

Supply Chain & Organizational Behavior through the Three Lenses

A Case Study

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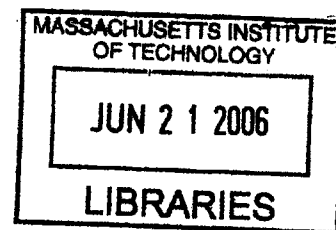
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ABSTRACT

SUPPLY CHAIN & ORGANIZATIONAL BEHAVIOR THROUGH THE THREE LENSES A CASE STUDY

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Introducing change in any company, organization or institution has never been an easy task to accomplish. There is always a resistance to change, as change creates confusion in the minds of people, makes them uncomfortable and requires compromises and adjustments in the way people are used to functioning. However, for the advancement of technology, organizations, society and life change is inevitable and will take place sooner or later. This thesis focuses on one such change - change in operational behavior in addressing a new market entry (IC programming socket market) by the semiconductor burn-in socket business unit of ACME Inc.

The new market entry is done such that the solutions currently provided in the burn-in market are made to operate in a larger solution space with minimal changes to the product/solution to help maximize profitability of the same. This thesis discusses the differences between the two semiconductor test markets and the similarities between the solutions offered.

Further, applying Paul Carlile's approach of using the Three Lenses approach in analyzing an organization - Strategic, Cultural and Political, the thesis brings out the salient issues in employing the new market entry strategy through an organizational perspective.

In addition, the thesis discusses some fundamental inventory management techniques and application of the same to the development of an inventory management program. The deployment of 'all customers are not equal, all products are not equal and all service levels are customer-product level dependant' strategy helps in addressing the issues identified by the Three Lenses.

Besides the identification of the strategy, the thesis also shows the importance of the implementation phase to the success of the program. Sharing the inventory analysis with the implementation team; identifying the market opportunity and sharing its effect on the top and bottom line with the management team; political influences required to get the team (direct and indirect) on board are the steps that were taken, without which implementation of the new market entry strategy would have seen a different end.

On brining the two overarching business principles of organizational behavior and supply chain management together, ACME Inc. now enjoys the benefits of entering a new market with minimal engineering resources. It provides the organization an increase in profitability through product reuse, avoiding high volume manufacturing disruptions, avoiding not on time delivery excursions and a successful entry into a new market.

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I dedicate this thesis to my wife, Pooja.

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1 INTRODUCTION

Change in management, change in geographical locations, change in business processes, change in organizational structure, change in business model, change in market focus, change in resource allocations, change in center of expertise, etc are only some of the various forms of changes that can take place in an organization. These kinds of changes are absolutely necessary for the development and success of the organization. This thesis focuses on one such change - change in operational behavior in addressing a new market entry (IC programming socket market) by the semiconductor burn-in socket business unit of ACME Inc.

1.1 BACKGROUND

The semiconductor industry is a constantly evolving one with new technologies arising out of different parts of the world on a daily basis. Figure 1 shows the segmentation of the semiconductor market into Memory and Logic and further sub segmentation of the same into SRAM, DRAM, Flash, MRAM, FRAM under memory and microcontroller, microprocessors, DSP, SOC and Analog under logic. This segmentation is based mainly on the end application and the IC's specific function in those applications. The interesting outcome of Figure 1 is the fact that each of these market segments are characterized by various packages, which according to Fjelstad, Joseph [1], are defined based on how the package is presented to the next level of interconnection.

This complex and varied combination of different potential IC packaging requirements of the semiconductor industry makes it obvious that the packaging option has a significant effect on the semiconductor's supply chain. Even though this complexity has its own drawbacks, one of the advantages of the same is that this complexity in the supply chain creates a wide range of business opportunities for the various solution providers in the semiconductor value chain. This thesis pays special attention to two specific market opportunities (a) burn-in socket market and (b) flash programming socket market and the steps the burn-in business unit of ACME Inc took to enter the new IC programming socket market.

The burn-in business unit of ACME Inc. is one of the leading suppliers of burn-in test sockets to the \$220MM burn-in socket market. Burn-in is a relatively old back-end test process in the semiconductor industry that [2] involves the application of thermal and electrical stresses for the purpose of inducing marginal failures of microelectronic devices with inherent defects or defects resulting from manufacturing aberrations which cause time and stress dependent failures. One of the many components that help in conducting burn-in test is the burn-in test socket, which holds the IC package during testing.

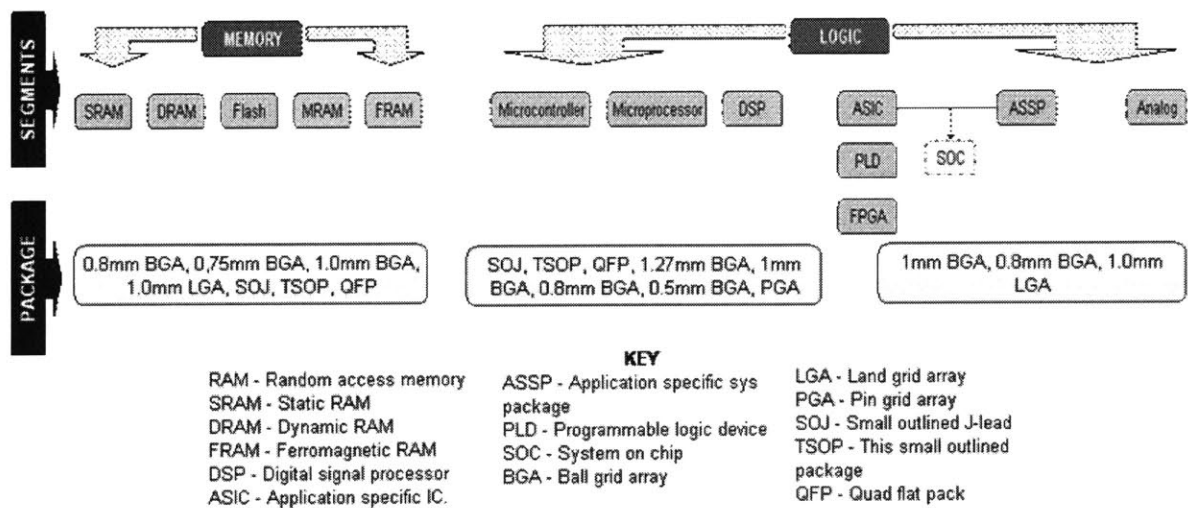


Figure 1 – Semiconductor market segmentation and its corresponding package requirements.

Figure 2 highlights the usage and pricing of the burn-in sockets (per program) in the different semiconductor market segments. A single customer may have close to 10-12 programs a year, which include new IC development, IC modification, package modification, miniaturizing ICs or packages, etc., that have a varied need of burn-in sockets. It is clear from Figure 2 that the burn-in environment is a high volume low price environment, and from Figure 1 that the complexities of different packaging requirements of each market segment do not make it very easy for the burn-in socket suppliers to manage their supply chain, manufacturing lines and the involved logistics. However, each burn-in socket supplier handles these issues in their own unique way hence providing a variety of winning value proposition to the market space and end customers.

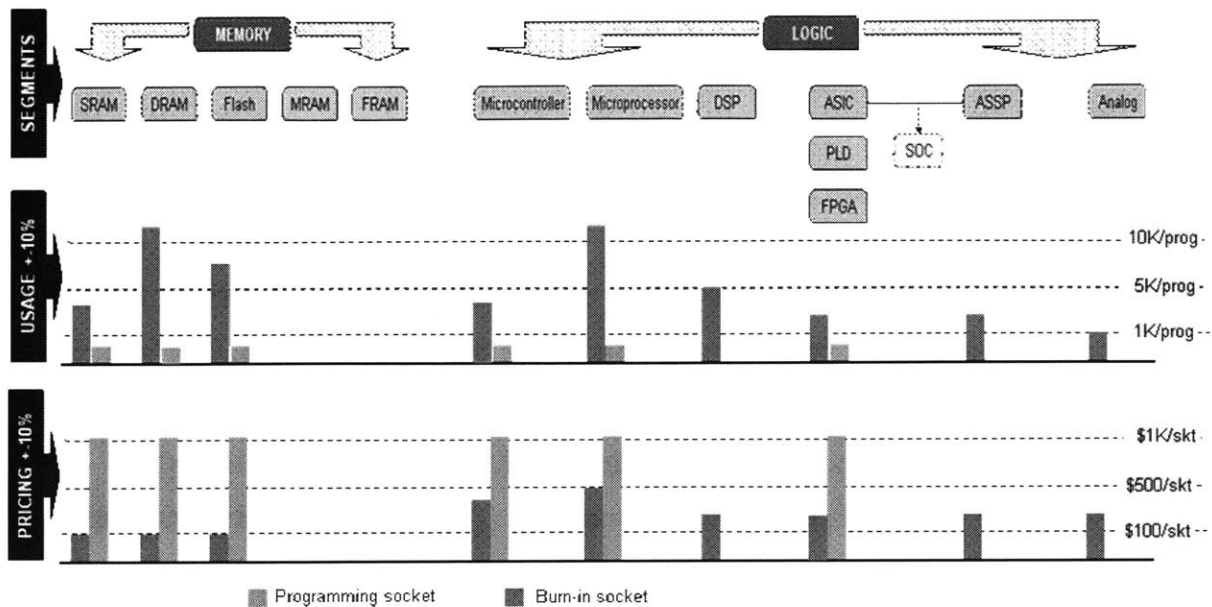


Figure 2 – Burn-in and programming socket – usage and in the different semiconductor market segments

As indicated earlier the semiconductor burn-in business unit of ACME Inc. is a leading supplier of burn-in sockets to this industry and uses BCP (best cost producer) strategy, which involves the use of optimal manufacturing locations (based on total cost, availability of resources and logistical advantages), and concentrates its business around BGA (ball grid array) socket development. It leverages the economies of scale in the high volume socket environment and optimizes its overall cost of manufacturing the burn-in sockets to meet the low price requirement of the industry. However, the burn-in business unit of ACME Inc. is also interested in the adjacent IC programming socket market of the semiconductor industry.

Similar to burn-in testing, IC programming also belongs to the back-end test process. IC programming is the process of reading, writing and erasing information into different cells of the memory IC based on its end application and its desired function in the computing world. This information transfer could be [3] either production based or development based. Once again (compared to burn-in), one of the many components that help in programming ICs is the IC programming socket that holds the IC package during programming. Figure 2 highlights the usage and pricing of the IC programming socket per program in the different semiconductor market segments, which are characterized by low volume and high price market requirement.

As in the burn-in environment, the IC programming market also needs to deal with complexities of different packaging requirements shown in Figure 1.

1.2 PROBLEM STATEMENT

Based on the above discussion, it is clear that there exists a fundamental difference in the needs of the burn-in market and the IC programming market. The first case is characterized by high volume, high mix and low price, while the second case is characterized by low volume, high mix and high price. The semiconductor burn-in business unit of ACME Inc is currently designed to operate in the burn-in market environment. The requirements of the manufacturing line (maximizing output, minimizing inventory, reducing setup time and overall costs), product development, supply chain, sales and marketing and the various metrics in the organization are designed around success through high volume production of the sockets.

However, it is also important to note that the basic need of the IC programming market is to program the same IC that has undergone burn-in. This implies that there is a high probability that the IC programming socket for the IC already exist as (low cost) burn-in sockets. Therefore, there is a possibility that without making significant capital investments, the burn-in business unit of ACME Inc can provide the burn-in sockets as IC programming sockets at a price premium (significant cost reduction over current IC programming sockets) and hence enter the new IC programming socket market. However, this market entry will create tradeoff issues between a high volume production environment and a low volume market requirement.

Therefore ACME Inc.'s, decision to leverage its existing engineering and manufacturing capability to address the needs of the adjacent IC programming market has experienced significant organizational resistance because its habits and incentives in engineering, manufacturing, and supply chain management are geared to the burn-in socket market. The thesis describes how this resistance was overcome using fundamental organizational behavior analysis techniques and supply chain principles.

1.3 APPROACH

Organizational behavior has been long used as a mode of studying, understanding and defining how organizations should function and react to change. Starting from the early 1900's with Frederic Winslow Taylor, Scientific Management, Hawthorne's studies, Douglas McGregor's Theory X and Theory Y have all tried to define organizational behavior to make the organization a more efficient system. This thesis will use the works of Carlile, P [4] to understand the organization by employing the Three Lenses or three views through which all organizations can be viewed – Strategic, Cultural and Political. The Three Lenses will be applied to the operational group of the burn-in business unit of ACME Inc to understand the effects of entering a new market. The three lenses approach will provide a deep insight into the organization to understand the strategic direction in entering a new market, the effect of this decision on the cultural aspects of ACME Inc. and finally the political clout and the influence of the same on the success of the market entry. Such an analysis will highlight and bring out the various issues in addressing the market need; the various solutions that may help overcome these issues and also help prioritize the issues based on the level of importance to the organization.

In addition the thesis discusses some of the fundamental supply chain principles and inventory management techniques and application of the same to the development of an inventory management program. The inventory management program is an extremely simple and elegant solution to the fundamental problem of overcoming the tradeoff issues between a high volume production environment and a low volume market requirement. Finally the thesis shows how the opposition to the program implementation by the engineering and manufacturing groups (due to its adverse affects on the volume based incentive programs) was overcome by leveraging management backing and political influences that was determined using the political lens of the threes lenses approach to understanding an organization.

1.4 CHAPTER SUMMARY & THESIS LAYOUT

This chapter provides the reader background about the role played by ACME Inc. in the burn-in market of the semiconductor industry. It also discusses the role played by the IC programming market in the semiconductor industry. In the problem statement section, it clearly outlines the similarities and differences in the market spaces for burn-in and IC programming and how a strategy could be designed for ACME Inc to participate in both markets at the same time. Finally, in the section on thesis approach, it discusses the two fundamental techniques – organizational behavior and supply chain management that ACME Inc needs to incorporate to successfully address the new market entry.

To be able to get a better understanding of the market opportunity of ACME Inc, the various issues that may be expected and the various processes that were put in place to overcome these issues the thesis is structured as follows:

Chapter 2 ‘Literature Review’ provides the reader a detailed analysis of the techniques in organizational behavior and supply chain management utilized in this thesis with specific emphasis on the three lenses and inventory management.

Chapter 3 ‘Market Analysis’ provides an in depth analysis of the markets in question – burn-in and IC programming.

Chapter 4 ‘Applying the Three Lenses’ uses the information from the Literature Review on organizational behavior and describes the application of the same to the organization to highlight the organizational behavior based issues in entering a new market.

Chapter 5 ‘Inventory Management’ uses the information from the Literature Review on supply chain management and describes the application of the same to the organization to overcome the issues identified by the three lenses.

Chapter 6 ‘Conclusions’ brings closure to the thesis by summarizing the results from the culmination of the three lenses and the inventory management program.

2 LITERATURE REVIEW

This thesis addresses the issues of the tradeoffs between a high volume production environment and the organizations attempt to enter a low volume market using the three lenses approach of organizational behavior and the fundamental inventory management principles of supply chain management. This literature review will provide the reader basic concepts on the subject matter, which would be helpful in appreciating the application of these principles and techniques to the semiconductor burn-in business unit of ACME Inc.

2.1 THE THREE LENSES

According to Carlile, P [4] in order to understand an organization, we can employ three lenses or three views through which all organizations can be viewed. Change management can be effectively and successfully employed when using the three lenses that are as follows.

2.1.1 ORGANIZATION AS A STRATEGIC DESIGN

In viewing the organization as a strategic design, [4] the organization is seen as an input, throughput and output system, and the role of the leader is seen as a strategist or organizational architect. In real world, the strategic lens could be used to understand the strategic path of the organization. In the context of this thesis, understanding an organization as a strategic organization is very critical as it helps drive employee activities and set up standard practices that are aligned with the corporate strategy at the corporate level. It can also be a source of understanding why the employees in the organization behave in a certain way.

The strategic direction taken by an organization determines the mission, goals, objectives, tactical decisions and success metrics that shape how the business will be conducted and the forward outlook of the organization. Different organizations use different methods and approaches to address their strategic direction. However, the fundamental steps in addressing

the strategy of the company along with ‘who is being served’, ‘what is being satisfied’ and ‘how value is being delivered’ can be answered using a market assessment process outlined in Figure 3.

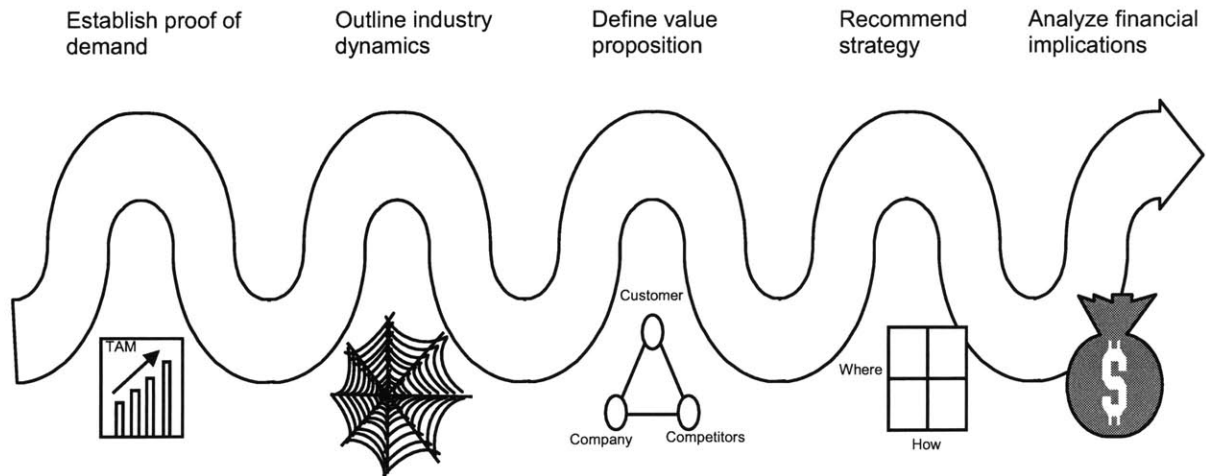


Figure 3 – Market Assessment Process

Establishing proof of demand: This step involves identifying the end user needs, the sources of demand, the alternatives available to the market, the competitive threats and situations, price/performance comparisons and the total cost. This is usually understood by market research, talking to early adopters and historical analysis. Using all this information, the projected market size is determined, market segmentation is performed and market boundaries are established.

Outlining industry dynamics: This step involves understanding the value web that includes knowing the key participants, the competitive landscape (strengths, weaknesses, opportunities threats), influencing nodes in the value chain, key uncertainties, impending discontinuities, regulatory implications and probability estimations. These are usually attained by conducting interviews, using focus groups, product road map comparisons and scenario planning to come to an agreement on the industry dynamics using baseline analysis.

Define value proposition: This step involves mapping of the product features to the multiple careabouts of the customers in the defined market segments, separating the customer needs

from the wants, understanding both the current and projected competitive advantages and defining the barriers of entry and understanding exit opportunities. This is typically accomplished by utilizing the information obtained in the previous two steps of the market assessment process and converting the same into a defensible value proposition to the value chain.

Recommending strategy: Once the first three steps of the market assessment process have been completed, this step converts the information into a strategy. The strategy comprises of where to compete – that includes the segments to go after, target customers and the key control points to be addressed; what to compete with – that includes the type of product or concept to use, defining product road maps, pricing and costing structure; and finally how to compete – that includes defining the primary sources of value capture, outlining partnership scenarios, defining the channels to market, the type of investments to be made to secure control of key sources of value and exit strategies.

Analyze financial implications: The final step in the market assessment process involves understanding and determining the financial implications of the strategic direction in addressing the market opportunity. It involves determining the resources (man, money and machine) required and how it varies over a period of time, defining milestones, investments required, the return on investment, break even points and the sensitivity of the opportunity to market dynamics and environmental factors. This step also outlines the responsibilities of monitoring the progress versus milestones, accountability with metrics for each of the identified milestones and the overall profitability and pay back to the business.

It is clear that the outlined market assessment process is a detailed analysis that would be required for the success of a business group or an organization. However, it must also be noted that the above process is only an outline and will vary between businesses and opportunities based on the market, economic and time constraints.

In addition, companies are usually operations focused, and hence tend to focus almost entirely on the strategic aspects of business. Companies focus on such aspects as these are tangible,

there are many metrics for strategic success, and management training is strategy-centric. Businesses feel that strategy is the most important issue, but the problem is that over-emphasizing strategy leads to neglecting business culture and internal politics.

2.1.2 ORGANIZATION AS A POLITICAL SYSTEM

The organization is viewed as an arena for conflict, while viewing organization as a political system. [4] While viewing organization through this lens, it is important to understand the various stakeholders, their relative power and influence, their interests and the dominant coalitions in the organization. The leader in such a system is seen as an astute negotiator who forges right coalitions while identifying and leveraging interests of various stakeholders. In the context of risk management, the political lens is very important, especially if the firm has organizations rigidities in place. In the context of change management, right coalitions can make the make or break difference.

[5] A political perspective of an organization is composed of individual and groups who not only contribute important resources to an organization and depend on its success but also have different interest and goals and bring different amounts and sources of power to bear in organizational interactions. Moreover organizational interactions are not one time events and hence no specific organizational interaction is independent of the past or of expectations about the future. According to Ancona, et al, [6] to design and implement group and organizational processes to produce joint gains or acceptable compromises among the stake holders and their interests, it is important to (1) identify and map the relationships among the different stakeholders involved; (2) uncover the most salient interest and goals the different stake holders bring to the interaction and the extent to which the conflict exists; and (3) asses the amount and sources of power of the different stakeholders.

Power is shared in an organization and is shared out of necessity more than out of concern for principles of organizational development or participatory democracy. [7] Power is shared because no one person controls all the desired activities in the organization. [8] From a political perspective, power is the ability to get things done when goals conflict. At the same

time it must be noted that power is not a zero sum game i.e. when one gains power it does not imply that the other loses the same amount of power. Henry Mintzberg [9] summarizes power into three main groups: (1) Resources, technical skills or specialized bodies of knowledge. (2) Formal power that has the ability to sanction behavior or impose choices through formal positions, legal rights, responsibilities or ownership. (3) Power derived through access to individuals or groups who have power. Further, each of these groups has different factors that help the individuals or groups either more powerful or powerless depending on the nature of the factor.

[6] Table 1 attempts to show the contributions of the factors towards power and powerlessness.

Factors	Generates power when	Generates powerlessness if
Rules inherent in the job	Few	Many
Predecessors in the job	Few	Many
Established routines	few	Many
Task variety	High	Low
Rewards for reliability/predictability	Few	Many
Rewards for unusual performance/innovation	Many	Few
Flexibility around use of people	High	Low
Approvals needed for non routine decisions	Few	Many
Physical locations	Central	Distant
Publicity about job activities	High	Low
Relation of tasks to current problem areas	Central	Peripheral
Focus of tasks	Outside work unit	Inside work unit
Interpersonal contact in the job	High	Low
Contact with senior officials	High	Low
Participation in programs, conferences, meetings	High	Low
Participation in problem solving task forces	High	Low
Advancement prospects of subordinates	High	Low

Table 1 – Factors contributing to power and powerlessness

The political issues that may face a particular company during expansion into a new market, revenue growth, global expansion, etc. will vary from company to company and from market to market. A common political issue with new market entry is when management indicates that current products need to be modified in some way to be relevant to the new market; employees may influence this modification to serve their own department's interests, which may have a negative impact on the product itself. Another opportunity for political strife may occur if a team from a US-based company would need to move to a new location to facilitate business focus on the new market. The employees of the location, where the business is being moved out of, resist this and use political means to make the move a failure. The management, from the top down, must be aware of these issues during an expansion opportunity. The best defense against many political issues may be a corporate culture that is geared towards expansion.

2.1.3 ORGANIZATION AS A CULTURAL SYSTEM

According to Ancona, et al, [6] the cultural perspective of an organization takes place with a good deal of conventional managerial wisdom on how to run a business. The cultural perspective on organization focuses first and foremost on the meaning people assign to their respective work experiences. They are meaning makers, symbol users, story tellers who are actively engaged in organizational life, and, through interactions with one another, they continually create, sustain, and modify organizational events, processes, and products. [6] Taking a cultural perspective on organizations helps predict areas of potential trouble and can help reduce such conflict, if possible, or at least help manage it more effectively where and when they arise. [6] Five features of the cultural lens on organizations stand out as particularly crucial, as summarized below:

Focusing on symbol and meaning: Taking a cultural perspective means trying to decipher what things mean to people in organizations. Strengths, goals, rewards, and so forth may well mean different things to different people and discovering where and why such differences arise is a matter of considerable diagnostic and ultimately practical importance for the understanding and running of an organization

Identifying various forms of social control: Organizations must develop means to ensure that employees act in ways that are more or less beneficial to the goals of the enterprise. Both individuals and groups may follow norms and standards that disrupt or otherwise interfere with managerially approved objectives. Identifying the ways in which satisfying and productive work cultures are created in organizational settings is a crucial diagnostic task for managers and one that requires paying close attention to matters such as recruitment practices, socialization and training programs, reward policies (formal and informal), corporate rituals, exemplary role models, and the stories that are frequently told in and around the company.

Recognizing sub-cultures: Homogeneous organizational cultures are quite rare and, when present, are typically found in relatively small closely held and highly focused firms. As organizations grow in size, subcultures emerge more or less naturally and on occasions challenge and resist managerial direction. Within a given organization, subcultures provide alternative identities for employees and allow meanings that flow from groups outside the firm's boundaries to find internal expression. Understanding subcultures is often a mostly practical matter, for it means being able to anticipate the different meanings that new policies or programs may take in various segments of the organization.

Diagnosing organizational culture: Despite considerable sub-cultural variation within large organizations, there is often a relatively small set of governing ideas that are built into the organization by way of mental maps or schemas that members use as guides and are often called 'basic assumptions'. They are built up over lengthy periods of time, typically originating with the founders of the firm. These assumptions should not be confused with organizational values or company prescribed norms, structures, rules or routines. The basic assumptions concern the way many values and artifacts of an organization are patterned over time.

Looking across cultures: Strong cultural models claim that national, local, or firm-specific cultures fully explain organizational behavior. The counterpoint is taken up by either strong power or structural models that discount the potential lead-culture takes in promoting or thwarting organizational change, or ignore the mediating and legitimating roles culture plays when stability is desired. The cultural perspective presented here rejects an either-or approach

in favor of a more complicated mutual accommodation idea that stresses the cultural influences on power and structure and the need to always interpret both in light of a specific cultural lens. Such an approach is particularly helpful when an organization operates in more than one country and/or several cultural groups must work together in a single operational setting. Managers cannot control the cultural frameworks that make their operations meaningful in such settings, but they can appreciate their lack of control and inability to impose unitary meanings. Given such inherent limitations, managers can perhaps understand just when cultural incompatibilities will seriously challenge what they would like to do and thus act sensibly and respectfully in light of such understanding.

In conclusion, according to Ram Charan [10], “Revenue growth is everyone’s business” and is a tenant that must be instilled in the company. Everyone, from the repair teams to technical support, can and should give valuable feedback to the management in both ways to grow and how they are doing in current products and markets. Ram Charan [10] states that it is critical to dispel the myths that “we are in a no-growth industry” or “customers are buying only at one price”. To do so, management has to create an explicit growth agenda that is known and understood by the organization as a whole. With an explicit agenda, a “social engine”, as Ram calls it, is formed and begins to generate ideas that build upon each other, and thereby allows all levels of the organization to contribute. Creating a culture where the entire organization contributes to growth is the ultimate key to any corporate expansion into a new market.

The above discussion on the three lenses shows that any organization can be and should be looked at through the strategic, cultural and political perspective to be able to make better decisions and be successful as an organization, both internally and externally. The discussion to follow takes the internal aspect of the organization and provides the reader a better understanding of the supply chain aspects of an organization with special emphasis on inventory management.

2.2 SUPPLY CHAIN

Supply chain management is not a new concept and has been in practice ever since the first industry was formed. However, the various principles of supply chain and the importance of the same are relatively new. The following section attempts at highlighting some of the leading thoughts in supply chain and provides a brief introduction to the same.

[11] Supply chain management is a set of approaches utilized to efficiently integrate suppliers, manufacturers, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations and at the right time, in order to minimize system wide costs while satisfying service level. Supply chain management takes into consideration every facility that has an impact on cost and plays a role in making the product conform to customer requirements. The objective of supply chain management is to be efficient and cost effective across the entire system to enable system wide cost minimization. This is done by efficient integration of suppliers, manufacturers, warehouses and stores by encompassing the firm's activities from the strategic to tactical to operational levels.

In order to implement a supply chain management strategy efficiently there are a number of questions and tradeoff associated with different decisions that need to be answered. This has been classified by Simchi-Levi, et al [11] into different key issues, which are distribution network configuration, inventory control, supply contracts, distribution strategies, strategic partnerships, outsourcing and procurement, products design, information technology and customer value.

In the past few years to address these trade offs and issues with supply chain management different strategies have been developed. They are (a) Push strategy – In this strategy the production and distribution decisions are based on long term forecasts. Typically, the manufacturer's bases demand forecasts on orders placed by the retailer's warehouses. It hence takes a significant amount of time before the supply chain can react to a market change. This can lead to inability to meet changing demand, inventory obsolescence, excess inventory, deterioration in service levels and product obsolescence. (b) Pull strategy – In this strategy

production and distribution are demand driven, which helps in coordinating true customer demand rather than forecasted demand. Such a strategy leads to decrease in lead times, decrease in inventory and decrease in variability. However such strategies are difficult to implement and maintain especially for long lead time items and does not allow leveraging economies of scale. (c) Push-Pull strategy – In this strategy some stages of the supply chain, typically initial stages, operate in a push based manner while the remaining stages operate in a pull based manner. The interface between the push and the pull systems is referred to as the push-pull boundary. Such a strategy allows the manufacturer to take advantage of aggregate forecasts that are more accurate; uncertainty in component demand is much smaller than uncertainty in finished goods demand and leads to safety stock reduction.

For the sake of simplicity and to implement effective supply chain strategies the supply chain can be divided into three (a) down stream – the suppliers (b) internal – the manufacturing and logistics of the organization (c) upstream – the sales channel and customer delivery methodology. Due to the fact that the main issues that arose during the new market entry strategy were to do with the internal organizational resistance, this thesis will deal mainly with the internal aspects of supply chain with special emphasis on the development of the inventory management and the implementation of the same.

The importance of inventory management and the need for the coordination of inventory decisions and transportation policies have a significant impact on the customer service level and the system wide supply chain costs. [11] There are several forms on inventory and can be broadly categorized in to (a) raw materials (b) work in process and (c) finished product inventory.

There are a number of factors that contribute to inventory variability in the supply chain which is also referred to as the bull whip effect. [15] These factors can be classified into (1) Demand forecasting – An important characteristic of all forecasting techniques is that as more data is observed, the more the estimates of mean and standard deviation are modified. Since safety stocks (a multiple of the standard deviation of demand during lead time) and orders up to level strongly depend on these estimates, the user is forced to change the order quantities hence

increasing variability. (2) Lead time – This is an important factor in determining the safety stock and reorder points. Hence when lead times are longer, a small change in the demand variability implies a significant change in the safety stock and reorder levels which in turn causes increase in variability. (3) Batch ordering – This is a technique used by various companies for different reasons such as reduced transportation costs, fixed ordering costs and application of min-max inventory policy. This ordering system leads to some weeks of extremely large quantity orders and some weeks of no orders at all. (4) Price fluctuations – Events such as this leads to the supply chain stocking up when prices are low causing high demand during certain times and extremely low demand during others and hence causing variability in the system again. (5) Inflated orders – Such orders are usually placed by retailers and distributors when they expect a shortage of supply. When the shortage event is over they go back to the regular schedule. This kind of a situation has some adverse effects on the supply chain and hence variability and the bull whip effect.

There are numerous ways in which these issues can be resolved. However each situation has its own limitations and constraints that make it extremely difficult to generalize these techniques. It is hence more important to make sure that the organization keeps a strong vigilance over such issues and resolves them before they can appear rather than looking for and applying a canned approach to all supply chain problems.

This thesis utilizes one of the supply chain strategies listed – Push-pull strategy in combination with a detailed analysis of the market need, the demand trends and the capabilities of the manufacturing organization to develop a ‘fool-proof’ inventory management system. It must be also noted that the decisions made at each level of implementing the inventory management system is, to a very large degree, controlled by the findings of the three lenses.

2.3 CHAPTER SUMMARY

It is very clear from the discussion in this chapter that organizational behavior can be easily understood using the three lenses – strategic, cultural and political lens. However, the discussions have also shown that using only one of the three lenses will provide an incomplete

deduction and will hence lead to wrong decisions being made. With regard to supply chain management this chapter has highlighted some of the supply chain strategies such as push strategy, pull strategy and push-pull strategy and the advantages of one over the other. In addition, the chapter has also provided the reader with numerous issues such as the bull-whip effect and the variability in the system that one must be aware of to implement an inventory management system successfully.

Having outlined the three lenses and the role they play in analyzing organizational behavior along with the introduction to supply chain management, the next chapter will provide the reader a detailed discussion on the two markets that the burn-in business unit of ACME Inc currently participates in (burn-in socket market) and is looking to enter (IC programming socket market).

3 MARKET ANALYSIS

As discussed in the previous chapters, this thesis addresses the issues faced by the burn-in business unit of ACME Inc when entering the new IC programming socket market in addition to the burn-in socket market that they currently serve. To be able to get a better understanding of the application of the organizational behavior analysis techniques and supply chain management principles it is absolutely necessary to understand the needs and behaviors of the two markets along with their respective value chains. This chapter will hence provide a detailed analysis of the burn-in and IC programming markets.

3.1 BURN IN

3.1.1 BURN-IN OVERVIEW

The development of the electronics industry has its roots in military and space exploration – both areas where uncompromising reliability is a must. The cost and inability to repair a satellite once launched was one of the earliest drivers for the institutionalizing of test processes to ensure reliable performance. One test method – burn-in – developed during those early days, has remained essentially unchanged. The infrastructure, the equipment, the test details and strategies have changed but the essential idea of stressing a component to identify the weak units and cause them to fail remains the fundamental principle behind this test.

Figure 4 shows the overall value chain of the semiconductor manufacture and test process. Today burn-in is an essential part of the BAT (Back-end Assembly and Test) area of a semiconductor producer. This element of the infrastructure including testers, ovens, boards and sockets is estimated to be about \$1 billion industry.

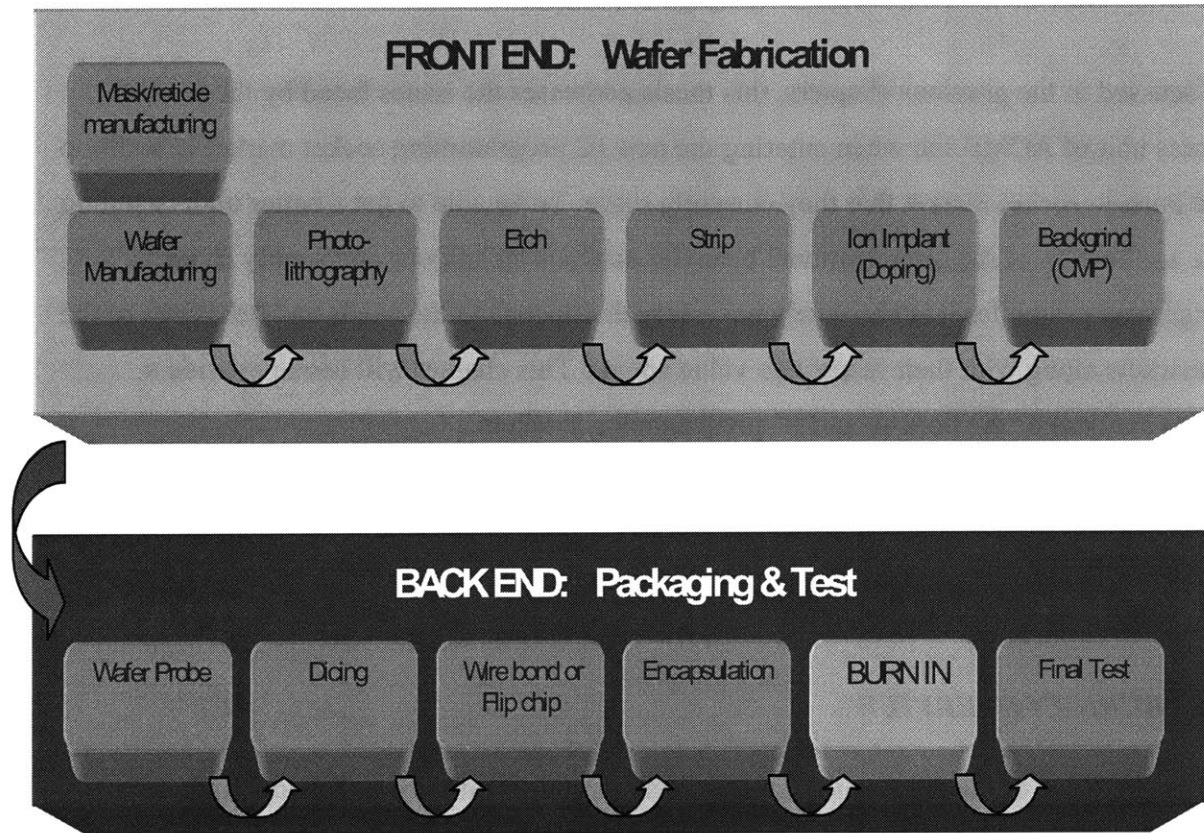


Figure 4 – IC manufacturing value chain

A chip or semiconductor device, at its most basic level, is simply a series of gates, switches and transistors or amplifiers which, when arranged in a specific way, can perform addition and subtraction. The beauty and elegance of semiconductor processing is the way in which these elements have been miniaturized. This enables designers to create circuits, with millions of transistors, which are capable of solving mathematical equations and solving problems. A natural consequence of such complex circuits and miniaturization is the potential for a defect and the impact of such a defect on the functionality of the chip. Unfortunately chips are not ‘stand-alone’ devices – they are assembled into products such as cell phones and computers and a single defective chip will cause the product to fail. Because of the processes used in the manufacturing process some chips may be ‘fragile’ and could fail after a short period of time. It is essential that these devices be identified and scrapped before assembly into other products.

A typical reliability curve of failure rate versus time, which can be applied to many products, is shown in Figure 5 - because of its shape this is referred to as the Bathtub Curve. 'Fragile' devices will fail soon after manufacture as shown by the high initial failure rate – this is normally identified as 'infant mortality'. The failure rate is then flat as other types of 'random' failure occur. After some time, when the product comes to the end of its useful life, the failure rate will increase as the product 'wears-out'. The problem facing the manufacturing and reliability engineer is how to identify and remove these 'fragile' devices so that the reliability of the end product is not compromised. The process to identify and cull these 'fragile' devices is known as burn-in. This involves stressing the part to force the failure of weak or fragile devices.

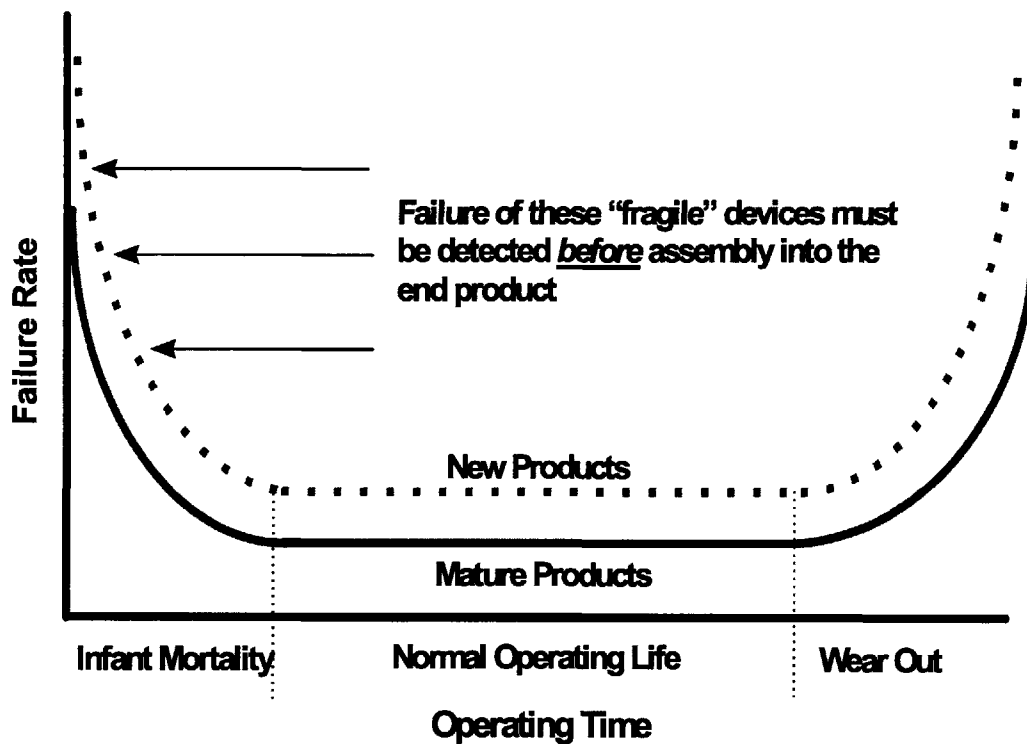


Figure 5 – The bathtub curve

3.1.2 BURN-IN MARKET VALUE CHAIN

Burn-in is a non-value-added process. Every semiconductor company has an informal program to reduce or eliminate burn-in with ideas ranging from BIST (built in self test) to wafer level burn-in and test. Not all devices require 100% burn-in – flash memory and many DSP’s (digital signal processors) for example might only be burned-in during the qualification process. Once the semiconductor processing technology is proven, and the reliability of the device shown to meet specific requirements, then there is no need for this process step. However for semiconductor devices, which are at the leading edge of the semiconductor fabrication technology, such as DRAM memory and microprocessors, burn-in is an essential part of the manufacturing process. The rapid change of technology used in these products and the constant die shrinks, to meet cost and performance goals, contribute to a process that does not reach steady state.

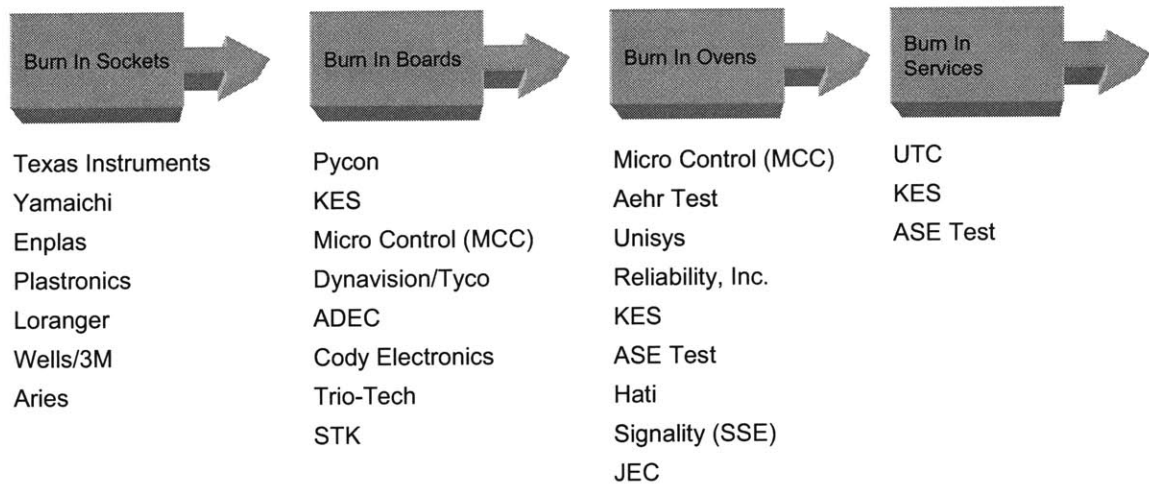


Figure 6 – Burn-in value chain

Figure 6 provides a closer look at the burn-in value chain and the various players involved in the same. The value chain is greatly driven by the various components that make up the burn-in process. The burn-in area of a back-end assembly and test area comprises an assortment of custom ovens with test equipment attached. The ovens have a series of slots which hold burn-in boards (BIB). The BIB is a custom printed circuit board which is designed to withstand numerous thermal cycles to 150°C and to provide the electrical interconnection between the tester and the devices being tested. An integral part of the burn-in board is the socket, which

holds the device being burned-in and provides temporary electrical interconnection between the burn-in board and the semiconductor package.

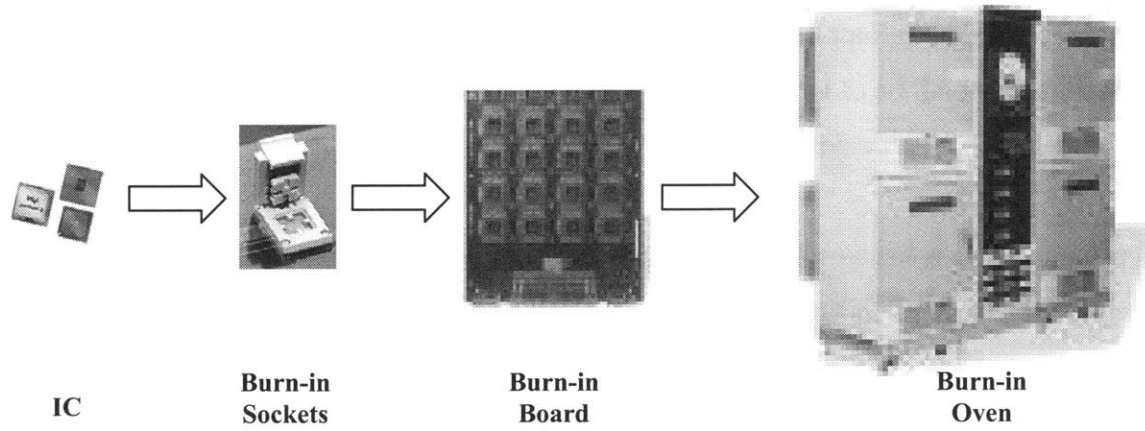


Figure 7 – Components of the burn-in process

Figure 7 shows the components of the burn-in process. The ICs are either manually or automatically loaded into the high temperature burn-in test sockets, which make temporary electrical contact with the device leads. These burn-in sockets are already assembled on to the high temperature circuit boards that have the circuitry to provide the proper voltages and stimuli to the devices. The devices are isolated from one another with passive components which limit the current each device can draw, and filter noise from voltage busses. The burn-in boards (BIB) are then loaded into a convection oven which elevates the temperature of the devices and provides an electrical interconnect to the power supplies and signal generators. The burn-in oven, power supplies and signal generators are also referred to as the burn-in system. The devices are stressed thermally and electrically - that is they are placed in an oven at temperatures up to 150 degree C and have voltages applied which could be as high as 1.5 times the normal operating voltage. The time at temperature can be as short as a few hours to up to 48 hrs, some space applications require two burn-in cycles with total time at temperature of more than 240 hours. This stressing of the electrical paths within the chip, and the thermal expansion issues associated with heating the chip, has proven to be the most effective way to force early life failures.

The fact that the semiconductor cycles are extremely small (new packages can be designed in a few weeks time) and delaying the launch of the end product (Xbox, Pentium 4 processors, Cell

phone processors, etc) can make or break a business, places significant amount of pressure on burn-in especially in terms of speed and cost. Further, if the component that is used to test the reliability of a product is in itself unreliable, the entire process is a complete waste. The value chain hence demands that its suppliers have speed of delivery, cost of components and component reliability to all be of equal weighting when participating in a program. Having one but not the other calls for an automatic disqualification.

The burn-in value chain is hence characterized by high volume, high speed of delivery, low cost of components, high reliability coupled with being able to accommodate the complexity that arises from various package types, package sizes and dimensional differences when semiconductor companies need a potential burn-in solution. In addition the fact that most semiconductor companies are trying to eliminate burn-in (unsuccessfully) makes the entire burn-in supply chain, product design and market response an extremely challenging and interesting market space.

3.2 IC PROGRAMMING

3.2.1 IC PROGRAMMING OVERVIEW

Similar to burn-in flash or IC programming also comprises the testing market. IC programming is the process of reading, writing and erasing information into different cells of the flash memory IC based on its end application and its desired function in the computing world. Taking a closer look at Figure 2 in the introductory chapter of this thesis, one can make a fair deduction that IC programming is more applicable to the memory segment of the semiconductor industry than to the logic segment (even though microprocessors and microcontrollers have programming requirements). It is hence important to discuss the memory segment and in particular the flash sub-segment to get a better understanding of the needs and requirements of the IC programming world. The fact that the logic segment is comparatively much smaller, the needs of the logic segment typically follow that of the flash programming requirements.

Flash memory is a type of EEPROM (electrically erasable programmable read-only memory) device that can retain information even when power is removed from the device. [12] The difference between flash memory and other types of EEPROM is the ability to erase and write to blocks of memory very quickly. This has made flash memory the memory of choice for devices such as cell phones, PDA's, digital cameras, and MP3 players. As these markets have experienced tremendous growth this decade, so has the flash memory market, which [12] comprises of two types of technologies: (1) NAND invented by Intel in 1988 and (2) NOR invented by Toshiba in 1989.

Generally, NOR memory offers better data integrity and faster read speeds than NAND. [12] However, erasing and writing to a NOR device takes several seconds. NAND devices generally offer faster write speeds, lower cost per byte, and come in larger capacities. These characteristics led to the use of NOR devices for storing program and executable code and use of NAND devices when write-speed and increased memory are a necessity. [13] Thus, NOR has generally been the choice for cell phones and PDA's, while NAND is the leading memory choice for digital cameras and MP3 players. The markets for NOR and NAND had previously been somewhat segmented. [14] More than 50% of the NOR market comes from cell phones, however with the increased storage requirements of multimedia phones; NAND is beginning to make inroads. Similarly, NOR suppliers are improving their products and beginning to market them for products that have traditionally been NAND based.

The high growth rates in its traditional base in digital cameras, music players, memory cards, combined with its entry into the cell phone architectures should continue to propel sales growth of NAND at a rate faster than NOR [14]. To get a better understanding of the ranking of flash manufacturers worldwide, please refer Chapter 8. The important take away from the above discussion is the fact that the demand for flash IC will continue to grow over the years as long as the consumer demand for applications such as digital cameras, music players, memory cards, cell phone and other small electronic gadget continues to increase.

3.2.2 IC PROGRAMMING MARKET VALUE CHAIN

As discussed earlier IC or flash programming is the process of reading, writing and erasing information into different cells of the flash memory IC. There are four ways to program the flash blocks in a factory environment (a) Using the Serial Boot loader present in the boot flash; (b) Using a commercially-available device programmer; (c) Using the JTAG/OnCETM (Joint Test Action Group/On-Chip Emulation for unobtrusive real-time debugging) port and (d) Using GPIO (General purpose input output) pins with a custom boot loader. While the first two methods do not require any developmental effort to use, the last two requires the user to develop their own loader program. However, in all cases the fundamental need is the same (a) Speed (load the program in the IC as quickly as possible); (b) Reliability (eliminate errors during program loading) and (c) Minimize cost (maximizing the usage of all components used for programming).

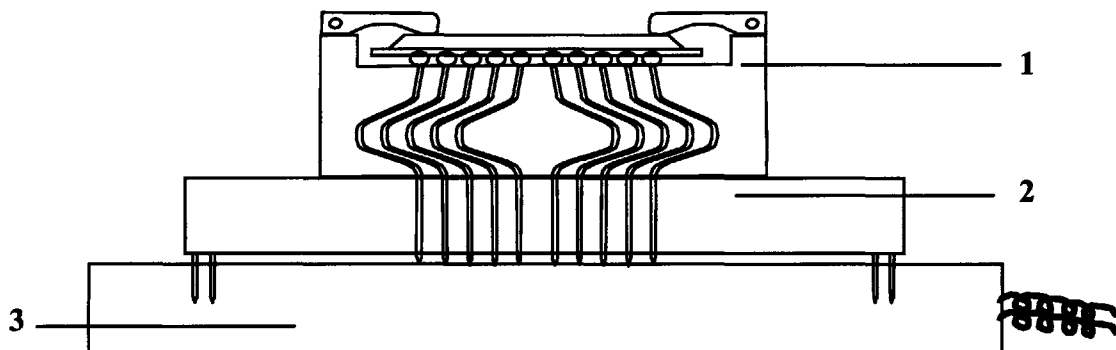


Figure 8 – Components of Flash IC programming

In order to be able to reliably transfer data quickly into the flash cells at a low cost, different manufacturers use different component options. However, the basic components as shown in Figure 8 are:

1. IC Programming socket that is used to encapsulate the flash IC that needs to be programmed.
2. Adapters/converters that are circuit boards that help hold the sockets on one side and have pins that connect to the device programmers on the other side.
3. Device programmers that handle the adapters and sockets and provide the interface between the programming software and the flash IC.

Figure 9 shows the IC programming value chain which is once again (similar to burn-in) mainly driven by the IC programming components. The adapter manufacturers assemble the programming socket and the adapters for use with the programmers at the IC programmer's location. The IC programmers use the assembly provided by the adapter manufacturers in synch with the flash programmers and its respective software to program the ICs provided to them by the flash IC manufacturers. These programmed ICs are then released into the market to the end customer. It is very clear from this value chain that the cost speed and reliability needs are passed down from the end customer (i.e. users of the flash IC) all the way to the adapter manufacturers.

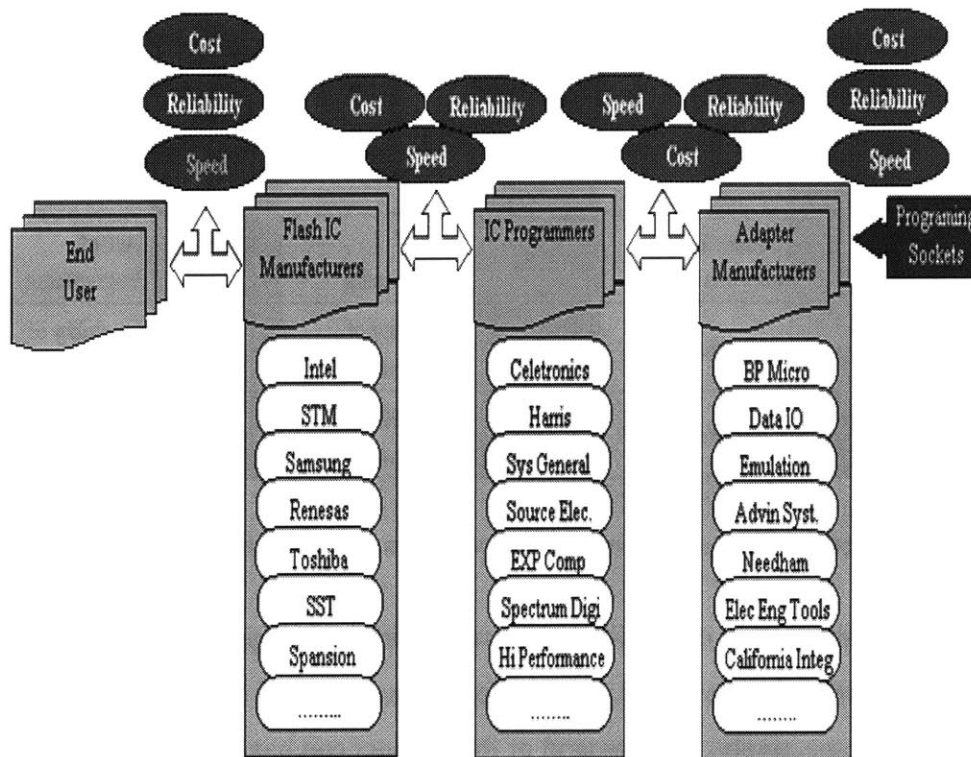


Figure 9 – IC Programming Value

The relative importance of the needs is dependant on the node of observation and differs from each other. The end customer places a larger demand on cost and reliability versus speed (in terms of availability), which is similar to what the flash IC manufacturer does with respect to the IC programmers. However, due to the fact that the speed of programming is a driving factor for cost and gaining business at the programmers location, speed is very critical for the

programmer, which is hence passed on to the adapter manufacturer. Finally, the adapter manufacturer is driven mostly by cost.

3.2.3 FLASH PROGRAMMING MARKET NEEDS

The relative importance of the care-about is as shown in Table 2. The care-about at each node is rank ordered from 1 to 3, where 1 is considered the most important or primary care-about. The table also represents the drivers for the care-about in each case that will help understand the change variables in the value chain.

	Cost	Driver	Speed	Driver	Reliability	Driver
End User	1	Demand	-	Availability	2	Manufacturer
Flash IC Manufacturer	1	Commonality between ICs	2	Ease of Programming	1	Ease of Programming
IC Programmers	2	Component cost	1	Capability of Programmer	1	Capability of Programmer
Adapter Manufacturers	1	Component cost	-	Availability of components	2	Capability of components

Table 2 – Rank ordering the care-about at the various nodes in the Value Chain

End User Node: Table 2 shows that cost followed by reliability is the primary care about for the end users. These are driven by the actual demand for the product and the manufacturing process of the Flash ICs respectively. The demand of the product can have both positive and negative effects on the cost of the end product. Discussions on the effect of demand on the costing and pricing of the end product are avoided as this is outside the scope of the thesis.

Flash IC Manufacturer Node: Table 2 shows that cost and reliability have equal weighting in rank ordering followed by speed at this node. Cost is primarily driven by the commonality between the various ICs the manufacturer manufactures. Difference in the IC demands differences in the equipment to program the IC, which does not allow the supply chain to leverage economies of scale. Similarly, the fundamental design of the IC should cater to ease

of programming to overcome reliability and speed of programming issues. A complicated design will make the programming extremely difficult, hence affecting reliability and speed significantly.

IC Programmers Node: Table 2 shows that speed of programming and reliability of programming are the primary concerns followed by cost of programming at this node. The capability of the programmer is a significant driver for the primary care-about at this node. The cost care-about is driven by the component cost that is provided by the adapter manufacturers. The speed of programming and the reliability of programming, drive the acceptance of the programmers in the market that in turn helps them expand their customer base and increase market share. (This effects total cost as well, which is different from the cost mentioned in Table 2)

Adapter Manufacturers Node: Table 2 shows that cost of components followed by the reliability of the components are the primary concerns at this node. The speed of obtaining the components to be able to manufacture is also significant. However, most suppliers are able to meet the nominal lead times in most circumstances, which hence negate this being considered as a key concern. An important deduction from Table 2 for this node is the fact that the primary concerns at this node are driven by the components and that the component reliability at the Adapter Manufacturers Node does not have a direct effect on its following nodes. The only direct effect it has is the cost aspect of the components at both the Adapter Manufacturer Node and the IC Programmers Node.

Based on the above discussions on value chain and the market need, it can be deducted that the component costs are the main factors driving the value chain careabouts. Further, the fact that the programming industry has become extremely competitive, the component pricing and cost of assembly plays an even more important role not only at the adapter manufacturers node but through out the value chain.

3.3 CHAPTER SUMMARY

This chapter provides a detailed analysis of the burn-in market and the IC programming market. It discusses about the various components required to perform burn-in, which are the burn-in oven, the burn-in board and the burn-in test socket that also make up the burn-in value chain. It shows that the burn-in value chain is characterized by high volume, high speed of delivery, low cost of components, high reliability coupled with being able to accommodate the complexity that arises from various package types, package sizes and dimensional differences. In addition the chapter also brings out the challenging and interesting aspect about the entire burn-in supply chain, product design and market response as most semiconductor companies are trying to eliminate burn-in (unsuccessfully) due to the non-value add feature of burn-in. On the IC programming side, the chapter introduces the types of flash ICs (NOR and NAND) and discusses its potential growth opportunities with the growth in electronics gadgets. It also discusses the various IC programming components, the value chain and the various careabouts at different points (nodes) in the value chain. It finally goes to show that contrary to popular belief, the cost careabouts outweighs the reliability careabouts through out the value chain.

With this in depth understanding of the two markets, their needs, the value chains and the drivers, the next chapter will utilize the information from both the Literature Review and Market Analysis chapters to apply the same in analyzing the burn-in business unit of ACME Inc through the three lenses.

4 APPLYING THE THREE LENSES

In this chapter, Carlile, P [15] three lenses approach in understanding the semiconductor burn-in business unit of ACME Inc will be used in understanding the effect of entering the IC programming market. Recapping the discussion from the Literature Review chapter, it is very clear that organizational behavior can be easily understood using the three lenses. However, the discussions have also shown that using only one of the three lenses will provide an incomplete deduction and will hence lead to wrong decisions being made. This chapter will hence apply the strategic lens, the cultural lens and the political lens to the burn-in business unit of ACME Inc. by leveraging the information provided on market analysis and organizational behavior in the previous chapters of the thesis.

4.1 APPLYING THE STRATEGIC LENS

The fundamental steps in addressing the strategy of the company including ‘who is being served’, ‘what is being satisfied’ and ‘how value is being delivered’ can be answered using a market assessment process that was outlined in Figure 3. The following discussion will help answer these questions by identifying the similarities and differences between the products in two different markets and determining the strategic direction for the burn-in business unit of ACME Inc.

4.1.1 SIMILARITIES IN BURN-IN AND IC PROGRAMMING SOCKETS

The first step is to understand the product that the burn-in business unit or ACME Inc currently provides to the burn-in market and then compare the same with the IC programming socket requirements demanded by the IC programming market.

An extremely simplified design of a burn-in test socket as shown in Figure 10 consists of:

1. An opening that encloses the IC under test

2. A contact system that helps transfer power and signals to the IC package from the burn-in board (BIB).
3. A holder to keep the IC in place when the IC is being tested in the oven or the BIB and socket assembly is being handled on the production floor.

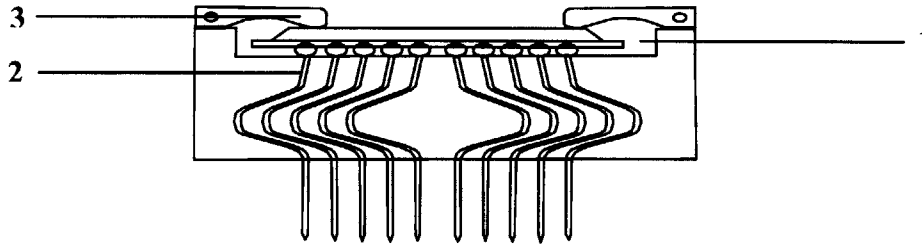


Figure 10 – Simplified components of the burn-in socket

Similarly, a simplified design of a programming socket is shown in Figure 11 and consists of:

1. An opening that encloses the flash IC that requires programming.
2. A contact system that helps transfer power and signals to the IC package from the adapter.
3. A holder to keep the IC in place when the IC is being programmed.

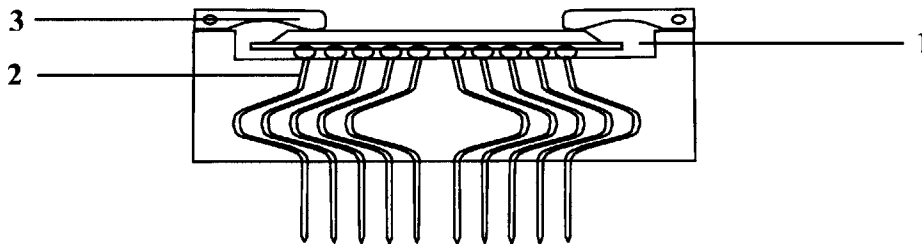


Figure 11 – Simplified components of the IC programming socket

This amazing similarity between the burn-in socket and the IC programming socket is what has prompted the team to address the IC programming socket market need with the burn-in socket. However, in reality the design of the burn-in socket and the IC programming socket is much more complex than that shown in Figure 10 and Figure 11. The design of the components of the sockets in both cases are driven by various regulatory bodies such as MIL-STD 883E (military standard) and EIA (Electronic Industry Alliance) or JTAG (Joint Test Action Group) standards and can vary between customers just because of the variation in the package types

and sizes. This makes the design of the sockets even more challenging and prohibitively expensive, as these sockets not only need to function in synch with the other components of its value chain but also need to be able to accommodate the variety of customer IC packages. However, once a socket is designed for use in the burn-in environment, there is no reason it cannot accommodate the same IC in the programming environment.

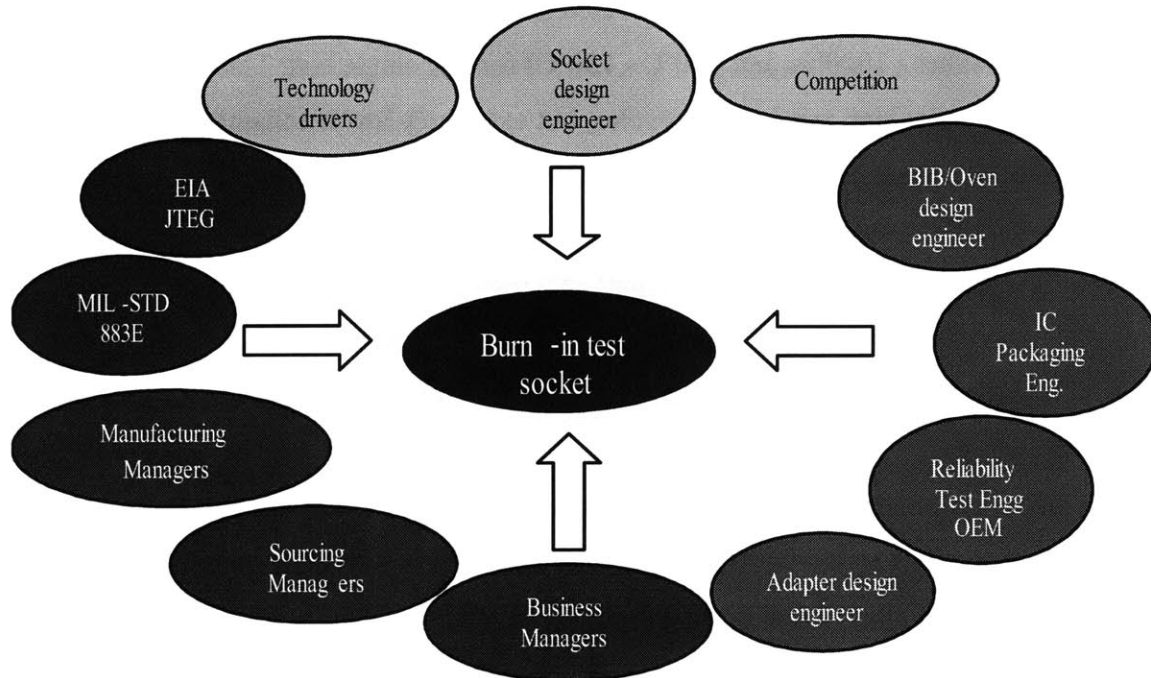


Figure 12 – Burn-in and IC programming socket design drivers

Figure 12 shows a graphical representation of the various stakeholders influencing the design of the socket. The design drivers for the socket can be broadly classified into (a) Internal technical drivers comprising of technology, socket engineers and competitive sockets (b) External technical drivers comprising of the IC packaging engineers, reliability test engineers and burn-in board and burn-in oven engineers for burn-in sockets and adapter design engineers for IC programming sockets (c) Business drivers comprising of the manufacturing managers, the sourcing managers and business managers and (d) Standards drivers comprising of EIA, JTAG standards and MIL Standards. These constraints, drivers and stakeholders are hence responsible for converting a simplified socket design to a more complex and detailed burn-in socket or IC programming socket design.

4.1.2 DIFFERENCES IN BURN-IN AND IC PROGRAMMING SOCKETS

Even though there is a significant similarity in the sockets for burn-in and IC programming, there also exists a fundamental difference between the same in term of its functional and commercial performance.

Functional: Burn-in sockets are used at elevated temperature for extremely long durations (approximately 48hrs - 1000hrs and 100°C - 150°C) for one single test. This implies that the burn-in sockets notice high temperature cycles, but extremely low mechanical cycles, .i.e. a burn-in socket will see one device inserted into it every 48hrs or 1000hrs. However, the programming of ICs is done at room temperature and at an extremely fast rate where each socket experiences a large number of mechanical actuations (30K-100K cycles) in a very short duration of time (1 cycle in 10-60 sec) depending on the size of the instruction set transfer. This is in line with the speed of programming being one of the more important careabouts for this industry where the loading-unloading cycles are typically performed by an auto-loader or pick and place equipment. Hence the burn-in sockets are characterized by hi temperature low mechanical cycle requirement while IC programming sockets are characterized by room temperature and high mechanical cycle requirements.

Commercial: Due to the fact that each programming cycle is less than 60 seconds, the programmers typically use only one socket (unload and load) for close to 30K-100K flash ICs. This implies that a single socket can be used to program numerous ICs. In order to further reduce overall programming time, most programmers may utilize about 50-100 sockets simultaneously for each programming job order, which would hence provide them with close to 1.5M-100M flash ICs programmed. This low volume usage with extremely high mechanical and electrical stress requirements causes the sockets to be significantly expensive (anywhere from \$200-\$1500 depending on the complexity of the flash IC). This scenario has made the various stake holders in the IC programming industry conscious about the cost of the programming sockets and its effect on the value chain.

On the other end of the spectrum of the semiconductor industry is the burn-in process where they use anywhere between 12-50 burn-in boards that hold a large number of burn-in sockets (24-300) per board in burn-in ovens to perform the burn-in test. Due to the fact that burn-in sockets are 'sitting' in the burn-in chambers for extended periods of time, most test houses will try and maximize the number of ICs being tested during each test interval. Further, in order to minimize the time to unload a socket and reload them with new ICs, there is typically a secondary set of burn-in boards loaded with burn-in sockets and ICs outside the burn-in ovens awaiting their turn to get loaded. This implies that as opposed to the IC programming sockets, the burn-in sockets are used in large volumes (300K-1M sockets per job order) especially in the memory applications, hence providing the ability to leverage economies of scale and reduce the cost of sockets to \$6-\$100 per socket depending on the complexity of the IC chip.

It is hence obvious that even though the sockets are similar in design, the functional difference between them makes the IC programming socket a much superior socket compared to its burn-in counterpart. However, the fact that there is a commercial drive for an inexpensive socket and the market analysis shows that cost is more important than reliability to the value chain, the burn-in sockets are a much better alternative to the IC programming sockets to the IC programming value chain.

4.1.3 STRATEGIC DIRECTION

As a value provider in the burn-in supply chain, the burn-in business unit of ACME Inc. has been looking for opportunities to work with their customers to provide them increased value addition in order to differentiate them, displace competition and consolidate its position as a leading burn-in socket supplier. ACME Inc. has two options to be able to do this (a) redesign a socket specifically for the IC programming industry (b) introduce the burn-in socket as a replacement for the IC programming socket.

To redesign a new IC programming socket will require significant resources and investment. It would however help ACME Inc. develop a product that is extremely reliable and would be capable of handling a large number of mechanical actuations (30K-100K cycles) in a very

short duration of time (1 cycle in 10-60 sec). However, redesigning the socket does not allow ACME Inc to leverage the high volume production of the burn-in sockets to address the market needs. This implies that that ACME Inc. will have to spend more money in setting up an entire line to make the new sockets, address the market needs and produce a product that will be a 'me too' programming socket, which would make the socket extremely expensive. The discussion in Section 3.2.2 has shown that cost is more important than the performance of the sockets to the IC programming industry. Hence following such a strategy will not be beneficial to ACME Inc. and would only lead to the failure of entering the new market for ACME Inc.

On the other hand, introducing the burn-in socket as IC programming sockets will help ACME Inc. leverage the economies of scale of the burn-in business. These burn-in type IC programming sockets can be priced at a premium and still be ~3x more cost effective than the existing IC programming sockets. These cost savings would hence be passed on by the IC programmers to the flash memory manufacturers (who are in turn ACME Inc.'s burn-in customers). Further, ACME Inc.'s resources would be untouched in addressing this market as the programmers would use the sockets that are already designed for use in the burn-in application (programmers program the same ICs that have undergone burn-in).

ACME Inc. will hence provide the burn-in sockets as low cost IC programming sockets by leveraging economies of scale and minimal engineering resources to the programming houses that will eliminate the need for expensive programming sockets and completely negate socket design and qualification time (the sockets are designed and qualified during burn-in). ACME Inc. will hence address the system cost issues, delivery speed and global availability of the IC programming sockets making the IC programming market segment more efficient.

4.2 APPLYING THE CULTURAL LENS

It is very clear from the strategic lens analysis, that there exists a well defined market opportunity for ACME Inc. to be a valuable solution provider and hence be able to obtain leadership position in the markets they serve. However, it is important to note that the discussion on the three lenses in the chapter on Literature Review has shown that using only

one of the three lenses will provide an incomplete deduction and will hence lead to wrong decisions being made. Therefore, the next step is to look at this new market entry opportunity through the cultural lens to understand the effect the strategic direction will have on the organizations culture or vice versa (the culture on the strategic direction).

The market analysis on the burn-in socket market has clearly outlined that the burn-in market is an extremely fast paced, high tension and complex business area, where the end customer does not really value the service provided (mainly due to cost). However, the customer is forced to incorporate burn-in to improve the quality and reliability of the end product, especially if it is life or mission critical. Further, it is apparent that the high volumes and numerous programs that arise every day (note the time line is day and not year) make this business extremely lucrative for all the players involved.

The burn-in market hence embeds a way of thinking, working and addressing the market needs in the burn-in business units of organizations such as the burn-in business unit of ACME Inc. This has led to a high degree of informality; frenetic activity all around; a high degree of confrontation, conflict, and fighting in meetings; an obvious lack of status symbols such as executive dining rooms, etc.; and a sense of high energy and emotional involvement, of people staying late and expressing excitement about the importance of work. From the outside it appears that the group dealing with burn-in sockets is in a rapidly growing high technology field where hard work, innovation, and rapid solutions to things are important and essential for everyone to contribute to their maximum capacity.

In addition because of the kind of technology that the company manufacturers and the strong beliefs and values, the group operates on several critical and coordinated assumptions: (1) individuals are assumed to be the source of all innovations (2) the best ideas are those that can survive constant deliberation, debates and heated arguments (3) the ideas implemented are assumed to have been agreed by one and all (almost) in the group (4) every individual thinks for himself or herself and does the right thing even if it means disobeying the boss (5) and finally all members of the group are members of a family that help and protect each other even if mistakes and errors are made.

Such culture in an organization helps the group thrive through rapid changes and serve the market successfully even through high demand from the market. However as the company begins to grow the decision process takes longer, the individual autonomy that each member has may prove to be destructive and the notion of a family quickly breaks down due to large number of members involved. This gets further complicated with globalization. Organizations such as ACME Inc. have grown globally to be able to serve their customers on a global scale. Further, in order to leverage manufacturing cost benefits, they have operations in various parts of the world that not only complicates control factors, logistic issues and supply chain but also creates a conflict in cultures.

This trend towards multidivisional company has (and continues to) changed the cultural attributes of the organization. The organization has started to accept a high degree of formality; an architecture that puts great emphasis on privacy; a proliferation of status symbols and deference rituals such as addressing people by their titles; a high degree of politeness in group meetings; an emphasis on carefully thinking things out and then implementing them firmly through the hierarchy; a formal code of dress; and an emphasis on working hours, punctuality and so on. One can also find the total lack of lateral communications in such a culture.

It must be noted that with the advent of globalization, the entire value chain has forced the various stakeholders in the value chain to adopt a multidivisional style of culture as an organization, but has required the local culture to be that of an action oriented one. It becomes obvious that the two cultures clash when an interaction is required and leads to internal tension that needs to be handled differently based on the level in the organization (local, boundary, global, etc.)

On a local level the sales force is aggressively trying to determine opportunities in the semiconductor world, which could easily slip, if they are not there in front of the customer at the right time. This happens very often as the time line for the programs are short enough that the test houses, burn-in board and test engineers do not have the time or the luxury of researching different suppliers. In most cases they have already been contacted by 2-4 suppliers. This immediately gets translated into a rapid response time requirement on the burn-

in socket (and other component) engineers, the corresponding supply chain and the various other factors discussed in the previous section (burn-in sockets).

Similarly, on a global level the response to an activity in a local region is not given the same level of importance as what is required in that particular local region. For e.g. a requirement coming out of North America may not receive the same level of importance by the engineers in Japan compared to a requirement coming out of Japan. This leads to a significant amount of tension between different local regions and hence creates regionalism. The existence of global strategy managers are, to a large extent, responsible for reducing this tension and in some cases eliminating the same. However, these managers need to be equipped with providing and convincing each region of the benefits that the strategic direction provides to that region.

Now that we have gained a better understanding of the industry served, the culture that such an industry drives and the complexities of the globalization and its effect on the culture of the organization, it should be clear that employing the strategy defined in the strategic lens section of this chapter (leverage the economies of scale and provide the programming market burn-in sockets at a reduced cost relative to the programming sockets) will have its own set of issues when viewed through the cultural lens. The issues can be classified under (a) design and (b) manufacturing.

Design: It has been shown that there exists a fundamental difference between the burn-in sockets and the programming sockets. In the first case the sockets are used at elevated temperatures with relatively low mechanical cycles while in the latter, the sockets are used at room temperature with significantly higher mechanical cycle exposures. This fundamental difference immediately creates a reason for opposition by the burn-in socket design engineers when proposed with the idea of using burn-in sockets as programming sockets. Some common comments are “they are not designed for programming”, “you are on your own if these sockets fail”, “the sockets will not function in the new environment”, and “we will need to make significant changes if you want to use these sockets (burn-in sockets) as programming sockets. These comments make perfect sense when the engineering community is looked at through the cultural lens. They are used to working in the burn-in atmosphere and are used to adapting to

changes within that environment. They have created and established processes and procedures to facilitate quick adaptation to changes – only in the burn-in environment. The proposed strategy to use the product for a completely new application that it was not designed for puts the engineering community on the defensive. The engineers believe that burn-in is their primary business and hence any time spent on non burn-in related programs will be a waste of their time. This leads to a priority issue within the engineering team. However, one of the fundamental reasons for employing the IC programming socket strategy is the fact that there will be no need to re-design the burn-in sockets for use in programming as these sockets have already been designed to accept the IC's that are being programmed (Refer Section 4.1.3 on the strategic direction is using existing burn-in sockets as IC programming sockets versus redesigning the burn-in socket as IC programming sockets). Further, it has also been shown in Table 2 in the chapter on Market Analysis that the cost of the components is more important than the reliability of the components to the value chain. Hence the customer (programmer) is ready to sacrifice a certain level of quality for a significant decrease in cost. This implies that even though the engineering community is correct about voicing their concerns, it really does not affect the strategy. The driving factors for the engineering concerns are cultural rather than business based.

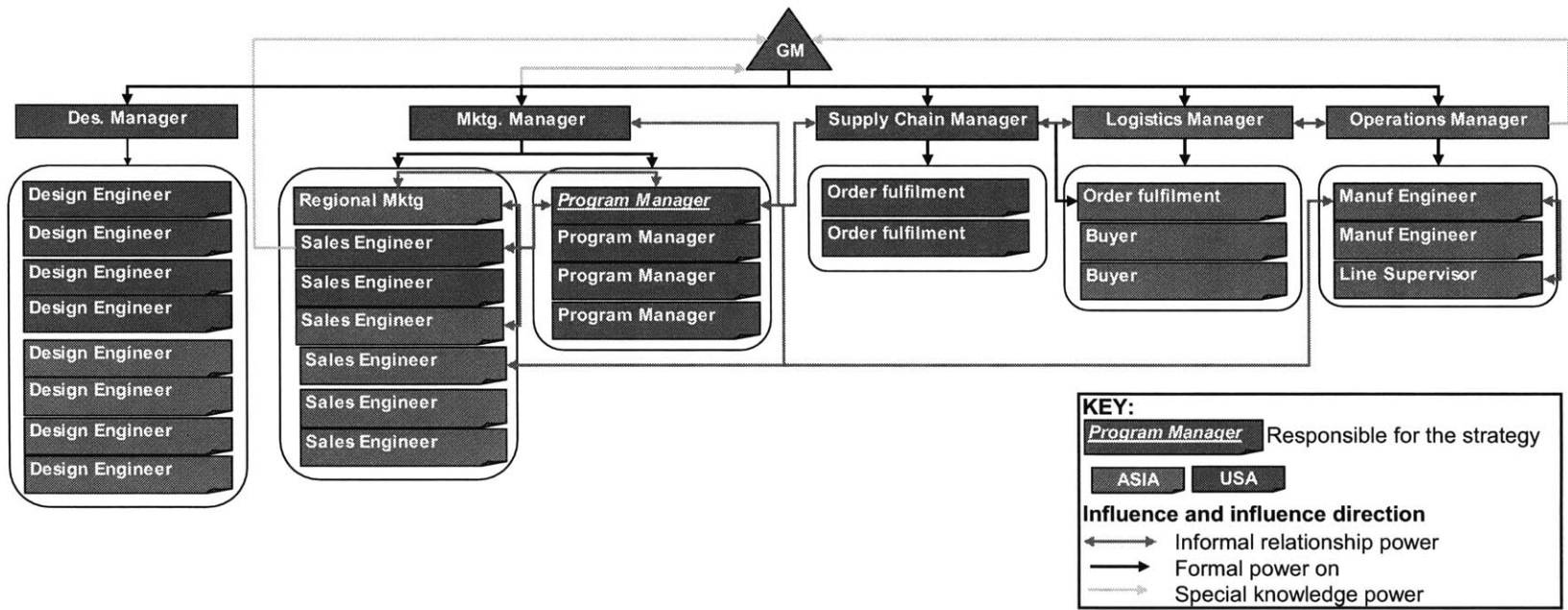
Manufacturing: The organization follows the BCP (best cost producing) policy. This policy means that the organization is on a constant lookout for the most effective manufacturing location. In most cases, this is immediately linked to outsourcing due to cost. However, even though cost is the driving factor of such a strategy, it is usually the total cost combined with availability of best in class resources, the level of quality and the sustainability of the BCP location that usually defines the entire BCP strategy. The BCP strategy hence establishes metrics for the BCP sites that are related to the above discussed variables. Minimizing inventory costs, minimizing set up costs and maximizing the output efficiency of the production system typifies the BCP metrics. The BCP strategy combined with the metrics has imbibed a cultural identity for these sites. The members of the BCP sites are on a constant search for optimizing and eliminating cost; they are continuously looking to maintain their BCP status (China vs. Korea vs. Vietnam etc.) and are hence driven away from low volume manufacturing and shy away from any external influences on their inventory management

strategy. It is hence clear that the new IC programming socket strategy has a direct effect on cultural behavior of the BCP sites. The strategy to address a low volume high mix market is in direct conflict with the mindset and cultural behaviors of the members of the BCP sites. It is hence essential that to be successful the concerns of the BCP sites are placed at top priority when the strategy is converted to tactical actions.

4.3 APPLYING THE POLITICAL LENS

In order to apply the political lens to the burn-in group of ACME Inc., the first step is to understand the organizational hierarchy and structure. Figure 13 shows the organizational structure of the burn-in group. For the sake of simplicity (1) the organizational structure not relevant to the discussion has been omitted, (2) hierarchy is geographically separated only into USA and ASIA even though Asia is really comprised of Asia Pacific, Korea, China, Japan and India, (3) the influence relationship (bi-directional informal and special knowledge) has been outlined only for the stakeholders involved in the discussion , (4) the informal relationship power encompasses all types of non-formal and non-special knowledge based influences such as friendship, mentors, past team member, etc and (5) the entire system is conceived around the program manager who identified and determined the opportunity and strategy.

Figure 13 – The burn-in group organization structure



As shown in Figure 13 each of the managers (design, marketing, supply chain, logistics and operations) report to the GM (General Manager) and have employees reporting to them from across the world irrespective of their geographical locations. The program managers, the regional managers and the sales engineers report to the marketing manager who resides in the North America. Due to the global nature of the burn-in business there exists a very close working relationship between every member of the global sales and marketing team. In addition the program manager (in question) enjoys an informal influence over and from the regional marketing manager (Japan), the sales engineer in North America and the sales engineer in Asia (Asia Pacific). Further, the regional marketing manager has a similar relationship with the sales engineer (Korea). Beside the influence on the peers, the same program manager also has an informal relationship with the marketing manager (supervisor) due to a past friendship that they shared. External to the sales and marketing group, the program manager also has a close working relationship with the supply chain manager and all the design engineers (especially in North America). In addition one of the sales engineers (Asia Pacific) has a friendship based relationship with the manufacturing engineers (Korea) while the supply chain manager has a working relationship with the logistics manager (Korea). These relationships are also significantly important to the program manager as he can indirectly influence some of the stakeholders if and when the need arises.

An interesting outcome of Figure 13 is the influence caused by the special knowledge that certain people possess in the organizations. As discussed, Figure 13 does not show all the special knowledge influences, but only those that are relevant to the discussion. Due to the fact that the marketing manager controls the sales and marketing world wide, the marketing manager's knowledge about the market becomes extremely centralized and hence extremely critical for the functioning of the organization. The General Manager is highly reliant on the marketing managers knowledge about the market (trends, forecasts, disruptions, discontinuities, etc) hence giving the marketing manager special powers. A similar knowledge base resides in one of the sales engineers (North America). The long lasting relationship that he has developed over the years is a wealth of customer information that is once again centralized hence providing him the knowledge based influence or power. The general manager is constantly

reaching out to this sales engineer to get the 'latest and greatest' from the customers hence providing the sales engineer special powers as well.

Both these relationships are extremely useful to the program manager as he has both a formal and more importantly an informal relationship with these individuals. Hence any decision that needs to be made by the general manager can be influenced by the sales engineer and the marketing managers in favor of the program manager whenever the need arises.

This network hence implies that the program manager through his network has an informal influencing power on most of the sales and marketing members, which could be leveraged in times of need. Furthermore, one can clearly establish that the program manager is extremely influential (at least) within the sales and marketing group.

To appreciate the rest of the discussion it is important that the discussion on applying the cultural lens is revisited. It was concluded from that discussion that it is essential that the concerns of the BCP sites are placed at top priority when the strategy is converted to tactical actions. As the BCP sites are located mainly in Asia, the head of the BCP sites is operations manager based out of Asia (Korea). Furthermore, converting the strategy to tactical actions would imply that the team would need a 100% buy in by the line supervisor for the line that is affected.

Figure 13 shows that the line supervisor has a formal relationship with the operations manager and an informal relationship with the manufacturing engineer. It is important to note that both the manufacturing engineer and the line supervisor will be affected by the IC programming socket strategy. Further, the metrics laid out by the operations manager for the manufacturing engineer and line supervisor, which are maximize output along with minimize inventory costs and setup costs (the actual numbers have been omitted) are potential conflicts for the new strategy that involves addressing a low volume high mix product requirement market. In addition to the formal relationship between the line supervisor and the operations manager, which is significant in the Asian culture, there also exists a knowledge based relationship between the operations manager and the General Manager. The operations manager has been

involved in the development and growth of the organization ever since its inception. The information that he has is unsurpassed even by the other knowledge based power houses – the marketing manager and the sales engineer. Even though the title suggest that he is involved in the operations side of the business, he has developed long lasting relationships with all the Asian customers, suppliers and has been responsible for the growth of various employees under him. The operations manager is hence one of the more powerful figures in the organization and hence close to being considered the ‘right hand’ of the General Manager. This implies that if the line supervisor and the manufacturing engineer are convinced and hence convince the operations manager that the IC programming socket strategy will adversely affect their metrics and hence career opportunities, the strategy may be shot down even before initial discussions.

It is hence imperative that even though the strategic lens has indicated that the organization should penetrate the new market (IC programming), both the cultural and political lenses have shown that the BCP sites have to be placed at top priority in developing a tactical action in addressing the market and that the manufacturing site has more political mileage than one would initially estimate.

4.4 CHAPTER SUMMARY

The application of the three lenses to the organization in the context of the new IC programming market has shown that this is an extremely useful and efficient approach to determining the various issues one can expect implementing a strategy. The strategic lens helped the team determine that an opportunity exists and that the organization could greatly benefit in revenues and profits by product reuse and minimal resource requirements. Further, looking at the organization through the cultural lens shows the team that implementing the IC programming socket strategy would require addressing the issues of both the design and the manufacturing groups in the organization. It also shows that even though the design related issues are valid, they would not be affected by the strategy due to product reuse. However, the needs of the BCP sites have to be placed at top priority before addressing the strategy. Finally,

the political lens brings out the powerful position that the manufacturing groups holds within the organization and the detrimental effect it could have on the strategy if rolled out incorrectly. It must also be noted that most organizations, usually consider the cultural and political lenses as the soft issues or fluff and go ahead with the strategy without understanding the repercussions the tactical aspects may have on the same. This chapter has clearly shown that if the organization is not analyzed through the cultural or political lens, the project will definitely fail.

The following chapter will detail the need for and the application of an inventory strategy that will help address the market need (strategic lens), the manufacturing need (cultural lens) and avoiding the power struggle issues (political lens).

5 INVENTORY MANAGEMENT

The previous chapter highlighted the various organizational issues and opportunities at ACME Inc. using the three lenses. It is clear that there exists a market opportunity that needs to be addressed keeping the needs of the organization's internal manufacturing group in mind. This thesis has addressed these needs and concerns by making use of a widely used supply chain strategy called inventory management. A brief introduction to supply chain management, its related issues, different types of supply chain strategies, inventory management and its related issues has been provided in the Literature Review chapter of this thesis.

This chapter will leverage this information by conducting a detailed analysis of the market opportunity and applying the techniques and principles of supply chain to develop a successful inventory management strategy.

5.1 ANALYSIS

In order to understand the effects of the IC programming strategy on the manufacturing line a detailed analysis of the ordering patterns by different programming customers and the different types of sockets was initially done through simulation. Figure 14 is a graphical representation of the relationship between the order quantities on the abscissa and the number of such events on the ordinate for a defined time interval. It also shows the relationship between memory and logic style sockets (not relevant for this discussion). It can be seen from the graph that there are a significant number of events that have order quantities less than 1000 pieces per order with close to 55% of the events having order quantities less than 100 pieces. This implies that manufacturing/production will need to stop high volume production set up the new socket, make about 20-30 pieces, stop the line, set up a new socket and make another 20-30 pieces and then go back to large volume socket production. Such frequent changes in the setup of the line cause significant increase in the setup costs in addition to delayed lead time effect. Not only does the manufacturing line face cost and lead time issues, but the customer awaiting the sockets is also delayed in production affecting the upstream supply chain, which hence has a

negative effect on the service level causing system variability. Such a situation is defined in Chapter 2 (Literature Review) as a significant contributor to the bull whip effect.

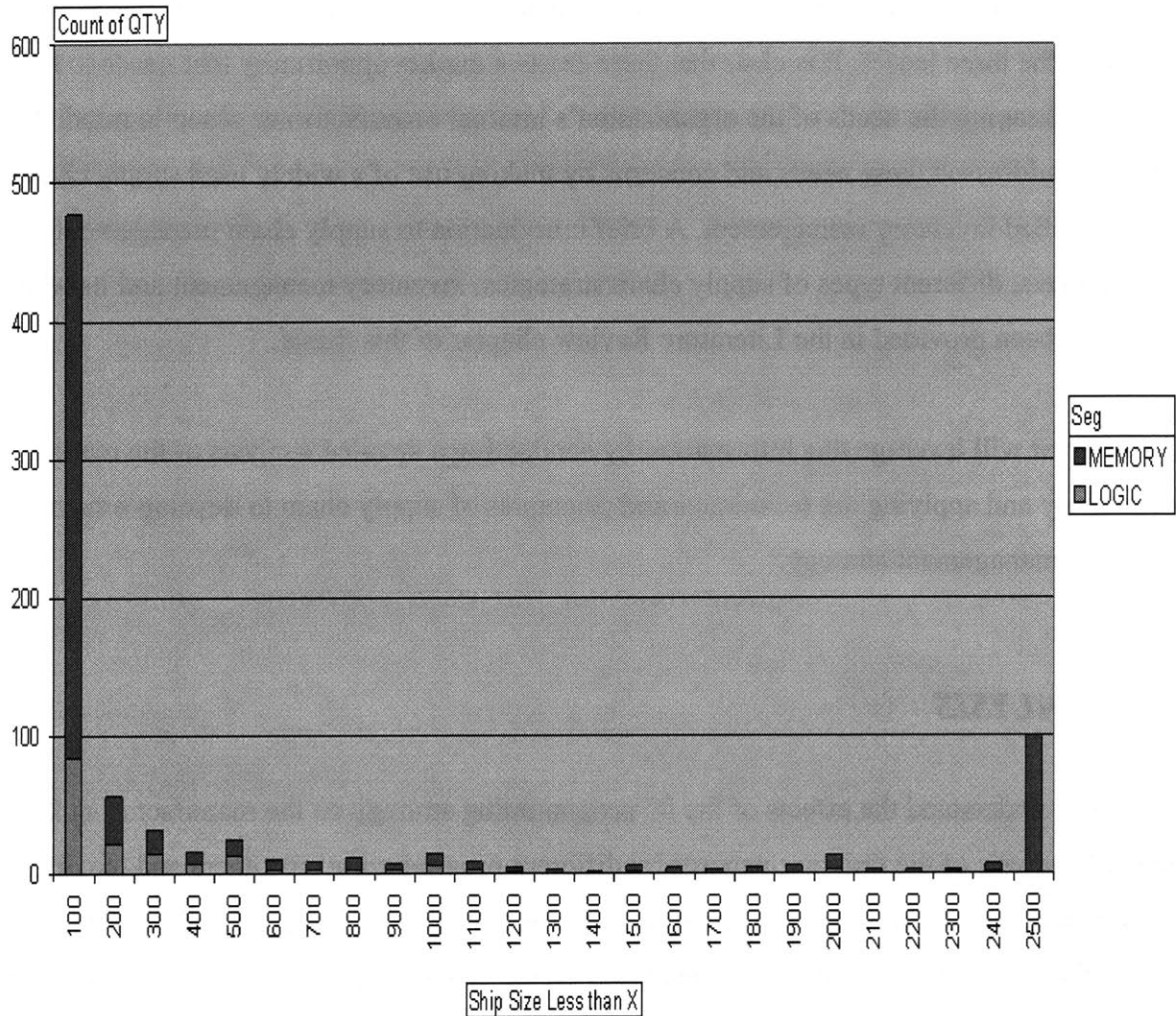


Figure 14 – Graphical representation of number of events corresponding to different order quantities

On further analysis and ‘zooming’ into the sub 100 pieces order quantity level it was determined that the situation was even worse than the situation described by Figure 14. Figure 15 shows a graphical representation of the relationship between the order quantities less than 100 pieces on the abscissa and the number of such events on the ordinate for the same time duration as in Figure 14. It can be observed that more than 70% of the events take place in the less than 60 pieces order quantity range. (The color schemes are not relevant for the discussion) This implies that the manufacturing situation described earlier in terms of setup

costs and lead time is nearly two times worse than estimated. It is also clear now that the manufacturing/production team will make it extremely difficult and almost impossible to roll out the flash programming strategy as it would not enable effective manufacturing.

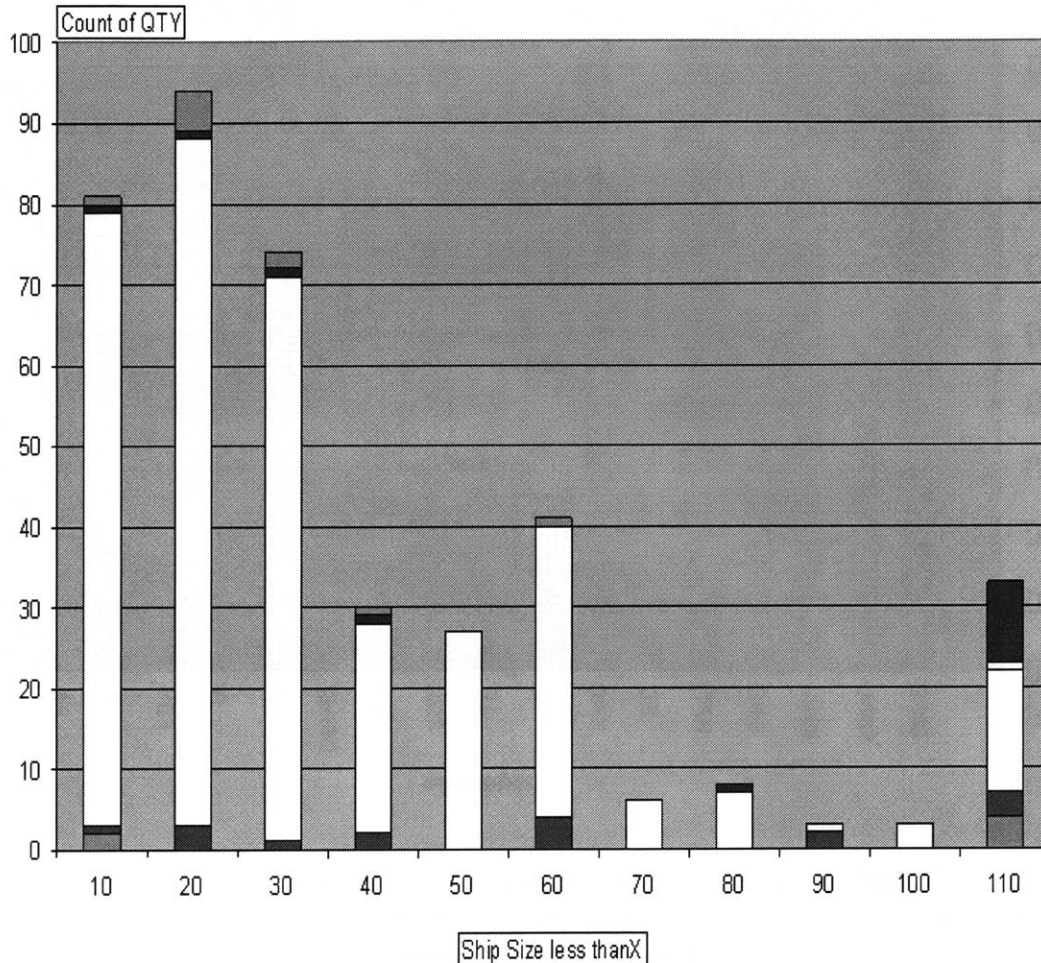


Figure 15 – Graphical representation of number of events corresponding to order quantities less than 100 pieces

Once the situation is better understood in terms of order quantities, the next step is to determine the various customers and their ordering trends. Figure 16 is a graphical representation of the same. It shows that there are about 19 IC programming customers with order events ranging from 1 order all the way to 90 orders (time period is similar to the time period in the previous discussion). Further the high frequency orders are spread between 5-6 customers representing close to 80% of all the orders. At this point in the analysis, it is clear

that most of the orders are concentrated in a small section of the customers, who are also responsible for the manufacturing issues described by Figure 14 and Figure 15.

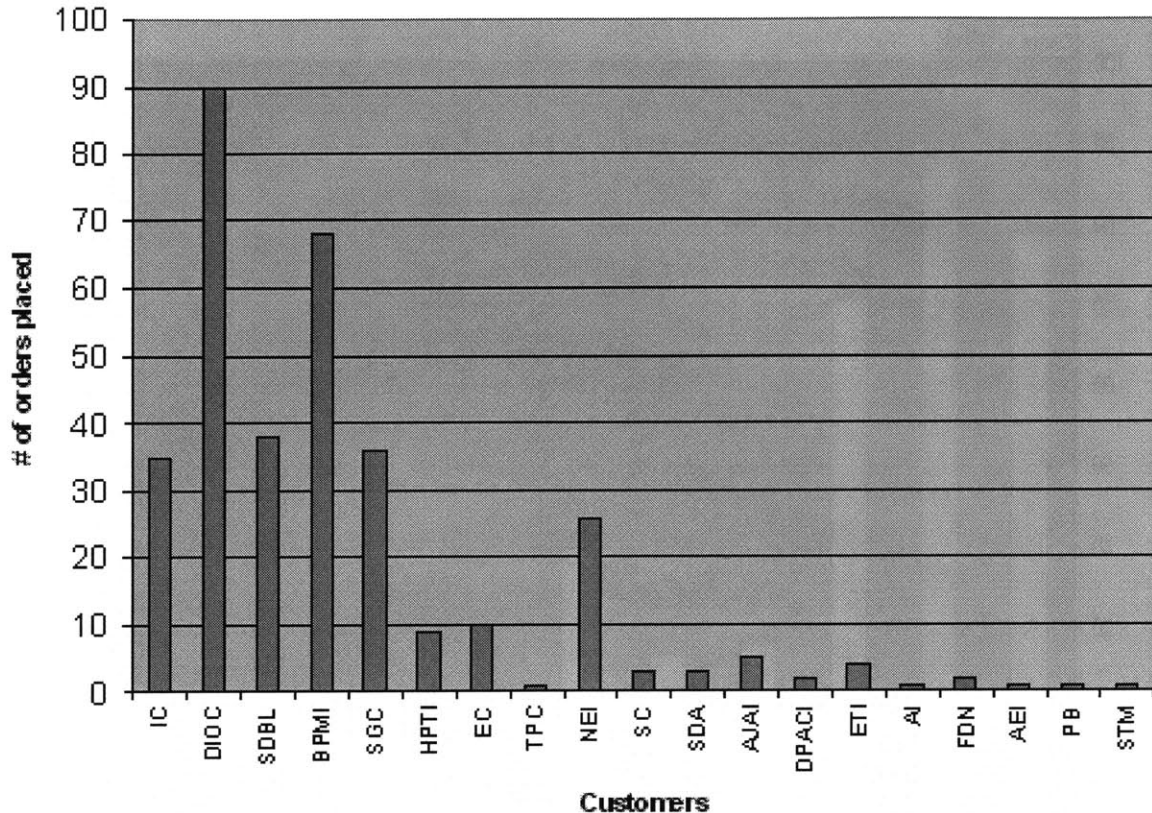


Figure 16 – Graphical representation of the ordering trend (events) for different customers whose order quantities are less than 100 pieces (names have been masked due to sensitive nature of information)

The next step in the analysis was to determine products that are a contributor to the flash programming strategy. Figure 17 shows that the situation has worsened even more. There are close to 59 different sockets that need to be included in the IC programming socket strategy. The reason this situation is considered bad is because, even though the organization has hundreds of different types of sockets, they are rarely produced in less than 500-1000 pieces. 59 different sockets distributed over 19 different customers who have an order trend of about 40 events in a given time period will have a devastating effect on production, setup costs, lead time and may also lead to a non-profitable business.

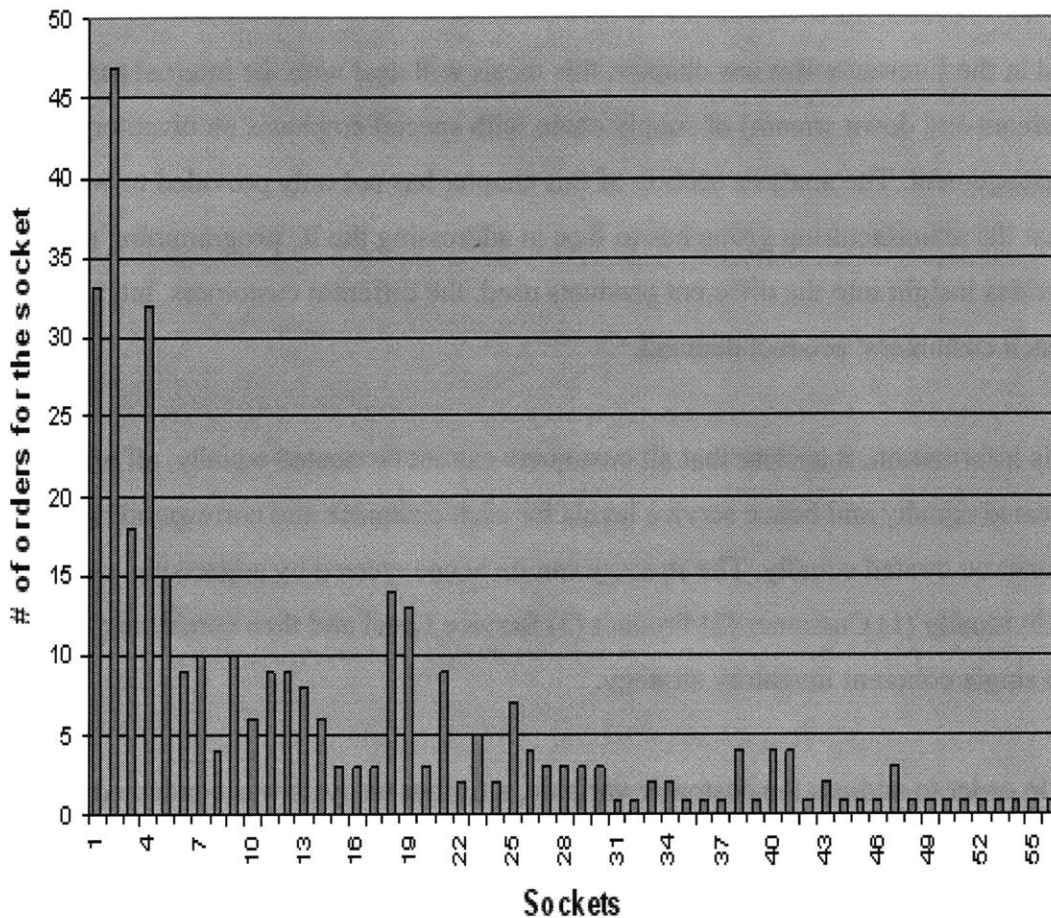


Figure 17 – Graphical representation of the ordering trend (events) for different sockets (names have been masked due to sensitive nature of information)

It is hence extremely clear that in order to implement the IC programming business strategy, the manufacturing and production system issues need to be handled. The options that the business has are (1) continue operating in the existing fashion and pass on the costs to the customer. However, this would destroy the value that the customer sees in using a burn-in socket (inexpensive but less reliable). If the cost is passed on to the customer then the reliability issue surfaces and the business plan is nullified. (2) Give up on the flash programming business plan (3) Implement a manufacturing strategy that would help address the customer needs as well as the internal operation requirements – inventory strategy.

5.2 INVENTORY STRATEGY

As discussed in the Literature Review chapter, this thesis will deal with the internal aspects (versus up stream and down stream) of supply chain with special emphasis on inventory and inventory management. The analysis section of this chapter has not only provided us with all the issues that the manufacturing group has to face in addressing the IC programming market, but also provides insight into the different products used, the different customers, buying trends and each customers' product demand.

Based on this information, it is clear that all customers cannot be treated equally, all products cannot be treated equally and hence service levels for each customer and corresponding products cannot be treated equally. The strategy can be hence created by addressing each of the variables individually (1) Customer (2) Product (3) Service Level and then combining the same to develop a single coherent inventory strategy.

Customer: In order to address the customer variable, a further analysis was conducted to determine the total revenue obtained from each of the customers, their average order quantities and their relative role in the burn-in and flash programming value chain. Figure 18 shows the percentage of total revenue broken down by customer (customer names are masked due to the sensitive nature of the information) for two different time periods. It is easy to observe that customer IC is a clear and dominant revenue generator followed by a bunch of customers (DIOC, SDBL, BPMI and SGC) who collectively generate ~30% revenue. Finally, the rest of the customers are relatively smaller customers in terms of net revenue. However, they would still need to be served as they are significant players in the value chain.

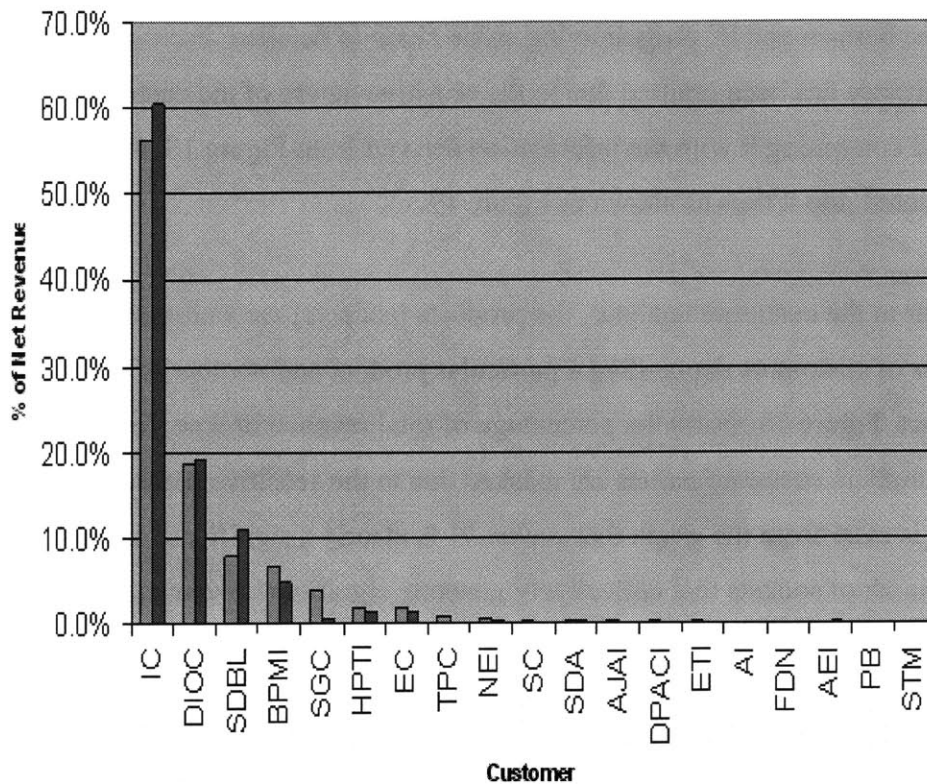


Figure 18 – Percentage of total revenue for each customer for two different comparable time intervals (names have been masked due to sensitive nature of information)

PRIMARY	IC
SECONDARY	DIOC
	SDBL
	BPMI
TERTIARY	SGC
	HPTI
	EC
OTHERS	TPC
	NEI
	SC
	SDA
	AJAI
	DPACI
	ETI
	AI
	FDN
	AEI
	PB
	STM

Figure 19 – Customer ranking based on revenue & ordering trend (customer names masked due to the sensitive nature of the information)

Furthermore, using the information shown in Figure 16 and information about each customer's importance in the burn-in and IC programming value chain (a detailed discussion on each customer's importance has been omitted due to the sensitive nature of the customer information) and combining it with the information derived from Figure 18, the customers can now be rank ordered into 4 tiers as shown in Figure 19.

Product: Similar to the customer analysis, the products (sockets) are analyzed based on revenue, number of customers demanding a particular product and number of orders for a particular product. Figure 20 shows the percentage of total revenue broken down by product (actual socket numbers customer names are masked due to the sensitive nature of the information). It is clear from the graph that socket #1 is clearly a significant revenue generator followed by a bunch of sockets that collectively generate significant revenue.

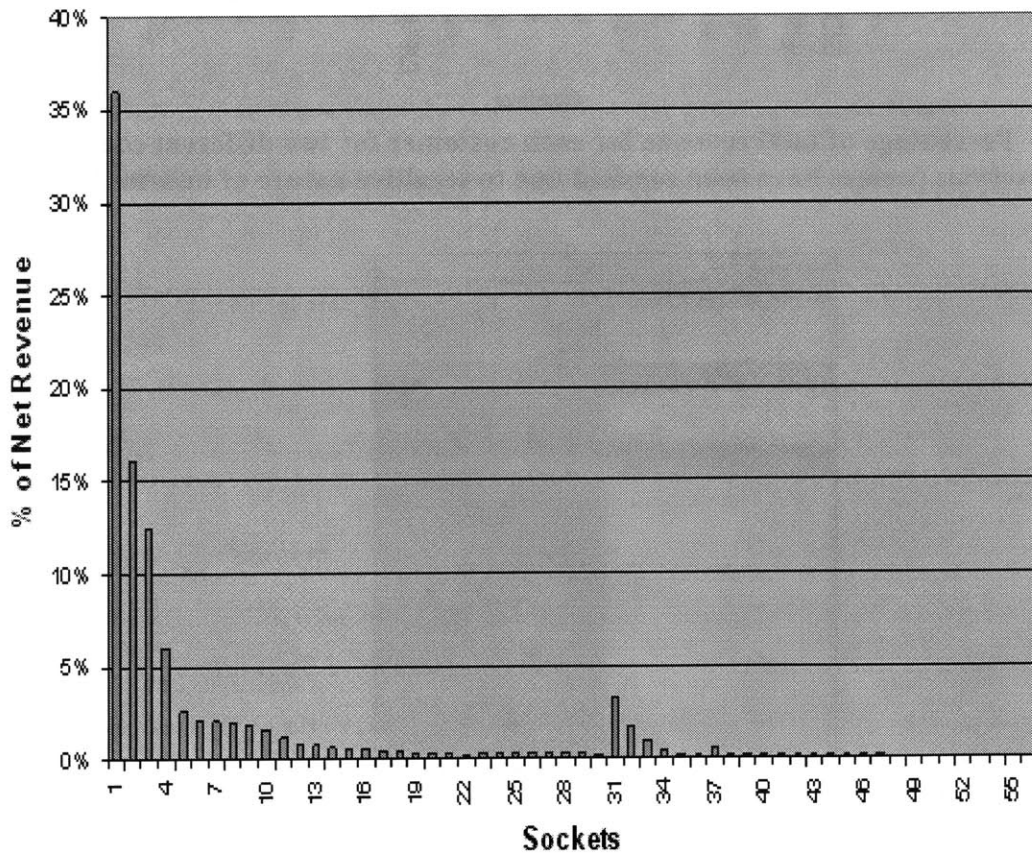


Figure 20 – Percentage of revenue for each socket type (actual socket numbering has been masked due to the sensitive nature of the information)

Finally, the rest of the sockets are relatively smaller in terms of revenue. However, as shown in Figure 21, these play a significant role as these sockets have significant number of customers demanding them.

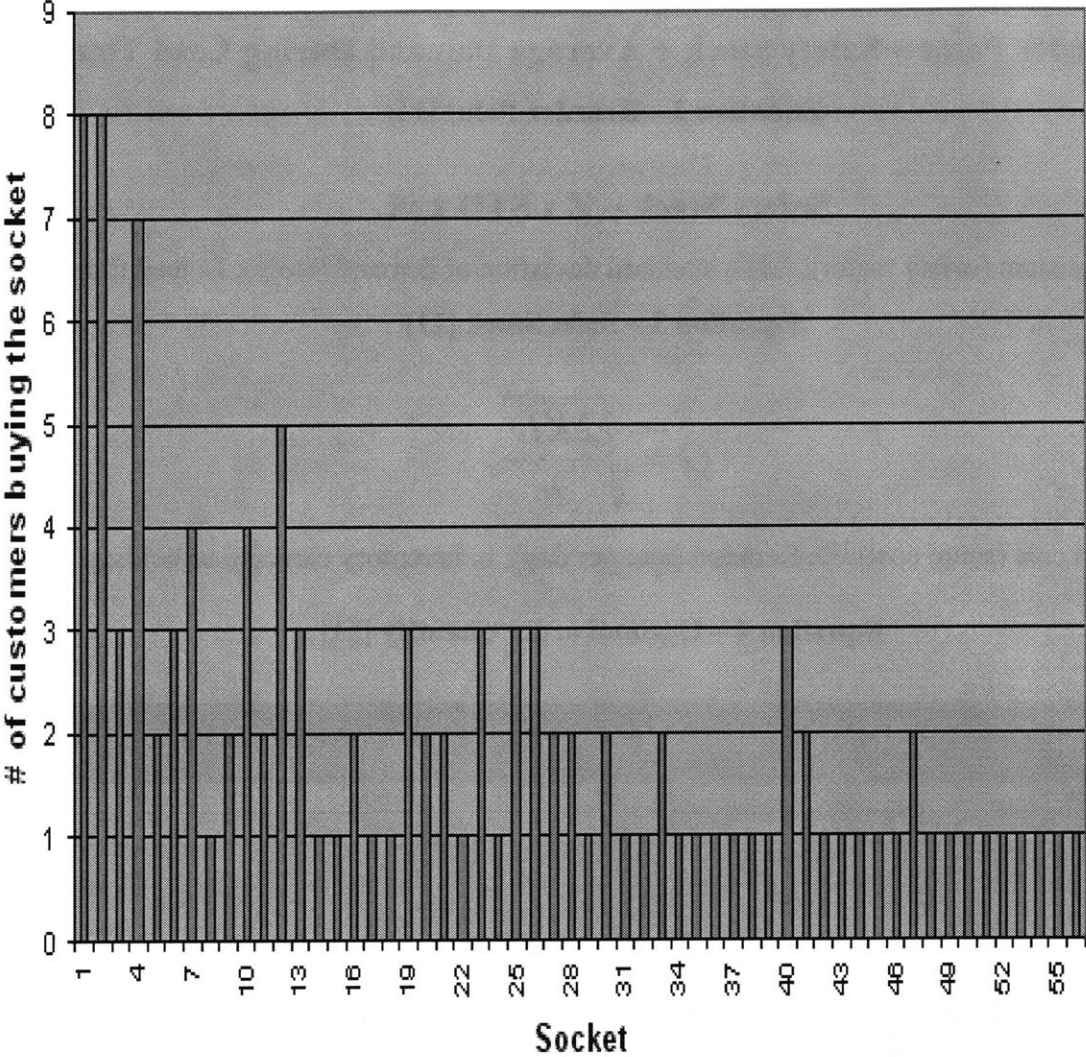


Figure 21 – Number of customers demanding a socket

Furthermore, using the information shown in Figure 17 and combining it with the information derived from Figure 20 and Figure 21, the sockets can now be rank ordered into 4 different tiers with each tier having different inventory levels that is calculated based on Equation 1, Equation 2, Equation 3, and Equation 4.

$$\text{Average Inventory Level} = \text{Reorder Point} + Q$$

Q: Optimal order quantity

Equation 1 – Average inventory level [11]

$$\text{Reorder Point} = \text{Safety Stock} + \text{Average Demand During Lead Time}$$

Equation 2 – Reorder Point [11]

$$\text{Safety Stock} = Z \times \text{STD} \times \sqrt{L}$$

z: Constant (safety factor); STD: standard deviation of demand (daily); L: lead time.

Equation 3 – Safet Stock [11]

$$Q = \sqrt{\frac{2KD}{h}}$$

K : fixed cost (setup cost); D: Demand (rate per day); h: inventory carrying or holding cost.

Equation 4 – Optimal order quantity [11]

Tier	Inventory Quantity	Reorder Point	MOQ	# of Socket Styles
Tier 1	300	100	200	6 (1-6)
Tier 2	200	100	100	16 (7-22)
Tier 3	100	25	100	8 (23-30)
Tier 4	NO INVENTORY/NO ISSUE (31-36)			
Tier 4	NO INVENTORY (37-59)			

Figure 22 – Sockets segmented into 4 tiers with each tier having an inventory level, reorder point and minimum order quantities (MOQ)

Figure 22 shows the different tiers with their respective inventory levels, the order quantities and the various sockets that account for risk pooling and are categorized under each tier.

Service Level: This is the final section of the inventory strategy to address the needs of the flash programming market. In order to optimize the inventory management system and reduce the burden on the manufacturing lines, a service level strategy was introduced. This strategy

helps to make sure that the assumption that all customers cannot be treated equally and all products cannot be treated equally are managed efficiently.

Figure 23 represents the service levels or lead times that are based on the customer and product ranking. The abscissa represents the 4 tiers of product ranking with Tier 1 being most important while the ordinate represents the 4 levels of customer ranking with the primary level being most important. The intersection of the product levels and the customer levels in the matrix represents the lead time or service level that the organization will provide. This not only helps the most important customers get the best service, but also helps the manufacturing line spend the least amount of time trying to satisfy the least important customer-product levels.

Customer	<i>Others</i>	8 - 10 Wks	8 - 10 Wks	10 - 12 Wks	10 - 12 Wks
	<i>Tertiary</i>	6 - 8 Wks	8 - 10 Wks	8 - 10 Wks	10 - 12 Wks
	<i>Secondary</i>	4 - 6 Wks	6 - 8 Wks	8 - 10 Wks	10 - 12 Wks
	<i>Primary</i>	4 - 6 Wks	4 - 6 Wks	6 - 8 Wks	8 - 10 Wks
		<i>Tier 1</i>	<i>Tier 2</i>	<i>Tier 3</i>	<i>Tier 4</i>
		300	200	100	0
		100	100	25	0
		200	100	100	0
		Sockets			
					Inventory
					Reorder Pt
					Min Reorder

Figure 23 – Service level (lead time) based on customer and product ranking

5.3 STRATEGY IMPLEMENTATION

The previous section has shown that a fundamental inventory strategy can be employed to be able to address the low volume requirements of the new market. It also involves the categorization of customers and products based on priority and hence identify different service levels for each customer and corresponding products. However, the implementation of the strategy is a completely different challenge compared to identifying the strategy.

It must be noted that the discussions in Section 4.2 have shown that the BCP (best cost producer) sites are on a constant lookout for the most effective manufacturing location that

takes into account total cost combined with availability of best in class resources, the level of quality and the sustainability of the BCP location. The metric for the BCP sites are typically minimizing inventory costs, minimizing set up costs and maximizing the output efficiency of the production system. This implies that such sites are on a constant search for optimizing and eliminating cost; they are continuously looking to maintain their BCP status (China vs. Korea vs. Vietnam etc.) and are hence driven away from low volume manufacturing and shy away from any external influences on their inventory. It is hence important that the BCP site is made aware of the new market entry and inventory management strategy.

In order to successfully implement that inventory management strategy, the following steps were essential and followed (a) share the inventory analysis with the line supervisors and manufacturing engineers (b) share the market opportunity and the expected revenue and profits with the management team and (c) use political influences to get the direct and indirect team on board. The following sections outline these steps.

5.3.1 SHARING INVENTORY ANALYSIS

At this point, it must be noted that the estimation of the inventory levels was being done in coordination with the manufacturing line in Korea (BCP site where the sockets under consideration were being built). The various variables in Equation 4 such as the fixed cost or setup cost – K , the inventory carrying cost or holding cost – h , and hence the optimal order quantity were all provided by the BCP site in Korea.

Most of the information needed to be confirmed and re-confirmed as the information seemed to be exaggerated to be able to generate larger than optimal order quantities. Most times, the costs were quoted to be ~2X the actual values that led to the optimal order quantities being high enough to warrant further analysis and confirmation. However, it was eventually determined that in order for the manufacturing line not to experience a significant effect on line loads and set up costs, the optimal order quantity for the line was approximately 100 pieces. It was hence decided that the order quantities for the manufacturing line would be placed at a minimum of 100 pieces irrespective of the product being ordered. This order quantity of 100 pieces was also

in line with a low quantity burn-in socket order that the line would see (approximately one to two times a month) occasionally and did not disrupt the operations of the line.

Once the order quantities were determined and agreed upon, the next step and a significant issue was holding inventory and its associated costs. There were significant deliberations and arguments that took place over a period of time before determining the solution. However, the resulting solution was a compromise that arose from political influences that needed to be employed, which are discussed later in Section 5.3.3.

5.3.2 SHARING MARKET OPPORTUNITY

An important aspect of implementing the inventory strategy was to obtain management backing. To be able to get management buy in, an in depth market analysis that included the various sections discussed in Section 2.1.1 was presented to management. The strategic direction that resulted from this analysis was discussed in Section 4.1.3 – “ACME Inc. will provide burn-in sockets as low cost IC programming sockets by leveraging economies of scale and minimal engineering resources to the programming houses that will eliminate the need for expensive programming sockets and completely negate socket design and qualification time (the sockets are designed and qualified during burn-in). ACME Inc. will hence address the system cost issues, delivery speed and global availability of the IC programming sockets making the IC programming market segment more efficient”.

However, the analysis only shows that there exists a market opportunity and ACME Inc. can address the same with minimal resources and provide value to the IC programming industry. The analysis has not shown the effect this has on the top line and bottom line for ACME Inc. Such an analysis is what drives management decisions, and rightfully so, in favor of or against new market entry programs. The figures to follow were used as forecasts on the projected revenue increase and corresponding profit margins on the products.

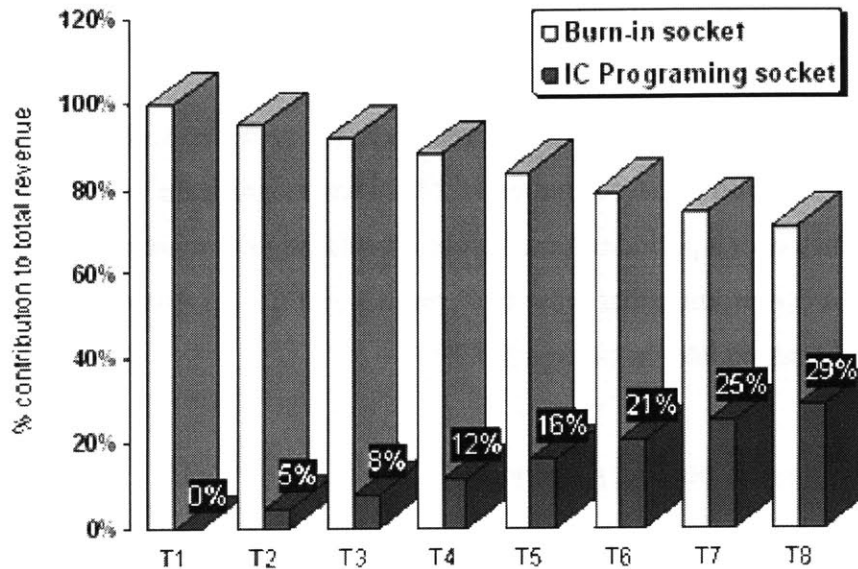


Figure 24 – Projected % contribution towards revenue by the burn-in and IC programming sockets for ACME Inc.’s burn-in business unit over the next 8 quarters

Figure 24 shows the projected contribution towards ACME Inc.’s burn-in business unit revenue over the next 8 quarters by the two different market segments – burn-in sockets and IC programming sockets. It is clear from the projections that the IC programming sockets have the potential to be close to 30% of the total revenue for the burn-in business unit of ACME Inc. In addition Figure 25 shows the growth of the two markets over the same time period. It is clear that the burn-in socket business is expected to grow 15-20% a quarter with a CAGR of ~16%. This implies that the information derived from Figure 24 that the IC programming socket business is expected to be ~30% of ACME Inc.’s burn-in business units revenue is not attributed to the decline of the burn-in socket segments revenue but due to the faster growth rate of the IC programming socket segment.

Figure 25 shows that the IC programming socket business is expected to grow significantly faster in the early period (~100% quarterly growth) and will stabilize in the later quarters (~50% quarterly growth). This growth leads to a CAGR of 57% for the IC programming socket segment and a CAGR of 21% for the entire burn-in business unit of ACME Inc.

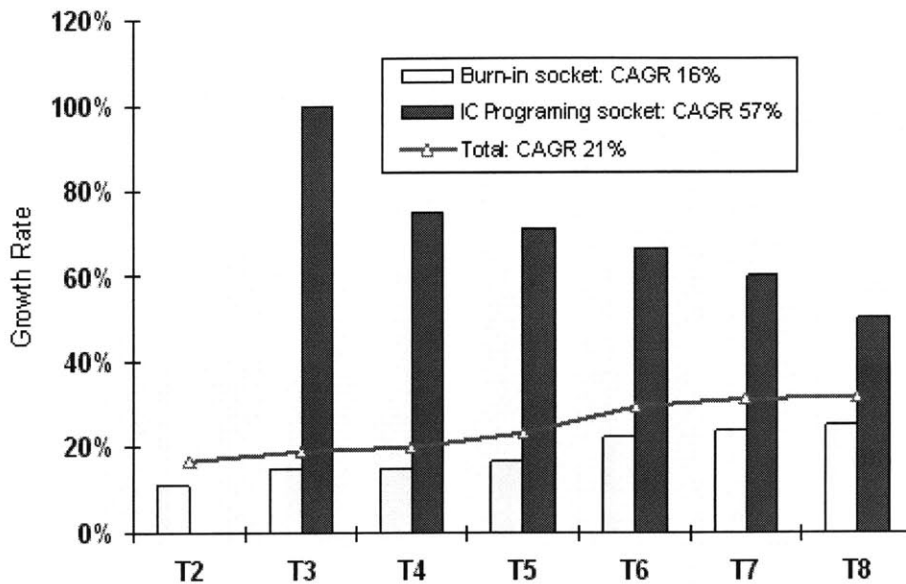


Figure 25 – Growth rate for the burn-in socket, the IC programming socket and the over burn-in business unit of ACME Inc over the next 8 quarters

Finally, the most influential piece of information that helped obtain management buy-in was Figure 26. Figure 26 shows the percentage of gross profit dollars contributed by each of the market segments – burn-in sockets and IC programming sockets. It is clear from Figure 26 that the IC programming socket segment contributes significantly to the profit dollars. Even though Figure 24 shows that the IC programming socket segment contributes only ~30% of the total revenue in the 8th quarter, the profit dollar contributions are ~41% of the total profit. This implies that the business is extremely profitable with most of the revenue earned corresponding to profit. Furthermore, this information is in line with the analysis in Chapter 3, which shows that addressing the IC programming socket market need requires leveraging the existing infrastructure, no additional resources and utilizing economies of scale. Combining the information from Figure 24, Figure 25, Figure 26, and the market opportunity discussed in Chapter 3 along with the inventory management program discussed in Section 5.2, management buy-in was finally obtained. The next step was to be able to get the manufacturing and engineering teams to implement the inventory management program.

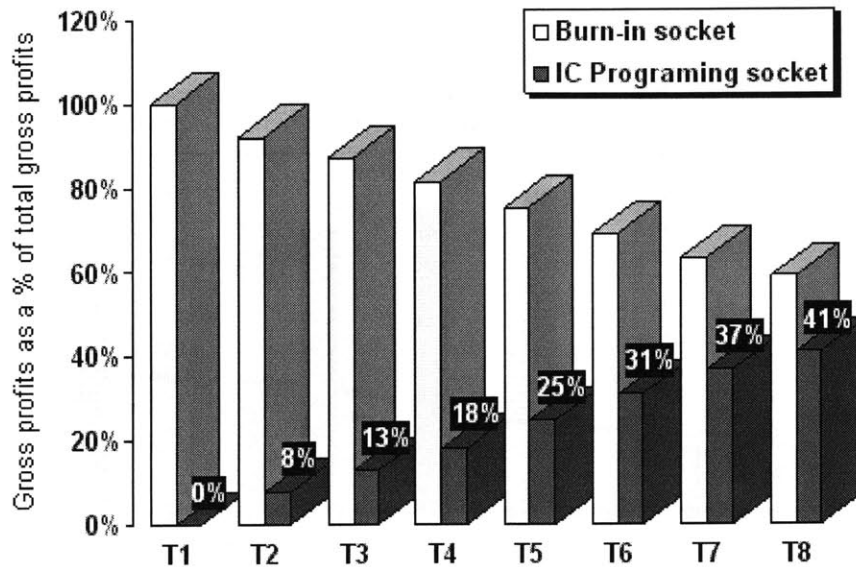


Figure 26 – Gross profits from the burn-in socket and the IC programming socket business segments as a percentage of the total gross profits for the burn-in business unit of ACME Inc.

5.3.3 POLITICAL INFLUENCE

Now that the management was excited about the program, the next step was to get the BCP teams buy in to implement the inventory management program. As discussed in Section 5.3.1 the manufacturing team at the BCP site had provided the information and helped in determining the optimal order quantity for the line to be ~100 pieces. This was in line with the low quantity burn-in socket order that the line would experience (approximately one to two times a month) occasionally and did not disrupt the operations of the line. Therefore, placing an order for the burn-in sockets to be supplied as IC programming sockets was not going to affect the line loading as long as the orders were above 100 pieces.

However, the fact that the line now experienced such low quantity orders more than one or two times a month would lead to the need for management and political influences to get the BCP team to accept such low volume orders. In addition, the 100 piece minimum order quantity also indicated that an inventory of the products would need to be maintained. Even though this

inventory was extremely small (5800 pieces – refer Figure 22) it still comes at a price, the burden of which the BCP sites were not willing to take (clashes with low inventory metric).

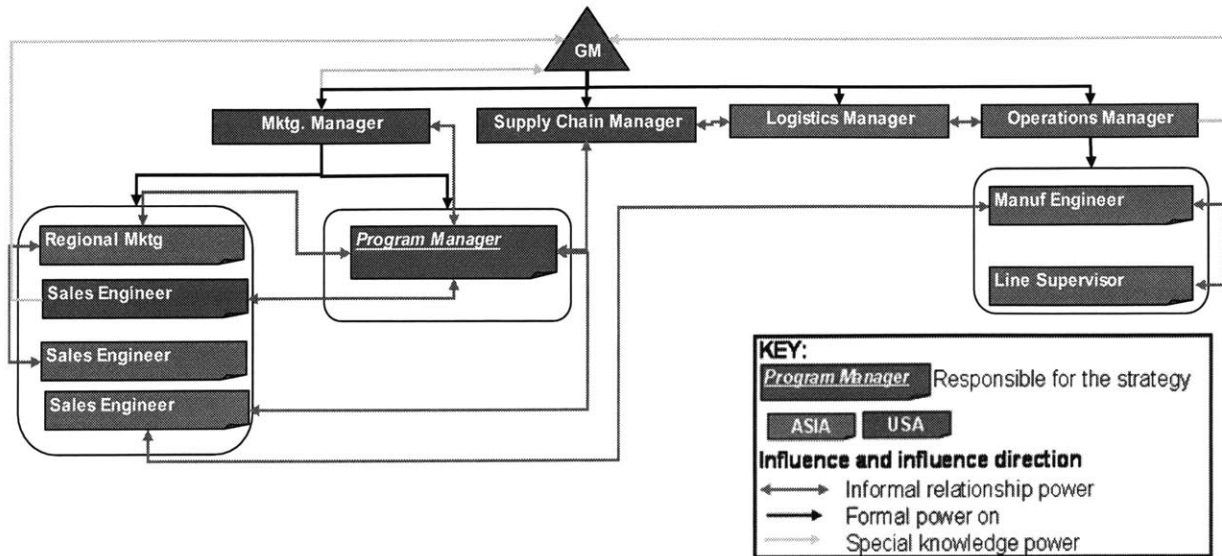


Figure 27 – Simplified version of Figure 13 specific to the inventory management program

Figure 27 is a simplified version of Figure 13 that represents the various influences (informal, formal and special knowledge power) people have in the burn-in business unit at ACME Inc. with special emphasis on the inventory management program. The Program Manager shown in Figure 27 is the one responsible for the new market entry and the implementation of the inventory management program. Discussions in Section 4.3 have shown that the program manager through his network has a formal or an informal influencing power on most of the sales and marketing members, making him extremely influential (at least) within the sales and marketing group. In addition the Program Manager also has an informal relationship with the Supply Chain Manager, who in turn has an informal relationship with the logistics manager who in turn has an informal relationship with the Operations Manager. The discussions in Section 4.3 have also shown that the Operations Manager is extremely powerful and can be considered to be the right hand of the GM (General Manager). The discussions have also shown that the BCP team (manufacturing engineer and the line supervisor) has a formal relationship with the Operations Manager. This implies that the BCP team also has a significant amount of influence on the decisions made in the organization and hence on the inventory management program.

To be able to successfully implement the inventory management program, the program manager used the influence of the special knowledge power houses - Sales Engineer and the Marketing Manager on the General Manager. This was done in addition to sharing the market opportunity with the GM described in Section 5.3.2. This helped obtain strong and solid management backing for the program. In addition, the program manager used his informal relations with the Sales Engineer and the Regional Marketing Manager in Asia to influence the thoughts of the Manufacturing Engineer and hence the Line Supervisor (this was done in addition to the formal weekly team meetings between the program manager, the manufacturing engineer and the sales engineer in the US and Asia).

The revenue and profit analysis that was discussed in Section 5.3.2 and the Inventory Management analysis discussed in Chapter 5 were shared with the Operations Manager. This helped convince him of the potential that the IC programming socket business had for the burn-in business unit of ACME Inc. In addition, the informal relationship between the Supply Chain Manager, the Logistics Manager and the Operations Manager was leveraged by the Program Manager to be able to get the Operations Manager on board.

Finally, with the GM, the Operations Manager and the sales and marketing team supporting the program, it was only a matter of time that the BCP site agreed to participate whole heartedly in the implementation of the inventory management strategy. The metrics for the line now included addressing the optimal low volume quantities. However, the inventory of the 5800 sockets had to be kept away from BCP-Korea as it was seen to negatively affect the plants overall performance. The inventory was hence located in a special location in the US, which was a design and marketing center as opposed to a manufacturing line. The 5800 pieces would not adversely affect the US logistics and at the same time was able to overcome the issues faced by BCP site.

Using the steps described in the previous sections on sharing the inventory analysis with the line supervisors and manufacturing engineers, sharing the market opportunity and the expected revenue and profits with the management team and using political influences to get the direct

and indirect team on boards were greatly responsible for the successful implementation of the inventory management program at the burn-in group of ACME Inc.

5.4 CHAPTER SUMMARY

The application of the principles of supply chain management and in particular inventory management has shown that these techniques not only make it a cost effective and optimized solution for an organization such as the burn-in business unit of ACME Inc, but also helps in addressing the issues identified by the three lenses. The organization will now enjoy the benefits of entering a new market with minimal engineering resources. It provides the organization an increase in profitability through the reuse of the socket due to an increase in production runs. It has helped address the concerns of the manufacturing group by avoiding disruption to high volume manufacturing due to the minimum order quantities ordered to the production line. It has also helped the organization avoid delivery excursions as the organization now follows the service level based on customer-product level strategy. The chapter has also shown that merely developing a strategy, however simple and robust the strategy is, does not guarantee its success. Organizational acceptance and getting the functional team on board is of equal importance. More often than not, the use of political pressures and management influences help get such acceptances and hence successful implementation of programs within organizations.

6 CONCLUSIONS

The thesis has shown that organizational behavior can be easily understood using the three lenses. This technique helps in understanding how an organization would react to decisions made when looked at the same through a strategic perspective, a cultural aspect and also a political view. However, the discussions have also shown that using only one of the three lenses will provide an incomplete deduction and will hence lead to wrong decisions being made. Using the three lenses, this thesis has drawn the following conclusions about the burn-in business unit of ACME Inc in trying to enter the IC programming market:

1. The burn-in market is characterized by high volume, high mix and low price, while the IC programming market is characterized by low volume, high mix and high price.
2. The sockets for both markets are similar in design, however the functional difference between them makes the IC programming socket a much superior socket compared to its burn-in counterpart.
3. There is a commercial drive for an inexpensive IC programming socket making the burn-in sockets a much better alternative to the IC programming sockets to the IC programming value chain.
4. With the advent of globalization, the entire value chain has forced the various stakeholders in the value chain to adopt a multidivisional style of culture as an organization, but has required the local culture to be that of an action oriented one. It becomes obvious that the two cultures clash when an interaction is required and leads to internal tension that needs to be handled differently based on the level in the organization (local, boundary, global, etc.)
5. Even though the engineering community is correct about voicing their concerns on the new strategy, it really does not affect the strategy. The driving factors for the engineering concerns are cultural rather than business based.

6. The strategy to address a low volume high mix market is in direct conflict with the mindset and cultural behaviors of the members of the best cost producing sites. It is hence essential that to be successful the concerns of the best cost producing site are placed at top priority when the strategy is converted to tactical actions.
7. If the line supervisor and the manufacturing engineer in best cost producing site are convinced and hence convince the operations manager that the IC programming socket strategy will adversely affect their metrics and hence career opportunities, the strategy may be shot down even before initial discussions.
8. Finally, the conclusion of the three lens analysis shows that the opportunity definitely exists; however, the needs of the best cost producing site have to be placed at top priority before implementing the strategy

The thesis has also helped define the applicability of supply chain strategies to address the issues brought out by the three lenses. An in-depth analysis of the market need and the corresponding demand on the manufacturing line was done. The analysis modeling has shown that:

1. 59 different sockets distributed over 19 different customers who have an order trend of about 40 events in a given time period with most events containing less than 50-80 sockets will have a devastating effect on production, setup costs, lead time and may also lead to a non-profitable business.
2. The options that the business has are:
 - a. Continue operating in the existing fashion and pass on the costs to the customer. However, this would destroy the value that the customer sees in using a burn-in socket (less reliable but inexpensive). If the cost is passed on to the customer then the reliability issue surfaces and the business plan is nullified.
 - b. Give up on the flash programming business plan

- c. Implement a manufacturing strategy that would help address the customer needs as well as the internal operation requirements – inventory strategy.
3. In addition to the analysis, the inventory strategy section of the thesis concludes that:
 - a. All customers cannot be treated equally
 - b. All products cannot be treated equally
 - c. Service levels for each customer and corresponding products cannot be treated equally.
4. Applying the above principles, and conducting further analysis, it was also shown that the IC programming business segment has the potential to be ~30% of the total revenue earner by the burn-in business unit of ACME Inc, with gross profit contributions of ~41% to the total profit of the business unit. This shows that the IC programming market has a significant affect on both the top line as well as the bottom line growth.
5. Disruption to high volume manufacturing due to the minimum order quantities ordered to the production line is now avoided. On time delivery excursions are now eliminated due to the service level based on customer-product level strategy
6. The thesis has finally shown that implantation of the strategy is of equal importance compared to identifying the strategy, however simple and robust the strategy might be. Organizational acceptance and getting the functional team on board is of equal importance. More often than not, the use of political pressures and management influences help get such acceptances and hence successful implementation of programs within organizations.
7. The thesis shows that for successful implementation of the inventory management program the following steps were used:
 - a. Sharing the inventory analysis with the line supervisors and manufacturing engineers

- b. Sharing the market opportunity and the expected revenue and profits with the management team**
- c. Using political influences to get the direct and indirect team on boards**

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8 APPENDIX

Table 3 shows the overall ranking of the Flash customers worldwide [16]. It can also be clearly seen from Table 4 and Table 5 that the overall ranking is well split between the NAND and NOR manufacturers.

2004 Rank	Company Name	2004 Revenue	2004 Market Share	2003 Revenue	2003 Market Share	2004/2003 Sales Growth
1	Samsung Electronics	\$ 3,994	25.1%	\$ 2,255	19.4%	77.1%
2	Advanced Micro Devices (AMD) Spansion	\$ 2,411	15.2%	\$ 1,840	15.8%	31.0%
3	Toshiba	\$ 2,334	14.7%	\$ 1,816	15.6%	28.5%
4	Intel	\$ 2,285	14.4%	\$ 1,694	14.5%	34.9%
5	STMicroelectronics	\$ 1,217	7.7%	\$ 784	6.7%	55.2%
6	Sharp Electronics	\$ 885	5.6%	\$ 1,003	8.8%	-11.8%
7	Renesas Technology	\$ 865	5.4%	\$ 1,059	9.1%	-18.3%
8	Silicon Storage Technology	\$ 447	2.8%	\$ 295	2.5%	51.5%
9	Macronix International	\$ 334	2.1%	\$ 224	1.9%	49.1%
10	Hynix	\$ 221	1.4%	\$ 19	0.2%	1063.2%
	Others	\$ 902	5.7%	\$ 484	6.0%	
	Total Revenue:	\$ 15,895	100.0%	\$ 11,649	100%	36.4%

Table 3 – Total Flash Market Ranking (Revenue in Million US Dollars), [16]

2004 Rank	Company Name	2004 Revenue	2004 Market Share	2003 Revenue	2003 Market Share	2004/2003 Sales Growth
1	Samsung Electronics	\$ 3,531	55.7%	\$ 2,125	50.3%	66.2%
2	Toshiba	\$ 1,850	29.2%	\$ 1,408	33.4%	31.4%
3	Renesas Technology	\$ 600	9.5%	\$ 591	14.0%	1.5%
4	Hynix	\$ 221	3.5%	NA	0.0%	NA
5	Infineon Technologies	\$ 30	0.5%	\$ 16	0.4%	NA
	Others	\$ 105	1.7%	NA	0.0%	NA
	Total Revenue:	\$ 6,337	100.0%	\$ 4,221	100.0%	50.1%

Table 4 – NAND Flash Market Ranking (Revenue in Million US Dollars), [16]

2004 Rank	Company Name	2004 Revenue	2004 Market Share	2003 Revenue	2003 Market Share	2004/2003 Sales Growth
1	Advanced Micro Devices (AMD) Spansion	2,411	25.2%	1,840	24.8%	31.0%
2	Intel	2,285	23.9%	1,894	22.8%	34.9%
3	STMicroelectronics	1,192	12.5%	784	10.8%	52.0%
4	Sharp Electronics	885	9.3%	1,003	13.5%	-11.8%
5	Toshiba	484	5.1%	408	5.5%	18.6%
6	Samsung Electronics	483	4.8%	130	1.8%	256.2%
7	Silicon Storage Technology	447	4.7%	295	4.0%	51.5%
8	Macronix International	334	3.5%	224	3.0%	49.1%
9	Renesas Technology	285	2.8%	468	6.3%	-43.4%
10	NEC Electronics	219	2.3%	181	2.4%	21.0%
	Others	573	8.0%	303	5.4%	
	Total Revenue:	9,558	100.0%	7,428	100.0%	28.7%

Table 5 – NOR Flash Market Ranking (Revenue in Million US Dollars), [16]