CASE STUDY: AN ANALYSIS OF THE MATERIAL RESOURCE PLANNING(MRP) II SYSTEM IN AN ELECTRONIC MANUFACTURING COMPANY

by

WONG CHING-NGOK

黃 精 岳

MBA PROJECT REPORT

Presented to

The Graduate School

In Partial Fulfillment

of the Requirements for the Degree of

MASTER OF BUSINESS ADMINISTRATION

THREE-YEAR MBA PROGRAMME

THE CHINESE UNIVERSITY OF HONG KONG

MAY 1998

APPROVAL

Name: Wong Ching-Ngok

Degree: Master of Business Administration

Title of Project: Case Study: An analysis of the Material
Planning(MRP) System in an electronic
manufacturing company

SCKim

Dr. Seung Chul Kim
(Name of Supervisor)

Date Approved: _May 4, 1998_

TABLE OF CONTENTS

CHAPTER I

INTRODUCTION

In the electronic industry, technological complexity is ever increasing. Products came out a few months ago would be outdated nowadays and be replaced by another newcomer. This process repeats itself indefinitely, but every time, the product life cycle shortens. With the advance of the knowledge, technology is also easily and quickly replicated. What one achieves right now would be matched and even be surpassed later. Complacency should not appear, even for a short while, in this industry.

It is in this breath-holding background that I intend to explore how a typical semiconductor manufacturer and supplier serves this industry & maintains her competence, or even outperforms other suppliers.

Company A is a global semiconductor manufacturing corporation, with headquarters located in US, which specializes in designing, producing and selling a wide variety of electronic components for the mega electronic equipment producers such as Apple, HP, Motorola, Canon, Sony & other regional manufacturers as well. In the past ten years, the company's market share has dropped from over 10% to just 7% in 1996. She now ranks no. 3 in terms of revenue worldwide versus no. 1 in 1985. Obviously, she is losing to her competitors. A Research corporation has done a survey which found that customers from Corporation A were extremely dissatisfied. In fact, they have suffered two allocation events which they have adopted A's products into their design but received limited cargo. Some even received nothing and

were forced to redesign their products to adapt other vendors' parts. A major customer once complained: " Corporation A is the most inflexible, arbitrary and capricious vendor among my supplier list. Other vendors become cheaper, faster, more reliable and more flexible." Results of the survey is generalized in Figure 1.1 on next page, in comparison with the leader in this field.

The Corporation has been kept holding a fixed factory capacity. They receive customer orders from a First-Come-First-Serve basis. That is, whoever issues an order first will get an order acknowledgment until the factory capacity is fully occupied. Then she will turn down any additional order. Moreover, a giant customer may unpredictably issue a huge order which can overload the factory immediately. Undercapacity arises as there is no monitoring system when the factories nearly achieve the full-load limit. Only when the limit is achieved then she will announce allocation in which products will be provided in a limited quantity in a specified period. If the situation carries on, the prospect will be at risk. Increasing the throughput by establishing new factories requires at least US$1 billion/factory and only when she is certain the sufficiency of the demand, the management would then order to build a new one.

Hence a company-wide program, Equator, is launched to address the issues faced. It aims at revamping the missing link between supply side(Corporation A) and the demand side(customers). Equator's charter is to design and implement the business processes to support Closed Loop Planning.

Categories	Percentage Satisfied

Product Quality

78%

94%

Product Pricing

30%

61%

Delivery Lead Time

43%

62%

Adaptability to Changing Customer Needs

56%

74%

Quality Improvement

61%

81%

New Product Cycle Time

50%

81%

Leading Edge Technology

69%

88%

Sales & Support Staff

72%

78%

☐ Corporation A

■ Best

Competitor
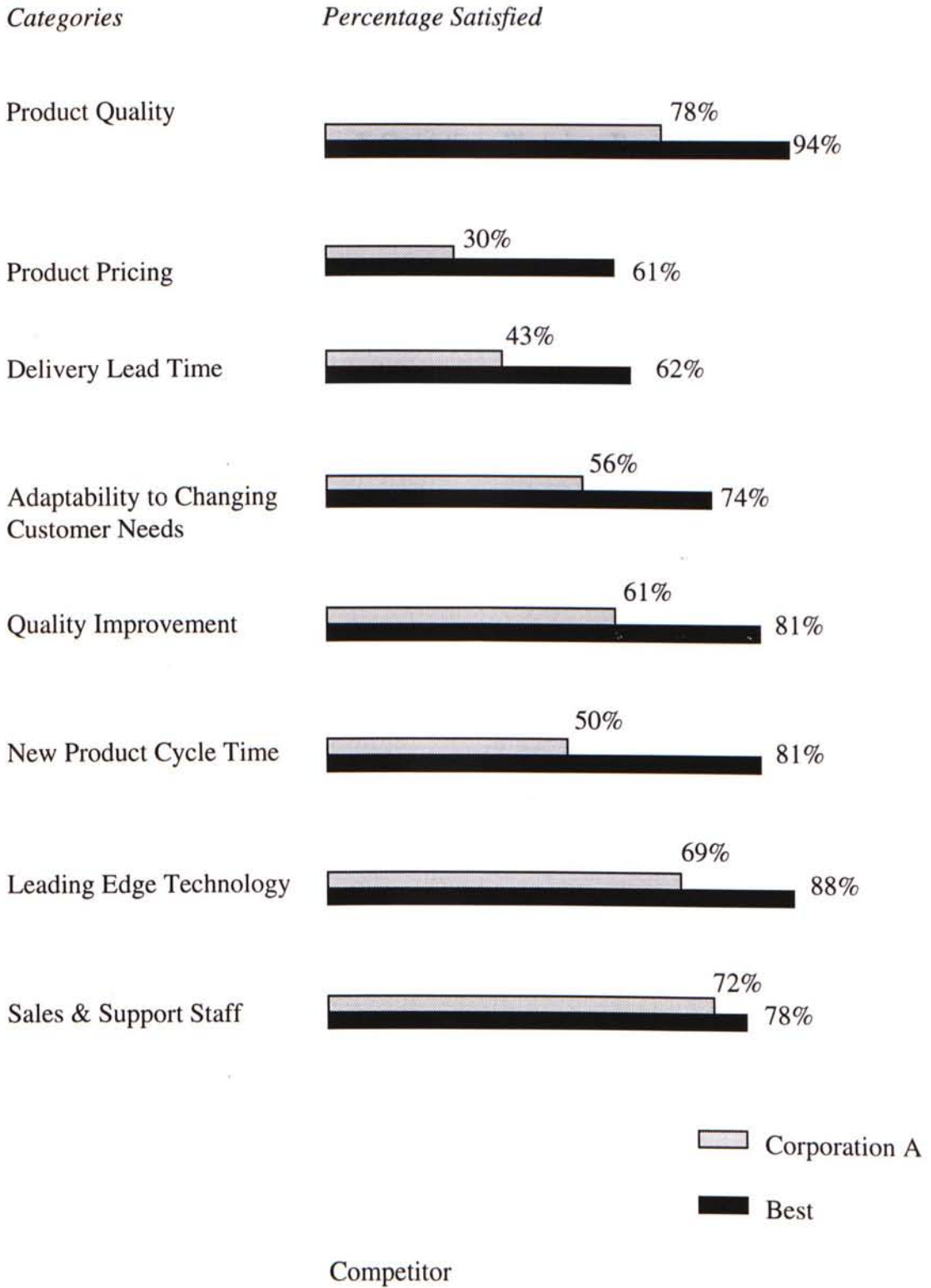
Figure 1.1 Survey Results on the performance index of Corporation A compared with the best performed company in the semiconductor industry.

A case study approach utilizing the Materials Resource Planning(MRP) II, a closed loop planning system, in the corporation is expended. I will explore the constituent processes e.g., Sales & Operations Planning, Rough Cut Capacity Planning, etc. in Equator. Data and information are collected from website and company's meeting minutes. Several milestones such as cycle time, inventory, margin parameters are set up to measure its performance. Comparisons with the past data will act as criteria to determine whether improvement or deterioration results from the launch of the program.

Questionnaires/Interviews will be designed and exchanged with the employees in the organization to understand how they perceive on the change and their views on it, since human factor also plays a crucial role in the implementation of the system.

Any system will have its own drawbacks, despite the many advantages it brings. In the final chapter, the pros & cons of the system will be summarized. Specifically, whether it is a truly effective closed loop system will be discussed. Since Equator is still in the working stage and may finish well after this report is written out, I will pinpoint the remaining part that has not yet been completed and will try to propose a solution.

CHAPTER II

METHODOLOGY

Through a case study approach of the production and operation system in an industry leader, a MRPII system structure is to be explored and examined on how it copes with reality and issues concerned. Before that, we need to define a standard on which we can judge on the system developed. Not only does it serve as a benchmarking purpose, it also provides a foundation on developing the whole system. Such criteria can be drawn through a process of literature review. The provisions from intranet and company publications are the sources to obtain the Equator details. Equator is a lever to align and balance the company's supply with customers' demand. Hence, it has to leverage both the business goals, constraints and the customer needs. The following metrics are to be collected and analyzed to determine the success of the program.

& Customer Needs	Business Goals & Constraints
Backlog	FAB Capacity
Forecasts	Cycle Times
Product Availability	Back-end Capacity
Lead Time	RONA Goals
Service Levels	OTD Goals
Competitive Pricing	Inventory Objectives
Delivery Flexibility	Margin
Objectives	
Sourcing Requirements	Utilization Targets

Business goals & constraints are defined with the consideration of the corporation resources and past historical data, market trends as well as benchmarking with industry leader. Since Total Customer Satisfaction is one of the key beliefs in company culture, customer needs are always part of the major factors in formulating the policy and guiding the behavior of the organization. They are determined through conducting in-house customer surveys at the end of every year and hiring consultancy firms in researching the overall market requirements.

Last but not the least, human factor cannot be neglected when setting up a system. Questionnaires will be distributed to employees for comments and direct feedback can be garnered during interviews.
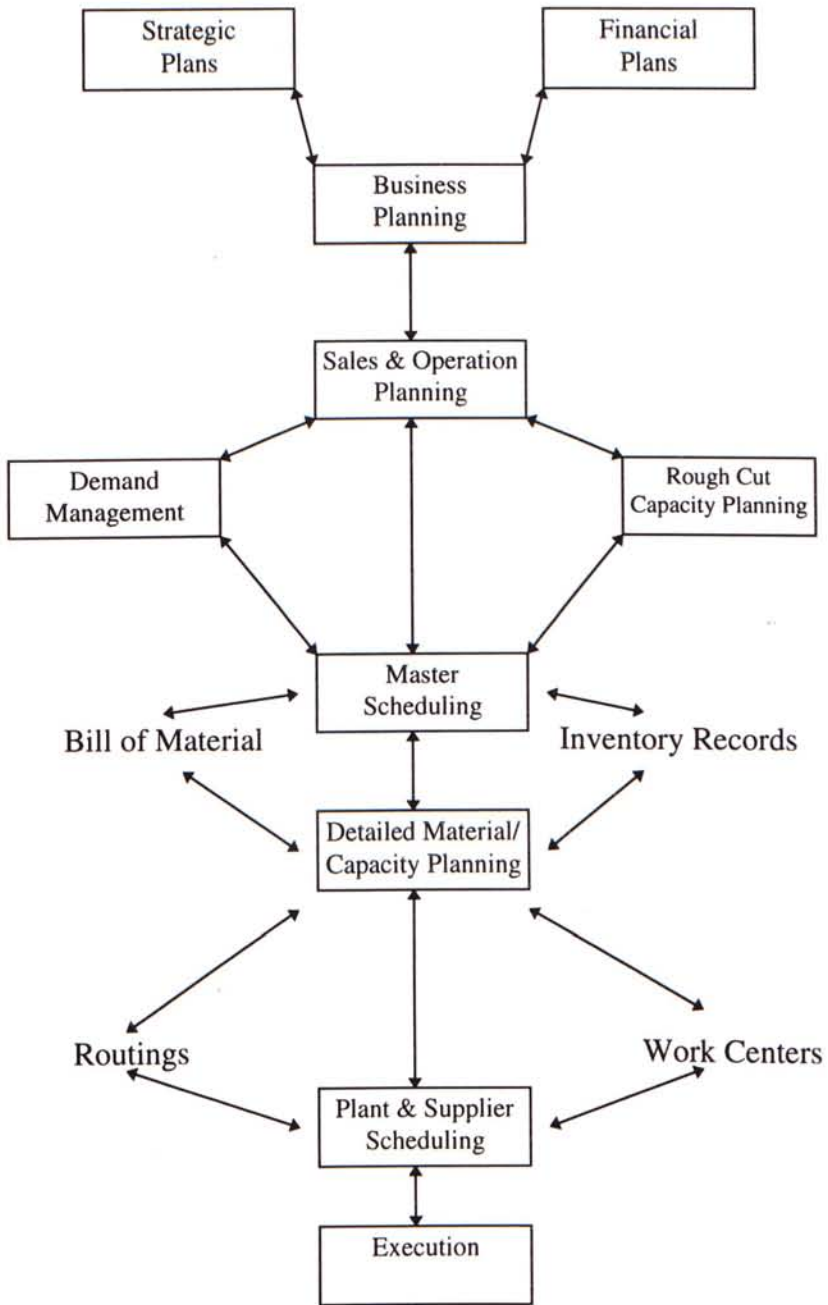
CHAPTER III

LITERATURE REVIEW

Material Resource Planning is an integrated business operating system commonly adopted by most manufacturing companies nowadays. It is a kind of people-computer interactive system which defines the responsibilities of various parties and carry out the communication functions among departments, company, suppliers and customers.

Figure 3.1 depicts a general model of the MRPII. Before defining the system, the company needs to plan how she intends to run the business. She has to define the products/services delivered; the target market segments or customers served; the resources - people skills, technology, plant, equipment facilities required; the competition- price, quality, delivery faced; the financial plans- growth, profits, ROI , inventory levels to be achieved or other goals. The Strategic Plans and Financial Plans will identify all the above factors as well as define the respective parameters, and then put them into consideration in the Business Planning Process.

The Business Planning will optimize various factors in consideration and adjust the goals if necessary. It can be differentiated into 3 levels, depending on the time horizons. Long range planning overviews the following 5 years the company will go. The Sales and Operation Planning takes a horizon of around one and a half years

```
                Strategic                          Financial
                  Plans                              Plans

                              Business
                              Planning

                          Sales & Operation
                              Planning

          Demand                                 Rough Cut
        Management                           Capacity Planning

                               Master
                             Scheduling
   Bill of Material                              Inventory Records

                          Detailed Material/
                          Capacity Planning

      Routings                                     Work Centers

                          Plant & Supplier
                             Scheduling

                              Execution
```

Figure 3.1 Manufacturing Resource Planning II

while the Annual Budget Exercise will set the objectives every coming year.

Sales and Operation Planning is a process led by senior management that, on a monthly basis, evaluates revised, time-phased, projections for supply, demand, and the resulting financial achievements. It is a decision making process that ensures the tactical plans in all business functions are aligned and in support of the business plan. The objective is to reach consensus on a single operating plan which allocates the critical resources of people, capacity, materials, time and money to most effectively meet the marketplace in a profitable way.

The relationship among Sales & Operations Planning, Rough-Cut Capacity Planning and Demand Management are shown in Figure 3.2
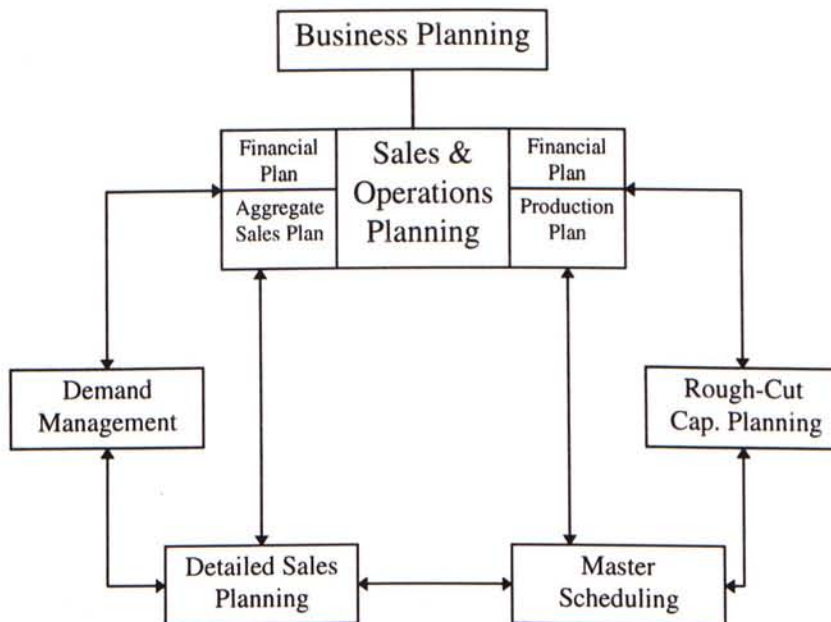
Figure 3.2 Sales & Operations Planning Relationships

Production Plan is the budget for Master Production Schedule(MPS) while MPS is the build schedule in terms of the products delivered at a specific date with quantities stated.

Rough Cut Capacity Planning(RCCP) is a set of logical steps using information about customer demands and the manufacturing capacity to optimize a match between the two.

Demand Management integrates the marketing plans, sales plans, new product plans, new initiatives/projects, forecasts and customer orders with the company's operational and business plans.

As mentioned before, MPS is a management commitment to produce a certain quantities of goods in a given period. In order to derive that decision, it takes customers future requirements forecasts and their order backlog as inputs. The system will then optimize those requirements with the production capacity - consisting of manpower and equipment facilities, and then produce a schedule which states the requirements of the goods in different time frames.

Detailed Material/Capacity Planning can be divided into two components:- Material Requirements Planning and Capacity Requirements Planning. When the MPS outputs the finished goods required, Material Requirements Planning process will check the bill of material for the corresponding finished goods, then calculate the respective components needed for manufacturing. With the inventory records on hand, this process will deduce the material plan. Capacity Planning Process will calculate the required. capacity(required pieces x standard working hours) and measure the demonstrated capacity(actual pieces produced x standard working hours). The two parameters will be compared and then decide to adjust either one.

The Plant scheduling involves the detailed work flow planning process among various work centres. There exists two work flow types: Job Shop & Flow Shop models. Job Shop model groups resources by like types and operations involves

moving and queuing among various production departments. Flow Shop model

groups resources by process. Hence, such planning involve minimal moving and

queuing among operations.

Figures 3.3 & 3.4 exhibits the differences between these two.

The supplier scheduling will issue purchase order commitment to suppliers

according to the material plan from Material Requirements Planning. Most of the

purchasing organization consists of Supplier Scheduler and Buyers. The former is

responsible for the scheduling of the materials needed before production starts. The

latter will issue purchasing orders to suppliers.

Thus the whole MRPII process has been introduced. It should be noted that

the whole flow is not 1-way, the lines are doubly-arrowheaded, implying that they are

back and forth. The operations in each process can adjust according to the feedback

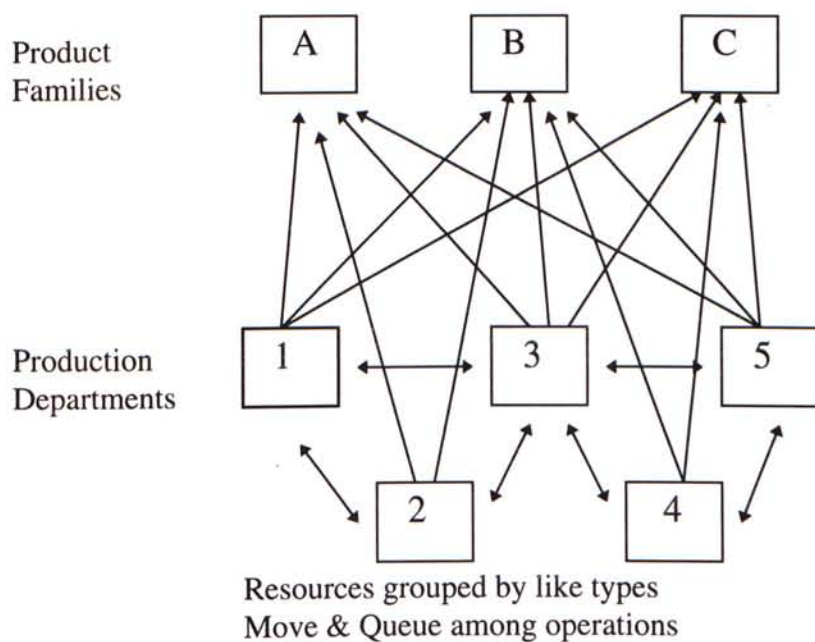from the subsequent process, forming a closed loop system.

Product
Families

Production
Departments

Resources grouped by like types
Move & Queue among operations

Figure 3.3 Job Shop Model

Product
Families

Production
Departments

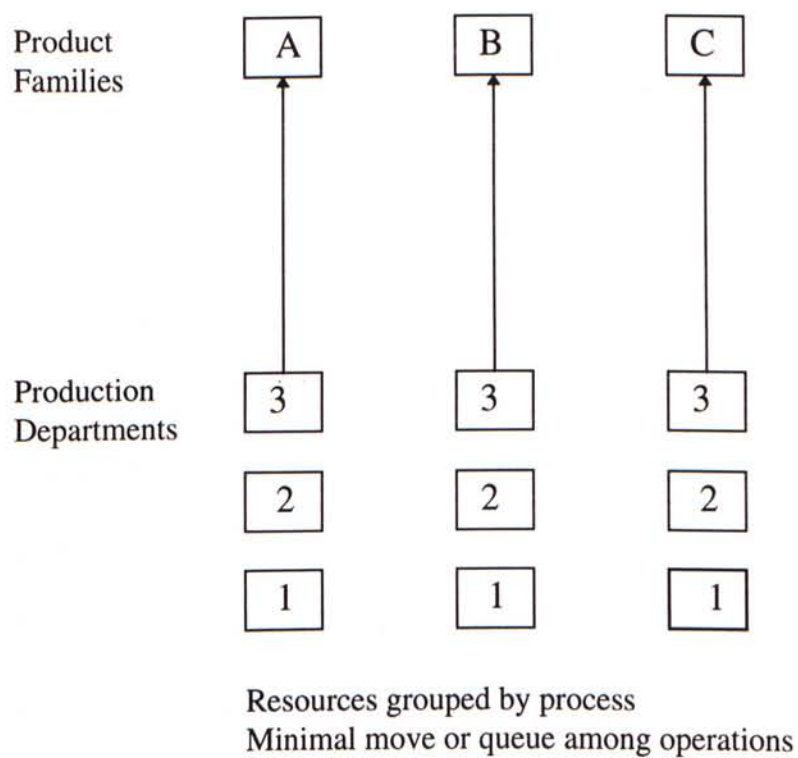Resources grouped by process
Minimal move or queue among operations

Figure 3.4 Flow Shop Model

CHAPTER IV

ANALYSIS

In the real business environment, various internal and external factors affect the production and operation decisions of a manufacturing organization. Customer expectations never stop rising; Competition amplifies; Product life cycles shorten; Opportunity cost of inventories exists; The macroeconomic conditions can never be precisely predicted. Hence, every business entity would require an integrated business operating system.

Equator

Equator is a closed loop planning system for customer service. It encompasses and defines the whole manufacturing process, with customers' demand forecast of the goods needed as the input, via the internal processing: demand coordination, rough cut capacity planning, detailed planning and execution; till to the manufacturing capacity calculated as the result. Customers will receive assured supply figures in the end. This forms a closed loop system. Closed loop planning is just a lever to align and balance the company's supply with customers' demand. Figure 2.1 summarizes the process flow of the concept.
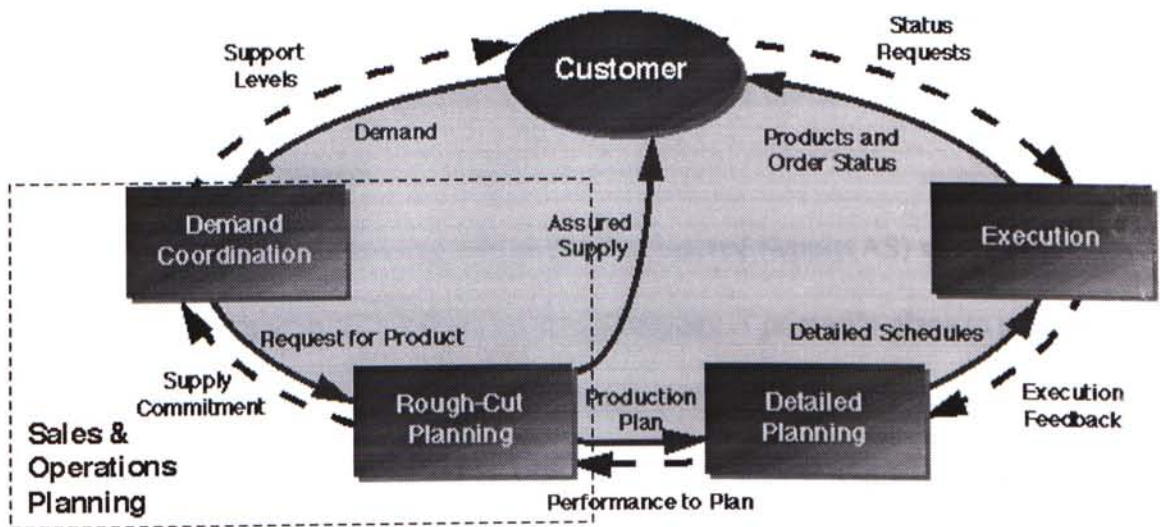
Figure 4.1 Closed loop planning in the Equator Program

Equator is modeled from the Material Resource Planning(MRP) II Concepts. "Closed loop" implies that there is not only information flowing from the customer to the planning process, but there is also feedback from the execution functions so that planning can be kept valid at all times.

As stated before, Sales & Operations Planning encompasses finance, demand coordination, rough cut capacity planning and new product introduction. This process allows the company to better utilize factory capacity to meet her service policy. At the same time, it is a support to the business plan and insures the plans are realistic. It will also manage inventory, lead time, backlog, capacity and demand.

Demand Coordination is an initiative to improve the way company A captures demand data and to generate worldwide requests for product(RFP). RFP is the customer demand for products from company A. The data are input over a 18 months' horizon through sales forces of company A every month, on a rolling basis. It is to address the previous lack of customer demand information, which subsequently leads to allocation events. By implementing the RFP tool, sales force of company A is

integrated into the closed loop planning process and it enables the employees to manage accounts globally. Moreover, it targets to improve on-time delivery and responsiveness to customers.

The Rough Cut Planning will output the Assured Supply(AS) which is a feedback to the sales force/customers on how Company A primarily plans to support the product on a monthly basis. It is this feedback which is most welcomed by customers and is unparalleled in the company's history. RCCP will also send out a production plan to the next process, Detailed Capacity Planning. There are four data elements governing the operations of the process. They will be analyzed in the next section. Production will then be executed according to the master production schedule released. Company A will inform the customers on the products and order status in more detail. In Equator, the information is not flowed into one direction. Feedback from customers will be directed in the opposite way, enabling the individual processes to adjust accordingly.

Data Standards

As mentioned in the above section, There are 4 types of data elements governing the operations of the detailed capacity planning: supply, demand, bill of material and inventory of data elements. The benefits of defining data standards are to:-

1) establish undisputed company wide manufacturing metrics, since company A consists of 17 factories worldwide, and a number of subcontractors in various regions;

2) provide one set of operational numbers to work on;

3) provide product tracking from raw materials to finished goods.

Supply Standard

Supply standard consists of 7 entities: Inter-Location Routing, Capacity/Tradeoff, Yield, Cycle Time, Master Data, Stage Process Codes and Planning Device.

An interlocation routing is a representation of a valid path between manufacturing locations for a salable device(generally a finished goods). Each inter-location routing for device represents one possible "chain" that the device can follow during its production. Inter-location routings are important because they allow the model to understand where products could be potentially manufactured, and thus lead to the best use of manufacturing resources to produce a product.

Key relations between inter-location routings and locations are summarized in Figure 4.2 and include:

1) Each physical manufacturing location will map to one or more stages of completion. For example, a facility that performs both fabrication and bump would be two separate locations;

2) Interlocation routing is a valid routings between manufacturing locations;

3) The inter-location routing contains all the possible factories, assembly, and testing locations which are used to make a salable part.
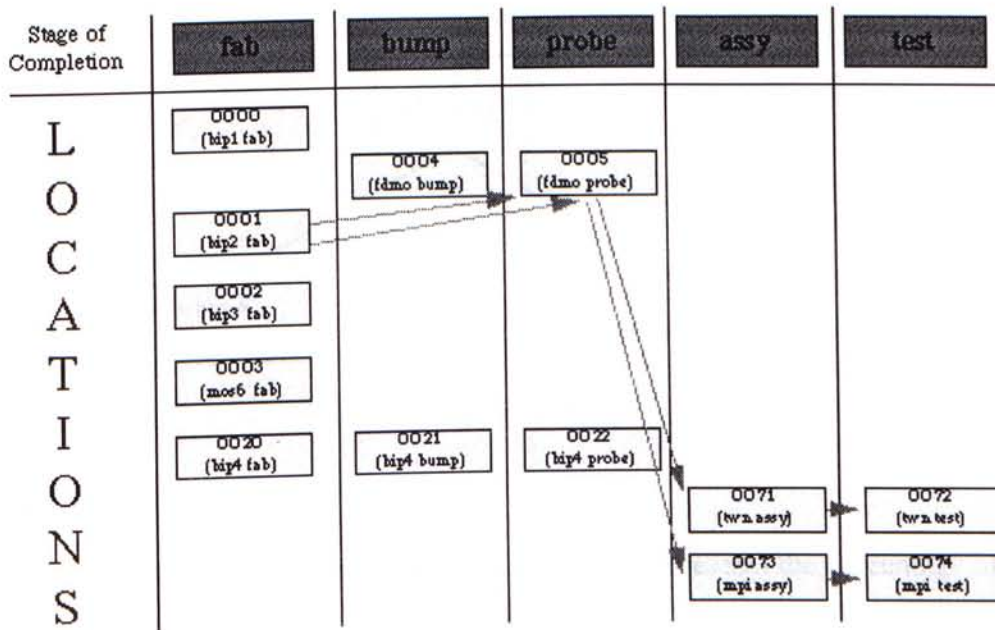
Figure 4.2 Relations between inter-location routings and locations

Capacity/Tradeoffs

"Capacity" is a measure of the total available productivity of the

manufacturing equipment. "Tradeoff" is the usage or consumption of the capacity of

manufacturing equipment. The tradeoff capacity is each product's rate of capacity

usage. It is the actual processing time required to produce one unit. "Step" and

"Operation" are two terms that are most often used when referring capacity.

Step is defined as a manufacturing entity where capacity is consumed. The

primary purpose of steps are to constrain starts. It can be thought of as a high level

manufacturing flow within a given location. It can be chosen from specific bottleneck

machines or more abstract groupings of machines.

Operation is used to represent the requirements for device manufacture. Each

operation can be measured in terms of cycle time or how much of a specific resource

is used and yield which measures the quality and output upon completion of the

operation. Figure 4.3 illustrates the relationship between step and operation:-
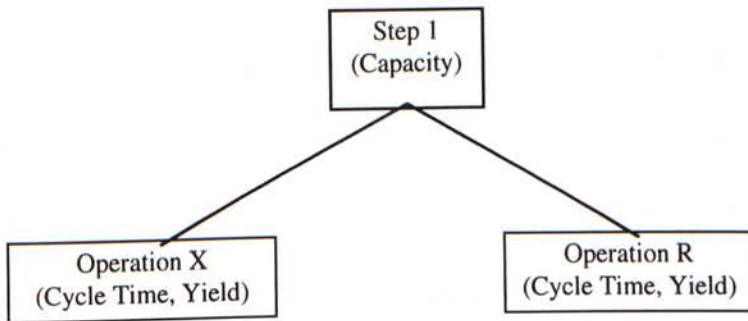
Figure 4.3 Relation between Operation and step

Yield

Yield is a number between 0 and 1 that represents the percentage of devices that successfully complete a given operation or process. Process yields are independent of device, and are related to the nature of the operation being performed. Product yields vary by device. There are also other types of yields used:-

Financial Yields - period yields that measure the amount of product out of a cost relative to the amount entering that block.

Manufacturing Yields - specific yields at each stage of completion estimated by process engineers.

Engineering Yields - yield estimates created by product engineers

Historical Yields - yields tracked on the shop floor and kept for reference

Cycle Time

Cycle time is used in the planning process to determine required start quantities and dates to achieve desired end product quantities and schedule. Cycle time is the number of days that it takes to complete a particular manufacturing operation.

Master Data

Master data is composed of two elements: calendar and location. A calendar is defined as a data entry that provides a schedule of work days and shut down days for each location where product is made. It defines the work week, work week in each monthly bucket, start and end dates of work week and 52 work weeks in a year. These will constitute the total calendar of the year. Location is a representation of an area where production work specific to a given stage of completion can occur. Stage of completion consists of five stages which cover the whole semiconductor manufacturing process.

Stage	Indicator
Fab	F
Bump	B
Probe	P
Assembly	A
Test	T

Indicators are used to associate the manufacturing plant with the stage of completion it takes.

Stage Process Codes

Stage Process Codes, or SPCodes, are collections of manufacturing operations within a stage of completion. Products that use an intra-location routing consume capacity at similar rates within a stage of completion. Stage process codes may exist at multiple locations, but they cannot cross stages of completion. It is used to generate Planning Devices. At each location in an inter-location routing, the components of a planning

device must have the same intra-location routing. An intra-location routing must have the following characteristics:-

- It will use a particular manufacturing capability

- It will consume available capacity at a particular rate

Each stage of completion has a unique set of SPCodes. Stage of completion(SOC) is used to partition the manufacturing flow into smaller, more manageable planning segments. It is often associated with levels in BOM. In addition, SOC may indicate a break in processing for transportation or inventory holding. Part number changes occur during manufacturing process between stages of completion. For example, wafer part numbers transition to die part number between fab and probe differ.

| Stage	Description
Fab	The fab stage of completion finishes with a processed wafer prior to bump and probe. It is associated with the wafer level of the Bill of Material.
Bump	The bump stage of completion finishes with a fully processed wafer that has had surface bumps deposited for package connection. It is not identified by a level of the BOM.
Probe	The probe stage of completion finishes with a functionally tested die yielded from a fully processed wafer. The die may still be physically part of a wafer, but the inventory system tracks the total number of functional die rather than the number of wafers. It is associated with the die level of the BOM
Assembly	The assembly stage of completion finishes with a packaged device. It is associated with the raw stock level of the BOM.
Final Test	The final test stage of completion finishes with a device fully performance tested to the complete specification limits. It is associated with the end item level of the BOM.

Key relations between intra-location routings and steps include:

- A series of steps comprise a routing. Routings contain one or more steps which are executed to build a product. Steps are not necessarily in a sequential order as certain steps may be repeated;

- Steps may belong to more than one routing;

- Intra-location routings are routings within one physical manufacturing location. Multiple locations may have the same intra-location routings; however, the two routings are not the same physical routes. The routes will be the same process at a different location. This implies that the intra-location routing together with the manufacturing locations uniquely identify manufacturing capacity consumption. It is diagramatically shown in Figure 4.4.
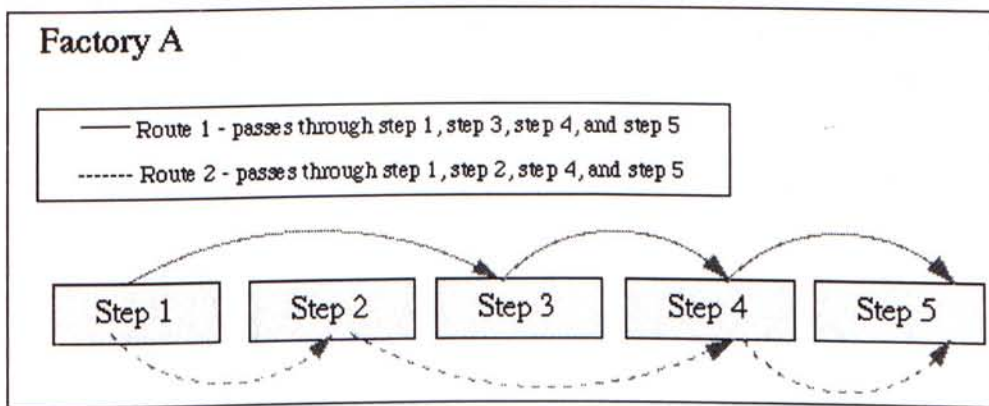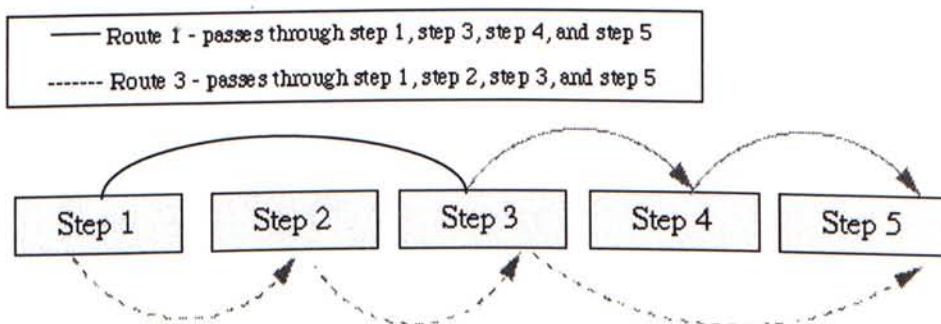
Figure 4.4 Relations between intra-location routings and steps

An additional complexity regarding routings and steps is that two intra-location routings may use the exact same steps. In such cases, although routings use the same

steps, they consume capacity differently. Figure 4.5 provides an example of this
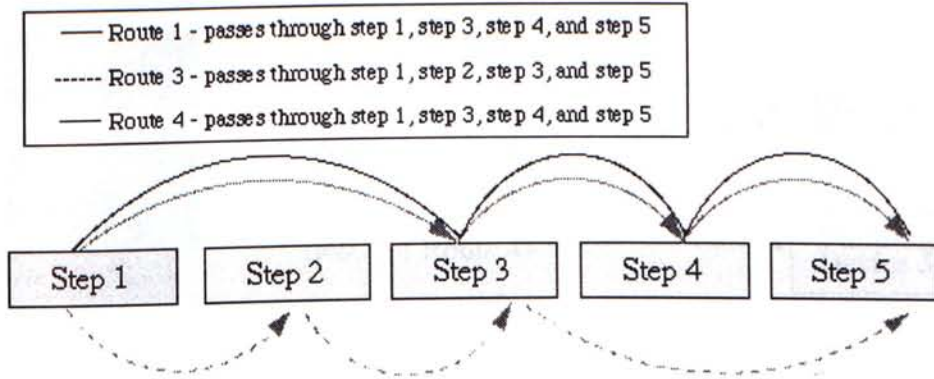
situation.

Factory B

Route 1 - passes through step 1, step 3, step 4, and step 5
Route 3 - passes through step 1, step 2, step 3, and step 5
Route 4 - passes through step 1, step 3, step 4, and step 5

| Step 1 | Step 2 | Step 3 | Step 4 | Step 5 |

Figure 4.5 Routings with same steps can consume capacity differently.

Planning Device

Planning device is an aggregation of finished goods devices that consume

capacity in roughly the same manner, which means they pass through the same stages

of completion with the same set of locations for each stage, and are assigned the same

set of stage process codes. The primary purpose of planning devices is to reduce the

number of devices used in planning. The following diagram illustrates how a planning

device is defined.

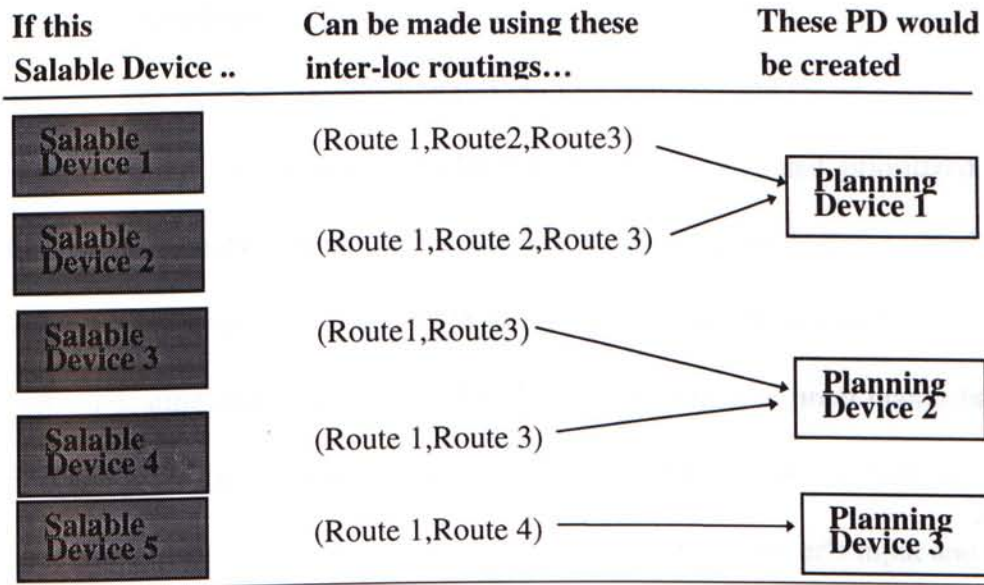| If this Salable Device ..	Can be made using these inter-loc routings…	These PD would be created

Figure 4.6 Transformation from salable device to planning device

We have discussed all the supply data standards and the relations with each other.

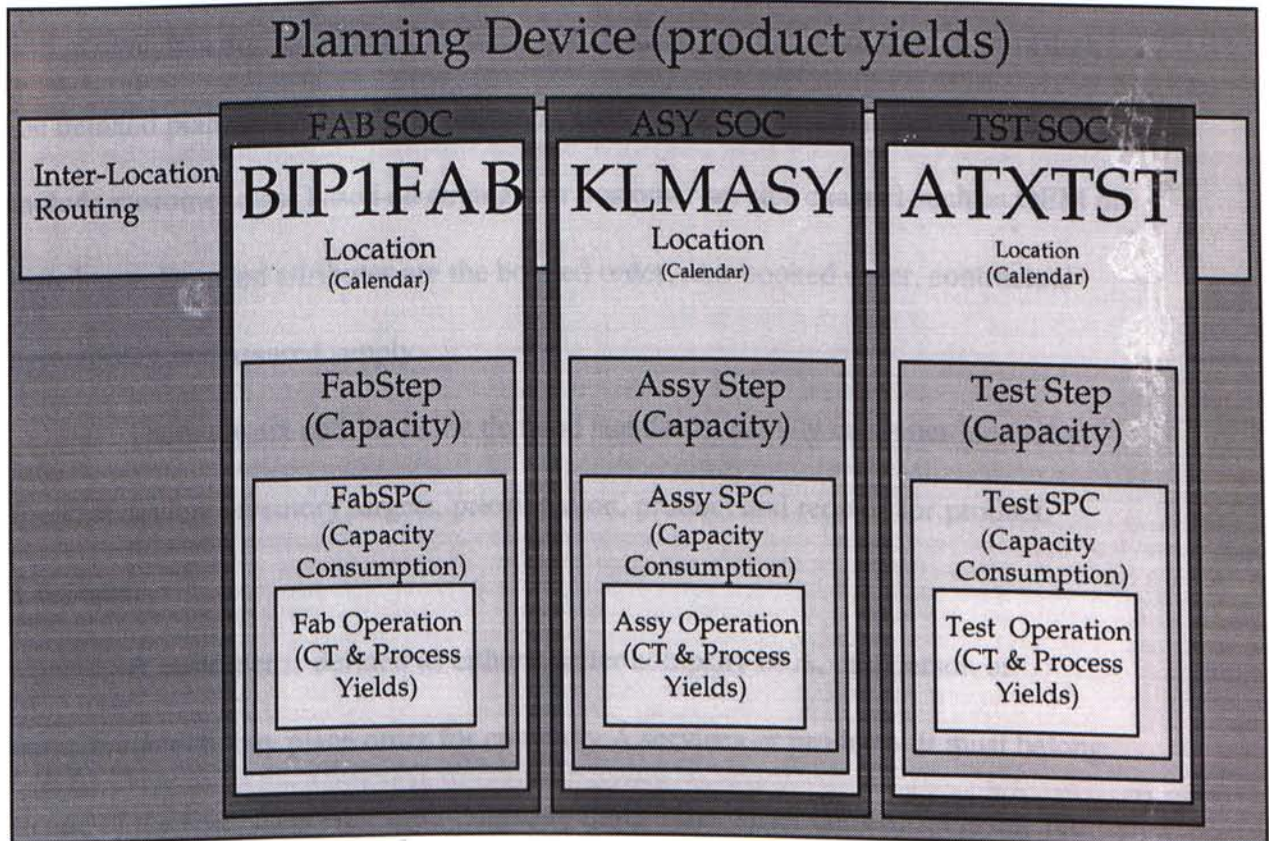Figure 4.7 is a summary showing their inter-relationships.

Figure 4.7 All supply data relations tying together

Demand Standards

The demand coordination process forecasts demand for products and customers, and generate a monthly RFP. RFP is then aggregated, prioritized, netted for inventory, and combined with a strategic inventory target to compose a Demand Requirement Statements(DRS). DRS is an input to generate an order plan for communicating back to customers. The Equator definition of order plan is backlog plus an agreed upon booking plan. The entire Rough Cut Capacity Planning process becomes a true closed loop planning process when the customer's input and comments about the communicated order plan are then documented and included as part of the next sales and operations planning cycle's RFP. In order to generate accurate, timely and reliable forecast, the use of existing customer and product hierarchy data structures defined as below, as well as the ability to capture customer and market data are necessary. Customer and demand attributes are used to prioritize the demand plan for inventory netting and capacity allocation. Customer attributes include customer class based on strategy, or customer service channel such as OEM or distributor. Demand attributes are the booked order, non-booked order, contractual agreements, and assured supply.

There are six entities in the demand standards, namely customer hierarchy, forecast device, inventory targets, prioritization, product and request for product.

Customer

A customer is defined as either a sister company of A, or a person or company which may place order for company A services or products. It must belong to one of the five categories: intra-company units, other sister companies inside the

group which company A belongs to, distributors, original equipment manufacturers
and subcontractors for original equipment manufacturers.

A customer hierarchical structure is established to provide multiple customer
level view capability as well as required flexibility for customer defined aggregation
levels for generating forecasts, RFPs, and order plans. For instance, HP may require
that a RFP be generated for an aggregate market level the whole HP group involves
while IBM may require local sales office or subcontractor specific RFP generation. In
addition, when IBM buys a device directly from Company A on one occasion and
through a distributor on another, A can predict end use demand from IBM and not the
demand from IBM and a distributor separately. After specifying the merits, the
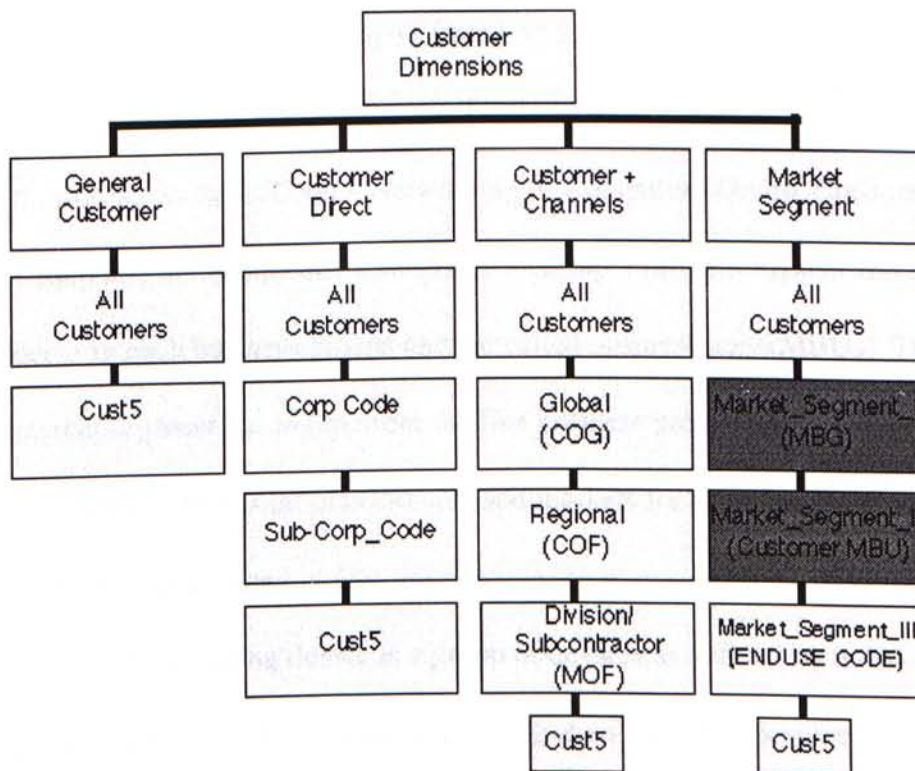customer hierarchy is shown as follows:

Figure 4.8 Customer Hierarchy Data Structure

In Figure 4.8, Company A considers customers from 4 dimensions. The
general customer view branches directly for all customer codes(Cust5) and allows the

viewing of all Cust5 codes that are associated with any location on the product dimension.

The customer direct view allows customers demand to be individually viewed. Subcontractors, distributors and suppliers demand is rolled up only through their own corp-code and not through the end use customer demand. Corp code is a code assigned to the corporation in which the customer belongs to. For instance, HP is a corporation that has numerous subsidiaries purchasing from A directly.

The goal of the customer + channels view is to align JIT warehouses and subcontractors to their main contracting customer.

The goal of market segment view is to provide mapping of the market segments to customers. Company A has undergone restructuring recently and forms 5 market business groups(MBGs), based on the market segments she determines to concentrate and develop. They are Transportation Systems Group, Wireless Subscriber Systems Group, Networking & Computing Group, Consumer Systems Group and Semiconductor Components Group. Further divisions and sub-divisions occur in each business groups and are called business units(MBUs). The intent of market segment I is to represent the five business groups and to use market segment II as a further distinction of customers and markets for those business units.

Forecasting Device

Forecasting device is a group of devices as defined by individual business groups inside Company A for forecasting at an aggregate level as desired. Each business unit has to define the aggregate grouping of devices.

Inventory Target

Inventory target is defined as the demand related salable device strategic stocking levels expressed in units, weeks of usage or lead time, and specific to a S&OP cycle month. The inventory target is selected based on the largest value of the two inputs: manual input, or calculated inventory targets. Manual input is specific to the lowest customer hierarchy level and lowest product hierarchy level intersection(device). Calculated inventory target is derived based on weekly usage, number of weeks of inventory desired and the order rates that are specific to the customer and product intersection.

Demand Prioritization

Prioritization is defined as groupings of demand line items with similar demand and customer classifications, the relative ranking of each of these groups and the relative priority values assigned to each demand line item within each grouping. The demand attributes are defined as delinquencies(delivery delay), minimum required demand, extra demand, inventory target demand and other. The customer attributes are defined according to the Company service policy.

The demand and customer attributes information is used to group and rank similar demand line items. The rank denotes the relative importance of the group with respect to others, for the purpose of allocating capacity. Group of demands with a higher rank are satisfied first before those within lower ranks. For each ranked demand line item, a priority value is assigned that reflects its degree of relative importance with respect to other line items within the same group. Capacity tradeoffs exist for demands with different priority values. It is possible that demand with both a high merit value and capacity usage rate will be allocated capacity after a demand with a lower merit value and lower capacity usage rate.

Product

Product is defined as a forecastable or manufacturable device that will provide a valued function for its customers. A product hierarchy is established to represent the variety of product groupings needed for marketing and customer reference:

General Product View - branches directly for all products to device codes. It allows viewing all devices that are associated with any given location on the customer dimension.

PTI3 View - allows for product inquiries following the PTI structure, which is associated with the primary application the product will be in.

Package Code View - allows for product inquiries by package codes summed within a given PTI3 code.

Product Line View - supports product inquiries through the straight parent - child relationships.

Forecasting Device View - allows flexibility for MBU to define product grouping that would be the best for forecasting or other purposes.
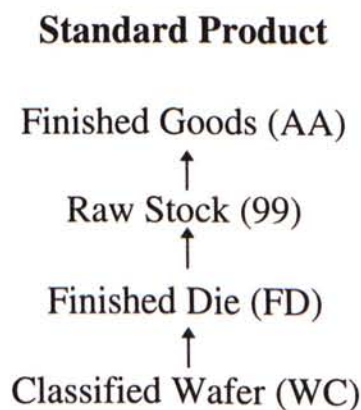
Request for Product

It is a statement of demand specific to a device and customer. The information required to identify the RFP is customer ID, device, requested S&OP cycle month and business units involved. The information contained in the RFP is units and ASP(average selling price) from coming month till to the next 18 months. Below shows a sample of the RFP input done in Apr/98.

Customer ID	S&OP Cycle	Business Unit	Device	ASP(US$)	98/May	98/Jun	98/Jul	....	99/Oct
XYZ	98/04	computer	HA14069	0.10	20,000	20,000	30,000	....	10,000
XYZ	98/04	computer	HM54141	1.50	5,000	5,000	10,000	....	5,000
ABC	98/04	telecom	TA1062	0.50	100,000	100,000	500,000	....	500,000
ABC	98/04	telecom	TA1093	1.25	200,000	200,000	300,000	....	400,000

Bill of Material standards

The goal is to establish and implement a defined standard for Bills of Material from wafer to finished goods that can meet the r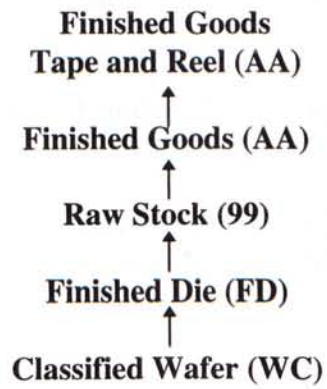equirements of planning, procurement and manufacturing. The merits are standardized planning procedures, support for transition to new planning systems and tools, inventory and cost control for pieceparts, cataloging of like package type of bills of materials for increased integrity and speed of BOM selection. There are 7 kinds of product types in which BOM standards are defined. They are Standard Product, Standard Product Marked in Assembly, Standard Product Tape & Reel, Die Sales, Flip Chip, Modules and MCM Multichip Module-Proposed.

<div align="center">

Standard Product

Finished Goods (AA)

↑

Raw Stock (99)

↑

Finished Die (FD)

↑

Classified Wafer (WC)

</div>

Standard Product Marked in Assembly

Finished	Finished	Finished	Finished	Finished
Good 1 (AA)	Good 2 (AA)	Good 3 (AA)	Good 4(AA)	Good 5(AA)
↑	↑	↑	↑	↑
Raw Stock	**Raw Stock**	**Raw Stock**	**Raw Stock**	**Raw Stock**
(99)	(99)	(99)	(99)	(99)
↑	↑	↑	↑	↑

Finished Die (FD)

↑
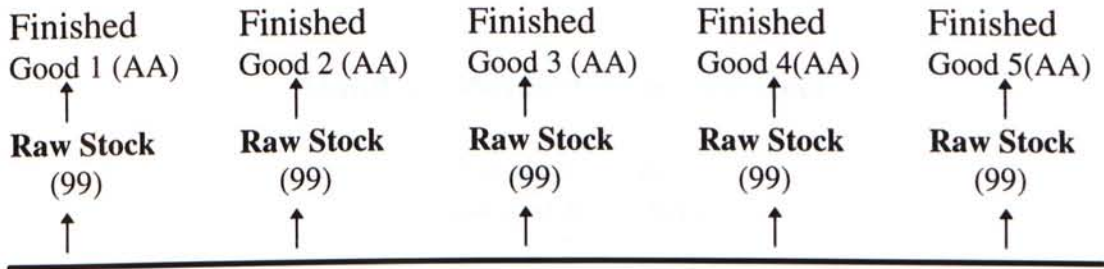
Classified Wafer (WC)

Standard Product Tape and Reel

**Finished Goods
Tape and Reel (AA)**

↑

Finished Goods (AA)

↑

Raw Stock (99)

↑

Finished Die (FD)

↑

Classified Wafer (WC)

Die Sales

Die Sales (WD)

↑

Finished Die (FD)

↑

Classified Wafer (WC)

Flip Chip

Flip Chip (CP)

↑

Finished Die (FD)

↑

Classified Wafer (WC)

Modules

Finished Good 1 (AA)	Finished Good 2 (AA)	Finished Good 3 (AA)	Finished Good 4 (AA)	Finished Good 5 (AA)
↑	↑	↑	↑	↑
Raw Stock (99)	Raw Stock (99)	Raw Stock (99)	Raw Stock (99)	Raw Stock (99)
↑	↑	↑	↑	↑
Finished Die (FD)	Finished Die (FD)	Finished Die (FD)	Finished Die (FD)	Finished Die (FD)
↑	↑	↑	↑	↑
Classified Wafer (WC)	Classified Wafer (WC)	Classified Wafer (WC)	Classified Wafer (WC)	Classified Wafer (WC)

Multichip Module - Proposed

Finished Goods (AA)
↑
Raw Stock (99)
↑
Die Kit (FD)

Die 1 (FD)   Die 2 (FD)
↑   ↑
Wafer 1 (WC)   Wafer 2 (WC)
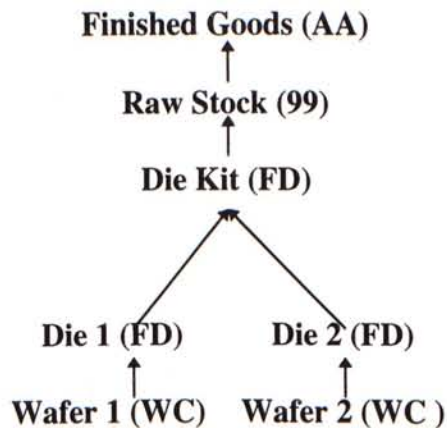
Figure 4.9 Various product types from Bill of Materials view.

Inventory of Data Elements

The inventory of data elements is created to be used as a reference in understanding the definitions and values allowed for data elements being used in the Equator closed loop planning process.

CHAPTER V

CONCLUSION/COMMENTS

After explaining the concepts and discussing the implementation of Equator, I am going to explore the human prospects of the system:- comments from the employees and interpretations from A's customers. They are summarized as follows:-

Employee Feedback

Unified Standard Before the introduction of Equator, the company does not have conforming rules for order processing and manufacturing. Company A has built over 40 factories worldwide in the past twenty decades. Each factory is quite independent in the sense that she has her own standards and procedures for receiving orders from sales and marketing side and order processing. Hence, the sales and marketing people in the company have to work with different guidelines in various factories among the same company. Sometimes, people will apply Factory X rules when interfacing with Factory Y and hence chaos will result which will lengthen the cycle time as well as draining the resources. With the implementation of a unified standard, the procedure is drastically simplified and become more systematic.

Goal Convergence Besides, with the establishment of the S&OP meeting every month, an agreed upon set of number is presented to all parties concerned. Thus, conflicts will be resolved at an early stage and each business unit will base on one set of number to work on. Goal convergence can be achieved.

Computerization Equator requires a wide adoption of computer automation process which automatically reduces the tedious, manual routine works. Response time is drastically reduced.

However, every system is not without its defects, despite the merits it brings.

Class Prejustice Since there exists prioritization in customer support, those serving lower rank ones will feel inferior and are dissatisfied, as their performance is tied with how well they can satisfy their customers.

Customer Comments

One Face Customers now perceive a consistent service offered to them due to the company wide adoption of Equator. Company A is no longer a multi-faced company due to the multiple standards from different people in different divisions.

Adaptability to changing customer needs Owing to the establishment of a forecast system, Company A can well-prepare her capacity planning in the future. From the customer point of will, they will receive acknowledgment on the product support from company A. Both sides can take precautionary actions in case any thing gets wrong or situations change.

On Time Delivery Since one of the key metrics in measuring the effect of the program is the on-time delivery performance, customer surveys have been conducted among the key customers. On time delivery is achieved 99% versus the previous 85% before the launch.

Again, customers are not patient to wait during transition period:

Transition Issue As Equator is still in its implementation stage, the initial phase is launched for giant customers first. Big players such as HP, IBM receive order plans from company A on a monthly basis while other customers are still in the waiting list.

Disconnection happens since those customers who submit the RFP while not receiving any order plans will be at a loss, as they do not know how Company A is going to support them.

Priority Issue The satisfactory on time delivery performance for global customers may be at the expense of the poor support to medium-small size regional and local ones, since the survey was only conducted to global customers. Moreover, in case of capacity issue, customers will be prioritized for support based on the business amount involved and strategical reasons.

Looking Forward

From the very beginning, the problems of the company have been stated, and it thus leads to the design and launch of Equator. The program is historical in the sense that it does not happen before, and it revamps the drawbacks of the old, independent system each factory adopts. Equator is overwhelmingly accepted by the company employees and customers. Employees find that they have a standard procedure to follow while the customers are grateful to share and cooperate on the future support plan, and they believe this is the way to go for vendor-customer relationships. JIT is one of the program every customer would like to implement, but it cannot come true without the support of the MRPII from the manufacturers and customers.

Throughout the thesis, I do not mention on the teams and committees that help set up and monitor the performance of the system. This does not mean that it is not essential. In fact, the committees help refine the system and propose any fine-tuning. In addition, more and more vendors from Taiwan join the competition game in the semiconductor industry, customer satisfaction is one of the major focus in this

game. Equator is expected to constantly be revised to reflect the customer needs and latest industry situations. For instance, the existing commitment window to customer order may be extended from 26 working week horizon to let say, 30 weeks. The project teams should be here to monitor the latest development and adjust the system accordingly. Not only the information flow is closed loop, but the system design itself should also be closed loop. Human factor is the key.

BIBLIOGRAPHY

Books

Hill, Terry. <u>Production/Operations Management</u>. 2nd ed. Englewood Cliffs, New Jersey: Prentice Hall, 1991.

Williams, Glyn., and Harvey, Bruce. <u>Manufacturing Resource Planning</u>. The Oliver Wight Companies, 1995.

Interview

10 employees, Company A. Interviews, 16-20 Mar 1998.

3 global customers. Interviews, 23-24 Mar 1998.