INTEGRATION OF THIRD PARTY LOGISTICS PROVIDERS WITHIN THE DISTRIBUTION NETWORK

by

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Submitted to the Sloan School of Management and the Department of Mechanical Engineering in partial fulfillment of the requirements for the degrees of

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Abstract

In its attempt to sustain the growth expectations in an increasingly competitive market, Intel Corporation has invested in a number of new products and services, which differ significantly from its core semiconductor business. In 2000, Intel purchased 12 companies, amounting to an investment value of approximately 6 billion dollars. Associated with these various businesses ventures are new customers, new channels, different product attributes, uncertain demand profiles, and various service requirements, all of which have a direct impact on Intel's strategy for physical distribution. The existing logistics infrastructure is not equipped to optimally distribute the greater product mix and respond to the added complexities. The integration of third party logistics providers into its current distribution network may enhance Intel's ability to respond to the growing needs of the diversified product offerings.

This thesis explores the decision to outsource logistics activities. It presents both the financial and non-financial, strategic and operational factors, which affect the decision. The decision framework presented is applied to the current business situation at Intel and an outsourcing strategy, which both addresses the current distribution challenges, and compliments the overall strategy of the corporation, is recommended. The description of the recommended distribution strategy is followed by a discussion of the complications associated with executing the strategy and guidelines for effective supplier management in a logistics context.

The decision to outsource is just one of the decisions analyzed in the development of distribution strategies. Studying the strategies utilized by other organizations can enhance the competitiveness of a firm's logistics network. This paper also describes the methodology developed for exchanging logistics information with other companies, and based on the evidence from the specific study conducted by Intel's Planning and Logistics Group, discusses the critical success factors for future external studies.

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I also acknowledge the Leaders for Manufacturing Program for its rich collection of resources and tools made available to me. Its community of staff, faculty, corporate partners, alumni, and colleagues played an instrumental role in my development and growth over the past two year at MIT. I extend a special thanks to my thesis advisors, Stephen Graves, Lionel Kimerling, and Jung-Hoon Chun for offering valuable guidance and feedback along the way.

And most of all, I am extremely grateful for my family and friends who have provided me with endless support and inspiration during my masters work at MIT, and throughout *all* of my life's endeavors.

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Chapter 1: Introduction and Overview

1.1 Introduction

The work presented in this document is based on a 6-month internship with Intel's Planning and Logistics Group in Chandler, Arizona. The internship assignment is a result of a partnership between Intel Corporation and the Leaders for Manufacturing program at the Massachusetts Institute of Technology.

1.2 Chapter Previews

CHAPTER 2: PROJECT SETTING AND BACKGROUND

This chapter presents an overview of Intel's position within the microprocessor industry and the changes, which are evolving its overall business structure, followed by the specific effects on its distribution activities.

CHAPTER 3: BASELINE ASSESSMENT OF INTEL'S CURRENT LOGISTICS NETWORK

Chapter 3 establishes a baseline of Intel's existing logistics operation and practices and identifies areas of strength and weakness.

CHAPTER 4: ANALYSIS AND CONCLUSIONS FROM BENCHMARKING

Chapter 4 describes the methodology designed to explore the logistics practices and strategies utilized by companies recognized as industry leaders and summarizes the key findings and observations collected from our study of 7 different companies.

CHAPTER 5: POST MORTEM OF THE BENCHMARKING PROCESS

Assessing the effectiveness of the process designed to study the logistics operations and practices of other companies, Chapter 5 presents the critical success factors for conducting logistics benchmarking activities in the future.

CHAPTER 6: AN INTEGRATED DISTRIBUTION MODEL

Utilizing the findings from the benchmarking, combined with research conducted in the area of third party logistics, Chapter 6 presents a distribution strategy, which integrates third party logistics providers. The chapter describes the cost and strategic benefits realizable with this

strategy, as well as the implications associated with successful implementation of the distribution model presented.

Chapter 2: Project Setting and Background

2.1 Chapter Overview

This chapter begins with an overview of Intel's position within the semiconductor industry and the changes, which are evolving its overall business structure. Shortened product life cycles, the growth of product mix, and e-Business commerce all affect the logistics processes used for finished goods distribution.

The logistics network strategy provides a logistics solution, which is intended to continuously meet the approved customer service levels at the lowest total costs. As will be described in Chapter 3, the integration of new businesses has added complexity to this task. The network requires a larger degree of flexibility and scalability to effectively meet the changing service needs, potential volume shifts, and greater uncertainty associated with the integration of new businesses. The detailed description of these logistics challenges is included in this chapter, followed by the process utilized by Intel's logistics organization to formulate the network strategy and how the benchmarking project fits into the current process.

2.2 Company Background and Outlook

Over the last decade, Intel has dominated the microprocessor industry. Eighty percent of the world's computers are currently powered by an Intel-branded processor.[1] Although Intel remains the world's largest manufacturer of microprocessors, it is compelled to respond to the external pressures that currently affect the industry, including the slowed PC market and the growth of competition. While PC sales growth in the 3rd quarter averaged 20% from 1994 to 1999, the growth amongst consumer and corporate customers fell to approximately 16% in the 3rd quarter of 2000.[2] Within the microprocessor industry, Intel no longer holds an exclusively dominating technological position amongst its competitors. During its recent product release in February 2000, AMD overtook the number one ranking for the fastest processor available. This represented the first time Intel relinquished the position to a competitor. AMD also continues to capture a greater share of the PC market, which was at 17% in 2000, up from 13% in 1999. With its ability to offer more cash incentives to customers and its demonstration that it can deliver equivalent product in terms of performance and reliability, AMD's share of the market is likely to show similar trends in the upcoming years.

Although it still drives the health of its core microprocessor business, Intel has sought supplemental growth opportunities. In 2000, the new business growth amounted to $8.5 billion investment dollars for a total of 25 different companies, including both product and service based businesses. Unlike previous growth initiatives, this effort involves the investment in businesses, which, in many cases, radically differ from its core business. Its diversification into communications and networking, for example, involves products unlike the traditional silicon products. New products include servers, networking equipment, and devices specifically designed for portable communication equipment. Services include server farms, which store and deliver web content.

The acquisition strategy has a sizable effect on the organization and its various supporting disciplinary areas. Intel's existing logistics infrastructure, for example, is one piece of the supply chain, which is not designed to optimally meet the needs of the changing business environment. A discussion of the logistics challenges and the factors for its future success define the focus of this paper.

2.3 Challenges for Logistics

2.3.1 SHORTENING PRODUCT LIFE CYCLES

Shortening product life cycles have implications not only for a firm's research and development, but also for logistics activities. The model of product life cycles is depicted in the graph of Figure 1.

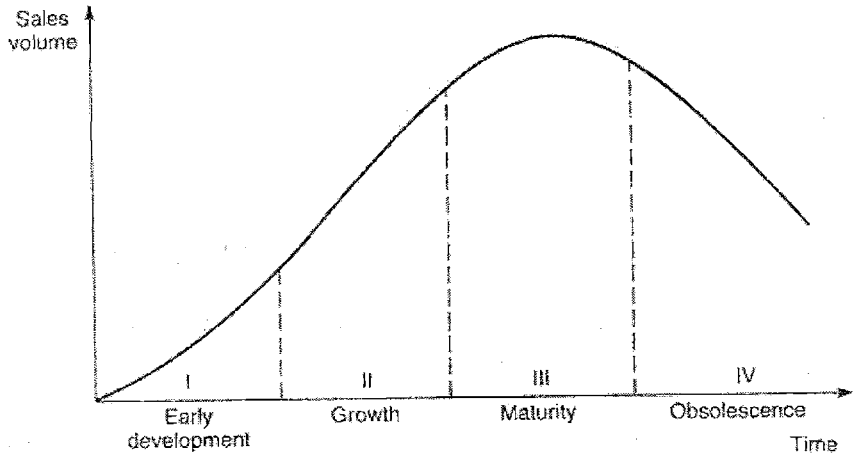

Figure 1: The Model of the Product Life Cycle[3]

As illustrated, the product life cycle traces a product's demand profile over a time horizon beginning with its market introduction and ending with its eventual obsolescence and disappearance. During stages I and II, early development and growth, demand for a product grows at an increasing rate. The demand peaks during maturity and declines quickly. For electronics and consumer goods industries, the time to maturity and obsolescence is decreasing, which heightens the pressure to launch and deliver products at increasing speeds.[4] To reduce the launch cycle, innovation and speed in manufacturing ramp-up must be coupled with ready and appropriate logistics solutions.

2.3.2 GROWTH IN PRODUCT MIX

In its attempt to sustain the growth expectations in an increasingly competitive market, Intel has invested in a number of new businesses, many of which differ significantly from its core semiconductor business. The product line has widened to include both traditional silicon products, as well as various types of consumer products such as cameras and computer peripherals. With 12 companies purchased in 2000, the level of complexity will continue to grow. The new products are characterized by various physical attributes and customer service requirements, which differ significantly from those of microprocessors. Supplying product to new customers, delivering product through different channels, and meeting different demand profiles all affect the distribution of goods. The existing logistics infrastructure is not equipped to optimally distribute the greater product mix and respond to its added complexities.

The larger product mix increases the complexity of the current distribution network map. For one, as a result of the utilization of subcontracted manufacturers by several new product groups, product is shipped from a larger number of locations. Highlighted in the map in Figure 2 are the subcontracted manufacturers locations currently used by the Consumer Products Group. As illustrated in the map, in many cases, these locations are not positioned close to Intel sites. The number of warehouse and distribution locations within the network has also increased. On average, the addition of 2-3 new origin sites results from each business acquisition.

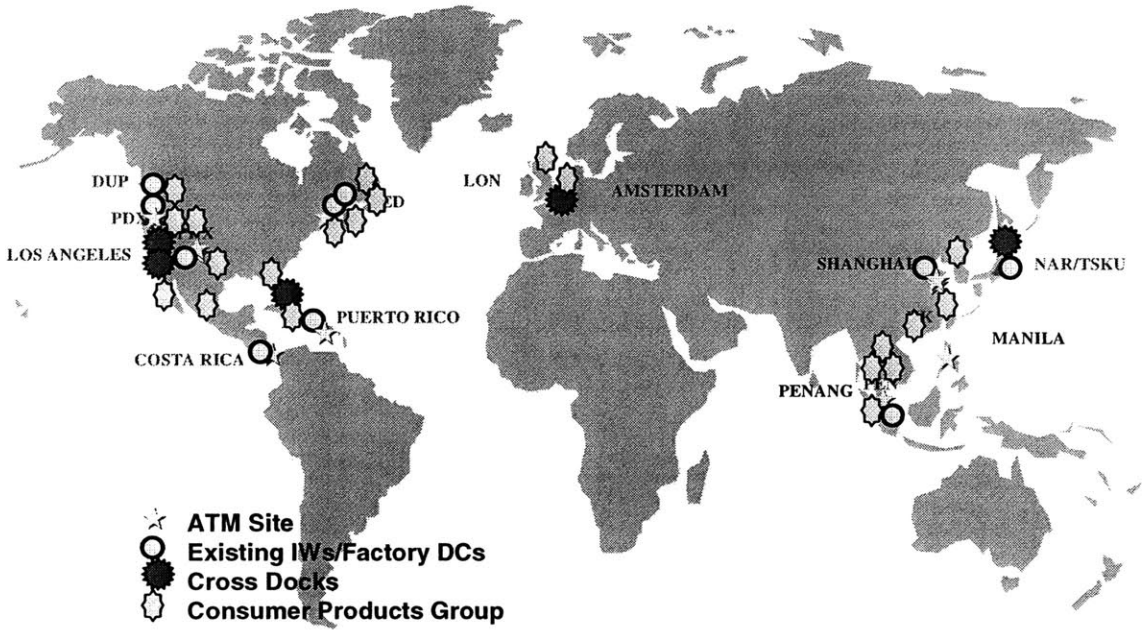

Figure 2: Map of Production and Distribution Sites

Similarly, the number of ship-to locations has grown exponentially with the introduction of new products. Given the level of current acquisition activity, the growth of the customer base is estimated at approximately 5% annually.

A larger breadth in product line also presents several challenges for Intel's logistics operation. A greater product mix increases the complexity of orders. There is a larger product mix within each order and a larger variation of order types. Stocking the larger variety of product and order combinations increases inventory costs at the regional warehouses.

The proliferation of stock keeping units (SKUs) not only increases the amount of inventory, but it also increases the risk of obsolescence within Intel's distribution facilities. Unlike Intel's microprocessor and chipset products, a limited amount of historical demand data exists for the newer products. While the expectation is that the new businesses will grow, the demand volumes and growth projections are difficult to predict with certainty.

2.3.3 E-BUSINESS TRENDS

The explosive growth of electronic commerce has obvious implications for logistics. An increase in internet-based transactions results in both increasing order frequency and smaller order sizes. For an order management system and logistics infrastructure designed to ship large

quantity orders on a daily or weekly basis, Intel's logistics operation struggles to efficiently pick, pack, and ship the increasing volume of small quantity orders.

2.4 Logistics Network Strategy Group

In response to the changing business environment, the Worldwide Logistics Network Strategy team was formed to develop an integrated 3-5 year strategic plan to proactively position Intel's logistics organization to meet current and planned service requirements at the lowest total costs to its business units, customers, and various stakeholder organizations. The strategy is expected to deliver:

- An optimal service / cost mix
- The most stable, long term logistics solution
- A consideration of the possible scenarios

The strategic plan defines the complete logistics infrastructure, including the required warehousing facilities with a definition of their locations and size, the transportation modes and corresponding delivery times, the information system requirements, and the level and types customer service. The fundamental tradeoff to be evaluated by the strategic design is the service / cost mix.

As graphically depicted in Figure 3, the logistics cost increases as service level improves, where service level is measured in order to delivery time. The service level obtainable by the logistics network is largely influenced by its proximity to the key markets it serves, which is improved as the number of distribution facilities in the network is increased. At the same time, a greater number of facilities increases working capital and inventory costs, as well as fixed costs. The logistics strategy applies an analytical framework, using optimization model tools, to evaluate this tradeoff. This analysis is described in the following section.

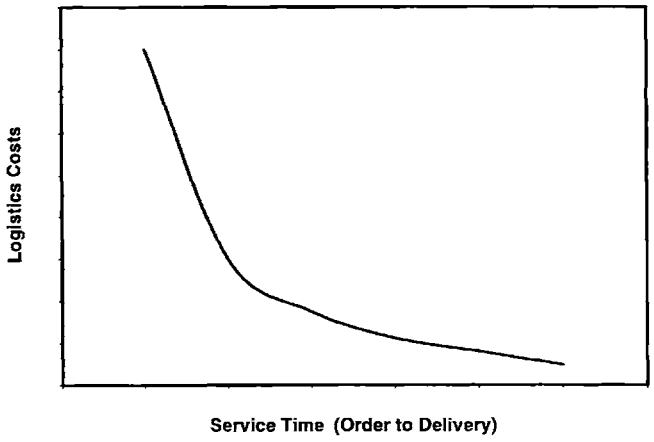

Figure 3: Logistics Cost Service Tradeoff Curve

2.5 Strategy Development Process

The logistics network strategy is developed for each of the three geographies sequentially from a collection of informational inputs and optimization models. During the year prior to June 2000, the finished goods distribution strategies for two of the three geographical regions, the Americas and Asia, were completed. The final region to address is Eastern Europe, Middle East, and Africa (EMEA). The specific geographical regions, which fall within EMEA, include the United Kingdom and Ireland, Western Europe, Scandinavia, Southern Europe, Eastern Europe, Middle East, and Africa.

Formulating the strategy involves a large amount of data from parties across the company and from outside customers and suppliers about current and future business. Internally, operations must define the utilized and available capacity of current warehouse facilities, transportation lanes, and manufacturing sites. Sales and marketing provide a forecast of the demand and service level requirements by product and ship-to location, since both weight and transport distance will influence the routing of goods distribution. The finance group determines the appropriate variable and fixed cost elements, including the tax, legal, and customs cost implications of transporting goods across country boundaries.

After aggregating the data, the logistics network strategy team applies a series of tools, illustrated in the figure below, to analyze the data and understand all of the tradeoffs associated with the logistics strategy. Amongst the analyses performed are the results of two optimization models, the transportation and the financial. The transportation model, supported by a supply chain management commercial software package provided by *Manugistics Group, Inc.*, is designed and constrained to yield the lowest cost transportation networks for delivery of products from Intel's source nodes to its customer nodes. Generating total revenues of $152.4 million in the year ended February,

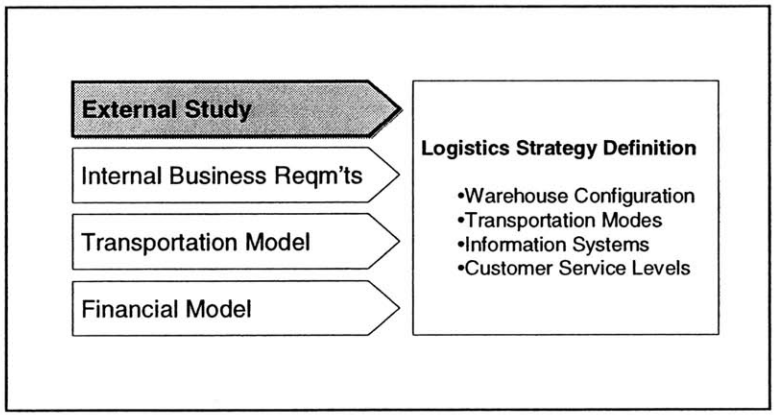

Figure 4: Logistics Network Strategy Development

2000, *Manugistics* supplies decision support software, designed to help enterprises worldwide optimize and manage their supply chain networks. The source nodes represent various manufacturing sites. The financial model combines the results of the transportation model with the remaining cost elements, including production costs, inventory-holding costs, facility material handling costs, taxes, duty, and the fixed costs of the facilities. Meanwhile, numerous interviews with internal stakeholders provide data on internal business requirements. These internal business requirements, as well as extreme conditions and the projections of future business changes, are translated into various scenarios. Rerunning the model under the various scenarios tests the robustness of the model and reveals the service limitations of the network. Evaluating the results from all of the analyses conducted, the strategy team defines the long-term warehousing, systems, transportation, and customer service strategies for a 3-year horizon.

A number of internal and external factors, described earlier in section 2.3, which have a direct impact on logistics provide the motivation for a renewed logistics strategy. The existing logistics infrastructure is not equipped to optimally distribute the greater product mix and respond to the added complexities. Interactions with the logistics operations of other organizations experiencing similar logistics challenges are a valuable source of information. The data collected provides the organization with greater knowledge of regional markets and the processes and strategies being used to provide superior service to customers in that market. In the end, an understanding and application of the logistics strategies utilized by other companies shall challenge the existing assumptions and enhance the competitiveness of Intel's strategy developed for EMEA.

Chapter 3: Baseline Assessment of Intel's Current Logistics Network

3.1 Chapter Overview

This chapter summarizes the information collected on Intel's current logistics operations. The internal assessment was the fundamental step to the benchmarking process. As will be presented in this chapter, the exercise established the key performance criteria for logistics and Intel's performance along each of these criteria. The assessment provides the basis of comparison for studying the logistics operations of other companies, as well as for measuring the effects of implementing changes to the supply chain in the future. The internal assessment also unveiled the strengths and weaknesses of the current operation. The benchmarking study was then designed to incorporate questions, which would address these deficiency areas.

3.2 Characteristics of the Current Supply Chain

3.2.1 PRODUCT OVERVIEW

There are two main groups of finished goods distributed, components and boards and systems. Within the components category are microprocessors, chipsets, and flash product. Systems and boards products consist of mother boards, network cards, add-in cards, and other board products.

3.2.2 SUPPLY CHAIN OVERVIEW

Intel's supply chain is comprised of a network of suppliers, manufacturing sites, distribution centers, distributors, and OEM customers. Figure 5 illustrates a simplified version of the supply chain for both components and boards and system products. The manufacturing stage pictured in the diagram represents the processes after wafer fabrication, namely the assembly and test processes. All semiconductor product, both component and boards and systems, is distributed from an assembly and test site. From the assembly and test plants, product is air shipped to regional distribution centers in each of the three geographies before final delivery to the customer. Forward staging inventory in the regional distribution centers enables next day delivery by ground or air to the final customer.

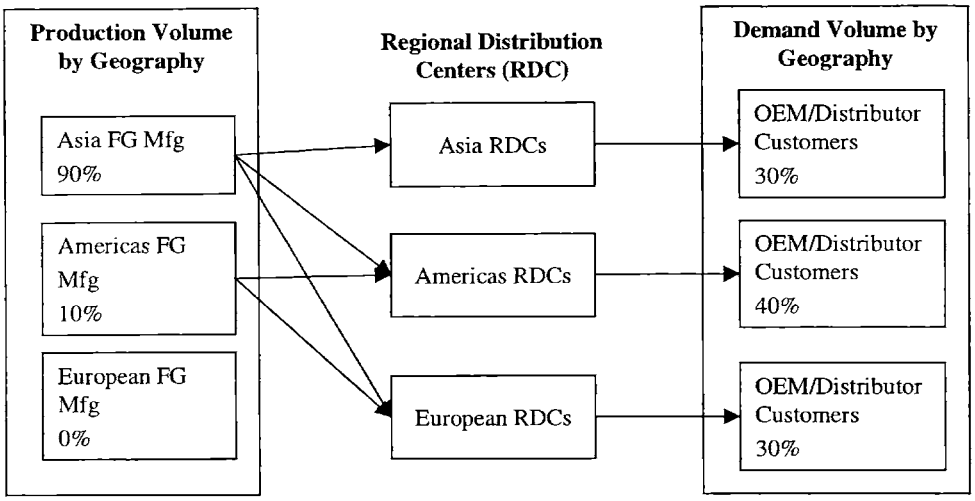

Figure 5: Intel Worldwide Distribution Flow

3.2.3 LOGISTICS TRANSPORTATION NETWORK MODEL

The figure above identifies the three geographical regions serviced by the logistics network; Asia, the Americas, and EMEA. A forecast of the demand provides an estimation of the likely product requirements in each of the geographies. The transportation network model is developed and run by the capacity planning group, which interfaces closely with the logistics network strategy team. The output of the model determines the optimal material flows for transporting product from the assembly and test plants to the various customer locations. As the figure indicates, there are two types of variables determined by the model; the flows of material from A/T plants to regional DCs and the flows of material from regional DCs to the customer. The objective of the model is to optimize the output along two dimensions; minimized transportation costs and maximized service levels.

The transportation network model is constrained by the following:

- The existing network map of sources and sinks
- The product demand volume required by various customers
- Capacity limitations of the inbound and outbound transportation lanes
- Storage and processing capacities of the regional distribution facilities

The map depicted in Figure 6 locates the current assembly and test plants, which supply the finished goods product. Intel's assembly and test plants in Asia supply 90% of the

semiconductor product volume. The demand volume, on the other hand, is nearly evenly split amongst the three geographies. The absence of any finished goods source plants is unique to EMEA. Plants in Asia and America supply all of the components and boards and system products consumed by this region.

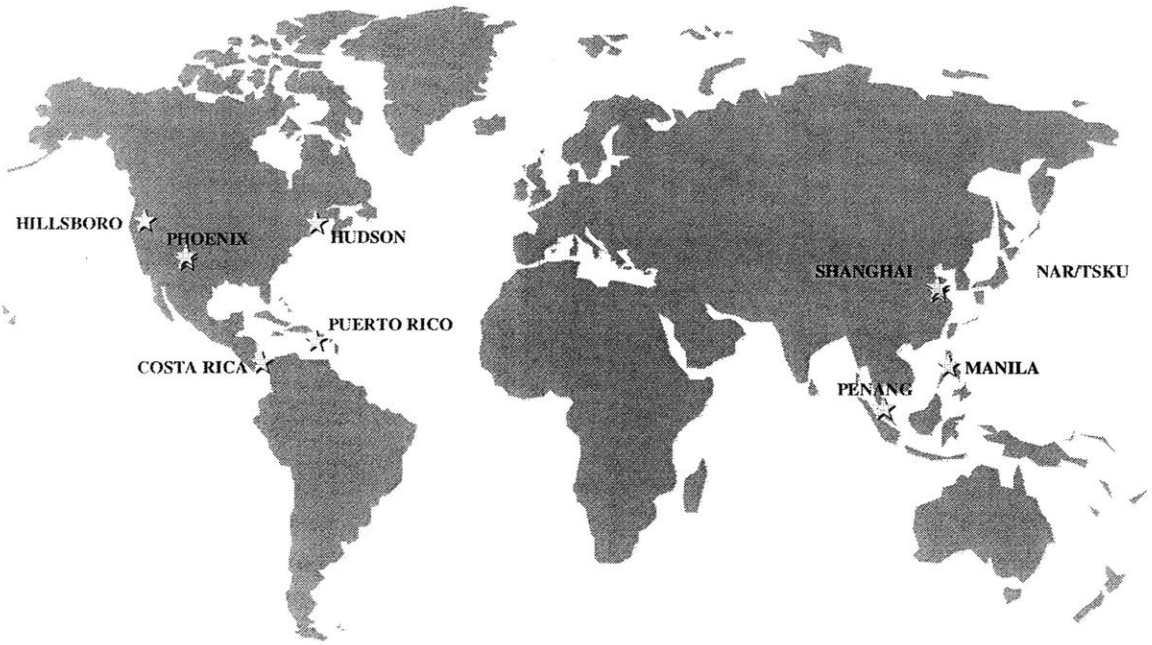

Figure 6: Map of Existing Assembly and Test Plant Locations

3.2.4 CHANNELS OF DISTRIBUTION

Intel distributes its products through a variety of channels, including direct to original equipment manufacturers, retail and industrial distributors, value added resellers, and various retail customers such as PC World and Dixon's in EMEA.

3.2.5 WAREHOUSE AND DISTRIBUTION NETWORK

Worldwide, Intel's warehouse and distribution network consists of 10 facilities, including distribution centers, integrated warehouses, and cross-docks. These facilities receive consolidated orders or bulk shipments from multiple manufacturing sites. At the distribution facilities, the large inbound shipments are broken down and used to fulfill specific customer orders. For outbound shipments from the distribution site to the final customer, the orders of multiple customers are grouped according to final ship-to destination and loaded onto trucks. The

consolidation of goods for inbound and outbound shipments has cost advantages because of the lower transportation rates, which can be negotiated on large volume shipments.

Currently within EMEA, there are two distribution facilities, a distribution center in Amsterdam and a cross-dock in London. All customer ship-to locations within EMEA receive product via one of these facilities. The London cross-dock handles product delivered to customer locations in Ireland and the UK. Within a cross-dock operation, goods continuously arrive at the location and are almost immediately consolidated and delivered to the customer. Goods generally arrive and leave in the same day. Because of the short throughput time, very little inventory is stored at a cross-dock. Although this facility strategy limits inventory costs, its effectiveness requires a sufficient amount of daily volume, so that the size of the outbound customer shipments occupy near or full truckloads.[5] Various freight forwarders, AEI and BAX are two, pick up and package product out of the Asia assembly test sites, which will then be transported by air to London Heathrow airport. BAX is responsible for transporting the product from the airport to Intel's cross-dock in London. Out of the cross-dock, product is shipped to various customers within Ireland and the UK. Amsterdam ships product by air or ground to the remainder of the EMEA customer locations, with the majority of the transportation done by ground. Large customers within EMEA include OEMs, Dell, Compaq, Philips Electronics, and IBM.

The space within the Amsterdam operations center is broken into finished goods storage for components, finished goods storage for boards and systems, retail boxing operations, cross-dock and staging area, and the shipping and receiving docks. Figure 7 provides a visual representation of the facility layout and material flow.

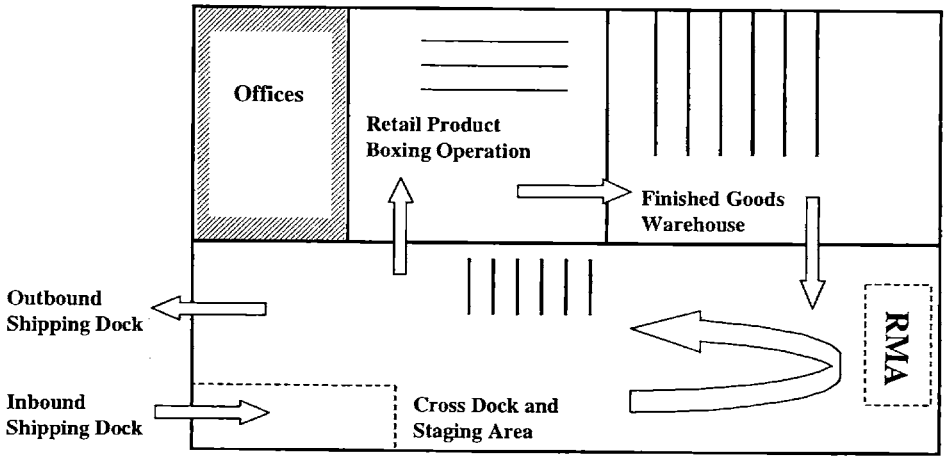

Figure 7: Layout of Amsterdam Distribution Center

Currently, a third of the building is allocated for storage of component product, a sixth for boards and system products, and a sixth for the retail product boxing operation. The cross-dock, where orders are staged for delivery, makes up about a third of the building space.

The configurations of Intel's warehouse facilities were designed to meet the specific requirements of the customers serviced by the particular facility. The capacity, for example, reflects the demand volumes of customers within the region. The areas allocated for storage of finished goods, operations, and administrative functions are dependent on customers' order characteristics, such as size of orders and frequency of orders. Furthermore, the Amsterdam warehouse was originally managed and operated by a 3rd party. Prior to 1998, its storage and operational capacities were shared with HP. Therefore, Intel had limited control in the design and layout of the warehouse facility. As a result of the differences between regions and the historical evolution of the warehouse network, the physical warehouse configuration differs significantly from one facility to another.

Realizing the advantages of the "Copy Exactly!" (CE!) approach exercised by the fabrication sites and later the assembly test sites, Intel's logistics organization adopted CE! in 1997. The adoption resulted in greater commonality of layout and processes amongst the distribution facilities constructed after 1997. The "Copy Exactly!" approach is applied during the start up of new facilities in an effort to achieve performance excellence across all its sites. All physical and procedure processes are replicated at the new site.[6] The logistics group established the integrated warehouse design as its standard for all new warehouse facilities. Such a facility provides storage and distribution capabilities for both finished goods and raw material. By grouping these activities, the needs of both the manufacturing operations and the end customers are fulfilled by a single operation. Since both finished goods and raw material are handled, a significant amount of flexibility is designed into the physical structure. The docks for both receiving and shipping, for example, are located on one end of the building. Within the storage area, the 30' ceiling height is designed to accommodate an overhead conveyor and additional bin storage. With this design, the floor space needed for additional operations capacity could be expanded without losing storage capacity.

3.2.6 ORDER FULFILLMENT

All order information is managed within SAP. A delivery note (DN) is generated for each order. All specific customer requirements are linked to the DN. Sample customer

requirements include the need for full or partial boxes, product revision restrictions, and customized labels. A 3-stage quality check sheet is immediately attached to each DN to ensure that the pick and pack operations comply with the customer requirements. Component products will enter the staging area where label generation, combine, and partial activities take place. At that point, the order enters quality assurance area, where the contents and requirements are compared with the specifications of the order before the boxes are closed. The order moves to the pre-pack area where the individual boxes are over packed in non-identified boxes for shipment. At consolidation, the boxes of the entire order are consolidated and labeled. The labeling process (1 of [total], 2 of [total], ... , [total] of [total]) requires all the boxes of the order to arrive at the consolidation hold area before labeling can take place. The orders are then grouped into bins designated for different geographies. Geographies, which have less frequent deliveries may be grouped by transportation provider.

3.2.7 INFORMATION FLOW MANAGEMENT

In addition to managing the flow of physical product, the logistics network must also support the various information flows associated with the order fulfillment process. Intel's storage and distribution of finished goods is supported by two different warehouse management information systems tool sets, called WM and WRx. WM is a module of SAP utilized in the component product warehouses. Although it is an off the shelf tool, the system has been configured and customized to the particular needs of the component warehouses. The customized solution supports all receiving, storage, picking, processing, packing, consolidation, inventory management, and other standard warehouse functions. WM interfaces with other systems within the warehouse. For example, a data collection system (DCS), developed in-house, interfaces with SAP WM to handle all radio frequency (RF) transactions in and out of the storage bins. Another customized enhancement is a labeling and customer-product specification system. It ensures that the correct label is generated and any customer specific label is added. In the US, an interface between SAP WM and FedEx Powership was built to assign FedEx waybill numbers to orders immediately and provide shipment information to FedEx in real time.

The second systems tool set, Autosoft's WRx warehouse management application, is utilized in the systems manufacturing warehouses. Another off the shelf application, WRx, has undergone a series of modifications to customize the system for Intel's boards and systems finished goods distribution needs. Acquired originally for one single facility, WRx has since been customized for multiple warehouse operations located worldwide. It is used for all

warehouse management functions, including receiving, storage, picking, plant clearance, shipment confirmation, and inventory management. The WRx system also interfaces with SAP sales and distribution (SD) and inventory management (IM).

Product is transported from the distribution center to the end customer location via Intel managed carriers. A Track and Trace tool enables tracking of the shipments. The carriers provide the tracking information via an electronic data interchange (EDI) transaction to Intel's Track and Trace system. The information is then made available on Intel's Web Order Management system, so that customers are able to view shipment status from the internet site.

Currently, the WRx system requires a systems support team to maintain and ensure all customer requirements are fulfilled. Based on its current size, only 25% of the team remains available for system enhancements, which are of greater necessity as customer requirements and product mix increase.

Building the systems infrastructure for a new warehouse facility requires significant set-up time to complete the data entry and configuration of the new system and ensure its compatibility. Compared to WRx, WM requires 2-3 times as long due to the more extensive amount of data loading needed to set-up this system.

3.3 Performance Criteria for Distribution

A number of key metrics, defined in this section, are used to manage the performance of distribution activities, including cost effectiveness, security, order fulfillment quality, and transportation supplier management. The utilization of these metrics is illustrated, by assessing Intel's current performance on this metrics, based on its distribution of traditional semiconductor product.

3.3.1 COST EFFECTIVENESS

The financial assessment of a firm's logistics network design involves an understanding of the key cost components for distributing finished goods. Distribution costs consist of both fixed and variable costs. The company's distribution centers, cross-docks facilities, and automation equipment makes up the fixed cost. The variable costs include inbound and outbound transportation, inventory, and warehouse operational costs. An understanding of these cost components unveiled an assessment of the cost effectiveness of the distribution network, which

services customers in EMEA. There are a number of customer destinations in EMEA. In turn, there is a number of transportation lanes needed to deliver product to all of these locations. The consolidation of the product in Amsterdam or London simplifies the transportation of finished goods to multiple destinations. In addition to the number of customers serviced in EMEA, many of these customers request smaller quantities per order. Because all product is transported by air from assembly test sites in Asia or Costa Rica, Intel achieves price breaks in their freight into Europe by transporting larger consolidated quantities. Transportation costs are further reduced by the postponement of the boxing operation on its retail products. Boxed processors and mother boards, fabricated in Manila for delivery to retail customers in Europe, are transported in bulk to Amsterdam. Within the Amsterdam distribution center, the shipment is broken down, the individual processors and mother boards are packaged into standard retail boxes, and the mounting brackets, other installation material, and instruction manuals are inserted. By delaying the packaging of the product, the volume of material air transported is minimized, which provides transportation cost savings. Finally, the number of the countries served and the variation of country specific requirements associated with the different countries drives Intel to store generic product within the European sites. The generic product shipped from the assembly test sites and stored in the Amsterdam distribution centers can be used to fulfill demand requirements of multiple customers within EMEA. Customized activities, such as placing the country specific label, inserting the customs invoice, and adding any other requested paper work, takes place within the Amsterdam warehouse operation prior to final shipment to the end customer. Because generic product is stored, Intel is less prone to rework or reconfiguring product as individual customer upswings or downswings occur.

3.3.2 CROSS-DOCK MANAGEMENT AND TRANSPORT THROUGH A SECURE NETWORK

Shipments to European customers pass through a cross-dock where product from multiple Intel origin sites are consolidated and delivered. Intel has robust security processes in place to minimize the risk of loss and theft of product. Because of the unmarked packaging specifications and continuous tracking of its transportation providers, the product is at relatively low risk as moves around the world.

3.3.3 ORDER FULFILLMENT QUALITY

Order fulfillment quality, which ensures right product, right quantity, right labeling, right paperwork, right packaging and palletization, is consistently at a low level of defects per million

(DPM) orders. A data base system, containing all customer and product packaging and delivery process specifications, is used to generate labeling and pack instructions so that all factories and warehouses perform to current customer requirements. Intel also has a global system for customer issues and execution failures from the field. Customer service categorizes, analyzes, drives corrective action, and tracks the deployment of the change and closure of the issue with the customer.

3.3.4 TRANSPORTATION SUPPLIER MANAGEMENT

Intel's effective supplier management process results in continuous improvements to transportation cost and quality. Evaluation, bid, and supplier report card processes allow Intel to place business with the most competitive transportation suppliers and allocate business based on supplier performance on quality, reliability and cost metrics.

3.4 Reassessment of the Performance Criteria Considering Acquisition Growth

Shortened product life cycles, the growth of product mix, the increased network complexity, and the higher order frequency, described earlier in section 2.3, will certainly affect Intel's performance to the outlined measures. Cost effective consolidation efforts are more difficult to achieve given a larger volume of the smaller quantity orders transported to a larger number of customer locations. In addition, an expanded product mix and larger network makes network security more difficult to track. Furthermore, Intel's ability to maintain high order fulfillment quality, as measured by DPU, remains to be determined as the increased order volume and increased ship-to locations becomes more prevalent.

In many cases, the means by which performance is measured and the established performance targets need to be redefined. The delivery and security standards set for microprocessors, for example, may not be appropriate for lower valued goods, such as computer peripherals or home PC cameras. Intel does not have the flexibility in its current practices and operations to handle the varying logistics needs of a diversified product mix.

Chapter 4: Analysis and Conclusions from Benchmarking

4.1 Chapter Overview

One source of operational improvement is the exploration of the practices and strategies utilized by companies recognized as industry leaders. A formal benchmarking study enables an organization to not only learn from other companies, but also gain a better understanding of its own operations. Due to the changes and challenges facing Intel's logistics organization, there is opportunity to benefit from the exchange of knowledge. Described in this section is the benchmarking methodology developed for Intel's logistics group in an effort to explore the distribution processes, strategies, and systems utilized by companies which service markets within the geography defined as Europe, Middle East, and Africa (EMEA). EMEA is the geography of interest given the scope and time of the internship.

Following the description of the benchmarking approach is a summary of the key findings from the external company study. A discussion with seven companies provided the evidence to support our assessment of the trends of logistics and the critical factors, which will enable companies to obtain competitive advantage in logistics. The specific observations, to be discussed in detail in section 4.3, include the integration of third party logistics providers into the supply chain, the increased importance of global supply chains, and the variation of logistics network designs amongst companies of similar industries.

4.2 Methodology for Benchmarking Process

4.2.1 OBJECTIVE

The objective of the benchmarking process is to examine the distribution networks of model organizations and utilize the learnings to enhance Intel's logistics network strategy. The specific goals underlying the project are outlined as follows:

- Develop a benchmarking methodology to collect information on the distribution processes, methods, and systems used by top performing companies serving the EMEA markets.
- Translate findings from the benchmarking activity into statements of delivery capabilities, transportation services, systems capabilities, and customer services needed for logistics competitiveness in the EMEA markets.

- Communicate results in order to influence the EMEA warehouse and distribution network strategy to be completed by the end of 2000.

4.2.2 AREAS OF ASSESSMENT

The four specific logistics areas assessed include warehouse network, warehouse operations, transportation network, and information system requirements. The definitions of these areas are detailed below.

1), 2) Warehouse and Transportation Network

The physical network design includes the size and location of the warehouses and distribution centers as well as the customer sites serviced by the network. Connecting these nodes are the transportation modes and services used to transport the product. The entire map of nodes and arcs is derived from the service and delivery capabilities to be carried out by the network.

3) Warehouse Operations

The warehouse operations consist of the management systems, business processes, and operational policies, which enable and ensure that the network fulfills the customer delivery and service requirements. This area includes the internal facility layout and processes necessary to fulfill high volumes of small quantity orders, as well as the effective management of the transportation provider relationships.

4) Information System Capabilities

An effective information system is an essential component for the management of information across the complexity of a global logistics network. This area targets the understanding of the system capabilities needed to support the various logistics processes, including worldwide fulfillment of high volume, small quantity orders, inventory level management, and product pipeline visibility of both inbound material shipments to the distribution facilities, and outbound shipments to customers.

4.2.3 COMPANY SELECTION

The model organizations targeted for the benchmarking study were not restricted to Intel competitors. Instead, selection criteria were defined based on the challenges of the Intel's current business changes and the impact they have on logistics strategy. The criteria represent key

product attributes. Companies targeted for participation in the benchmarking study demonstrate logistics excellence in distributing products and services with similar attributes. The attributes include:

- Perishable product types
- High volumes of small quantity orders
- Highly valued inventory

The industries found to best meet these criteria include electronics, telecommunications, computers, and pharmaceutical. Collectively, we visited 4 companies in the electronics industry, 2 logistics provider firms, and 1 distributor of electronic products. The data presented in this report is based a total of 7 companies: Dell, Motorola, Irish Express Cargo, IBM in partnership with UPS Logistics Group, Arrow Electronics, Texas Instruments, and Philips Electronics. Together the companies represent 3 different categories.

4.2.4 BUILDING A FRAMEWORK OF KNOWLEDGE FOR CURRENT LOGISTICS PRACTICES

Interviews were conducted with a content expert within Intel in each of the focus areas. The objectives of the interviews included a background of Intel's current operation and processes, as well as an understanding of what areas represent opportunities to learn from other companies. This information was necessary to develop the appropriate questions and discussion areas for the site visits, so that the most valuable information could be reported back to Intel. In a follow up discussion, the content experts reviewed the benchmarking questions to verify that both accuracy and completeness were achieved. The final list of questions, documented in Appendix A, incorporated all of the feedback.

Tours of multiple Intel distribution facilities provided another source of information in the design of the benchmarking study. They illustrated the process flow for a distribution operation as well as the key performance metrics.

4.3 Learnings from Benchmarking

Over the 6-month time period, we visited 4 companies in the electronics industry, 2 logistics provider firms, and 1 distributor of electronic products. The total number of distribution facilities toured covers 4 different countries in Europe. The information compounded from

discussions with 7 different companies, together with the examination of several cases studies of logistics operations provide the evidence to support the learnings reported in this section. Several key observations emerged; the integration of third party logistics providers into the supply chain, the increased importance of global supply chains, and the variation of logistics network designs amongst similar industries.

4.3.1 INTEGRATION OF THIRD PARTY LOGISTICS PROVIDERS INTO THE SUPPLY CHAIN

After examining the supply chains of customers, competitors, and logistics provider companies, we discovered that the integration of third party logistics providers is increasingly prevalent. For many cases, the integration has led to service and cost benefits for the corporation.

The contract logistics business has grown significantly. From 1992 to 1996, the total volume to contracted logistics activity grew from $10 billion to $25 billion.[7] The majority of 3rd party service firms achieve annual growth rates of 20%. The increase in utilization of logistics service providers is driven in part by the increased competitiveness of the third party logistics provider industry. The growth in the number of firms within the industry from 374 to 421 between 1992 and 1996 has increased the competitiveness of the market. The competitive market creates strong incentives amongst the logistics providers to raise their productivity, to improve quality, and to innovate since suppliers, who demonstrate the ability to meet and exceed their customers' expectations better than their rivals, will secure the contracts for new business opportunities.[8] Clearly, in this type of market, the buyers benefit. In the presence of an efficient market, as argued by Stuckey and White, the efficiencies of scale and scope, which are realized by the service providers, can be difficult to match in house.[9]

A competitive market also limits the risk associated with outsourcing. In his text Clockspeed, Charles Fine argues that outsourcing capabilities for which there is a high degree of industry competitiveness poses few strategic risks.[10] An abundant supplier base reduces the potential for price gouging or interruption of supply. The developments and growth trends within the third party logistics industry suggest that it is becoming a commodity industry in which many suppliers offer nearly equivalent services.

Although traditionally thought to provide services restricted to transportation and warehousing, today's 3PLs apply their expertise across a wider spectrum of logistics support

activities, including inventory control, value-added services, customer service, and logistics information management. In particular, the development and implementation of sophisticated information and data processing capabilities amongst most 3PLs have significantly contributed to their growth. This is mainly because the effectiveness of the supply chain is highly dependent on the availability of up-to-date supply and demand information. For global operations, the transfer of real time data between supplier, manufacturer, and distribution locations worldwide requires a sophisticated information management system. With leading edge IT systems, 3PLs are able to provide an interactive exchange of information between remotely located partners within the supply chain. In fact, the logistics groups at Fortune 500 companies, Motorola and Philips Electronics, reported being significantly dependent on their logistics service providers for the design and control of their information management systems. Other 3PLs offer secondary manufacturing and supply chain integration services. One type of secondary manufacturing, product customization, was observed during our visit to the UPS Logistics Group warehouse in Roermond, the Netherlands. For IBM, technicians at this UPS Logistics Group facility reconfigure hard drives to meet unique customer needs prior to delivery. Configuration of the hard drives involves replacing a generic circuit board with a customer specific board and testing 100% of the product before shipment to the customer. Delaying the differentiation and testing of the product allows IBM to ship generic product to its distribution site and reduce the level of its in-process inventory. Furthermore, locating generic product closer to the customer improves IBM's ability to respond to highly variable demand fluctuations, since inventory at UPS can be used for multiple customers.

4.3.2 GLOBALIZATION

Meanwhile, on the demand side, there are a number of external factors driving companies to seek more efficient service solutions for their logistics operations. The first of these factors is globalization. Particularly in the consumer electronics and computer industries, there is evidence that companies are seeking to increase their competitiveness in world markets. Company supply chains have many cross-country linkages. Raw materials are sourced from multiple countries and production facilities are scattered around the world. Product marketing targets customers on a worldwide scale.[11] The distribution points continue to grow as companies focus on sales and growth opportunities in emerging and underdeveloped markets. The power of the internet further accentuates the force of globalization trends. Because of the internet, it is possible to purchase goods without leaving the home or office to be delivered anywhere in the world. Serving a global market certainly has implications for logistics. Greater information system complexity, cultural

differences, proliferation of SKUs, and longer pipelines are amongst the effects of globalization on logistics.

4.3.3 VARIETY OF LOGISTICS NETWORK DESIGNS

The study of multiple organizations from similar industries points at the complexity of the design of the logistics networks. Seemingly like businesses were found to utilize very different logistics networks and service levels. The map of the distribution networks for the companies is pictured in Appendix C. As evident by the map, the size and the locations of the networks vary extensively from company to company.

Regardless of whether it is controlled internally or performed by an external provider, most companies consider logistics as a source of competitive differentiation, rather than merely a cost center. However, improving competitive advantage through logistics processes varied extensively and was difficult to measure. Companies have different views of the critical customer service requirements. Not only do they set different performance standards, but they also measure performance levels very differently.

4.4 Summary Remarks

Together the learnings from the benchmarking point at the complexity around the logistics network strategy design. The effectiveness of a company's logistics network involves a thorough understanding of the numerous external and internal issues, as well as the tradeoffs. Although there are a number of decisions, which comprise the network strategy, the remainder of the paper explores one piece of the logistics design, namely the decision to outsource logistics activities.

Chapter 5: Post mortem of the Benchmarking Process

5.1 Chapter Overview

The study of successful companies and their operations and practices, which make them successful, is an invaluable learning tool. However, no formal process exists for acquiring this knowledge. Formalizing the process and carrying forward the learnings from this study shall enable the logistics group to improve the effectiveness of future benchmarking studies. A post mortem of our benchmarking process led to a number of recommendations for future studies. As will be discussed in the following chapter, the critical success factors for logistics benchmarking studies include:

- Clearly define the areas and processes to be examined in the benchmarking study
- Use qualitative structured questions for strategic assessments
- Assess the current internal processes and performance and establish a baseline for comparison
- Match scope of study with size and composition of the benchmarking team

5.2 Critical Success Factors for Conducting Logistics Benchmarking

To attain the most beneficial results, the scope of the benchmarking process needs to be concretely defined. The definition of the scope should match the specific areas, where improvement or breadth is desired. In our study, four logistics areas for assessment were identified: warehouse network, warehouse operations, transportation, and systems capabilities. While the scope covered a very broad range of information, it was well suited for the high level information sought after by the network strategy team. For tactical implementation teams, on the other hand, a more in depth, focused agenda may be more appropriate. A clearly defined scope is important since it provides the basis for the question set used for the company visits. A well-designed, comprehensive question set ensures that the desirable information is captured during the discussions with the benchmarking partner companies. The clearly defined scope was instrumental not only to the information gathering, but also to the organization of the report outs to the team. The information was categorized by assessment area, making the reports easy to follow.

A clearly defined scope also created a well focused agenda for the site visits. This was particularly important during our visits to customer companies and 3PLs. Both of these partners have current interests, which could deter from the exploratory exercise of the benchmarking effort. We found that a tightly controlled and clearly communicated agenda kept our discussions focused. A clear agenda also minimized the amount of generic, promotional information presented by the 3PL, so that the firm's services could be demonstrated through the discussion and touring of the logistics operations they develop and manage for client organizations.

While quantitative metrics provide a standardized method for comparing performance capabilities across multiple companies, we note the value in non-data structured questions. For one, the time consuming tasks of defining precise and comparable metrics and collecting sufficient amounts of data is eliminated. In addition, a more open-ended question set permits a richer discussion between companies. Such discussions provide a setting in which an active two-way exchange of information can take place. Both companies recognize the opportunity for learning from one another. While performance based comparisons identify measurable strengths or weaknesses amongst companies, they often lead only to reactive responses. A two-way discussion, on the other hand, aims at understanding the best practices and determining if and where benefits exist for such practices to be applied to your own company. Furthermore, predetermined information is minimized. There is a greater opportunity for discovery of information that was not expected to come out of the visit initially. These nuggets are the information types, which are normally captured only during a face-to-face visit versus publicly available media sources.

Essential to carrying out a successful benchmarking project is an internal assessment of your own company's current operations and practices. It establishes a baseline, which is used to recognize where differences exist between your company and others, as well as what challenges exist today and in the future for your organization.

The size and composition of the team established for the site visits needs to reflect the scope of the areas being assessed in the benchmarking study. The team not only enables all the topic areas to be covered, but it also ensures that the interesting pieces of information are recognized and an acceptable level of understanding is obtained. In our case, the site visit team normally consisted of 3-4 people, together, which could knowledgeably cover all four of the logistics areas for discussion. Given the large breadth of assessment areas in our logistics

benchmarking study, we found that the size of the team was small. The team facilitated a debriefing of key learnings after each site visit in order to combine and clarify the data collected and identify areas in which follow up with the partner company was necessary. For future studies, a closer match between the scope of the study and the team size and composition should be obtained.

To maximize the discovery at the site visits, it is advantageous to also include team members, who hold a more senior level of the company. Because of their more extensive breadth of experience, these team members are able to recognize the relationships between benefits in one functional area to the corporate level implications. The site visits, which were attended by an Intel manager, resulted in much richer discussions. During our face-to-face discussions with the benchmarking company, he quickly drew in on particular responses of interest and could formulate a follow up question, which would probe the area one or several levels deeper.

5.3 Creating Incentives to Participate

The commitment of time and effort required of both the benchmarking company and the external companies can deter the desire to participate. Ensuring a sufficient response is achieved by providing an incentive to participate and creating an appropriate environment for knowledge exchange. Benchmarking is often viewed as a process of acquiring excessive amounts of qualitative data used to perform comparative analysis. Although the report may identify areas of competitive strength or weakness, the outcome lacks the information and insight, which can assist a company in its strategic development or operational practices. Building cooperative relationships with each participant is critical to minimizing this potential shortcoming of traditional benchmarking processes. A cooperative relationship is initiated by communicating the reciprocity of the exchange. Our team agreed to host a reciprocal visit to Intel by the participating company, as well as incorporated any additional logistics topics of interest into the agenda for its visit to Intel. Sending Intel's responses to the benchmarking questions to the participating company also helped set the tone for an equal exchange of knowledge on the subject of logistics practices. By receiving information upfront, the participating company immediately recognizes the value of the process and is more inclined to respond more quickly. As opposed to written surveys or phone calls, face-to-face discussions will also foster the relationship. A face-to-face discussion often leads to the involvement of a larger team from both organizations, in which multiple levels of the organizations can be engaged in the knowledge sharing.

Chapter 6: An Integrated Distribution Model

6.1 Chapter Overview

As the findings from the benchmarking support, the volume of logistics business handled by third party service providers has grown significantly. From 1992 to 1996, the total volume of contracted logistics activity grew from $10 billion to $25 billion. Today's logistics providers report an annual growth rate of 20%. This chapter describes the factors, which drive the decision to outsource logistics activities. The conventional approach to making outsourcing decisions in many organizations is based entirely on costs. A comprehensive exploration of the decision, however, requires the consideration of both financial and non-financial factors. A discussion of the financial drivers, as well as the non-financial, strategic and operational considerations is made in this chapter.

6.2 Definition of Third Party Logistics Provider

Third party logistics providers (3PLs) are external suppliers, which perform any or all of a company's logistics responsibilities. The range of services encompasses all activities, both physical and managerial, associated with a company's materials management and product distribution functions, such as transportation, storage, inventory control, value-added services, customer service, and logistics information management. The most basic services provided by a 3PL involve the storing, handling, inbound transportation, and outbound transportation of finished goods. Some companies rely on 3PLs for a much larger breadth of services, including information management, such as the tracking and tracing of orders in transit, assembly and customization of finished goods before shipping to the customer, and even the design and configuration of the logistics system. A contract agreement with a 3PL is generally a long-term commitment entailing multiple logistics support activities. Often the spectrum of activities performed expands across the total supply chain. The Saturn division of General Motors partners with 3PL, Ryder Integrated Logistics, to deliver raw material to its factory in Spring Hill, Tennessee, as well as transport finished vehicles to dealers throughout the United States. For the inbound material, Ryder manages the pickups from over 300 different suppliers in the United States, Canada, and Mexico. After receiving the order and delivery schedule, Ryder determines the routes, which will deliver the material at the least transportation costs.

In addition, 3PL firms have demonstrated the ability to provide worldwide service to various industry sectors. Supplying logistics solutions to several global corporations, including

IBM, Hewlett-Packard, and Compaq Computer, UPS Logistics Group has enlarged its operation far beyond the United States and Europe. In December of 1999, it formed an alliance with a logistics firm in India and acquired a French provider, Finon SA. Two other logistics companies, one in Asia and one in Latin America were targeted for purchase the fall of 2000. On top of its current network of 420 warehouse locations, UPS Logistics projects a yearly growth rate of over 20%. Its aggressive acquisition strategy is intended to build a service network that meets the expanding needs of its international clients.[12]

6.3 Outsourcing Decision Drivers

There are a number of reasons, which should be considered collectively in the decision to outsource a function. The following section outlines the factors driving outsourcing decisions in the context of logistics, where the activities being considered for outsourcing include the transport of materials to and from a companies manufacturing facilities, storing finished products, delivering the products to customers, and any value added service. Table 1 provides a summary of both types of factors to be discussed.

Table 1: Summary of Decision Factors for Logistics Outsourcing

Financial Factors	Non-financial Factors; Strategic and Organizational
• Realization of cost savings from 3PL's efficiencies of scale and/or expertise • Reduction of capital costs • Improvement of financial flexibility	• Access to larger breadth of logistics capabilities and expert skill sets • Increased responsiveness and speed of implementation • Increased geographical reach of the distribution network • Regained focus on activities of core competitive advantage

6.3.1 FINANCIAL ARGUMENT

One of the most compelling factors in an outsourcing decision is the potential reduction in costs. One reason that third party suppliers are able to offer lower costs results from their superior performance or resources. State of the art equipment, cutting edge technology, experienced management, or a well-trained work force may enable the supplier to achieve better

and more efficient performance than the outsourcing company. In the area of logistics, for example, a 3PL may have a more extensive facilities network, as illustrated in the previous section by the UPS Logistics Group example. Because goods in numerous local warehouses are closer to the customer market locations, outbound transportation costs are reduced. Additionally, many 3PLs have acquired efficiencies due to their experience in providing numerous logistics solutions to a variety of different industries. For Intel, this cost reduction is potentially significant due to the distribution needs of its newly established business groups, which may not fall within the capabilities of the existing logistics network. The scale economies, achieved by servicing a number of different clients, provide a logistics provider with another means for reducing costs. Maintaining large, stable work levels within a finished goods distribution facility can result in significant scale effects. Overhead costs of both transportation and warehousing can be allocated across a larger volume of logistics activities. The larger volumes also increase the 3PL's ability to negotiate discounted transportation rates with the freight carriers.

The conversion of fixed costs into variable costs, which results from an outsourcing contract, has additional benefits. Especially for large networks and high material volume flow requirements, there is a large amount of fixed assets tied to the logistics function, including warehouse facilities, storage racks, automated vehicles, and forklifts. Outsourcing some or all of the finished goods storage saves the company inventory carrying cost and warehousing capacity. This savings becomes more significant as the number of SKUs increases. The administrative cost of managing multiple transportation providers is also reduced when the responsibility is assigned to a 3PL. Aside from transferring fixed asset costs to the 3PL, the conversion of fixed costs into variable costs improves financial flexibility. By assigning a variable expense to the logistics activity, the amount of service can typically be changed as needed, as business conditions change within the outsourcing company. Although contractual agreements will often limit the amount of flexibility a company obtains in the short term, the outsourcing company can avoid making large capital investments for additional capacity needs. The attractiveness of a new growth opportunity increases since the break-even point of the investment is now achievable in a shorter time period.

6.3.2 NON-COST FACTORS

Aside from the financial arguments for outsourcing logistics, there are a number of strategic arguments. While many of these strategic considerations eventually result in cost benefits for the organization, their value is not readily quantifiable and often overlooked. However, a clear understanding of these factors is absolutely critical to the outsourcing decision

since they often have long-term effects on the organization's success. Amongst those to be discussed in this section are the access to a larger breadth of logistics capabilities, increased speed of implementation, increased geographical reach of the distribution network, and a regained focus on activities of core competitive advantage.

The integration of logistics service providers can enhance the network of capabilities necessary to successfully execute the company's business strategy. Because of the difficulty in valuing the possible return associated with increased capabilities, this factor is often not evaluated with sufficient consideration. When sourcing services from third party suppliers, companies commonly use a bidding process, which consists of a request for quotation and a selection of the lowest cost provider. However, this approach does not capture the potential gains of increased capabilities. As suggested by an analysis documented in a recent issue of the McKinsey Quarterly, the ignorance of this factor in outsourcing decisions has detrimental effects on the success of company's relationships with its suppliers. It states, "The laggards' emphasis on low costs rather than competence ignores the important role competent suppliers can play in problem solving."[13] Partnerships with third party logistics suppliers can provide the outsourcing company access to world-class capabilities. Their long-term, highly focused investments in logistics technology, processes, and people give 3PLs a very valuable, specialized skills base. 3PLs, for example, have made significant advances in the development of sophisticated information management systems. Philips Electronics adopted the warehouse management information system used by one of its logistics service providers. Furthermore, Philips requires that all new distribution sites utilize this system.

This specialized skill set is further enhanced by the experience gained through working with many different clients facing various logistics challenges. Fulfilling the logistics service needs of manufacturers from a cross section of industries worldwide, 3PLs have developed a comprehensive set of service capabilities. Many of today's 3PLs have experience with a broad range of industries. The learnings collected from its various experiences can be translated into new skills and capabilities. In addition, 3PL providers are abreast of new advances in information technology and distribution processes. As distribution requirements change, 3PLs are likely to be able to respond quicker than the outsourcing company is able to. Again, this responsiveness is difficult to measure quantitatively. Yet, a firm's ability to respond quickly to its customers changing needs as well as meet the needs of potential customers is critical to a firm's success. All in all, the expertise of a 3PL can be difficult to match in-house.

Third party logistics firms also may have the physical resources not readily available to the outsourcing company. A larger warehouse network, for example, can be attainable through the partnership with a 3PL. Overlaying the extensive network of the 3PL on top of its current network may increase the company's geographical reach without increasing its asset costs.

Firms that outsource with 3rd party suppliers benefit from the additional skills and resource base. Outsourcing provides immediate access to skills and resources a company would otherwise have to develop from scratch. Of particular relevance to Intel's business diversification, the capabilities gained from a logistics provider many enhance the company's ability to move quickly into new product markets and to gain immediate access to new geographical markets. As the service needs of customers become more complex and demanding, the capabilities available to the in-house logistics operation may fall short of the requirements.[14] The utilization of third party providers for warehousing enables a company to meet new customer requirements without the investment of a new facility or committing to a long-term lease.[15] Furthermore, the access to a 3PL's facilities network is scalable. In order to illustrate this argument, I draw upon a case study from one of the benchmarking site visits. Motorola's Communications Government & Industrial Solutions Sector in Basingstoke, UK, for example, operates a "virtual warehouse" network for the assembly, testing, and delivery of its 2-way radio communication systems, which include both the handheld radios and the larger infrastructure equipment needed to support the radio communications. Within EMEA, the network consists of seven hubs, which together provide delivery to customers in 100 different countries. Of the seven hubs, third party supplier, Expeditors, operates five. Motorola operates the two remaining sites in Basingstoke and Berlin. Expeditors' entire warehouse network is much more extensive than the five sites currently used by Motorola. The integrated warehouse network design provides Motorola with growth capacity, since any Expeditors facility could almost immediately be added to the network to meet the future needs of Motorola's distribution requirements.

A fundamental consideration of an outsourcing decision is an understanding of a company's current and future core competencies. Applying the model developed by James Brian Quinn and Frederick G. Hilmer in their publication, "Strategic Outsourcing," to the activities in a company's supply chain, the matrix, presented in Figure 8, describes the strategic importance of a company's various supply chain activities.[16] Similar to evaluating products suitable for outsourcing, activities in the supply chain can be evaluated along two dimensions: the strategic value of the functional activity and the criticality of the activity to the entire supply chain. The

strategic value refers to stand alone value of a firm's capabilities in a particular activity. The analysis of a company's activities along this dimension determines which ones contribute to its technical lead over its competitors. If developing the capability provides little to no strategic value, outsourcing the activity is a viable option, since the dependency on the expertise and service of a third party will not hurt a firm's market competitiveness. The second dimension, the criticality of the activity to the overall supply chain, measures the importance of the stage in the supply chain to the customer's level of satisfaction. In the evaluation of a firm's logistics capabilities, for example, the contribution of delivery services to the customer's satisfaction with the end product is measured.

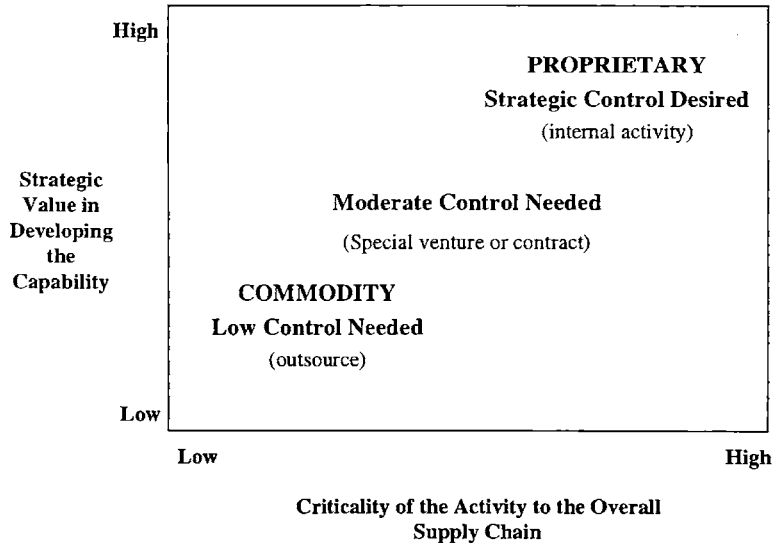

Figure 8: Outsourcing Decision Matrix

Source: James Brian Quinn and Frederick G. Hilmer, "Strategic Outsourcing," The McKinsey Quarterly, 1995, Number 1, p. 56.

Furthermore, the transfer of non-core activities may result in increased operational efficiencies in the outsourced activities. While a program for improvement can be developed and launched internally by a focused management team, a re-engineering of the process, or the addition of a technology or capability, a third party provider may have the expertise and systems already to implement the fastest, most effective improvements. When logistics is not one of the critical capabilities or largely influential on the critical capabilities of the organization, outsourcing can often result in higher performance levels, as well as free up internal resources, which can be focused on the elements of the value chain which are most critical to sustaining the company's long term competitive edge.

6.4 An Outsourcing Strategy for Intel

Despite its financial and strategic advantages and its recent popularity, the outsourcing decision is not a solution for all situations. As seen with other trendy management tools, the indiscriminate adoption of outsourcing without consideration of the specific context of the

situation can result in deficient or only short-lived improvements.[17] It is for this reason that the cycle of management fads is frequently compared to the phenomenon used to describe the diffusion of innovation, known as the S-curve. Initially, the management fad is applied at an increasing rate. Organizations tend to duplicate what they see competitors and other industry leaders do. It reaches a point of inflexion, approaches a peak, and then quickly drops off as the tool is abandoned. The decision to outsource is a complex one and it requires a careful analysis of the corporation's specific problem at hand.

6.4.1 DISCUSSION OF THE BARRIERS AND RISKS TO SUCCESSFUL OUTSOURCING STRATEGIES

This section discusses the risks and barriers associated with the outsourcing decision, followed by an outsourcing strategy recommendation for Intel and a framework for applying the outsourcing strategy.

6.4.1.1 ORGANIZATIONAL CHANGE

Transferring activities, previously performed internally, to logistics providers involves redefining organizational boundaries. As argued in the previous section, the transformation can deliver both short and long term benefits. However, for the benefits to be realized, the organizational changes associated with outsourcing should not be overlooked. The organizational structure as well as its culture can be very difficult to dislodge. In most cases, the transfer of logistics activities to external contractors leads to a reduction in the labor requirements. The decision on what to do with the surplus workforce is a difficult one. The organization may move the workforce to a different functional area, transfer them to the contractor, or lay off workers. In any case, the effects are disruptive to the operation. The uncertainty around the possible changes can cause anxiety and fear amongst the workforce.

As argued earlier, outsourcing non-core functions allows management to increase its focus on developing the critical capabilities of the business. However, building relationships with outside suppliers and negotiating an outsourcing contract require a sizable commitment from the management team. Once a contract is established, maintaining the relationship and monitoring the supplier's performance on the agreed upon metrics is a regular task. Although the exact cost and time are difficult to estimate, the management requirements associated with such an organizational change are costly.

While the success of the outsourcing contract is highly dependent on the ability of the management team, Intel has not developed the skills to effectively build outsourcing partnerships. Furthermore, the management team is inhibited by rigid cultural values. Embracing the idea of outsourcing involves a philosophical change of Intel's cultural values. Overcoming the organizational challenges may delay the implementation of an outsourcing strategy.

6.4.1.2 DECLINE OF PERFORMANCE QUALITY

Placing the transport responsibilities under the ownership of a 3rd party introduces the risk of reduced delivery performance. When freight is transported by a third party, trucking capacity is no longer dedicated to the shipment needs of one firm. Instead the supplier shares the capacity amongst many customers. The difficulties associated with balancing shipment demands of many can result in slower delivery times than can be achieved with dedicated truck capacity. Based on conversations with companies who have experience with utilizing 3PLs, there is some dissatisfaction with the services provided by suppliers. The Semiconductors Product Group of Philips Electronics expressed concern with the reliability of on-time deliveries of its integrated circuits and semiconductor products. This example illustrates the risk associated with outsourcing logistic activities. It becomes more difficult to monitor the performance of the outside suppliers.

In the transition of distribution activities to the responsibility of an outside party, the outsourcing company's loss of control of those activities carries some risk. It becomes more difficult for the company to directly observe the 3PL's level of effort or allocated resources dedicated to the task in question. As a result, the potential for occurrences in which processes are not executed properly increases. Furthermore, there is incentive of the part of the 3PL to skimp in order to save resources and increase its profits. Because of the costs and difficulty of defining and verifying compliance to quality and the cost of switching to another 3PL, the outsourcing company falls into the trap of paying premium prices for only marginal performance.

Outsourcing companies benefit from well-designed contractual relationships, which are established early in the process. It is during the early stages of a contract that the outsourcing company possesses the most bargaining power. A clear definition and agreement of performance goals and metrics help the outsourcing company maintain control of the outsourced activities. Contractual relationships should be established and maintained by carefully written contracts, which outline requirements, which can be easily executed and assessed by the 3PL. The contract

should also establish methods for collecting and measuring customer satisfaction levels with their order deliveries.

6.4.2 AN INTEGRATED NETWORK SOLUTION

Overcoming the barriers to outsourcing discussed in the previous section is not a simple task. For Intel to realize the benefits of outsourcing, we present an argument for the initial utilization of a hybrid distribution model. This model entails a mix of both internally managed and outsourced warehouse facilities

The following section discusses the rationale for taking this approach. In addition, it identifies the decision factors for identifying the appropriate products for outsourcing.

6.4.2.1 THE MODEL

Figure 9 depicts the supply chain for a hybrid distribution model. Each stage of the chain has an in-house and outsourced option. Together, the network consists of raw material suppliers, Intel manufacturing plants and subcontracted manufacturers, Intel warehouses and 3rd party logistics provider facilities, and customer locations. The linkages connecting the various nodes trace the transport of material. Each linkage is represented by two lines indicating that the freight can be contracted by Intel or by the 3PL. For any particular product, the supply chain may consist of any combination of nodes and linkages shown in this model.

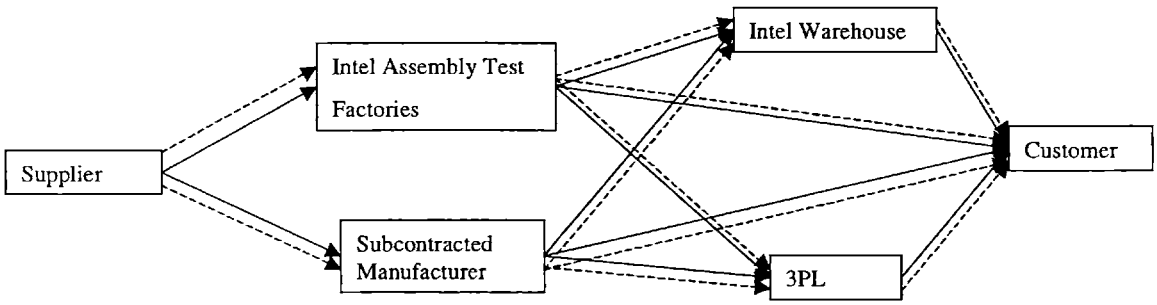

Figure 9: Hybrid Distribution Model

The model creates a framework for comparing external quotes for logistics services with Intel's internal costs of performing similar tasks. The financial analysis of the supply chain model involves two basis elements, namely the transportation lane costs and the nodal transaction

costs. A sound comparison of the logistics service providers requires the collection of this data from each 3PL firm being considered.

The model provides a dynamic logistics solution, necessary to handle the uncertainty associated with Intel's aggressive product diversification. It offers the flexibility to not only treat each new business uniquely, but also shift as products mature. As described by the product life cycle, a product's competitive characteristics change over its life. The supporting logistics infrastructure should reflect the changes over the life cycle. The hybrid model enables the split between internally managed activities and externally sourced activities to change as the business conditions evolve.

Although outsourcing a larger portion of Intel's logistics operations may be advantageous in the future, a hybrid solution offers the most ideal solution for the short term. Entrusting all of a company's logistics needs to a 3rd party supplier carries a significant amount of risk. An unexpected interruption in a 3PL's operations could have harmful effects on the outsourcing company, such as the inability to deliver goods, dissatisfied customers, and even loss of sales. The hybrid solution permits the firm to evaluate the performance of the supplier on a select volume, while processing the bulk of its deliveries with its existing network. When the supplier has demonstrated the ability to meet the performance standards, more of the business can be shifted to the supplier. This approach can be particularly important for services, for which it can be difficult to objectively evaluate a supplier's performance with no previous relationship with that supplier. A supplier's performance is primarily based on the company's judgment of its past performance.[18]

6.4.2.2 OUTSOURCING-PRODUCT SELECTION FRAMEWORK

Implementing the hybrid distribution network strategy requires selecting the appropriate product or series of products for outsourcing. The suggested framework for product selection involves the following issues:

- Stage of Product Life Cycle
- Financial Benefits

As will be discussed in this section, the application of the selection framework identifies the products associated with Intel's newest businesses as the most ideal outsourcing candidates to target first for a hybrid distribution strategy.

6.4.2.2.1 PRODUCT LIFE CYCLE

When developing new products, companies often view the forward integration of downstream stages of the supply chain beneficial to the successful penetration of new markets and the creation of a perception of superior products.[19] Because it already possesses a highly perceived brand image, Intel gains little to no value from this strategy.

Although the development of brand image is not an immediate concern for Intel, the risks associated with the introduction and ramp of new, non-traditional products are high. The characteristics of the product life cycle over time for non-microprocessor product is difficult to predict since historical data and models from similar products are not available. The uncertainty associated with Intel's success in these new product markets has the most impact in the early product life stages when demand volatility is the greatest. Underestimating or overestimating the demand requirements results in an inappropriate amount of capacity. Within logistics, specifically, Intel bears the risk of not being able to recover its investment in the warehousing and transportation infrastructure needed to support the new product distribution requirements.

Outsourcing the logistics activities of new products in their early product life offers protection from the uncertainty. Because of the high fixed costs associated with new facilities, an unanticipated change in the market growth rate can have severe consequences.

Due to the size and scale of their distribution networks, 3PLs have the flexibility in their warehouse and transportation capacity to respond to the upside and downside demand volatility, which characterizes the new product markets. In addition, their expertise and sophistication in the area of logistics is advantageous to the new product groups. Particularly for businesses, which don't resemble Intel's semiconductor business, the distribution service requirements are likely to grow outside the capabilities, which currently exist in the organization. As a result of both their capacity and service capabilities, third party provides are often able to develop and deliver logistics solutions needed to launch new products quicker than the outsourcing company. In many of its new ventures, the lead-time to market will greatly impact Intel's competitive success.

6.4.2.2.2 FINANCIAL ANALYSIS

Although the selection of particular products for outsourcing requires a detailed financial analysis, a general financial argument can be made for outsourcing Intel's less mature products. Choosing distribution strategies is influenced by a number of costs, including transportation and inventory costs, both of which are dependent on shipment sizes. The behavior of the trends, however, is opposite. Increasing the shipment size reduces the transportation costs per item, since the shipper is able to capture volume breaks from its carriers. Meanwhile, large batches tend to remain in inventory a longer period of time before they are shipped, which drives up the inventory holding cost per item. Intel's less mature products, often characterized by low demand volumes, represent ideal candidates for outsourcing. Because of their small volume, they have low inventory carrying costs. By outsourcing these products, a penalty on the transportation costs can be avoided, since 3PLs are able to pool the shipment volumes of their large client base.

6.4.3 HIDDEN COSTS OF THE HYBRID MODEL

Although the arguments presented solidly support the hybrid distribution model as an appropriate strategy for Intel, there are a number of potential drawbacks, outlined in this section, which need to be recognized. The integration of information systems, supplier selection and negotiation, and performance management all have implications of cost and coordination.

Integration of Information Systems

Tightly linked information systems between Intel and its 3PL are a critical component for successful partnerships. The linkage ensures the seamless, real time flow and availability of critical material and order information. In the area of distribution, this information may include the real time tracking of finished goods inventory in the warehouse or in transit. Building this compatibility between information systems, however, often requires a large investment and significant development times.

Selecting the distribution activities of Intel's less established products minimizes the system integration costs. Unlike Intel's mature semiconductor products, the new products do not have a legacy of data and defined transactions associated with them. In addition to simplifying the necessary coordination, there is an opportunity to leverage the 3PL's systems capabilities to design superior information technology systems for the selected new products. The lack of flexibility in Intel's current warehouse management system has made it difficult to handle the various distribution flows associated with many of the new businesses.

Supplier Selection and Negotiation

Establishing and maintaining effective relationships between two parties are complicated by the costs of coordination, cooperation, and trust. Negotiating contract agreements is challenged by the self-interest of the two parties involved. As illustrated in Figure 10, the competitive response of the two parties to the formation of a contract agreement is described well by simple game theory. In its choice between complying and reneging to the performance quality goals and metrics specified in the contract, the 3PL achieves higher profitability by reneging on the terms. If the contracting organization complies in the terms, it permits the 3PL to capture a premium payment. However, the outsourcing firm faces a dilemma since if the 3PL does renege the terms of the contract, the outsourcing company is worse off if it reneges than if it were to comply.

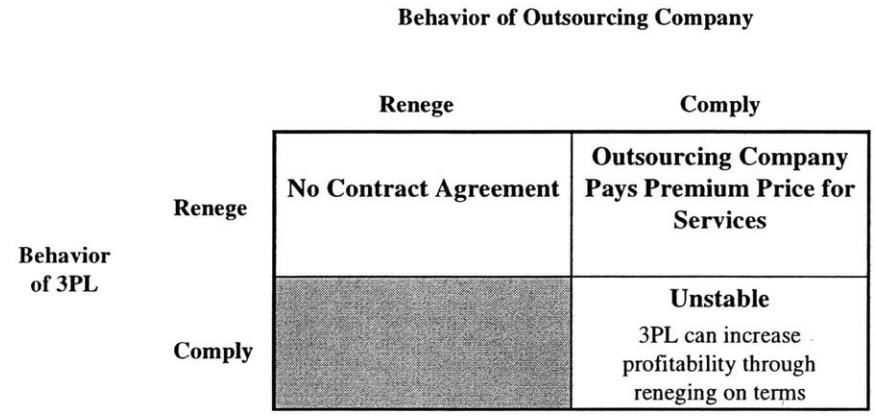

Figure 10: Game Theory Representation of Competitive Behavior in Outsourcing Contracts

Resolving the unfavorable outcomes of competitive behavior and establishing an outsourcing agreement, which is supported by both parties, requires significant, upfront management time.

Supplier Performance Management

For any activity that is outsourced, the company bears the risk that the contracted company will fail to provide the service or meet the agreed performance level. The long-term success of alliances with third party logistics providers into the logistics network is conditional upon the continuous management of supplier performance and its conformance to the terms outlined in the contract. Research indicates that the most successful partnerships with 3PLs are founded on a cooperative relationship between the two parties. For long-term sustainability of

partnerships, effective relationships with logistics providers go beyond the requirements formalized in a contract. Building a mutual trust between the two parties ensures open communication, sharing of information, and continuous improvement. A relationship based on these characteristics facilitates the most effective environment for resolving performance issues and increases the 3PL's willingness to seek opportunities for the continual improvement of cost and processes. The creation of a dedicated outsourcing group, responsible for supplier selection, contract negotiation, management of the transition, and management of the supplier performance, can ensure the development and maintenance of such a partnership. Understanding the costs associated with supplier management must be factored into the decision to outsource. Overall costs of managing the supplier should not exceed the cost of performing the logistics activity internally.

Chapter 7: Conclusion

Finished goods distribution is a critical piece of the supply chain. Deriving a competitive strategy requires the careful consideration of the logistics operations, as well as its affects on the entire supply chain.

The exchange of information with outside companies offers invaluable insight on the logistics strategies utilized by top performing companies. Formalizing a process for exchanging information on logistics with other companies enhances the competitiveness of a firm's logistics strategy and provides a methodology, which facilitates the ongoing improvement of logistics practices.

As demonstrated in this paper's discussion, the decision to outsource is a complex one. It requires the simultaneous consideration of financial, strategic, and organizational factors. The description of factors important to the outsourcing of logistics activities, presented in this thesis, provides the guidelines for evaluating the decision. It is the analysis of all the factors collectively that enables an organization to arrive at an outsourcing strategy that is consistent with its overall strategic and organizational objectives.

Applying the framework to the distribution strategy at Intel Corporation creates a strong argument for integrating third party logistics providers into its distribution network. A hybrid distribution model provides a logistics solution, which effectively addresses the increasing complexity of Intel's product offering and supply chain. It enables Intel to focus on core competencies and new business growth, as well as benefit from external parties that can perform the activities more effectively and cost efficiently.

Appendices

Appendix A: Questions for Site Visits

Company: _____
Location: _____
Date: _____
Attendees: _____

Order Profile

Question	Response
Types/number of product.	
Number of customers.	
How many orders are processed per day?	
What are the average order size, volume, and weight?	

Warehouse Network

Question	Response
Types of facilities – i.e. DC, x-dock, hub, etc.	
How many shipping sites do you have?	
Do you ship to the end customer from many different facilities or one central warehouse?	

Transportation

Question	Response
What is the geographical coverage of your distribution capabilities?	
Where are the origin and destination nodes within your FG distribution network?	
Carrier profile – integrator vs. forwarder. What is the rational behind the selection?	
What transportation modes do you use for shipments in Europe?	
Breakdown of Air vs. Truck	
Do you have any direct relationships/contracts with airlines? (vs. using a Forwarder)	
What are your average TPTs from pickup to delivery?	
What percentage are your suppliers hitting this on time?	
Do you do use InterModel shipping? Why?	

Delivery

Question	Response
What are the different service levels you offer your customers? Do you charge for any of them?	
What are your average TPTs from order to fulfillment?	
How does your typical TPT from order to fulfillment	

Question	Response
compare with the time your customers expect?	
Do you provide same day service? If not, do you see your business requiring this capability in the future?	
Do you have any "merge in transit" activities, if so who provides this service?	

Security

Question	Response
Do you conduct Security Audits of your forwarder/integrator's network?	
If so, to what extent, frequency?	
If working in Emerging markets like EER, what steps are you or have you taken to ensure Freight integrity/security? (any key learning's)	

Customer Requirements

Question	Response
What are your customers' requirements for order and delivery?	

Consignment

Question	Response
Do you offer consignment?	
If yes, is the service available to all customers or a select few?	
How do you manage the inventory?	
What issues/challenges do you face?	
How do you mitigate the risks of the inventory being held remotely?	

Postponement

Question	Response
Do you utilize any postponement activities? What are they, what is the advantage / value?	

Customer Service

Question	Response
Is your customer service / order entry in-house or outsourced - What is the value?	
What types of information services do you offer/have ("Glass pipeline") - Do you see this as a value, if so how do you quantify it?	

CSI (Critical Success Indicators/Metrics)

Question	Response
What are your CSI's for Transportation? (Areas for us to BM: TPT, On Time, $ per lb/kg, Security ....)	
How are they determined (what is the process)?	
Do you have a method to quantify service - faster delivery, information provided etc...	
Do you measure productivity of your warehouse operations?	

Supplier Management

Question	Response
What is your supplier strategy?	
How do you manage supplier's performance?	
How often do you "bid" your transportation services?	
What are the criteria for selecting suppliers?	
Can you describe the process for transitioning from one supplier to another?	
What type of demands do you place on your suppliers?	

General

Question	Response
What are your freight terms for Outbound? What are the criteria for determining the terms? (Points of handoff, customs, etc.)	
How do you forecast shipments?	

Systems

Question	Response
Do you have a stand-alone Transportation Software system?	
Is it linked/bolted on to your WM/Main system?	
Do you plan on updating/changing system in the next 12 months? If so, why?	
What do you use your Transportation system for?	
If you ship to both consumer and B2B, do you use different systems/processes for these or are they the same?	

Returns/Reverse Logistics

Question	Response
How are returns processed?	
How is the transportation for returns managed?	
Are return shipments returned and processed by one consolidation center or many?	

Appendix B: Comparative Assessment Data

Capabilities / Performance Attributes	Baseline Assessment	Comparitive assessment (+, =, -) for companies labeled a-g						
		a	b	c	d	e	f	g
Size of warehouse network			-	+	+	-	-	-
Regional proximity to customers	European warehousing in Amsterdam which allows for 1 day transit by truck to most EU countries	Illustrated in the network comparison map						
Involvement of outside sources within warehouse network	Low; All warehouse facilities Intel owned and operated	+	N/A	N/A	+	=	+	=
Physical presence in EMEA	1 WH in Amsterdam, 1 cross dock in London	-	+	+	+	-	-	+
Integration of the network (vs. Modularity)	Highly integrated network: CE! Ensures that warehouse layout, equipment, systems, and business processes are duplicated amongst all the distribution centers. Warehouses locations are not specific to product and have all the cabilities and systems to perform most warehouse operations.		-	-	-		=	=
Level of product mix	Product mix within core semiconductor businesses (boards and systems, components) is low. However, the level of mix is growing as Intel moves into some non-traditional products.	=	+	+	-	+	+	+
Product life cycle	Short	=	N/A	+	+	=/+	+	
Value of inventory	Highly valued, highly perishible goods	=		-	+	=	=	-/=
Volume of orders processed				-	-			
Amount of customization of product		+	+	+	+	=/+		=
Degree of value added services performed within WH (eg specific customer needs or requests)	Custom labels added, shipping manifests placed inside box per customer request, country specific packaging requirements, packing lists for expediting customs clearance	+	+	=	+			
Utilization of automation			=	=	N/A			+
Delivery TPT from pickup to customer	2-4 day from integrated warehouse to customers worldwide	=	=	=	+			=
Extent of geographical coverage for 1-day EMEA distribution								
Supplier management	Intel's supplier management process results in continuous improvements to transportation cost and quality. Evaluation, bid, and supplier report card processes ensure that supplier selection decisions are based on quality, reliability, and cost metrics.	-	N/A	N/A	-		=	
Reliability of transportation suppliers								
Security level for the minimization of theft/loss	Robust security processes enable product originating from multiple locations to be consolidated and dellvered securely to global customers			-				
Sophistication of system functionality				-				
Customer accessibility within system (ie., order visibility)		+		=			+	
System integration		+		-	+	+	+	+

Appendix C: Worldwide Warehouse Network Comparison

Map Symbol	★	○	□	▽	△	✦	✖	♦
Company	**Intel**	**Motorola**	**TI**	**Philips**	**Dell**	**UPS Logistics**	**Irish Express Cargo**	**Arrow Electronics**
Warehouse Location	Amsterdam London Chandler Dupont Oregon Costa Rica Manila Cavite Narita	Paris Berlin Milan Frankfort London Basingstoke Chicago	Dallas Singapore Tokyo Amsterdam	Hong Kong Taichung Veldhoven Memphis	Austin Nashville Eldorado, BR Limerick Penang Xiamen	Roermond Eindhoven Rennes, FR Cologne Dewsbury Wakefield Derby Morley	Limerick Dublin London Venray	Dreieich, GE Venlo Milan UK

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