is so huge while this spirit cascades down to the engineers' level.

3. *Based on the business valuation view point, formulate the recommended strategies of these two companies' future development.*

For Lam Research:

Adjacent market engagement: Since Lam has gained a lot of momentum from the revenue growth and this is mostly a direct result of market share growth. With the existing high market share that it already achieved (around 50%); the room for further growth may be somewhat limited. So it may be a good idea to consider attacking new market which

can leverage the current Lam expertise and resources. Lam is actually already doing so. As put by Lam's CFO Martin Anstice in F3Q07 (Qtr End 3/25/07) Earnings Call, "Lam's development of new products adjacent to the Etch market that provide the opportunity to double our served available market and potentially grow the company 2.5 times faster than the overall total growth in wafer fab equipment spending through 2010." Considering our forecasting of CAGR 8% from 2005 to 2011 in Chapter 3, the prediction made by Mr. Anstice is suggesting a 20% revenue growth rate annually. This is greater than the 15% CAGR of Lam's revenue from 2002 to 2006 already.

M&A: The other thing that may worth considering is the acquisition of other companies. With current management team experience, there may be chance that Lam can leverage the learning gained from the past several years and create another change. After all, the experience includes both improvements in ROIC-WACC spread and also invested capital turnover. Both these may have chance to be duplicated in another similar companies that experiences similar situation as Lam did back before 2002.

Knowledge management and People retention: Trying to stay at our current position for our current business alone is not going to be easy. Lam's strongest competitors are the number one and number two players in the WFE industry: Applied Materials and Tokyo Electron. These two companies have great resources and capabilities that they have demonstrated repeatedly they can turn things around over the past 20 years. So it is important for Lam to be able to hold on to everything that is already possessed and achieved. This includes getting patents for our precious technologies, keeping experienced people working for us still,

implement and leverage the knowledge acquired with hard work.

Optimize the capital structure: The other thing that we found in this analysis is that maybe Lam could lower down the WACC by having higher percentage of debts in stead of equities. WACC of Lam's is almost 2% higher than that of Applied's and this has caused some impact to the company value. For example, if we can drop the WACC to something similar to that of Applied by doing so, Lam's stock value can be boosted up from the original 46.05 to 53.97, a 17% gain!

For Applied Materials:

Be bold on expansion: Applied Materials is qualified to own good business and good managers. Being dominating at almost all major markets in WFE, it is a wise idea to engage in new markets. Compared to companies like GE, there is still room to grow, and to diversify. After all, with all the talents within the company, it is a pity not to utilize it to its most.

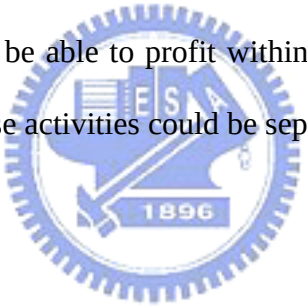
Enhance its operational excellence: As for the WACC-ROIC spread and Invested Capital turnover indexes, clearly there is still room for improvement.

This research has completed the evaluation of these two companies. It has also helped to formulate the recommendations for their future directions. The activities ratios together with the ROIC-WACC spread of Lam Research can also be used for benchmarking purposes for other WFE suppliers.

6.2 Limitations of this research

The limitations of this research include the following:

1. While forecasting NOPAT and Invested Capital, liner regression method is used. There are other more complex regression methods which may be better at forecasting.
2. WFE industry has a strong cyclical effect. It will be the best to do forecasting with this factor considered.
3. The financial data taken for this extrapolation are yearly data and only starts from 2002 to 2006. A quarterly data analysis may be helpful to add more data points to increase the solidity of this study.
4. Lam research and Applied Materials constantly starts many new business segments that may not be able to profit within 3 years. The valuation will be more accurate of if these activities could be separated.



6.3 Recommendations for further research

More study could be conduced to better answer the questions about how Lam went through the past years and achieved the changes.

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