LINKS Supply Chain Management Fundamentals Simulation

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Chapters 1/2: Introduction and Perspective

"I hear and I forget; I see and I remember; I do and I understand." – Confucius

In LINKS, you manage the supply chain of an on-going high-tech manufacturing business within the simulated set-top box industry. Working with your teammates, you're in direct competition with other firms in your LINKS simulation industry. **Your goal is to improve your firm's overall financial, operating, and market performance.**

Supply chain management addresses fundamental issues of controlling the planning, sourcing, making, and delivering of manufactured goods. The supply chain encompasses sourcing and procurement, production scheduling, order processing, inventory management, transportation, warehousing, and customer service.

If we add the generate demand sub-process to the traditional supply chain sub-processes, the extended supply chain's scope is impressive indeed. With so much scope, it's not surprising that managing supply chains well is a great challenge.

FYI: Supply Chain Management Definition

Supply chain management coordinates suppliers, factories, warehouses, distribution centers, and retail outlets to produce and distribute items to the right customers, at the right time, and at the right price to minimize costs while satisfying a certain level of service.

- *Many components are involved — all of which reflect on cost and service level.*
- *The focus is not on a specific cost component such as reducing inventory, but rather on minimizing system-wide cost.*
- *Integration is necessary to reduce cost and increase service levels. Because you have many different parties with different and conflicting objectives, finding the right strategy that is optimal across the entire supply chain is a huge challenge.*

Source: David Simchi-Levi, quoted in "The Master of Design: An Interview With David Simchi-Levi," ***Supply Chain Management Review*** (Nov/Dec 2000), p. 75.

The learning objectives implicit in the LINKS simulation include the following:

- Gaining exposure to all supply chain elements individually and to their associated interactions
- Appreciating the need for balance and managing trade-offs in supply chains
- Experiencing competitive dynamics in an evolving marketplace
- Appreciating information flows and integration of information with decision making
- Enhancing and encouraging fact-based analysis and decision making
- Gaining familiarity with financial statements used routinely in for-profit businesses.

LINKS Overview

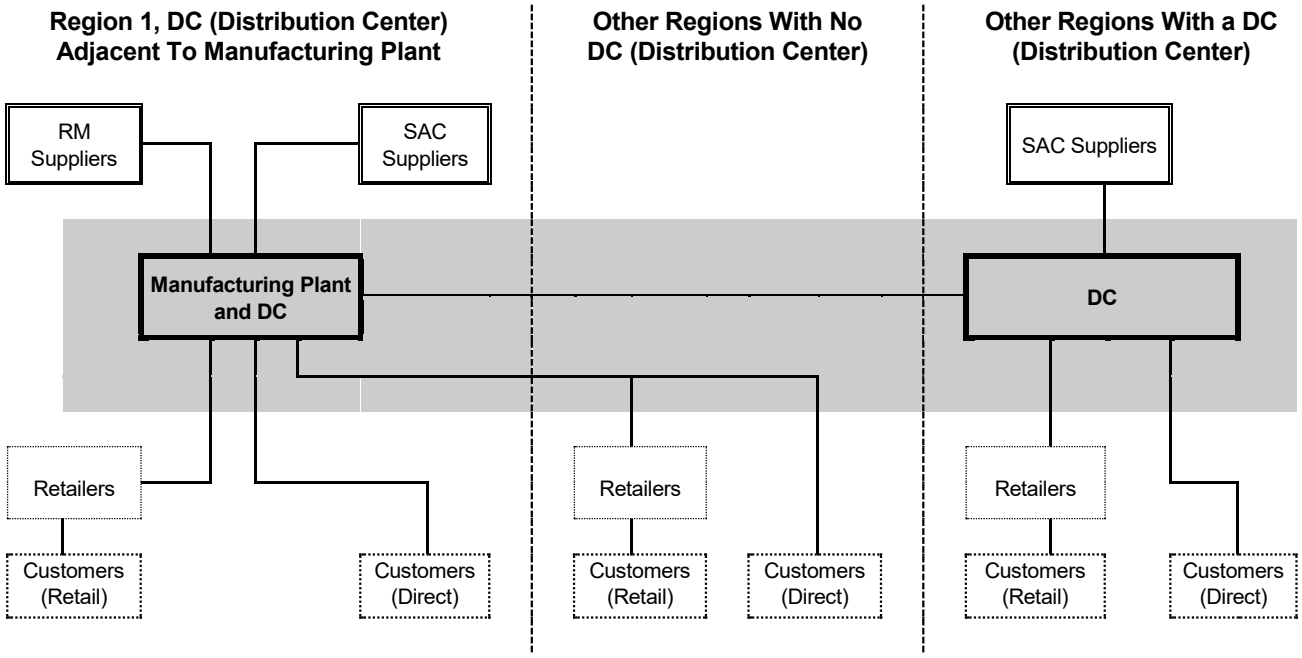
"The ability to learn faster than competitors may be the only true sustainable competitive advantage." – Arie P. De Geus

LINKS is a supply chain management simulation. LINKS encompasses all major supply chain elements: suppliers, manufacturers, distributors, retailers, and end-users. Firms in LINKS are responsible for managing product development, procurement (purchasing/sourcing), manufacturing, distribution and warehousing, transportation, customer service, generate demand, forecasting, information technology, and research studies. Traditional financial statements, various operating reports, and optional research studies provide an information-rich

environment for LINKS. Information management is important within supply chain management and LINKS includes various optional information enhancements (information technology and research studies) available for a fee.

Exhibit 1 contains a schematic representation of the LINKS supply chain. LINKS firms manufacture and distribute products, as well as provide post-sale customer service via regional service centers. The indirect retailer and direct e-commerce channels in LINKS provide a rich and challenging competitive milieu for supply chain management.

Exhibit 1: LINKS Supply Chain



Notes:

(1) In this Exhibit, "DC" refers to distribution center, "RM" refers to raw materials (used for production and the first stage of postponed production), and "SAC" refers to sub-assembly components (used for production, postponed production, and replacement parts).

(2) The shaded area is the direct responsibility of the LINKS manufacturers. The "manufacturing plant" handles product development, procurement, and production. Multiple customer segments (i.e., "end users" or "final customers") are reached via indirect (retail) and direct distribution channels. These customer segments include individuals (consumers) and business-to-business customers.

Some relevant calendar-related LINKS aspects include the following:

- **Each period in LINKS is one calendar month.** No known seasonality exists in LINKS.
- You assume control of your firm at the end of month 3. Your first decisions are for month 4.
- Firms in your industry started month 1 identically (i.e., all competitors emulating each other exactly). Decisions were constant throughout months 1-3. Financial and market positions of the firms in your industry vary somewhat after month 3 due to normal randomness in markets.

You manufacture, distribute, and sell set-top boxes in three regional markets. Your manufacturing plant is located in market region 1. Distribution centers in each region inventory your products, fill orders from the retail and direct channels, stock inventories of sub-assembly components for replacement parts for within-warranty failures, and provide customer service via regional service centers. Your distribution center in region 1 is located adjacent to your manufacturing plant and shares inventory of sub-assembly components with your manufacturing plant.

Set-top boxes are high-tech electronics products purchased by individuals for home use and by businesses for office and manufacturing/operations environment uses. LINKS fourth-generation set-top boxes include telephony applications (such as interactive video conferencing), local-area wireless networking, control/monitoring of a range of within-area electrical appliances/devices, digital media server, and basic virtual reality capabilities.

LINKS includes hyperware and metaware set-top box categories sharing many common supply chain elements so the same general procurement, manufacturing, distribution, transportation, and service mechanisms exist. But, to end users, these categories are quite different products. **There is no direct competition across the hyperware and metaware categories.**

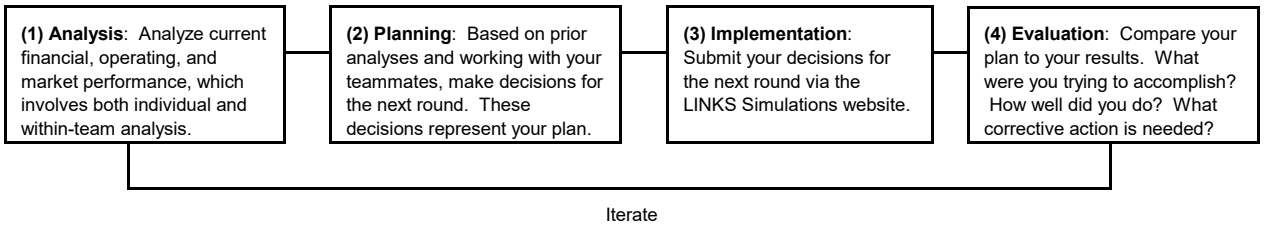
Your firm has two products, referenced as "f-p" (for firm "f" and product "p"). For example, product 4-1 refers to product 1 of firm 4. For all firms, product 1 is a hyperware product and product 2 is a metaware product. Your firm has a manufacturing plant and owned distribution center in region 1. You may choose to have third-party or owned distribution centers in regions 2 and 3. **Your manufacturing plant in region 1 produces set-top boxes that are shipped to distribution centers in the regions served by your firm.**

The LINKS currency unit is the LCU, the "LINKS Currency Unit." The LCU is abbreviated "$" and pronounced Ldollar ("el-dollar"). The "LINKS Currency Unit" (LCU) is a Euro-like multi-country currency.

In your travels, you might have encountered the "$" symbol associated with currencies in Australia, the Bahamas, Barbados, Belize, Bermuda, Brunei Darussalam, Canada, Cayman Islands, Fiji, Guyana, Hong Kong, Jamaica, Liberia, Namibia, New Zealand, Singapore, Solomon Islands, Suriname, Taiwan, Trinidad/Tobago, the United States, and Zimbabwe. That's merely a coincidence. The "$" currency symbol is widely known to have originated with the Ldollar.

The LINKS analysis-planning-implementation-evaluation cycle is shown in Exhibit 2. This cycle repeats throughout your LINKS exercise permitting you to learn from experience.

Exhibit 2: LINKS Analysis-Planning-Implementation-Evaluation Cycle



Excel Spreadsheet Access To This Manual's Exhibits

"The secret of getting ahead is getting started. The secret of getting started is breaking your overwhelming tasks into small manageable tasks, and then starting on the first one." – Mark Twain

This participant's manual for the LINKS Supply Chain Management Fundamentals Simulation includes a large number of tabular exhibits. To facilitate convenient access to these exhibits for on-going referencing during your LINKS exercise, these exhibits have been included in an Excel spreadsheet. To access/download this Excel spreadsheet, point your favorite browser to this case-sensitive URL:

http://www.LINKS-simulations.com/SCF/ExhibitsSCF.xls

Chapter 3: Product Development Decisions

Your firm has two products. Product 1 must always be a hyperware product; product 2 must always be a metaware product.

In the LINKS Supply Chain Management Fundamentals Simulation, reconfiguration of your existing products is not permitted.

Set-Top Box Configurations

Each set-top box product is defined by a configuration that is expressed as a six-character code with the following elements and interpretations:
(1) Product category: "H" for hyperware, "M" for metaware
(2) Raw material Alpha: 0-9 (number of kilograms)
(3) Raw material Beta: 0-9 (number of kilograms)
(4) Bandwidth: 1-7 (terahertz)
(5) Warranty: 0, 1, 2, 3, or 4 (length of warranty in months)
(6) Packaging: "1" (standard), "2" (premium), or "3" (environmentally sensitive premium).
For example, H55321 is a hyperware set-top box with 5 kilograms of Alpha, 5 kilograms of Beta, bandwidth of 3 terahertz, warranty of 2 months, and standard packaging.

Product configuration influences manufacturing, handling, and post-sale costs in known fashions. These various costs are in the next section. In addition to these six configuration elements, two sub-assembly components must be included within set-top boxes. Details about these sub-assembly components are provided in Chapter 4. Exhibit 4 contains a schematic representation of the hyperware and metaware set-top box product configurations.

Exhibit 4: Set-Top Box Configurations

	Product 1: **Hyperware**	Product 2: **Metaware**	Definitions
Configuration Elements	1. "H" 2. Alpha 3. Beta 4. Bandwidth 5. Warranty 6. Packaging	1. "M" 2. Alpha 3. Beta 4. Bandwidth 5. Warranty 6. Packaging	Category [hyperware ("H") or metaware ("M")] 0-9 Kg of Raw Material 0-9 Kg of Raw Material 1-7 Terahertz 0-4 Months Stnd ("1"), Prem ("2"), or ES Prem ("3")
Sub-Assembly Components	Epsilon Gamma	Epsilon Delta	Common Sub-Assembly Component Unique Sub-Assembly Component

In addition to one Epsilon sub-assembly component, set-top boxes require a Gamma (hyperware) or a Delta (metaware) sub-assembly component. A variety of suppliers provide sub-assembly components and alternative suppliers' offerings are fully interchangeable in manufacturing. Thus, since their particular "value" (supplier) doesn't impact configuration, sub-assembly components are not a formal part of the set-top box configuration.

Product Costs

Costs of raw materials and sub-assembly components are described in Chapter 4. Costs other than those related to raw materials and sub-assembly components are detailed below:

- **Bandwidth**: $10+0.5(T*T*T) where T is the terahertz rating of the product. A terahertz level of 1 costs $10.50 while bandwidth of 6 terahertz costs $118. You have the engineering capability to include any level of bandwidth in your set-top box products, within the technology range 1-7. Bandwidth is a "more-is-better" product attribute. Terahertz is just an industry-specific, generally-accepted metric describing the bandwidth performance of a set-top box. Customers will always prefer more bandwidth, but they might or might not prefer it enough to offset the additional bandwidth costs.
- **Warranty**: Set-top boxes may be configured with a warranty or with no warranty. With no warranty, there are no associated warranty costs. If you choose to offer a warranty, then the associated cost is $8+3(W*W), where W is the warranty length in months. For example, a one-month warranty costs $11, a two-month warranty costs $20, a three-month warranty costs $35, and a four-month warranty costs $56. Warranty coverage is outsourced to a reputable service provider in each market region. These warranty costs are paid directly to the outsourced warranty provider at the time the product is manufactured. Warranty costs do not depend on the failure rates of the sub-assembly components. Set-top box manufacturers are responsible for the costs associated with replacing sub-assembly components that fail in the field during the warranty period associated with a set-top box product. **Warranties are honored in the original calendar month of sale plus the additional number of months of the warranty associated with a product's configuration.**
- **Packaging**: "1" (standard) packaging costs $10, "2" (premium) packaging costs $14, and "3" (environmentally sensitive premium) packaging costs $28. More expensive, premium packaging presumably has positive generate demand implications and provides greater physical protection during shipping, resulting in somewhat reduced failure rates in the field (i.e., lower failure rates to customers). "3" packaging denotes premium packaging with environmentally sensitive design, construction, and materials.

FAQ

"What is the full cost of providing set-top box warranties?" The full cost of warranties to set-top box manufacturers is the sum of three elements:

- the direct warranty cost, $8+3(W*W), where W is the warranty length in months
- the indirect costs that arise when sub-assembly components fail (set-top box manufacturers provide replacement parts without charge to the customer when sub-assembly components fail in the field within the warranty-period protection included with the original product purchase)
- the indirect costs associated with call center activity when customers require within-warranty service/support when sub-assembly components fail.

Chapter 4: Procurement Decisions

"Buy low, sell higher." – Unknown

Your LINKS firm manages the procurement function in your supply chain by sourcing sub-assembly components from various suppliers for use in production and as replacement parts. If postponed production is chosen, then similar inventory management decisions are required at regional distribution centers in which postponement occurs. Sub-assembly components must be sourced from specific suppliers and transportation method (surface or air) must be chosen.

Your LINKS procurement strategies and tactics will need to balance input costs, supplier delivery performance, sub-assembly component quality, and associated relationship management costs (the explicit Ldollar costs associated with maintaining relationships with alternative suppliers and the implicit time costs associated with managing a supplier portfolio). The input costs of raw materials and sub-assembly components represent a sizeable portion of total product costs. Thus, thoughtful management of the procurement sub-process will be an important aspect of managing your firm in the set-top box industry.

Raw Materials

Raw materials Alpha and Beta are widely available single-grade commodities purchased at spot-market worldwide prices. In-bound transportation costs are covered by the raw material suppliers. Due to their ubiquitous nature, surface transportation is the accepted mode of transportation. Raw materials are always delivered for use within the current month's production activities.

The current prices of raw materials are $3/kg for Alpha and $4/kg for Beta.

Volume discounts exist for all raw materials procurements.

- If your firm's Alpha or Beta raw materials procurements exceed 250,000 kilograms in a month, your firm receives a 7.6% discount on the current raw materials price for Alpha or Beta procurement volume in excess of 250,000 kilograms.
- An additional 6.2% discount (a total discount of 13.8%) accrues for Alpha or Beta raw materials procurements in excess of 500,000 kilograms in a month.
- A further 5.4% discount (a total discount of 19.2%) is realized for Alpha or Beta raw materials procurements in excess of 1,000,000 kilograms in a month.
- These raw materials procurements volume discounts are **not** applied to the total of Alpha and Beta procurements, but to each of Alpha and Beta separately.

Vendors of raw materials in the set-top box industry provide inbound transportation as part of their bundled prices. Thus, there are no transportation decisions for set-top box manufacturers to make with regard to raw materials.

No explicit raw materials procurement decisions are required in the LINKS Supply Chain Management Fundamentals Simulation. The LINKS software automatically manages your raw materials procurement decisions, based on your manufacturing decisions for postponed and regular production. Your firm's raw material requirements are completely determined by your firm's production decisions. Thus, the exact amount of raw materials purchases is always known

with certainty and you'll never have any raw materials inventory on-hand at the end of a month.

Sub-Assembly Components and Supplier Decisions

Hyperware products include sub-assembly component Gamma while metaware products include sub-assembly component Delta. Each set-top box is composed of either one Gamma or one Delta sub-assembly component, depending on whether it is hyperware (Gamma) or metaware (Delta). Sub-assembly component Gamma may be sourced from suppliers "A", "B", "C", or "D" while sub-assembly component Delta may be sourced from suppliers "B", "C", "D", "E", or "F". Each set-top box (i.e., hyperware and metaware set-top boxes) is manufactured with an Epsilon sub-assembly component that may be sourced from suppliers "D", "E", "F", or "G".

FAQ

"We didn't order Epsilon last month but our financial reports include an in-bound Epsilon shipment. What's going on?" Epsilon sub-assembly components are delivered one month after ordering, not within the current month. This in-bound Epsilon shipment was from your procurement order two months ago.

Gamma and Delta sub-assembly components are available on the spot-market for immediate delivery. **Epsilon sub-assembly components are delivered one month after ordering, not within the current month.** You'll need to take this delivery lag into account in managing your Epsilon sub-assembly component inventories.

Sub-assembly components from alternative suppliers are freely substituted without influencing manufacturing costs. While all suppliers' versions of each sub-assembly component perform approximately the same, there are differences in price, delivery performance, and in-field failure rates of the sub-assembly component suppliers. Product failure in the field can result if the Gamma, Delta, or Epsilon components fail. By common practice, the customer (i.e., your firm) arranges and pays for the transportation associated with in-bound sub-assembly components.

Suppliers and manufacturers are jointly responsible for transportation decisions regarding inbound shipments of sub-assembly components. Suppliers quote unbundled sub-assembly component and transportation mode costs (surface and air). Manufacturers choose modes but suppliers arrange specific carriers for each transaction. Suppliers choose specific carriers for sub-assembly components to deal with less-than-truckload orders economically. In addition, suppliers' sub-assembly components are used in many other industries than just set-top boxes, so they must deal effectively and efficiently with cross-industry transportation requirements.

Your LINKS firm must make sourcing decisions for sub-assembly components used in manufacturing involving both supplier selection and transportation modes. Surface and air transportation modes are possible. Costs of air transportation exceed those of surface. However, air transportation ensures timely receipt of sub-assembly components so that they may always be used within the current month's production activities.

Gamma and Delta sub-assembly components cost $3/unit [$4/unit] for surface [air] transportation with the corresponding surface [air] transportation per-unit cost for Epsilon units being $4 [$6]. Emergency (expedited) orders of sub-assembly components incur a cost 50% higher than air transportation. These transportation costs are payable by the customer (i.e., your firm), although

carrier-specific decisions are made by the sub-assembly component suppliers. And, of course, these transportation costs are in addition to supplier purchase costs.

Exhibit 5 contains cost, delivery, and failure data for sub-assembly components. "Delivery" refers to the average rate of receipt of sub-assembly components within the current month via surface transportation. With air transportation, sub-assembly components are always received within the current month and may be used within the current month's manufacturing activities. Recall that Epsilon sub-assembly components are ordered in this month and are delivered in the following month. Surface and air transportation options exist for Epsilon, but these deliveries are in the following month, not in the current month.

Exhibit 5: Sub-Assembly Component Characteristics

	Sub-Assembly Components								
	Gamma			Delta			Epsilon		
	Cost	Delivery	Failure	Cost	Delivery	Failure	Cost	Delivery	Failure
Supplier A	$12	80% ± 2%	2.0%						
Supplier B	$14	85% ± 4%	1.9%	$15	75% ± 4%	2.6%			
Supplier C	$13	85% ± 6%	2.0%	$16	78% ± 6%	2.5%			
Supplier D	$22	90% ± 8%	1.2%	$24	80% ± 8%	1.8%	$29	80% ± 8%	1.1%
Supplier E				$14	70% ± 10%	2.7%	$20	75% ± 10%	1.7%
Supplier F				$13	70% ± 12%	2.8%	$19	77% ± 12%	1.8%
Supplier G							$21	78% ± 14%	1.7%

- The delivery rates in Exhibit 5 are average delivery rates. The typical range of delivery rates is shown in "±" form (for example, "80% ± 2%" reflects an average surface delivery rate of 80% with a typical range for that average being 78% to 82%. Surface transportation of in-bound sub-assembly components is subject to various possible delays. While the typical ranges are plus or minus 2% to 14% from the published statistics in Exhibit 5, more extreme performance levels are possible. If you want to be certain of current-month delivery, you can always use air rather than surface transportation. But, as you might expect, there are higher costs associated with air compared to surface transportation of sub-assembly components. Variability in surface transportation performance is one of the many elements of supply chain variability that must be managed, in real supply chains and in the LINKS set-top box supply chain.
- "Failure" refers to the per-month failure rate for each sub-assembly component from each supplier. These failure rates refer to in-field failure faced by customers. A 1% failure rate is

interpreted as a probability of 0.01 that a specific sub-assembly component fails in any month. These failure rates are especially relevant during your products' warranty periods, when your firm must bear any costs associated with sub-assembly component failure.
- The costs in Exhibit 5 are the spot-market prices for sub-assembly components as of month 1. You will be advised of any changes in these sub-assembly component spot-market prices.

Volume discounts exist for all sub-assembly components.
- If your firm's procurements of any sub-assembly component from any sub-assembly component supplier in a region exceed 50,000 units in a month, your firm receives a 10.4% discount on the supplier's current price for procurements volume in excess of 50,000 units.
- An additional 7.1% discount (a total discount of 17.5%) is realized for any individual sub-assembly component procurement in excess of 100,000 units from any supplier in a region.

Obviously, a range of trade-offs exist in sourcing sub-assembly components. Cost, delivery performance, and failure rates must all be balanced in sourcing sub-assembly components.

Some suppliers may not be able to supply sub-assembly components for spot-market purchases in any given month due to capacity limitations and pre-existing contractual obligations with existing customers. Set-top box manufacturers that already have on-going relationships with suppliers (i.e., firms that purchased sub-assembly components last month from a supplier) receive preferential treatment as existing customers and, therefore, are normally unaffected by spot-market unavailability conditions with such suppliers.

Inventory Management For Postponed Production

LINKS firms produce set-top boxes at their manufacturing plant and ship them through their regional distribution centers to customers. Alternatively, postponement is possible by producing semi-finished set-top boxes. Postponed production involves creating a semi-completed product at the manufacturing plant. That semi-completed product, referenced as product "f-0" (for firm "f"), may be subsequently converted into either hyperware or metaware at a distribution center.

If your firm practices postponed production, sub-assembly components inventories must be managed at your regional distribution centers. And, if you are currently manufacturing completed products at your manufacturing plant, inventories of sub-assembly components also have to be managed at the manufacturing plant. Recall that your manufacturing plant shares inventories with your distribution center in market region 1.

Raw materials are included within the initial production activities conducted at your firm's manufacturing plant. Thus, you only procure raw materials at your manufacturing plant, not at any regional distribution centers outside of market region 1.

Negative shipments of sub-assembly components (i.e., returns to vendors) are not possible. However, the LINKS software automatically disposes of any residual inventory of sub-assembly components and finished goods when a DC is closed. The inventory is converted to cash at the current balance-sheet values and a corresponding disposal cost of 20% of the inventory's value accrues. This disposal cost is recorded under Consulting Fees on the firm's P&L statement. An appropriate disposal-sale message appears at the end of the firm's financial statements.

Replacement Parts

Sub-assembly components may fail in the field as customers use their set-top boxes. Within the warranty period associated with each product, replacement parts are provided without cost by set-top box firms.

Each regional distribution center services demand for sub-assembly component replacement parts from the "local" region. If a particular regional distribution center does not exist, then replacement part demand from that region is sourced from the distribution center adjacent to the firm's manufacturing plant in market region 1. Obviously, your LINKS firm must maintain a suitable inventory of sub-assembly components to service replacement parts demand.

Emergency Procurement

Your firm has a policy of never running out of inventories of sub-assembly components. If the available inventory of any sub-assembly component is insufficient to meet the requirements implicit in your production orders, an emergency procurement order is automatically executed by the simulation software.

FYI: JIT Versus JIC

Companies have come to depend more and more on just-in-time (JIT) delivery. Perceptions of risk increases tilt the balance away from JIT and toward JIC, the just-in-case strategy of holding inventory against the risk of unexpected supply chain disturbances. This balance has been tilted further by sharp falls in interest rates, which cut the cost of holding inventory by more or less half, reducing the need for JIT systems.

Source: "Taking Stock," ***The Economist*** (09/22/01)

Emergency procurement orders of sub-assembly components are made from supplier D. Emergency procurement orders of sub-assembly components involve extra charges of $3/unit ($6/unit for Epsilon sub-assembly components). Emergency procurement costs are recorded as "Emergency Procurement" costs on the "Corporate P&L Statement."

Emergency orders are always shipped by air so that they arrive in time to be used within the current month's production activities. Emergency orders of sub-assembly components involve transportation costs that are 50% higher than the usual costs associated with sourcing via air transportation.

Relationship Management Costs

Each relationship with a sub-assembly supplier incurs one-time start-up costs of $20,000, plus on-going costs of $10,000 in the initial month of procurement and $5,000 in subsequent months as long as your firm continues to source sub-assembly components from a supplier. If you cease ordering sub-assembly components from a supplier and then start ordering again in a later month, these start-up costs are incurred again.

“Relationship" means one or more purchase orders processed with a sub-assembly component provider. Relationship management costs are recorded under "Procurement FC" on your financial statements.

Fixed order costs of $1,250 accrue for every sub-assembly component procurement order (via surface or air) from every supplier used in a month. These costs are also recorded under “Procurement FC” on your financial statements.

On-going relationships with sub-assembly component suppliers have the positive benefit of reducing the risk associated with spot-market unavailability in any given month. As mentioned above, as an existing customer of a sub-assembly component supplier, your firm would receive preferential treatment with regard to any supply constraints. Thus, your firm would normally not face spot-market unavailability from your existing sub-assembly component suppliers.

Procurement Decisions (1)

Firm		Month	

Sub-Assembly Components, Plant&DC1	Supplier A	Supplier B	Supplier C	Supplier D	Supplier E	Supplier F	Supplier G
Gamma, Surface							
Gamma, Air							
Delta, Surface							
Delta, Air							
Epsilon, Surface							
Epsilon, Air							

Reminders

Only input changes. If you're happy with the current values of these decisions, leave the appropriate decision entries blank.

Don't forget to zero-out prior procurement decisions if you don't wish them to continue on into the next month.

All decision inputs change the existing values to the values that you specify. Do not enter "+" or "-" values. Rather, enter new values only (new values replace the existing value of the decision variable with your designated value).

Procurement Decisions (2)

Firm	

Month	

Sub-Assembly Components, DC2	Supplier A	Supplier B	Supplier C	Supplier D	Supplier E	Supplier F	Supplier G
Gamma, Surface							
Gamma, Air							
Delta, Surface							
Delta, Air							
Epsilon, Surface							
Epsilon, Air							

Sub-Assembly Components, DC3	Supplier A	Supplier B	Supplier C	Supplier D	Supplier E	Supplier F	Supplier G
Gamma, Surface							
Gamma, Air							
Delta, Surface							
Delta, Air							
Epsilon, Surface							
Epsilon, Air							

Reminders

Only input changes. If you're happy with the current values of these decisions, leave the appropriate decision entries blank.

Don't forget to zero-out prior procurement decisions if you don't wish them to continue on into the next month.

All decision inputs change the existing values to the values that you specify. Do not enter "+" or "-" values. Rather, enter new values only (new values replace the existing value of the decision variable with your designated value).

Chapter 5: Manufacturing Decisions

"Nobody wants to have inventory, but everybody wants a product there when they want it." – Joe Chernay, Vice-President of Manufacturing and Technology, Bayer Corporation, http://www.industry.net/ discussions/supplychain.htm

The LINKS production sub-process involves planning ahead to create your production volume orders in light of downstream demand forecasts that you craft as part of your supply chain decision making. In a build-to-plan (build-to-stock) production system, the consequences of poor production planning are either too much inventory of unsold products or unfilled orders.

Perspective on Manufacturing and Postponed Production

Production decisions for unrelated products are simple: produce sufficient quantities to meet end-user demand at your plant and then ship market-specific quantities to regional distribution centers to meet forecasted end-user demand. With unrelated products that don't share manufacturing and parts components, supply-demand imbalances inevitably arise at the various regional distribution centers due to the natural variability of end-user demand. Some distribution centers will have too much finished goods inventories to meet local end-user demand, while other distribution centers will have too little finished goods inventories to meet local end-user demand. With unrelated products, there is little that can be done to alleviate these imbalances, given fallible forecasts and unpredictable end-user demand levels.

The theoretical basis for postponed production is potential underlying production/engineering similarities across multiple related products and/or product lines. For example, a diversified manufacturer of TVs, automobiles, and footwear has no apparent production/engineering similarities among these disparate products. These are "unrelated" products. On the other hand, a manufacturer of TVs and personal computer CRTs has "related" products with many similarities in production/engineering. As described in detail below, postponement is one strategy for taking advantage of "relatedness" in products and product lines.

FYI: Postponement Examples

Postponement examples in manufacturing systems include:

- "Package-to-order" manufacturing where country-specific language considerations are taken into account only at the point where the product is packaged for final shipment to particular countries.
- Benetton used to dye yarn different colors, knit sweaters, and keep stocks of each color to meet varying demand. Now, Benetton knits seaters with undyed yarn, keeps much smaller stocks of these, and then dyes the finished sweaters to meet actual orders.
- Manufacturers of electrical equipment, such as Philipps and Hewlett-Packard, used to build into their products the transformers and plugs needed for different markets. Then, they had to keep separate stocks of products destined for each country. Now, they make the transformers and cables as separate, external units. They only keep stocks of the basic, standard products and then customize then for different markets by adding the appropriate transformer and plugs at the last minute. The result, of course, is much lower inventory stocks.

Source: Donald Waters, ***Logistics: An Introduction To Supply Chain Management*** (Hampshire UK: Palgrave MacMillan, 2003), pp. 32-33.

Customer preference variations predispose manufacturers to offer extensive product lines to appeal to a range of customer segments, notwithstanding the customization costs accruing with specialized product offerings (e.g., shorter production runs with more products in a line). Perhaps less obviously, demand-supply matching is more challenging for each item in an extensive product line, since forecasting errors are inevitably larger as more disaggregate forecasts are required. The theory of postponed production is to mass produce a core product and then finish, customize, or refine it relatively close to the final customer, when customer preferences and demand for particular product variations are known.

With related products as in LINKS, some further supply chain management possibilities arise. The supply-demand imbalance issue still exists, of course, with the painful aspect that some products will have too much finished goods inventory at the regional distribution centers while other products will have too little finished goods inventory. If only there was a way to use the related products to meet these local supply-demand imbalances. Postponed production is one such strategy. **Retrofitting hyperware to become metaware and vice-versa would be another hypothetical strategy, but that's not possible in the set-top box for a variety of engineering and design reasons.**

FYI: Mass Customization

Modularized design and postponement allow manufacturers to build standard modules and put off making the final product from those modules until the very last minute. This gives them the flexibility to respond to changes in orders and in markets so they can minimize the risk both of putting the wrong products on the shelves and of consuming capacity better used to produce products in demand. The idea of postponement is to build a plain vanilla base product, then wait until the last minute to configure it precisely to the customer's needs.

Source: Adapted from G. Berton Latamore, "The Burden of Choice: Mass Customization Drives Market Differentiation," ***APICS — The Performance Advantage***, Volume 11, Number 1 (January 2001), p. 42.

Paint is an ideal example where postponed production is crucial. Suppose that paint had to be manufactured in all possible colors and shades at the manufacturing plant. This would involve hundreds or thousands of paint SKUs. Each paint SKU would have to be inventoried individually throughout the paint supply chain. Efficient inventory management of paint SKUs would be impossible. Too much paint of one color would accumulate at some DCs or retail outlets while there would be shortages of that paint color at other DCs or retail outlets. But, consider an alternative manufacturing process: base paint ingredients (prime colors) are produced at the manufacturing paint and these base paint ingredients are suitably mixed at the DCs, retail outlets, or at the customer's site to form the final paint color. In such a postponed production system, customization of paint color occurs close to or at the point of sale and inventories of paint SKUs do not accrue throughout the paint supply chain. With postponement, production of paint ingredients (base colors) occurs at the manufacturing plant with final customization into a finished product (paint color) occurring later in the supply chain, at the DC, retail outlet, or customer's site.

Hyperware and metaware share a variety of engineering and production characteristics. Except for a few product configuration elements (Gamma or Delta), hyperware and metaware products share a common production/engineering platform. To take advantage of this common production platform, postponed production is possible.

Postponed production involves creating a partially completed product, referenced as product "0" (zero), at your firm's manufacturing plant. Inventories of product "0" are tracked, like all other

finished goods inventories of your other products, from your manufacturing plant to your distribution centers. **Postponed production occurs at your regional distribution centers and involves converting product "0" into specific finished goods. With postponed production, final product identity is assigned at the distribution center (DC), not at the manufacturing plant.** Postponed production has the potential to reduce demand-supply imbalances at distribution centers since not all product shipped to the distribution centers has to be completely finished. Product "0" postponed units may be converted into either hyperware or metaware to meet local demand variations across your set-top box product line.

Postponed production is only possible with an owned DC in a region, not with a third-party DC or with no DC.

Production and Postponed Production

The costs associated with manufacturing and postponed production are described in Exhibit 6. DC-specific costs refer to the incremental production costs associated with converting postponed-production units into either hyperware or metaware completed products. There is a fixed cost per order associated with setting up each production run, whether at the manufacturing plant or for postponed production at any distribution center. In addition to these production-related costs, the implied costs associated with the configurations of the products are also added into the costs of the products.

Production volumes for each product (including postponed production [product 0]) can change by a maximum of 10,000 units from the previous month's value. You may, however, change a product's production volume to 0 units at any time, but you'd then be limited to a maximum production volume of 10,000 units in the following month. This constraint on successive month's production volumes is necessitated by load balancing requirements associated with available plant capacity and labor force overtime scheduling requirements.

FYI: Why Hold Inventory?

While low inventory levels are attractive from a cost perspective, there are a variety of reasons for holding inventory:

- *To create buffers against the uncertainties of supply and demand.*
- *To take advantage of lower purchasing and transportation costs associated with high volumes.*
- *To take advantage of economies of scale associated with manufacturing products in batches.*
- *To build up reserves for seasonal demands or promotional sales.*
- *To accommodate products flowing from one location to another (work in progress or in transit).*
- *To exploit speculative opportunities for buying and selling commodities.*

Source: Jeremy F. Shapiro, ***Modeling The Supply Chain*** (Pacific Grove, CA: Duxbury, 2001), p. 477.

In addition to the order-related fixed costs and the unit-related variable costs described in Exhibit 6, your firm absorbs costs associated with depreciation and maintenance of your dedicated plant capacity to manufacture set-top boxes. These costs are $100,000 per month for each production "shift," and they are recorded as "Plant Capacity FC" (plant capacity fixed costs) on your "Corporate Current P&L Statement." These costs are allocated equally among your products.

Exhibit 6: Manufacturing Costs (Per Unit)

		Postponed Production		
	Manufacturing Plant	DC1	DC2	DC3
Postponed Production				
Fixed Costs (per order)	$20,000			
Labor Costs (per unit)	$22			
Production Costs (per unit)	$11			
Hyperware				
Fixed Costs (per order)	$22,500	$5,000	$5,000	$4,000
Labor Costs (per unit)	$30	$14	$15	$12
Production Costs (per unit)	$20	$12	$14	$11
Metaware				
Fixed Costs (per order)	$24,500	$6,000	$8,000	$5,000
Labor Costs (per unit)	$36	$16	$20	$15
Production Costs (per unit)	$16	$10	$12	$10

Note: DC-specific "Postponed Production" costs are incremental, above and beyond "Postponed Production" costs recorded in the "Manufacturing Plant" column. For example, the total fixed costs (per order) associated with postponed production for hyperware completed at DC1 are $20,000+$5,000=$25,000.

With postponed production, the semi-completed set-top box (product 0) must be initially configured at the manufacturing plant to facilitate ultimate conversion to a specific hyperware or metaware product at the second-stage of postponed production which occurs at the regional distribution center. To do this, some elements of the set-top box must initially be overbuilt to ensure downstream conversion flexibility. **Postponed production of product 0 requires raw materials values of Alpha and Beta equal to 9.** At postponement completion at a regional distribution center, excess raw materials are retooled out of semi-completed production as product 0 is transformed into a complete finished product (product 1 or product 2). These excess raw materials are waste and have no recovery value.

- **Raw materials (Alpha and Beta) are only procured and inventoried at your manufacturing plant, not at your distribution centers.** The first-stage production process in postponed production occurs only at your manufacturing plant. That's where raw materials are embedded into your products, both postponed production and completed/finished goods. Raw materials are never needed at your distribution centers.
- **With postponed production, all sub-assembly components (Gamma, Delta, and Epsilon) are applied to the final-form product at the distribution center. Thus, inventories of all sub-assembly components must be maintained at DCs where postponement is executed.**
- With postponed production, the bandwidth associated with a product is engineered in at the final production stage at your distribution center, not during initial production at your plant.
- **Postponed production qualifies as "local" manufacturing at the owned DC in which product "0" is converted into finished goods. No duties and tariffs are payable for such**

"local" manufacturing at owned DCs. Of course, by definition, all finished goods sold in market region 1 are "local," since your firm's manufacturing plant is located in market region 1 and you own your DC in market region 1. "Duties & Tariffs" are levied on sales in a market region (orders from customers) with appropriate credit being provided for "local" production (i.e., for the second-stage of postponed production when the final identity is assigned to the finished product at the within-region owned distribution center).

Postponement and reconfiguration are two different concepts. With postponement, you're not actually establishing the identity of the postponed product (product 0) until the second-stage of the production process, at the distribution center when postponed production (product 0) is converted into a final finished good. Reconfiguration, on the other hand, involves changing the configuration of a fully complete/finished set-top box product.

Case Study: Zara

International fashion retailer Zara has crafted a value proposition of combining moderate prices with the ability to offer new clothing styles faster than competitors. To make this happen, the company designs and cuts its fabric in-house, and it acquires fabrics in only four colors to keep costs low. Zara postpones dyeing and printing designs until close to manufacture, thereby reducing waste and minimizing the need to clear unsold inventories.

Source: "How Zara Stays on the Cutting Edge," ***Optimize Magazine*** (December 2003).

A production "shift" can accommodate up to 50,000 units of production per month. If your total production volume across all products (including regular and postponed production at your manufacturing plant) is less than 50,000 units per month, then you only need one production shift, and the associated costs are $100,000. If your total production volume across all products (including regular and postponed production at your manufacturing plant) is 50,001 to 100,000 units per month, then you need two production "shifts" in that month, with associated costs of $200,000. The LINKS software automatically schedules the appropriate number of production "shifts" based on your total production volume. You must always have at least one production "shift" capability at all times, even if your total production volume in a month is zero units.

Unfilled Orders

Unfilled orders can exist in your set-top box industry. If demand for any product exceeds finished goods inventory, customer sales and scheduled product shipments to other DCs must be reduced (proportionately) by the amount that orders exceed finished goods inventory. The difference between potential customer sales (orders) and actual customer sales due to inadequate on-hand finished goods inventory is "unfilled orders" in LINKS.

Unfilled orders are not backlogged orders. Unfilled orders are not guaranteed (i.e., contracted, pre-paid) future sales. Unfilled orders occur at a particular time due to inventory shortages relative to potential customer demand (orders), given competitive conditions at that particular time.

Unfilled orders incur processing and handling costs of $25/unit.

Past experience suggests that current unfilled orders reflect three types of set-top box customers. Some customers immediately defect to another competitor's (available) product. Other customers decide not to buy any set-top product now or in the near-term future. A third segment

of customers are inclined to wait and attempt to repurchase the preferred product having these unfilled orders again in the future when supply (i.e., inventory availability) is more favorable. The size of these three types of unfilled-orders customers is unknown. In all cases, however, it should be expected that unfilled orders negatively impacting downstream demand to some extent.

If competitive conditions change (e.g., if you raise your unfilled-orders product's price dramatically or competitors substantially improve their own product offerings and marketing programs), then the share of customers with unfilled orders who would have been inclined to attempt to repurchase your unfilled-orders product in the future can decrease. Additionally:

- If you drop a product with unfilled orders from active distribution in a particular channel and region, the unfilled orders associated with that product in that particular channel and region are completely lost. They will not shift to another product, even your own dropped product still actively distributed in another channel in that region.
- If you reconfigure a product with outstanding unfilled orders, those unfilled orders are lost.

Unfilled orders represent additional potential demand that might have been realized beyond "filled orders" (i.e., sales) if sufficient product supply had been available to meet customer purchase requests. Note that unfilled orders also reflect industry-wide double-counting if multiple firms' products simultaneously have unfilled orders. If two products simultaneously have unfilled orders, then some customers might have wished to purchase first one of the products and then the other product when the stockout situation for the first product was encountered. In such a situation, a single customer would have been counted as an unfilled order by both stocked-out products.

The definition of unfilled orders varies by channel. For a direct channel (like channel #2), an unfilled order to an end-user customer is the same as an unfilled order to the manufacturer. However, for an indirect channel (like channel #1), inventory buffer stock routinely maintained by retailers complicates the interpretation of unfilled orders. If retailers order 1,000 units from a manufacturer but that manufacturer is only able to fill 600 units of that order, this represents 400 units of unfilled orders to the manufacturer. However, this doesn't necessarily mean that retailers have unfilled orders from end-user customers. If the 600 units of the retailers' manufacturer-order yield sufficient on-hand retailer inventory to permit all end-user customer orders to be filled, then there are no unfilled orders as far as retailers are concerned. (In this case, retailers' ending inventory level would be below the desired level, which presumably would lead to increased orders in the following month to meet expected end-user customer demand plus inventory restocking targets.) With the buffering nature of retailer inventory, there could be no industry-wide unfilled orders but individual manufacturers could still have unfilled orders in channel #1.

If dealers stockout, they'll reorder in anticipation of future rising demand above current sales levels, as well as having to account for their (i.e., dealers') desired inventory levels in the future. These are the total unfilled orders that manufacturers see arising from channel #1. Industry-wide unfilled orders, as reported in Research Study #12, reference actual final end-user customer stockouts now (not in the future). Note, too, that since industry-wide unfilled orders are customer-based, industry-wide unfilled order estimates presumably are based on customer surveys. Such survey-based estimates contain some statistical noise as well as reflecting the potential for biases in customer surveys, especially if there are lots of customers who encountered stockout situations. Thus, even a thoughtful/rational survey respondent might claim to have wanted to buy and encountered a stockout situation, to encourage manufacturers to have more plentiful inventory, especially when no contractual purchase commitment is required within the survey.

Manufacturing Decisions

Firm	

Month	

Manufacturing Decisions	Product 0	Product 1	Product 2
Production			

***Notes**:*
(1) "Product 0" refers to postponed-production units.
(2) Each production volume may change by a maximum of 10,000 units from the preceding month's value. You may, however, change production to 0 at any time. However, note that with a production value of 0 units, the following month's production volume would be limited to a maximum of 10,000 units.

Reminders

Only input changes. If you're happy with the current values of these decisions, leave the appropriate decision entries blank.

Don't forget to zero-out prior production decisions if you don't wish them to continue on into the next month.

All decision inputs change the existing values to the values that you specify. Do not enter "+" or "-" values. Rather, enter new values only (new values replace the existing value of the decision variable with your designated value).

Chapter 6: Distribution Decisions

Distribution decisions in LINKS include whether you have distribution centers (DCs) in regions other than your home-base (i.e., region 1) and, if so, the form of those DCs (outsourced vs. owned). For each region-specific DC, you also face a decision related to how RFID-application occurs for products distributed through the retail channel (channel #1).

Distribution Center Decisions

While you must always have an owned DC in region 1, you may or may not wish to have DCs in other regions. Even if you choose not to have a distribution center in a region other than region 1, you can have sales in that region if you choose to actively distribute products in any channel in that region. Such sales would be serviced directly from the region 1 DC.

With a distribution center in a region:

- Replacement parts demand is fulfilled from that regional DC, rather than from DC1, thus requiring inventories of sub-assembly components to be maintained at such regional DCs.
- Postponed production is possible at owned DCs, with consequent implications for inventorying of sub-assembly components at that regional DC.
- When you open a regional distribution center, you'll have no inventory of sub-assembly component Epsilon available at that DC for the first month. Thus, all first-month usage of Epsilon will be on an emergency basis, with consequent emergency ordering costs.
- Transportation of finished goods to customers from a regional DC is via surface transportation. Otherwise, air transportation is required to ship finished goods from the distribution center in region 1 to customers in other regions without a local distribution center.

Three distribution center decision options exist in regions other than region 1. In region 1, you must always own your distribution center (located adjacent to your manufacturing plant in region 1). The distribution center decision options, along with their cost consequences, are as follows:

- Decision Option "0" (don't have a distribution center): No distribution center costs exist.
- Decision Option "1" (outsourced third-party distribution center): By using a third-party logistics strategy, your firm outsources your regional distribution center to a reputable partner in any market region. Outsourced distribution centers involve one-time costs of $100,000 to open an outsourced distribution center, $50,000 in one-time costs to close an outsourced distribution center, $50,000 in recurring monthly costs as long as your firm has an outsourced distribution center in any region, and inventory charges of 5% based on the inventory value at any outsourced distribution center. These one-time costs of $100,000 are incurred to open any outsourced distribution center or to convert any owned distribution center to outsourced status.
- Decision Option "2" (operate owned distribution center): In operating your own distribution centers, your firm incurs one-time costs of $250,000 to open an owned distribution center in any market region, $150,000 in one-time costs to close any owned distribution center, $25,000 in recurring monthly costs as long as your firm owns a regional distribution center, and inventory charges of 3% based on the inventory value at owned regional distribution centers. These one-time costs of $250,000 are incurred to open any owned distribution center or to convert any outsourced distribution center to owned status.

Inventory costs are recorded under "Inventory Charges" on your "Corporate P&L Statement" and other distribution costs are recorded under "Distribution FC" on the "Corporate P&L Statement."

Your firm either has no DC in a region or your firm has one DC in a region. Your firm never has more than one DC in a region. The DC status code "2" denotes an owned DC in a region, not two DCs in that region.

DC-openings and DC-conversions (from outsourced to owned or from owned to outsourced) occur immediately (i.e., at the start of the next month). In DC-conversions, existing inventory is automatically transferred to the new DC-form.

The LINKS software automatically disposes of any residual inventory of sub-assembly components and finished goods when a DC is closed. The inventory is converted to cash at the current balance-sheet values and a corresponding disposal cost of 20% of the inventory's value accrues. This disposal cost is recorded under Consulting Fees on the firm's P&L statement. An appropriate disposal-sale message appears at the end of the firm's financial statements.

Postponed production is only possible with an owned DC, not with a third-party DC.

RFID-Application For Retail-Channel Sales

A recent development in the set-top box industry has increased your costs associated with selling through the indirect channel (i.e., channel #1). Retailers of set-top box products now require that your products be equipped with RFID (radio-frequency identification). Compared to bar codes, radio tags can carry more information about products, can be scanned more rapidly, and can be located easily even if they are hidden in cartons or behind other products. RFID is seen as the long-term successor to bar codes throughout the retail industry.

RFID is applied to your outbound set-top box products at your distribution centers. Only products being distributed to the retail channel (i.e., channel #1) require RFID-application.

At each distribution center, you have two choices with regard to how RFID is included on your set-top box products sold through the indirect (retail) channel.

- Decision Option 0 (outsourced RFID-application): Your current practice is to outsource RFID application to a reputable vendor in each market region in which you have a distribution center. Outsourcing adds $11 in variable costs to all of your set-top box products sold through the retail channel (i.e., channel #1).
- Decision Option 1 (insourced RFID-application): You can insource the provision of RFID for products sold through the retail channel. Insourcing incurs a one-time investment of $350,000 (for capital equipment purchases, process reorganization, and staff retraining) and reduces the variable costs to $1 for all set-top box products sold through the retail channel (i.e., channel #1). The one-time investment of $350,000 is recorded under "Consulting Fees" on your corporate profit-and-loss statement.

Note that there is no re-sale market for used RFID equipment. Therefore, you would not be able to recapture any part of the one-time $350,000 investment in RFID insourcing at any distribution center if you subsequently choose to close that distribution center.

Your RFID decision is specific to each distribution center. Thus, you may choose to insource at some DCs and outsource at other DCs, as you wish.

RFID insourcing is only possible if you already have (or simultaneously open) a DC in a region. With no DC in a region, your set-top box products must be sourced from DC1 and your RFID status at DC1 will be in effect for your retail-channel sales in other regions without a local DC.

Emergency Carriers For Plant-To-DC Shipments

You must also choose an emergency carrier for each of your DCs (other than DC1). This emergency carrier for each DC (other than DC1) is used for plant-to-DC transportation shipments required on an emergency basis. Your emergency carrier choices are recorded on the Distribution Decisions form, since these decisions are specific to each DC.

Distribution Decisions

Firm	

Month	

Distribution Decisions	Region 1	Region 2	Region 3
Distribution Center? {**0**=none | **1**=outsourced | **2**=owned}			
RFID-Application? {**0**=outsourced|**1**=insourced}			
Emergency Carrier? {**I**|**J**|**K**|**L**|**M**|**N**}			

Reminders

Only input changes. If you're happy with the current values of these decisions, leave the appropriate decision entries blank.

All decision inputs change the existing values to the values that you specify. Do not enter "+" or "-" values. Rather, enter new values only (new values replace the existing value of the decision variable with your designated value).

Chapter 7: Transportation Decisions

This chapter details the transportation decisions for which you are responsible in LINKS:

- transportation mode choice (surface and air) for in-bound sub-assembly components
- transportation mode choice (surface and air) and carrier selection for finished goods shipments from your plant to your distribution centers (DCs).

Different kinds of transportation decisions are required in different parts of your supply chain.

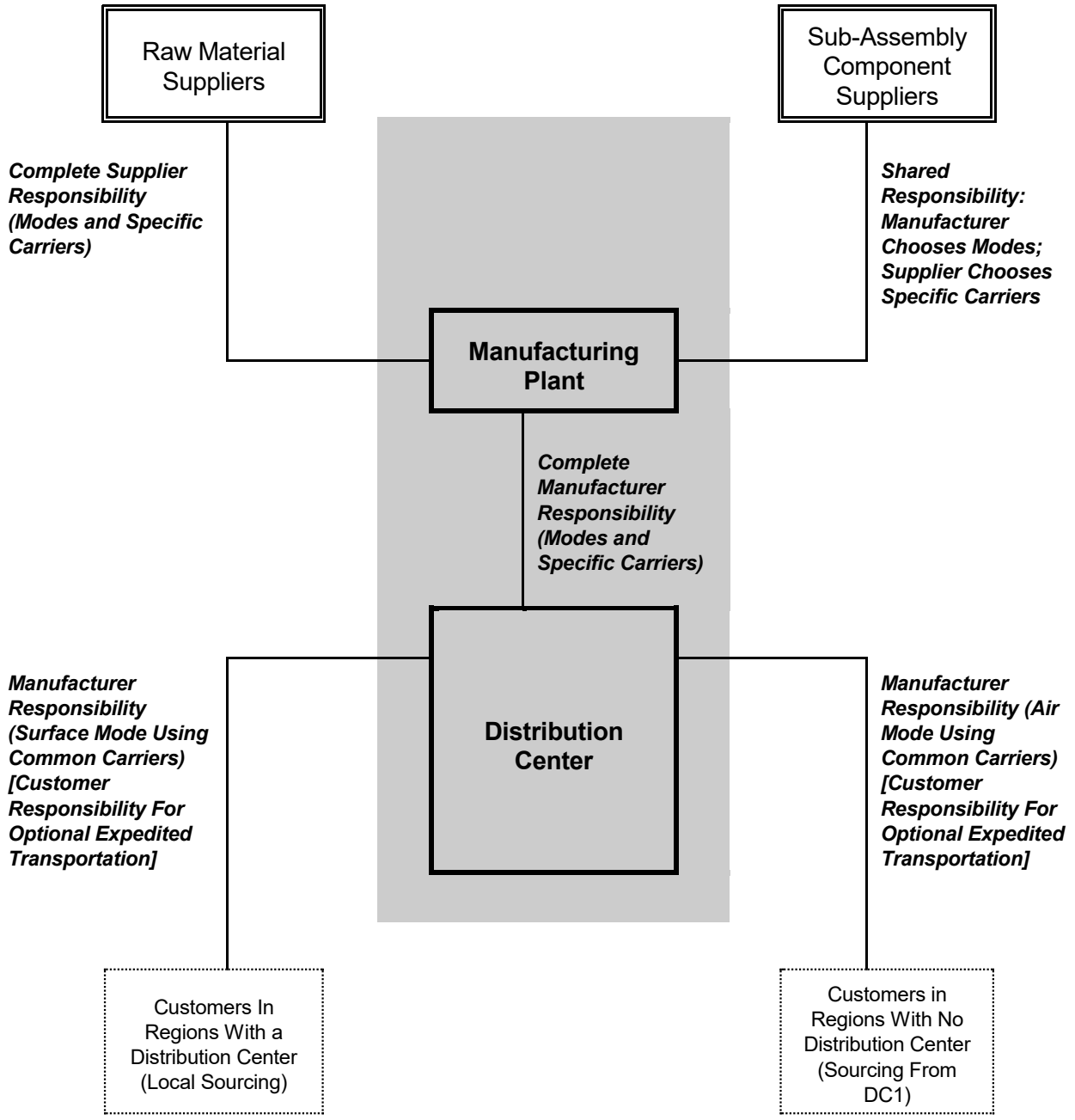
- **Inbound Raw Materials**: Vendors of raw materials in the set-top box industry provide inbound transportation as part of their bundled prices. Thus, there are no transportation decisions for set-top box manufacturers to make with regard to raw materials.
- **Inbound Sub-Assembly Components**: Suppliers and manufacturers are jointly responsible for transportation decisions regarding inbound shipments of sub-assembly components. Suppliers quote unbundled sub-assembly component and transportation mode costs (surface and air). Manufacturers choose modes but suppliers arrange specific carriers for each transaction. Cost and operating details for these transportation modes are provided in Chapter 4. Suppliers choose specific carriers for sub-assembly components to deal with less-than-truckload orders economically and to efficiently manage cross-industry transportation requirements for sub-assembly components.
- **Plant-To-DC Shipments**: Manufacturers are responsible for all transportation decisions related to within-firm shipments of postponed production and finished goods from manufacturing plants to DCs. Transportation decisions include mode choice (surface and air) for carriers I, J, K, L, M, and N. Cost and operating details are provided in this chapter.
- **DC Shipments To Customers**: Set-top box manufacturers ship by surface from within-region DCs and ship by air for customer shipments where a local DC doesn't exist (and direct shipment from DC1 is required). Since corporate policy and set-top box industry custom dictates the transportation modes and the carriers used for these transportation requirements, there are no active decisions required within LINKS at this supply chain linkage. Since the standard costs associated with DC shipments to customers are borne by manufacturers, these transportation activities impact the financial performance of manufacturers. If customers prefer expedited transportation above and beyond the standard transportation modes used, customers absorb any incremental costs associated with expedited transportation.

Exhibit 8 summarizes the roles of transportation throughout the set-top box industry supply chain. Some transportation decisions are the responsibility of suppliers, others are shared between suppliers and manufacturers, and still others are the manufacturer's responsibility.

Plant Shipments To Distribution Centers

The regional distribution center in region 1 is located adjacent to your manufacturing plant, so there are no transportation costs associated with shipments of your products to your distribution center in market region 1. For all other market regions, transportation decisions are required to ship your products to regional distribution centers. You make shipment volume decisions across two transportation modes (surface and air) and six possible carriers (I, J, K, L, M, and N).

Exhibit 8: Transportation Responsibilities



Notes: Transportation responsibilities in the set-top box industry are indicated by the bolded and italicized text at each supply chain linkage point where transportation activity occurs. The set-top box manufacturer's supply chain management responsibility domain is shaded. Recall that set-top box manufacturers both manufacture and manage distribution centers in the set-top box industry.

Based on past experience, 100% of all postponed production and finished goods shipped by air arrives at regional DCs to meet current-month orders. This 100% reliability of delivery is a major advantage of air transportation: guaranteed delivery performance. Of course, air transportation does have a cost premium over surface transportation.

Based on past experience, an average of about 70% of surface transported volume arrives at regional DCs in time to meet current-month orders. However, average surface delivery performance varies across carriers and regions. The range of surface transported production volumes received within the current month varies from about 40% to 100%. Surface transported finished goods volume that does not arrive within the current month always arrives by the end of the current month and it is, therefore, available for meeting orders in the following month.

FYI: Transportation Strategy

"When contracting for transportation, it is common for U.S. companies to bid for capacity on certain origin-destination movements ('lanes') and then bid separately for 'surge capacity.' Surges occur when a company's business grows unexpectedly in certain regions of the country (as a result of weather, for example or because of an unanticipated large order). Transportation carriers cannot be expected to have trucks or rail cars in reserve everywhere 'just in case.' They can, however, put in place certain operational procedures to identify available resources and move them around, helping them to respond to surges. Such surge capacity is typically priced higher, in acknowledgement of the extra equipment repositioning required by the carriers to respond to the increased demand."

Source: Yossi Sheffi, **The Resilient Enterprise: Overcoming Vulnerability For Competitive Advantage** (Cambridge MA: The MIT Press, 2005), p. 99.

Current transportation costs per unit between your manufacturing plant and your regional distribution centers for all carriers are shown in Exhibit 9. Note that these transportation costs are identical for all set-top box products (i.e., for hyperware and metaware products). Since postponed production can be shipped in bulk form to regional distribution centers, the cost of postponed production is 50% of the costs associated with transporting finished goods to a DC.

The surface delivery rates ("Delivery") in Exhibit 9 are averages. The typical range of delivery rates is shown in "±" form (for example, "70% ± 8%" reflects an average surface delivery rate of 70% with a typical range for that average being 62% to 78%. The "100%" delivery reliability for air transportation reflects the certainty of delivery within the current month when air transportation is chosen for plant-to-DC shipments.

FYI: Surface Transportation Delays

"In many parts of the world, the transportation infrastructure is relatively undeveloped or congested. Imagine, for example, sourcing product from a factory in Wuhan, China for retail sale within the US. After manufacture, the product may travel by truck, then by rail, by truck again, and then be loaded at a busy port; and it may repeat the sequence of steps (in reverse order) within the US. At each stage the schedule may be delayed by congestion, bureaucracy, weather, and road conditions."

Source: John J. Bartholdi and Steven T. Hackman, **Warehouse & Distribution Science** (Atlanta: Georiga Institute of Technology, 2010), p. 5.

Occasionally, carriers have limited available space and are unable to offer any shipping services in a particular month. This might arise due to prior contractual obligations, seasonal forces, or environmental developments (e.g., strikes, equipment limitations, etc.). Set-top box manufacturers that already have an on-going relationship with a carrier (i.e., firms that used a

carrier last month) receive preferential treatment as existing customers and, therefore, are normally unaffected by spot-market unavailability conditions with such carriers. If your specified carriers are unavailable in any month, carrier N will be used. Carrier N has an unblemished past record of availability and is the well-recognized carrier-of-last-resort in the set-top box industry.

Exhibit 9: Plant-To-DC Transportation Shipments

	Market Region 1	Market Region 2		Market Region 3	
		Cost	Delivery	Cost	Delivery
Carrier I, Surface Carrier I, Air		$6 $8	70% ± 4% 100%	$10 $14	70% ± 4% 100%
Carrier J, Surface Carrier J, Air		$4 $10	40% ± 8% 100%	$4 $14	30% ± 8% 100%
Carrier K, Surface Carrier K, Air		$6 $8	70% ± 12% 100%	$6 $14	60% ± 12% 100%
Carrier L, Surface Carrier L, Air		$8 $10	75% ± 4% 100%	$6 $14	60% ± 4% 100%
Carrier M, Surface Carrier M, Air		$6 $8	65% ± 8% 100%	$8 $16	75% ± 8% 100%
Carrier N, Surface Carrier N, Air		$10 $12	82% ± 12% 100%	$12 $18	78% ± 12% 100%

Note: Since your manufacturing plant is located adjacent to your DC in market region 1, there are no transportation shipments from your manufacturing plant to DC1.

Carriers offer a 20% rebate on the transportation charges if they are used exclusively in a given month. Shipments from your plant to your DCs may be divided between surface and air, but the 20% rebate only accrues if all of your plant-to-DC shipments (**including emergency shipments**, if any) are via a single carrier. This rebate is recorded as "Transportation Rebates" on your "Corporate P&L Statement."

You must also choose an emergency carrier for each DC (other than DC1). This emergency carrier for each DC (other than DC1) is used for plant-to-DC transportation shipments required on an emergency basis. Your emergency carrier choices are recorded on the Distribution Decisions form, since these decisions are specific to each DC.

Distribution Center Shipments To Customers

Your firm is responsible all costs associated with shipping your products from your DCs to your customers, to retailers in the retail channel and to end-users in the direct channel.

- If your firm has a distribution center in a region, then that distribution center is used to service all orders for set-top boxes. Your firm's policy is to ship by surface transportation when you have a local within-region distribution center. Occasionally, customers may request expedited shipment, but the custom in the set-top box industry is for customers to pay any incremental shipping charges above surface transportation rates.
- If your firm does not have a distribution center in a market region, then the distribution center in market region 1 (i.e., the distribution center associated with your manufacturing plant) must service such an order. Your firm's transportation policy is to ship via air in such situations, to ensure prompt delivery to customers within the current month.

The transportation costs associated with customer shipments are shown in Exhibit 10. Since direct-channel customers order in smaller quantities, shipping costs to customers in the direct channel (channel 2) are higher than the retail channel (channel 1). The cost of shipping replacement parts to end-users is 50% of the cost of shipping finished products to customers.

Exhibit 10: Customer Shipment Transportation Costs (Per Unit)

	Within-Region Surface Transportation Costs		Sourcing From Plant/DC1 With No Within-Region DC	
	Channel 1	Channel 2	Channel 1	Channel 2
Market Region 1	$4	$8		
Market Region 2	$6	$12	$18	$28
Market Region 3	$8	$16	$26	$36

Outbound Shipments

By combining the Exhibit 9 and Exhibit 10 data, total transportation costs for outbound shipments may be determined for any choice of plant-to-DC carrier. The total transportation costs for "outbound shipments" refers to finished goods transportation costs from the manufacturing plant to the customer, either through the "local" DC if one exists or directly from the plant/DC1 to regions where no "local" DC exists. Exhibit 11 contains the relevant calculations for a sample carrier, carrier I. Alternative calculations would follow for other plant-to-DC carriers.

- Costs for "air to DC" shipping for plant-to-DC shipping exceed "surface to DC" shipping.
- In all cases, total transportation costs are less when a "local" DC exists than when air sourcing is required from the plant/DC1 because no "local" DC exists. Of course, this variable cost advantage for having a "local" DC does not take into account the fixed costs of operating DCs and the incremental management effort required to manage a more complicated supply chain.
- In all cases, channel 1 total transportation costs are less than channel 2 total transportation costs, reflecting the relative costliness of shipping to individual (direct) customers purchasing single units of set-top boxes.

Exhibit 11: Sample Plant-DC-Customer Total Transportation Costs

	Channel 1			Channel 2		
	"Local" DC		Air Sourced From Plant/DC1	"Local" DC		Air Sourced From Plant/DC1
	Surface To DC	Air To DC		Surface To DC	Air To DC	
Region 1	**4**			**8**		
Region 2	6+6=**12**	8+6=**14**	**18**	6+12=**18**	8+12=**20**	**28**
Region 3	10+8=**18**	14+8=**22**	**26**	10+16=**26**	14+16=**30**	**36**

Notes: These total transportation costs refer to finished goods, not to postponed production. They reflect the sum of the cost of shipping finished goods from the plant/DC1 to the regional DC plus the cost of shipping finished goods to the final customer from the regional DC. With sourcing from plant/DC1 (when there is no "local" DC), the former cost is, of course, zero. These sample total transportation cost calculations reference carrier I for plant-to-DC shipments

Emergency Transportation Shipments

LINKS calculates inventory requirements at DCs in the first instance assuming that all potential demand can be met. This can lead to "tentative" emergency shipments being created from DC1 to other regions. After making adjustments for possible conversion of available postponed production, remaining excess demand over available inventory results in unfilled orders. Then, for example, if total worldwide unfilled orders represent 28.35% of total potential demand, all shipments including "tentative" emergency shipments are reduced by 28.35% to reflect the unfilled orders situation.

Intuitively, this situation is interpreted as follows. The regular (planned) surface and air transportation system is overwhelmed by unfilled orders. Surface and air transportation is planned ahead of time, presumably on a more-or-less regular basis throughout a month (e.g., weekly shipments). With unfilled orders occurring, (unplanned) emergency shipments have to

occur immediately to meet on-going unfilled orders. This can result in regular surface and air transportation shipments being converted to emergency shipments, with a corresponding reduction in the original amounts of the regular surface and air transportation shipments.

Emergency transportation shipments to a regional DC cost 50% more than the current air transportation costs of your designated regional emergency carrier.

Transportation Decisions

Firm	

Month	

Plant Shipments To DC2	Carrier I	Carrier J	Carrier K	Carrier L	Carrier M	Carrier N
Product 0, Surface						
Product 0, Air						
Product 1, Surface						
Product 1, Air						
Product 2, Surface						
Product 2, Air						

Plant Shipments To DC3	Carrier I	Carrier J	Carrier K	Carrier L	Carrier M	Carrier N
Product 0, Surface						
Product 0, Air						
Product 1, Surface						
Product 1, Air						
Product 2, Surface						
Product 2, Air						

***Notes**:*
(1) "Product 0" refers to postponed-production units.
(2) Residual inventory (inventory not explicitly shipped to another DC) is automatically "shipped" from your plant to your adjacent DC in region 1, with no associated shipment costs.

Reminders

Only input changes. If you're happy with the current values of these decisions, leave the appropriate decision entries blank.

Don't forget to zero-out prior transportation decisions if you don't wish them to continue on into the next month.

All decision inputs change the existing values to the values that you specify. Do not enter "+" or "-" values. Rather, enter new values only (new values replace the existing value of the decision variable with your designated value).

Chapter 8: Service Decisions

Rather than actively managing service, service is outsourced in the LINKS Supply Chain Management Fundamentals Simulation. Service outsourcing is provided by reputable call-center service providers in each region and is region-specific.

- Your firm's policy is to use the "Standard" level of outsourcing, with the following per-call costs and associated guaranteed service quality performance levels ("SQ Guarantee"): $10, $12, and $13 per call in regions 1, 2, and 3, respectively with a 20% service quality guarantee.
- These "SQ Guarantees" are long-run averages. Service-center outsourcers guarantee that perceived service quality won't vary by more than 3% from these averages in any month. Costs for call-center service outsourcing are reported as "Service Outsourcing" on your financial and operating reports.

Chapter 9: Generate Demand Decisions

Your LINKS firm is responsible for several region-specific and channel-specific generate demand decisions: channel selection, pricing, and marketing spending. Aspects of your supply chain management decisions influence end-user demand (e.g., product configuration, sub-assembly component in-field failure rate, and service center performance). Thus, supply chain management efforts must be closely coordinated with generate demand decisions.

Channel Decisions

> *"Channel selection ultimately boils down to three factors: (1) identifying channels that are well suited to customers' buying behaviors and needs; (2) ensuring that there is a good fit between those channels and a set of products and services; and, (3) determining which of those channels offers the most favorable economics."* – Lawrence G. Friedman and Timothy R. Furey, ***The Channel Advantage*** (Butterworth Heinemann, 1999), p. 76

There are two sales channels within LINKS market regions: retail and direct. You may choose to distribute your set-top box products in either, both, or neither channels in each market region. ("Neither" is the same as dropping a product from active distribution in a channel and region.)

- **Channel 1 is a retail channel.** The retail channel serves individual consumers who purchase set-top boxes for home use and businesses with set-top box needs. Retailers stock set-top boxes, along with an array of other similar and complementary electronic products. Retailers provide point-of-purchase support for in-person shoppers.
- **Channel 2 is a direct channel.** In the direct channel, firms sell set-top boxes directly to final customers via an e-commerce channel. Since your firm sells to final end-users in the direct channel, the price in the direct channel is the final price paid by customers.

FYI: Dell's Direct-Channel Strategy

- Sell what you have: Use day-to-day pricing and incentives to shift demand.
- Minimize stock: Carry less than four days of inventory (many companies routinely carry 30 days or more).
- Ensure extremely crisp product lifecycle transitions.
- Leverage real-time customer feedback and market insights.
- Control pricing on a real-time basis.

Source: William Copacino and Jonathan Byrnes, "How To Become a Supply Chain Master," ***Supply Chain Management Review*** (September/October 2001).

Alternative distribution channels tap into common and distinct customers, so the channels partially compete with each other. Some customers only purchase a set-top box product if it's available in their preferred distribution channel. Other customers purchase set-top box products from any of the available channels, to the extent that multiple channel options are available. These latter customers will, of course, shift some of their purchases away from existing channels and toward new channels, as new channels become available.

Another source of sales for new channels is channel-captive customers. Channel-captive

customers have not purchased in the past due to the absence of products being sold via their strongly preferred channel, the channel to which they are captive. Markets can grow (i.e., total category sales volume can increase) as firms open new channels, since captive customers in non-available channels do not purchase unless products are available in the preferred channel.

Differential order processing costs accrue for sales in these two channels in all regions: $4/unit and $24/unit in channels 1 ("Retail") and 2 ("Direct"), respectively.

Price Decisions

You set prices for each of your products that are actively distributed in each market region and channel each month. The retail channel price is the bulk-rate price for all units purchased for resale by retailers. The custom in the set-top box industry is to quote a single price regardless of order volume. In the direct channel, you set the final price paid by end-users.

You don't control final selling prices in the retail channel. Rather, your manufacturer price is marked up by a percentage by retailers in the various regions. You'll need to consult current research studies to determine average retailer prices for your products in the various regions. In the direct channel, you control final selling prices, since you're selling direct to final end-users.

You must take potential cross-channel competition into account in your price setting. If you sell a product in multiple channels in a market region, some customers will inevitably seek out the lower-priced channel to purchase preferred brands.

Prices affect customer demand in the usual fashion within the set-top box industry. Higher prices are normally associated with lower levels of customer demand in all markets, categories, and channels. The specific price sensitivities in the markets, categories, and channels that you face in LINKS are unknown. You will need to learn about the markets' responsiveness to price through your experience in LINKS and by exploiting available LINKS research studies. It's very easy to drop price to attempt to increase demand. However, it's always an interesting question whether that increased demand actually increases profits. Remember, the price drop that generates increased demand also reduces your margin on each unit sold. More importantly, it's easy for competitors to see and feel threatened by a price change.

In addition to the physical costs of producing and distributing updated price sheets, lists, and databases that accrue when a manufacturer changes price (so-called "menu costs"), a range of indirect and non-obvious costs arise with price adjustments.

- Managerial Costs: A manufacturer must gather information, analyze, assess, and ultimately communicate the logic associated with price changes throughout their firm. Managerial costs presumably increase with larger price changes, since there is more to assess/analyze and more organizational members become involved with larger price changes.
- Customer-Facing Costs: When implementing price changes, a communications program must be created and executed to portray a price change in the most favorable light to customers. In a B2B environment, price adjustments potentially involve (re)negotiation with those customers who are resistant to new (higher) prices.

In LINKS, each price change by your manufacturing firm for a product in a channel in a market region costs $10,000 **plus** $200 in costs per-dollar change in price (increase or decrease in price) **plus** costs of 0.25% of current-month revenues. For example, a $75 change in price on

a product with revenues of $4,500,000 in a particular channel and region incurs price change costs of $10,000 + ($200)(75) + (0.0025)($4,500,000) = $10,000 + $15,000 + $11,250 = $36,250. These price change costs are recorded as “Price Changes” in your firm’s profit-and-loss statements in the month in which the price change occurs.

Price change costs only accrue for products that are already actively being sold in a channel and region. No price change costs accrue for price changes for a product as it is being introduced into a channel and region (i.e., it was inactive in that channel and region in the last month).

Price wars are often initiated by thoughtless price manipulations by naive managers who assume that competitors won't notice, won't respond, or respond ineptly. To provide a fact-based approach for making pricing decisions, please refer to the "Pricing Worksheet" on the following page. Complete this "Pricing Worksheet" anytime you're planning to reduce prices. Review the worksheet details with your teammates. After this review, go ahead with the price decrease if you really think that it's appropriate. Review this "Pricing Worksheet" again after you receive next month's financial results to verify whether your assumptions and predictions were reasonable.

Marketing Spending Decisions

A marketing spending budget is required for each product in each region and channel. This budget, managed by your firm’s region and channel managers, is used for advertising, promotion, and sales force efforts associated with your products. You’re free to allocate funds to marketing spending as you see fit and spending doesn’t have to be equal in all regions and channels.

Significant percentages of advertising and promotion budgets are automatically spent on digital marketing, as is typical practice in other comparable industries. This includes allocations to Facebook, YouTube, and Google, for example, as well as location-based mobile marketing.

All marketing spending budgets are at your discretion within the limits of existing corporate policy. **Current corporate policy is that marketing spending budgets may not vary by more than $100,000 from their initial values for any product in any channel in any region.** That is, if the original marketing spending budget is $100,000 when you take over management of your firm in LINKS, then the maximum marketing budget spending discretion that you have is in the range of $0-$200,000. Values that exceed these discretionary limits will be automatically adjusted by the LINKS software.

Pricing Worksheet

This pricing worksheet is designed to provide an analysis framework anytime you are contemplating decreasing prices within LINKS.

Complete the "Before" columns and review the "Before" columns with your team members. Complete the "After" column with actual data from the next month, after the results are available. Review the before-after comparison with your team members.

Firm		Product		Region		Channel		Month	

		Before Action Analysis, Review, and Forecast		After Action Review
		Last Month, Actual	Next Month, Predicted	Next Month, Actual
	Industry Sales Volume [units]			
*	Volume Market Share [%s]			
=	Sales Volume [units]			
*	Manufacturer Price [$]			
=	Revenue [$]			
-	Variable Costs [$]			
=	Gross Margin [$]			
-	Fixed Costs [$]			
=	Operating Income [$]			

Marketing spending is thought to increase customer demand for set-top box products in all regions and channels. Past industry practice has been to budget at least $50,000 per month in marketing spending in all regions and channels in which a product is actively distributed. It is thought that marketing spending's impact on customer demand declines somewhat at higher spending levels, but the precise form of the relationship between spending and sales is unknown. You'll have to learn about marketing's influence on sales through your experience within the set-top box industry.

Since the channels overlap to an extent, marketing spending in one channel of a region will have some spillover in influencing customers in the other channel. Advertising, for example, targeted at individual consumers will have some spillover to businesses that purchase in the direct channel.

If you drop a product from active distribution in a region or channel, you must also reduce the marketing spending to $0. Otherwise, marketing spending will continue to occur, perhaps in anticipation of a future relaunch.

Introduction/Drop Decisions

You may introduce products into regions or channels not currently active or drop products from regions or channels as you see fit. Introduction incurs a one-time cost of $100,000. Dropping a product from active distribution in a region or channel incurs no special costs. Introduction costs are recorded under "Introductions" on your financial statements.

If you wish to "activate" a product in a channel/region, you must issue a specific introduction decision. Change the "Active Product?" status to "Yes" to introduce a product into a specific channel and/or region. To drop a product from active status in a channel or region, change its "Active Product?" status to "No."

You only have to introduce a product into a channel/region once. Once a product is active in a channel/region, it remains active until you make an explicit drop ("No") decision.

You must explicitly introduce or drop a product from a channel and/or region, regardless of your marketing spending and your sales volume forecasts. Setting marketing spending to zero does not result in the associated product being dropped from that market region and channel.

If you drop a product from active distribution in a region or channel, you must also reduce the marketing spending to $0. Otherwise, marketing spending will continue to occur, perhaps in anticipation of a future relaunch.

Given the capacity constraints associated with your manufacturing plant, your firm has a policy of limiting simultaneous new product-region-channel launches to a maximum of three in any month. For example, if you choose to launch a product in two channels of a region in the same month, that action represents a total of two new launches and only one other launch would be possible in that month in any other combinations of channels and regions. A product reconfiguration isn't a launch if that product is already actively distributed in a channel or a region.

Generate Demand Decisions

Firm	

Month	

Product 1, Channel 1	Region 1	Region 2	Region 3
Active Product? {**Yes** | **No**}			
Price			
Marketing Spending			

Product 1, Channel 2	Region 1	Region 2	Region 3
Active Product? {**Yes** | **No**}			
Price			
Marketing Spending			

Product 2, Channel 1	Region 1	Region 2	Region 3
Active Product? {**Yes** | **No**}			
Price			
Marketing Spending			

Product 2, Channel 2	Region 1	Region 2	Region 3
Active Product? {**Yes** | **No**}			
Price			
Marketing Spending			

Notes: *You only have to introduce a product into a channel once. Once a product is active in a channel, it will continue to be active until you make an explicit drop ("No") decision.*

Reminders

Only input changes. If you're happy with the current values of these decisions, leave the appropriate decision entries blank.

All decision inputs change the existing values to the values that you specify. Do not enter "+" or "-" values. Rather, enter new values only (new values replace the existing value of the decision variable with your designated value).

Chapter 10: Forecasting Decisions

In LINKS, your firm is responsible for short-term sales volume forecasts for all products/channels/regions for the next month.

Good forecasts are the cornerstone of any supply chain management process. Forecasting prowess reflects understanding of the demand drivers of any business. In LINKS, monthly sales volume forecasts are required for retail and direct channel sales of each of your products. While explicit recorded replacement parts forecasts are not required, you will need to forecast replacement parts demand to manage your inventories of sub-assemblies.

Administrative overhead costs increase by 1% for every 1% inaccuracy in your sales volume forecasts. For example, a forecast error of 10% (whether positive or negative) for a product in a region increases the administrative overhead costs for that product in that region by 10%.

- The maximum administrative overhead penalty associated with sales forecasting inaccuracy for each product in each region is a doubling of administrative overhead.
- Forecast error costs are recorded as “Forecast Inaccuracy” costs on your firm’s profit-and-loss statements, so the reported base administrative overhead costs are always $80,000/month and $120,000/month per product in channels 1 and 2, respectively, in all market regions.

Sales volume forecasting decisions are independent of your procurement and production decisions. Sales volume forecasting decisions are your best estimates of customer demand. Of course, your actual procurement and production decisions will be based on additional factors, such as fixed order costs and target inventory levels.

The following page contains a judgmental sales forecasting worksheet that provides a template for systematically approaching the sales forecasting process. Judgmental adjustments are challenging, but at least you're explicitly taking into account that your generate demand program changes, and those of your competitors, influence your sales.

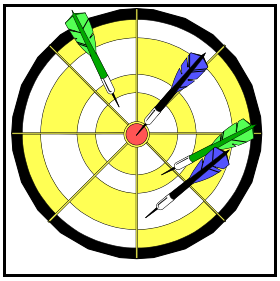
Forecasting Accuracy

Forecasting accuracy is an element of the multi-factor LINKS performance evaluation scorecard described in Chapter 15. In LINKS, forecasting accuracy influences operating performance both directly (via adjustments in base administrative overhead for forecasting inaccuracies) and indirectly (via inventory pipeline inefficiencies [too much or too little inventory]).

Forecasting accuracy is equal to 100*(1-(abs(Forecast-Actual)/Actual)) expressed in percentage terms, where "abs" is the absolute value function. Thus, a forecast value of 11,000 and an actual value of 8,000 results in a forecast accuracy of 100*(1-abs(11,000-8,000)/8,000) = 100*(1-(3,000/8,000)) = 100*(1-0.375) = 62.5%. The minimum possible value of forecasting accuracy is 0.0%. For example, with an Actual sales volume of 8,000, a Forecast above 16,000 results in a forecasting accuracy score of 0.0%.

Judgmental Sales Forecasting Worksheet

Sales forecasting drives everything in the supply chain. Unfortunately, sales forecasting is extraordinarily challenging due to the many factors influencing your sales (your current and recent generate demand programs, current and recent competitors' generate demand programs, and exogenous market forces).



Here's a judgmental sales forecasting process that, at a minimum, provides an organizational template to systematically approach the sales forecasting process. Judgmental adjustments are challenging, but at least you're explicitly taking into account that your generate demand program changes, and those of your competitors, influence your sales.

- **Step 1** (the "easy" part): Construct a trend-line extrapolation of past sales realizations based on a crucial assumption: future market and environmental forces will continue as they have existed in the recent past. Be watchful for structural considerations like channel loading (forward buying), unfilled orders, and backlogged orders.
- **Step 2** (the "hard" part): Make adjustments for planned changes in your generate demand programs. The potential impacts of changes in product, price, distribution, communications, and service on your sales must be quantified.
- **Step 3** (the "subtle" part): Account for foreseeable competitors' changes in their generate demand programs. It's easy to overlook competitors in forecasting. Assume that competitors are vigilant and thoughtful and present.

1	Trend-Line Extrapolation of Past Sales Realizations (Base-Line Forecast)	
2	Adjustments For Planned Changes In Generate Demand Program (list specifics, with judgmental estimates of sales impacts *[expressed in +/- %s]*) Product Changes Price Changes Distribution Changes Communications Changes Service Changes	
3	Adjustments For Foreseeable Changes In Competitors' Generate Demand Programs (list specifics, with judgmental estimates of sales impacts *[expressed in +/- %s]*) Product Changes Price Changes Distribution Changes Communications Changes Service Changes	
	Adjusted Sales Forecast	

About Forecasting and Forecasting Accuracy

Given the importance of forecasting in running your LINKS business, you might find that reading the following article has a positive return on your reading-time investment:

- J. Scott Armstrong, "The Forecasting Canon: Generalizations To Improve Forecast Accuracy," ***FORESIGHT: The International Journal of Applied Forecasting***, Volume 1, Issue 1 (June 2005), pp. 29-35.
  http://www.forecastingprinciples.com/paperpdf/The_Forecasting_Canon.pdf

Forecasting Decisions

Firm	

Month	

Short-Term (i.e., Next Month) Sales Volume Forecast, Product 1	Region 1	Region 2	Region 3
Product 1, Channel 1			
Product 1, Channel 2			

Short-Term (i.e., Next Month) Sales Volume Forecasts, Product 2	Region 1	Region 2	Region 3
Product 2, Channel 1			
Product 2, Channel 2			

Reminders

Only input changes. If you're happy with the current values of these decisions, leave the appropriate decision entries blank.

All decision inputs change the existing values to the values that you specify. Do not enter "+" or "-" values. Rather, enter new values only (new values replace the existing value of the decision variable with your designated value).

Chapter 11: Information Technology Decisions

LINKS information technology (IT) options extend traditional within-firm information technology systems or additional operating reports. The costs associated with your IT decisions are recorded on your "Corporate P&L Statement" under the heading "Information Technology."

IT Synchronization With Plant-To-DC Carriers

You coordinate your transportation needs with specific plant-to-DC carriers via IT synchronization efforts. By linking your IT system with the IT systems of a carrier, an enhanced degree of supply chain synchronization improves surface transportation delivery performance.

- IT synchronization involves a one-time cost per carrier to implement initially and a carrier-specific on-going per-month IT-synchronization maintenance cost. You may terminate IT synchronization with a plant-to-DC carrier at any time at no cost. If you subsequently decide to reestablish IT synchronization, the one-time setup cost would again accrue in the initial month of IT synchronization with any plant-to-DC carrier.
- IT-synchronization linkages improve surface transportation delivery performance for plant-to-DC carriers.
- Exhibit 12 details these specifics for plant-to-DC carriers. Your firm may establish/maintain IT synchronization with one or more plant-to-DC carriers with these costs and benefits.

Decision options associated with each plant-to-DC carrier are as follows:

- Decision Option "0": Do not have IT synchronization.
- Decision Option "1": Establish and maintain IT synchronization with costs and other ramifications as described above.

IT-synchronization decisions are required for each of the plant-to-DC carriers, carriers I to N.

Exhibit 12: IT Synchronization With Carriers, Costs and Benefits

	Plant-To-DC Carriers					
	I	J	K	L	M	N
One-Time Setup Cost	$9K	$8K	$9K	$9K	$6K	$5K
Monthly Maintenance Cost	$7K	$7K	$9K	$8K	$6K	$3K
Surface Transportation Change	+5%	+10%	+6%	+3%	+4%	+2%

Note: See Exhibit 9 for base surface transportation delivery performance statistics. These IT-synchronization adjustments are additive changes. For example, carrier I's surface transportation delivery performance for plant-to-DC shipments is estimated to change (improve) +5%, from 80% to 85%, with an IT-synchronization program in effect.

IT Synchronization With Sub-Assembly Component Suppliers

You may establish vendor-managed inventory system with your sub-assembly component suppliers. By linking your IT system with a supplier, an enhanced degree of supply chain synchronization is achieved in procurement, with corresponding improvements in surface transportation delivery performance and component quality.

- IT synchronization involves a one-time cost per supplier to implement initially and a supplier-specific on-going per-month maintenance cost. You may terminate IT synchronization with a sub-assembly component supplier at any time at no cost. If you subsequently decide to reestablish IT synchronization, the one-time setup cost would again accrue in the initial month of IT synchronization with any sub-assembly component supplier.
- IT-synchronization linkages improve surface transportation delivery performance for sub-assembly component suppliers. With greater delivery reliability, the relative attractiveness of surface transport compared to air transport obviously improves.
- An IT-synchronization linkage improves the failure rate of a supplier's sub-assembly components. Failure rates decrease based on closer synchronization between buyer (your firm) and the sub-assembly component supplier.

Exhibit 13 details these specifics for each sub-assembly component supplier. Your firm may establish and maintain IT synchronization with one or more sub-assembly component suppliers with these costs and benefits.

Decision options associated with each sub-assembly component supplier are as follows:

- Decision Option "0": Do not have IT synchronization.
- Decision Option "1": Establish and maintain IT synchronization with costs and other ramifications as described above.

Note that these options are supplier specific. A separate IT-synchronization decision is required for each of the seven available sub-assembly component suppliers, suppliers A to G.

Exhibit 13: IT Synchronization With Suppliers, Costs and Benefits

	Sub-Assembly Component Supplier						
	A	B	C	D	E	F	G
One-Time Setup Cost	$9K	$8K	$9K	$9K	$6K	$7K	$7K
Monthly Maintenance Cost	$7K	$7K	$9K	$8K	$6K	$5K	$5K
Surface Transportation Change	+5%	+4%	+6%	+3%	+4%	+5%	+6%
Failure Rate Change	-0.2%	-0.1%	-0.4%	-0.5%	-0.4%	-0.3%	-0.3%

Note: See Exhibit 5 for the base surface transportation delivery performance and base failure rate statistics to which these IT-synchronization adjustments accrue. These are additive changes. For example, supplier A's surface transportation delivery performance for Gamma is estimated to change (improve) +5%, from 80% to 85%, with an IT-synchronization program in effect.

Product Cost Report

The "Product Cost Report" information technology option provides a report documenting all costs associated with production and postponed production for all products and distribution centers. Decision options and associated costs for the "Product Cost Report" are as follows:

- Decision Option "0": Do not provide a "Product Cost Report."
- Decision Option "1": Provide a "Product Cost Report" at a cost of $750.

Replacement Parts Demand Report

The details of replacement parts demand by region, product, and channel are provided in the "Replacement Parts Demand Report." This report shows the current-month replacement parts demand levels to provide a fact-oriented basis for preparing replacement parts forecasts for future month. Of course, you may wish to reference past months' replacement parts demand to establish a longer-term view of trend lines for replacement parts demand.

Decision options and associated costs for the "Replacement Parts Demand Report" are as follows:

- Decision Option "0": Do not provide a "Replacement Parts Demand Cost Report."
- Decision Option "1": Provide a "Replacement Parts Demand Cost Report" at a cost of $1,250.

Procurement Transactions Report

The "Procurement Transactions Report" information technology option provides a report documenting procurement volumes and costs associated with your firm's procurement decisions. Breakdowns by each raw material and sub-assembly component for all DCs are provided.

Decision options and associated costs for the "Procurement Transactions Report" are as follows:

- Decision Option "0": Do not provide a "Procurement Transactions Report."
- Decision Option "1": Provide a "Procurement Transactions Report" for $500.

Transportation Cost Report

Given the complexity of transportation cost accounting in LINKS, a "Transportation Cost Report" is provided as an IT option. The report provides the details of all transportation costs which are summarized on your "Corporate P&L Statement." These details include per/unit costs, volumes, and total costs in the sub-categories of raw materials, sub-assembly components, plant/DC1 shipments to other DCs, customer shipments (from DCs to customers), and replacement parts shipments (from DCs to customers).

Decision options and associated costs for the "Transportation Cost Report" are as follows:

- Decision Option "0": Do not provide a "Transportation Cost Report."
- Decision Option "1": Provide a "Transportation Cost Report" at a cost of $1,250.

Transportation Report

The "Transportation Report" provides information on transportation cost details, sub-assembly component supplier surface transportation performance (percentage of surface transportation orders by supplier received within the current month), and plant-to-DC carrier surface transportation performance (percentage of surface transportation orders by carrier received within the current month). IT synchronization status is noted where it exists with sub-assembly component suppliers or with plant-to-DC carriers.

Breakdowns of transportation costs into five components are provided in the "Transportation Summary": raw materials, sub-assembly components, plant-to-DC shipments, DC-to-customer shipments, and replacement parts shipments from DCs. For the complete details which underlie these breakdowns, you'll need to order the "Transportation Cost Report" which is available as another information technology option.

Decision options and associated costs for the "Transportation Report" are as follows:

- Decision Option "0": Do not provide a "Transportation Report."
- Decision Option "1": Provide a "Transportation Report" at a cost of $1,000.

Information Technology Decisions Form

A blank "Information Technology Decisions" form may be found on the next page. Complete this decision form during your team deliberations.

Information Technology Decisions

Firm	

Month	

Carriers

	I	J	K	L	M	N
IT Synchronization With Carriers? {**0** | **1**}						

Suppliers

	A	B	C	D	E	F	G
IT Synchronization With Suppliers? {**0** | **1**}							

Procurement Transactions Report? {**0** | **1**}	
Product Cost Report? {**0** | **1**}	
Replacement Parts Demand Report? {**0** | **1**}	
Transportation Cost Report? {**0** | **1**}	
Transportation Report? {**0** | **1**}	

Note: *See the descriptions of these information technology options for the interpretation of each possible decision option.*

Reminders

Only input changes. If you're happy with the current values of these decisions, leave the appropriate decision entries blank.

All decision inputs change the existing values to the values that you specify. Do not enter "+" or "-" values. Rather, enter new values only (new values replace the existing value of the decision variable with your designated value).

Chapter 12: Other Decisions

This chapter details other decisions not described elsewhere in the LINKS participant's manual.

Your firm may choose a firm name. Any firm name with up to 40 characters is acceptable. This firm name is printed on the top of all financial, operating, and research reports. Firm names have no cost or known demand-side implications, so you are free to choose (or change) your firm's name as you wish.

A blank "Other Corporate Decisions" form may be found on the following page. Complete this decision form during your team deliberations.

Other Corporate Decisions

Firm	

Month	

Firm Name {max of 40 characters}	

Reminders

Only input changes. If you're happy with the current values of these decisions, leave the appropriate decision entries blank.

All decision inputs change the existing values to the values that you specify. Do not enter "+" or "-" values. Rather, enter new values only (new values replace the existing value of the decision variable with your designated value).

Chapter 13: Financial and Operating Reports

The LINKS financial and operating reports are described in this chapter. You receive these standard reports after each LINKS month.

Profitability Drivers

"A company can outperform rivals only if it can establish a difference that it can preserve. Competitive strategy is about being different, deliberately choosing a different set of activities to deliver a unique value mix." – Michael Porter

The financial and operating reports described in this chapter are lengthy (16 pages) and detailed. To provide an overall roadmap for thinking about the drivers of profitability, the three charts in Exhibits 14-16 decompose net income into its underlying components.

In Exhibit 14, the principal drivers of net income are revenues and costs. Taxes and non-operating income play lesser roles. Exhibit 15 provides a breakdown of the drivers of volume, one of the two key drivers of revenues. Exhibit 16 provides a roadmap to the drivers of variable costs. Collectively, these exhibits provide a sense of the DNA of net income in LINKS.

Performance Evaluation Report

"If you're riding ahead of the herd, take a look back every now and then to make sure it's still there." – Cowboy philosophy

Please consult Chapter 15 for a detailed discussion of the "Performance Evaluation Report" that forms the first page of your financial and operating reports.

Exhibit 14: Net Income Drivers in LINKS

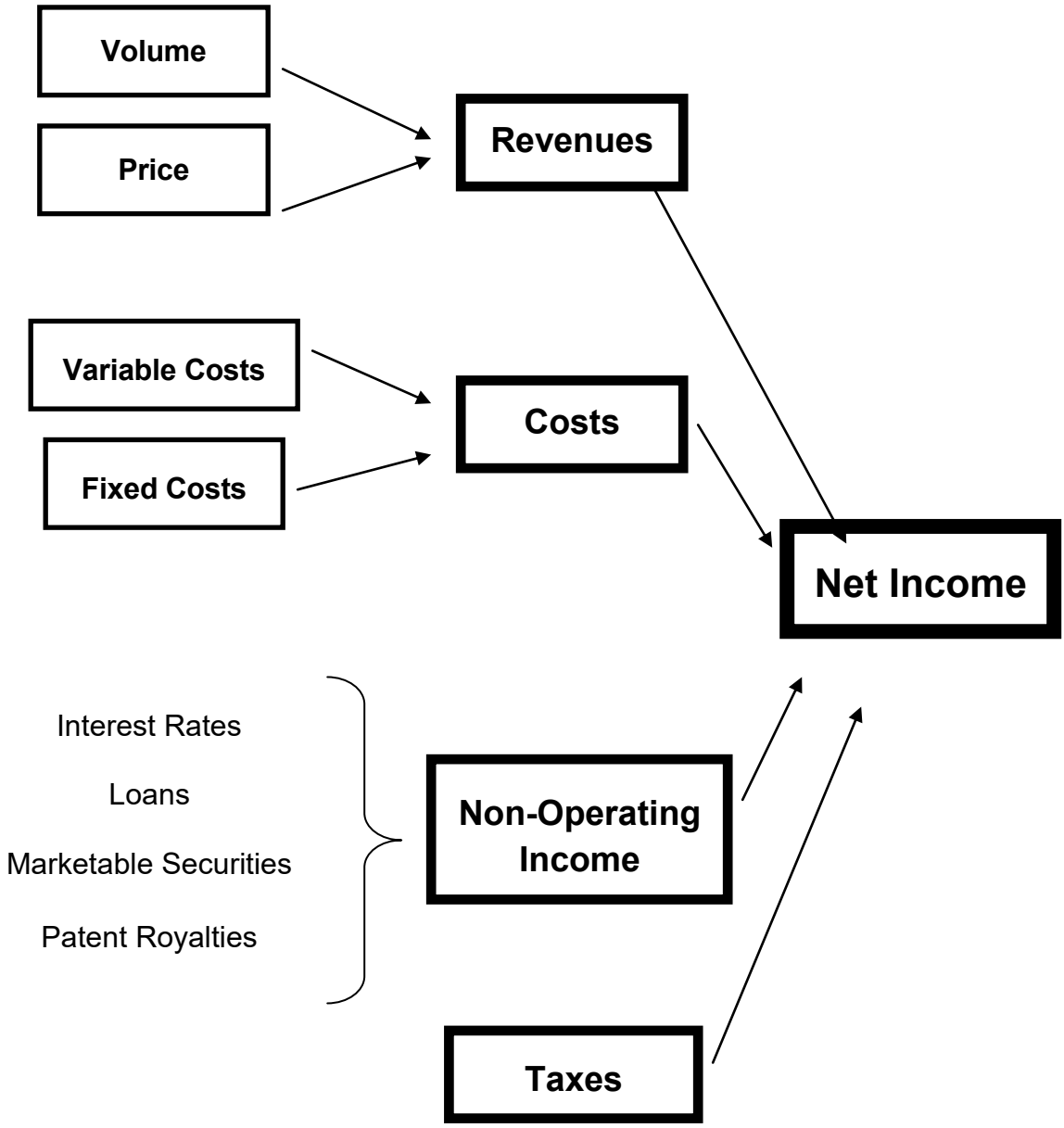


Exhibit 15: Volume Drivers in LINKS

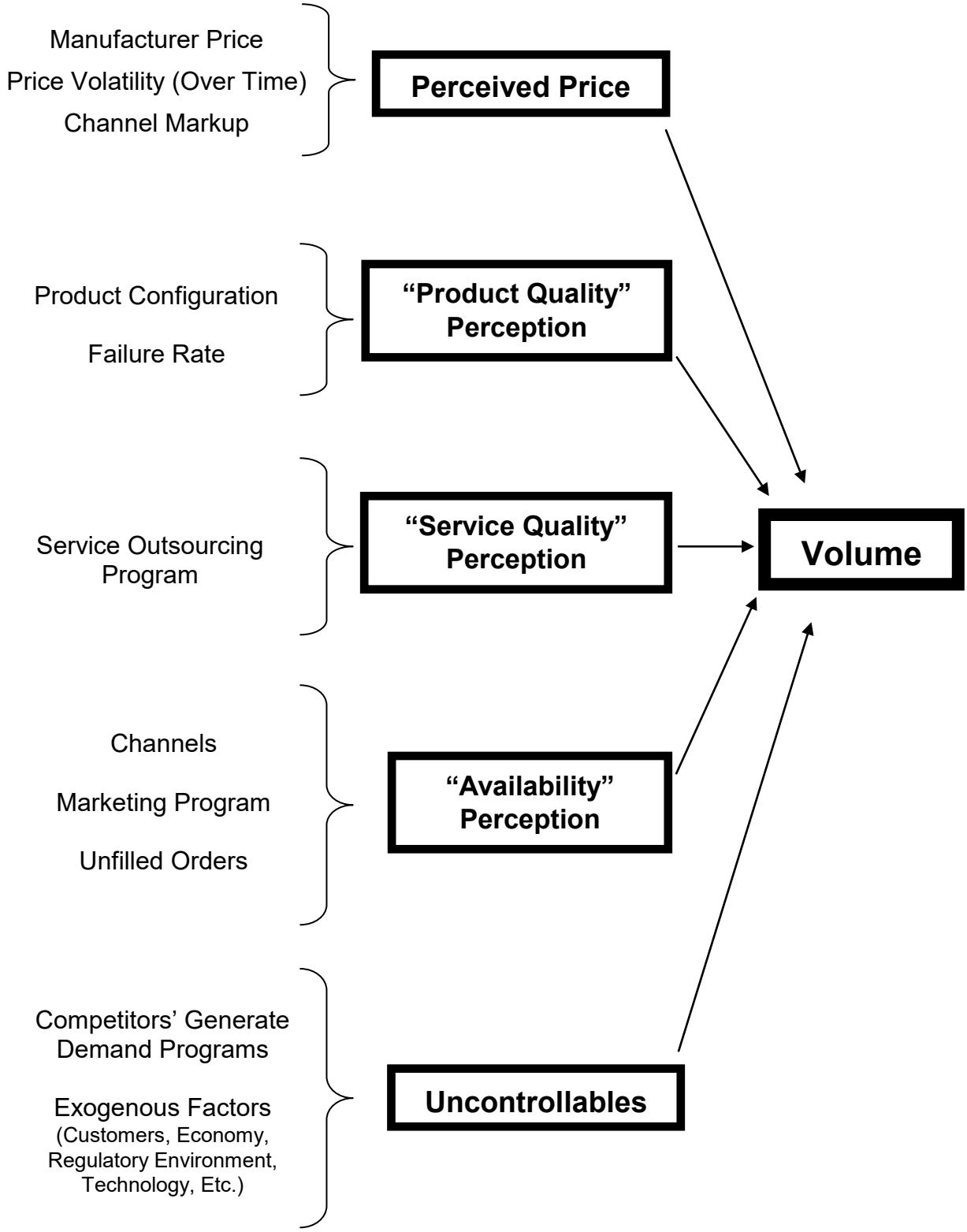
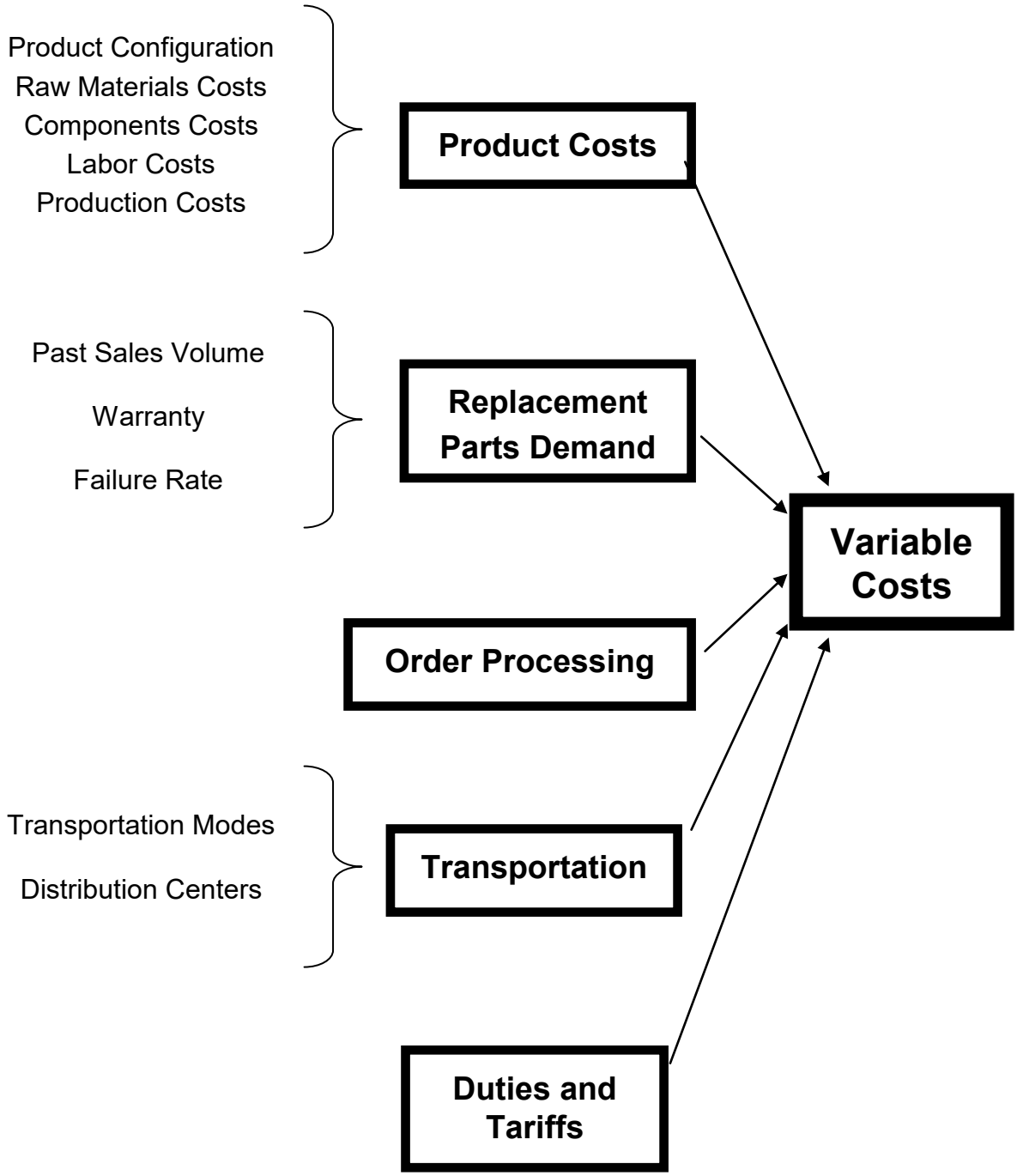


Exhibit 16: Variable Cost Drivers in LINKS



P&L Statements

The "Corporate P&L Statement" aggregates all of the product-specific profit-and-loss statements into an overall corporate profit-and-loss statement. A variety of line items appear on the "Corporate P&L Statement" only, because it is not possible to unambiguously allocate those costs to specific products in specific regions for specific channels.

Definitions of non-obvious line items on the "Corporate Current P&L Statement" follow:

- Administrative overhead ("Administrative O/H") is $80,000/month and $120,000/month per product in channels 1 and 2, respectively, in all market regions.
- Consulting Fees", which may be positive or negative, are adjustments to income or expenses.
- Corporate overhead ("Corporate O/H") is $250,000 per product per month. This per-product charge is incurred if a product is actively distributed in one or more market regions.
- "Distribution FC" reflects the fixed costs associated with operating distribution centers.
- "Duties & Tariffs" are a percentage of the average selling price for finished goods that are imported into any region. If a firm is based in a region (i.e., if a firm has a manufacturing plant in a region), there are no duties and tariffs payable. **Postponed production qualifies as "local" manufacturing, for which no duties and tariffs are payable.** The current duties and tariffs rates are 0% for region 1, 8% for region 2, and 12% for region 3. By definition, all finished goods sold in region 1 are "local" since your firm's manufacturing plant is located there. "Duties & Tariffs" are levied on sales in a region (orders from customers), with appropriate credit being provided for "local" production (i.e., for the second-stage of postponed production when the final identity is assigned to the finished product at the within-region DC).
- "Emergency Procurement" reflects all emergency procurement costs.
- “Forecast Inaccuracy” records the costs associated with forecasting errors.
- "Information Technology" records IT charges, including a $1,000/page per-firm charge for financial/operating reports. Each month's charge is based on the previous month's usage (e.g., the month-32 charge is based on the month-31 page count).
- "Introductions" reflects costs when products are introduced into market regions or channels.
- Inventory charges arise for sub-assembly components, in-process production (postponed production), and finished goods. These costs are recorded under "Inventory Charges" on the "Corporate P&L Statement." This inventory charge is equal to 3% per month for owned DCs and 5% per month for outsourced DCs based on the inventory value as recorded on your balance sheet. Inventory charges are levied on the average of beginning- and end-of-month inventory values, and include all costs related to storage, handling, waste, and insurance.
- "Non-Operating Income" derives either from interest earned on "Marketable Securities" (from the previous month's "Balance Sheet") or from interest paid on "Loans" (from the previous month's "Balance Sheet").
- "Operating Income" equals "Gross Margin" minus "Total Fixed Costs."
- "Plant Capacity FC" represents the costs associated with production "shifts" in your manufacturing plant. These costs cover all depreciation and maintenance associated with your plant capacity. These costs are allocated equally among your products.
- "Procurement FC" includes the fixed costs associated with procurement.
- "Production FC" includes the fixed costs associated with production orders. Fixed costs for regular and for postponed production are included in the "Production FC" line item.
- "Research Studies" reflects the total costs associated with last month's research study requests. Note that the current month's research studies are executed after the current month's financial reports are prepared. Thus, research study billings are lagged a month.
- "Unfilled Handling" costs are the unfilled orders handling costs.

- "Taxes" represents the corporate taxes payable in the market region in which your firm has its manufacturing plant (market region 1 in your case, with a corporate tax rate of 50%).
- "Total Fixed & Other" is the sum of all fixed costs. Note that "Total Fixed & Other" does not sum correctly down and across since some fixed costs are not allocated to specific products.

The "Historical Corporate P&L Statement" reports the previous and current month's corporate-level profit-and-loss data. In addition, all elements in the "Historical Corporate P&L Statement" are expressed in percentage-of-revenue terms.

Each product has a current profit-and-loss statement each month. The product "P&L Statement" includes the relevant data for all channels.

Balance Sheet

Your balance sheet records the usual assets and liabilities associated with your firm at the end of each month. Among other things, current levels of procurement and finished goods inventories are reported on the balance sheet.

On the "Balance Sheet":

- Cash in excess of 10% of revenues is automatically invested in short-term "Marketable Securities" which earn 0.5% per month in "Non-Operating Income" on the "Corporate P&L Statement" in the following month. If cash falls below 5% of revenues, a loan is automatically arranged to increase cash to 5% of revenues. You pay interest of 1% per month on "Loans" and this interest payment is recorded as "Non-Operating Income" (a negative value of "Non-Operating Income") in the following month's "Corporate P&L Statement."
- "Dividends" are cash payments to shareholders. In any month in which "Net Income" is positive, 30% of the "Net Income" is allocated to "Dividends."
- "Plant Investment" represents the Ldollar-value of your firm's investment in a manufacturing plant to produce set-top box products. The normal per-unit production charges that you pay for producing set-top boxes includes a component to cover the maintenance and depreciation of your plant. Thus, your "Plant Investment" value will also be the same through time.

On-order Epsilon sub-assembly components for delivery next month are reported at the bottom of your balance sheet. While you don't pay for Epsilon sub-assembly components until delivery, this contract is notable since it represents a future procurement purchasing commitment. Each region's Epsilon orders are noted. For example, a reported value of "12,000Fa" refers to a sub-assembly component order of 12,000 units from supplier F via air.

Other Reports

Additional reports included in the standard LINKS financial and operating reports are as follows:

- **Cash Flow Analysis Report**: Sources and uses of cash are reported in your firm's "Cash Flow Analysis Report." Cash sources include profits from operations and reductions in inventory holdings. Uses of cash include funding operating losses, increases in inventory holdings, and payment of dividends. Obviously, you require cash to run your set-top box business. You can't run out of cash within LINKS. As necessary, loans are automatically issued to bring your cash requirement up to minimum acceptable. Of course, you do have to pay interest on loans. Each month in which your firm is profitable, corporate policy is to allocate 30% of net income to dividends.
- **Finished Goods Inventory Report**: The details of your finished goods inventories (including postponed production) are reported on the "Finished Goods Inventory Report." Finished goods inventories are tracked separately for each of distribution center.
- **Procurement Inventory Report**: Procurement inventories are reported on the "Procurement Inventory Report." Procurement inventories are tracked separately for each distribution center.
- **Forecasting Accuracy Report:** The "Forecasting Accuracy Report" provides details of the forecasting accuracy associated with each of your sales volume forecasts. Forecasting accuracy is equal to 100*(1-(abs(Forecast-Actual)/Actual)) expressed in percentage terms, where "abs" is the absolute value function. Thus, a forecast value of 11,000 and an actual value of 8,000 result in a forecast accuracy of 100*(1-abs(11,000-8,000)/8,000) = 100*(1-(3,000/8,000)) = 100*(1-0.375) = 62.5%. The minimum possible value of forecasting accuracy is 0.0%. For example, with an Actual sales volume of 8,000, a Forecast above 16,000 results in a forecasting accuracy score of 0.0%.

Sample Reports

"The meaning of life is to do the best you can with what you've got." – Anonymous

The following pages provide samples of the standard LINKS financial and operating reports. In addition to these reports, you'll receive the results of any research studies that you order on additional pages after the last page of your financial and operating reports.

These samples are provided to familiarize you with the style and format of the reports that are provided to your firm after each LINKS round. The data reported in these sample reports are only illustrative of reports formatting. These data aren't specific to your particular LINKS industry. Please do not interpret these samples as suggested guidelines or benchmarks for good decisions and performance within LINKS.

If you'd like some further background on interpreting LINKS financial statements, please access Tutorial #1 ("P&L Statements") on the LINKS website and spend 45 minutes or so working through it prior to (or close to) the beginning of your LINKS event.

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FIRM 3:  ??????????????????????????????????????????????      INDUSTRY PSU
PERFORMANCE EVALUATION REPORT, MONTH 16                            PAGE   1
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	Firm 3	Industry Worst	Industry Average	Industry Best
FINANCIAL				
Net Income to Revenues	4.5%	4.5%	5.4%	5.9%
Change in Net Income to Revenues	-1.7%	-1.7%	-0.1%	1.0%
Return on Assets	13.8%	13.8%	16.4%	18.0%
Net Asset Turns	3.0	2.8	3.0	3.0
OPERATIONAL				
Inventory Turnover	4.5	3.9	4.3	4.7
Fill Rate	91.1%	91.1%	96.6%	100.0%
Failure Rate	7.2%	7.5%	7.1%	6.8%
Controllable Procure&Mfg to Revenues	3.1%	3.1%	2.8%	2.1%
Transportation Expenses Per Unit Sold	34.1	34.1	32.6	31.1
Forecasting Accuracy	81.8%	81.8%	85.2%	87.7%
(Marketing + Service) to Revenues	8.7%	9.0%	8.7%	8.5%
CUSTOMER				
Change in Market Share	-0.1%	-1.0%	0.0%	0.5%
Customer Satisfaction	26.6%	24.4%	25.3%	26.6%

For Your Information

You receive the LINKS scorecard (shown above) automatically each month as the first page of your financial and operating reports. This scorecard provides comparatives to assess how your firm's data compares to the industry averages and industry bests on every Key Performance Indictor (KPI).

Historical plots of all KPIs are provided in your firm's supplementary results Excel spreadsheet ("KPIcharts" worksheet), accessible within the LINKS Simulation Database on the LINKS website. Data from the past six months are displayed, to the extent available in your industry's historical archives, to create month-by-months plots for each of the LINKS performance evaluation metrics (KPIs) compared to the relevant month-specific industry best, industry average, and industry worst in your LINKS industry.

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FIRM 4:  ??????????????????????????????????????????????      INDUSTRY PSU
CORPORATE P&L STATEMENT, MONTH 16                                   PAGE   2
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	All Products	Product 4-1	Product 4-2
Sales Volume	73,258	46,691	26,567
Unfilled Orders	6,487	1,919	4,568
Price	386	387	386
Revenues	28,336,600	18,077,760	10,258,840
- Product Costs	15,280,081	8,147,111	7,132,970
- Order Processing	968,072	619,404	348,668
- Replacement Parts	150,927	59,614	91,313
- RFID Costs	434,566	275,649	158,917
- Transportation Costs	2,174,696		
+ Transportation Rebates	34,131		
+ Volume Discounts	0		
- Duties & Tariffs	2,030,189	1,338,524	691,665
Gross Margin	7,332,200	7,637,458	1,835,307
Fixed & Other Costs:			
Administrative O/H	1,200,000	600,000	600,000
Consulting Fees	0		
Corporate O/H	500,000		
Disposal Sales	0		
Distribution FC	75,000		
Emergency Procurement	58,047		
Forecast Inaccuracy	157,919	87,993	69,926
Information Technology	15,000		
Introductions	0		
Inventory Charges	122,929		
Marketing	1,440,000	720,000	720,000
Plant Capacity FC	200,000		
Price Changes	0	0	0
Procurement FC	20,000		
Production FC	47,000		
Research Studies	0		
Service Outsourcing	1,040,914	629,154	411,760
Unfilled Handling	162,175		
Total Fixed & Other	5,038,984	2,037,147	1,801,686
Operating Income	2,293,216	5,600,311	33,621
Non-Operating Income	0		
Taxes	-1,146,608		
Net Income	1,146,608		

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FIRM 4:  ??????????????????????????????????????????????      INDUSTRY PSU
HISTORICAL CORPORATE P&L STATEMENT, MONTH 16                        PAGE   3
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	Previous (Month 15)		Current (Month 16)	
Sales Volume	69,588		73,258	
Unfilled Orders	551		6,487	
Price	383		386	
Revenues	26,682,395	100.0%	28,336,600	100.0%
- Product Costs	14,555,442	54.6%	15,280,081	53.9%
- Order Processing	887,212	3.3%	968,072	3.4%
- Replacement Parts	139,203	0.5%	150,927	0.5%
- RFID Costs	430,595	1.6%	434,566	1.5%
- Transportation Costs	2,086,723	7.8%	2,174,696	7.7%
+ Transportation Rebates	29,810	0.1%	34,131	0.1%
+ Volume Discounts	0	0.0%	0	0.0%
- Duties & Tariffs	1,991,253	7.5%	2,030,189	7.2%
Gross Margin	6,621,777	24.8%	7,332,200	25.9%
Fixed & Other Costs:				
Administrative O/H	1,200,000	4.5%	1,200,000	4.2%
Consulting Fees	0	0.0%	0	0.0%
Corporate O/H	500,000	1.9%	500,000	1.8%
Disposal Sales	0	0.0%	0	0.0%
Distribution FC	75,000	0.3%	75,000	0.3%
Emergency Procurement	40,326	0.2%	58,047	0.2%
Forecast Inaccuracy	242,588	0.9%	157,919	0.6%
Information Technology	15,000	0.1%	15,000	0.1%
Introductions	0	0.0%	0	0.0%
Inventory Charges	158,742	0.6%	122,929	0.4%
Marketing	1,440,000	5.4%	1,440,000	5.1%
Plant Capacity FC	200,000	0.7%	200,000	0.7%
Price Changes	0	0.0%	0	0.0%
Procurement FC	20,000	0.1%	20,000	0.1%
Production FC	47,000	0.2%	47,000	0.2%
Research Studies	0	0.0%	0	0.0%
Service Outsourcing	948,716	3.6%	1,040,914	3.7%
Unfilled Handling	13,775	0.1%	162,175	0.6%
Total Fixed & Other	4,901,147	18.4%	5,038,984	17.8%
Operating Income	1,720,630	6.4%	2,293,216	8.1%
Non-Operating Income	-3,760	0.0%	0	0.0%
Taxes	-858,435	-3.2%	-1,146,608	-4.0%
Net Income	858,435	3.2%	1,146,608	4.0%

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FIRM 4:  ????????????????????????????????????????????????      INDUSTRY PSU
PRODUCT 4-1 P&L STATEMENT, MONTH  6                                 PAGE   4
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```

	All Regions (TOTAL)	Region 1 (U.S.A.)	Region 2 (Europe)	Region 3 (Pacific)
Active? Ch#1,2		Yes Yes	Yes Yes	Yes Yes
Sales Volume, Ch#1	25,059	7,103	6,200	11,756
Sales Volume, Ch#2	21,632	6,943	4,907	9,782
Unfilled Orders	0	0	0	0
Price, Ch#1,2	320 465	320 465	320 465	320 465
Revenues	18,077,760	5,501,455	4,265,755	8,310,550
- Product Costs	8,147,111	2,450,886	1,938,060	3,758,165
- Order Processing	619,404	195,044	142,568	281,792
- Replacement Parts	59,614	16,071	12,776	30,767
- RFID Costs	275,649	78,133	68,200	129,316
- Duties & Tariffs	1,338,524	0	341,259	997,265
Gross Margin	7,637,458	2,761,321	1,762,892	3,113,245
Fixed Costs:				
Administrative O/H	600,000	200,000	200,000	200,000
Forecast Inaccuracy	87,993	23,778	22,548	20,667
Marketing, Ch#1	360,000	120,000	120,000	120,000
Marketing, Ch#2	360,000	120,000	120,000	120,000
Price Changes	0	0	0	0
Service Outsourcing	629,154	154,790	145,776	328,588
Total Fixed Costs	2,037,147	630,568	608,324	798,255
Operating Income	5,600,311	2,130,753	1,154,568	2,314,990
Distribution Center?		2 Owned	1 3rd-Party	0 None
RFID Outsource/Insource?		0 Outsourced	0 Outsourced	0 Outsourced
Emergency Carrier			N	N
Sales Volume Forecast, Ch#1		6,268	5,383	10,003
Sales Volume Forecast, Ch#2		5,417	4,416	8,336
Service: Service Outsourcing		2 Standard	2 Standard	2 Standard

Product 4-1 Configuration: H55111

For Your Information: *The standard LINKS monthly reports include separate product P&L statements for each of your products. In this sample display, only the report for product 1 is included.*

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FIRM 4:  ??????????????????????????????????????????????      INDUSTRY PSU
BALANCE SHEET, MONTH 16                                          PAGE   6
********************************************************************************

ASSETS
------
Cash                                                                2,833,660
Marketable Securities                                                 603,672
Finished Goods and Postponed Production Inventory:
  Plant & DC1:  Product 4-0 (       0 units @      0.00/unit)               0
                Product 4-1 (       0 units @      0.00/unit)               0
                Product 4-2 (       0 units @      0.00/unit)               0
  DC2:          Product 4-0 (       0 units @      0.00/unit)               0
                Product 4-1 (   2,404 units @    173.99/unit)         418,269
                Product 4-2 (     447 units @    267.75/unit)         119,684
Plant Investment                                                  100,000,000
Procurement Inventory:
  Plant & DC1:  Alpha       (       0 units @      0.00/unit)               0
                Beta        (       0 units @      0.00/unit)               0
                Gamma       (     799 units @     25.92/unit)          20,713
                Delta       (   1,978 units @     27.93/unit)          55,237
                Epsilon     (   5,962 units @     32.06/unit)         191,150
  DC2:          Gamma       (   3,374 units @     23.98/unit)          80,911
                Delta       (   2,290 units @     26.18/unit)          59,952
                Epsilon     (   4,686 units @     30.22/unit)         141,620
Total Assets                                                      104,524,868

LIABILITIES AND EQUITIES
------------------------
Corporate Capitalization                                          100,000,000
Dividends, Current Month                                             -343,982
Dividends, Cumulative Prior To This Month                          -1,595,243
Loans                                                                       0
Retained Earnings, Current Month                                   1,146,608
Retained Earnings, Cumulative Prior To This Month                  5,317,485
Total Liabilities and Equities                                    104,524,868


Note:  These Epsilon components are on-order, for delivery next month  :
  Region 1:    32,500Ds  32,500Da
  Region 2:       600Ds     600Da
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FIRM 4:  ??????????????????????????????????????????????      INDUSTRY PSU
CASH FLOW ANALYSIS REPORT, MONTH 16                               PAGE   7
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  Starting "Cash" Balance (Final "Cash" Balance, Month 15)          1,854,147
+ Marketable Securities (Converted To "Cash" In Month 15)                   0
- "Loans" (Liquidated During Month 15)                                      0
+ "Finished Goods Inventory" Changes:
    Product 4-0 (From          0 To          0)                           0
    Product 4-1 (From  1,135,249 To    418,269)                     716,980
    Product 4-2 (From    269,011 To    119,684)                     149,327
+ "Plant Investment" Changes                                                0
+ "Procurement Inventory" Changes:
    Alpha       (From          0 To          0)                           0
    Beta        (From          0 To          0)                           0
    Gamma       (From    142,766 To    101,624)                      41,142
    Delta       (From     97,961 To    115,189)                     -17,228
    Epsilon     (From    223,108 To    332,770)                    -109,662
+ "Net Income"                                                      1,146,608
= Preliminary "Cash" Balance                                        3,781,314
- "Dividends" (Paid at End of Month 16)                              -343,982
= Actual "Cash" Balance (End of Month 16)                           3,437,332
- Operating "Cash" Excess (To "Marketable Securities")              -603,672
+ Operating "Cash" Deficit (From "Loans")                                   0
= Final "Cash" Balance (End of Month 16)                            2,833,660


Notes:
(1) "Marketable Securities" and "Loans" refer to the values on last
    month's balance sheet.
(2) Investment changes can be positive, negative, or zero.  A positive
    (negative) {zero}.  Investment change corresponds to an increase (a
    decrease) {no change} in the dollar value of the investment from last
    month to this month which leads to a decrease (an increase)
    (no change) in current-month "Cash" balance.
(3) At most, one of Operating "Cash" Excess and Operating "Cash" Deficit will
    be non-zero; it is possible for both to be zero.  Recall that "Cash" must
    be between  5.0% and 10.0% of current-month sales revenues.  Excess
    "Cash" (above 10.0% of revenues) is invested in "Marketable Securities";
    shortfalls in "Cash" (below  5.0% of revenues) result in "Loans."
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FIRM 4:  ??????????????????????????????????????????????      INDUSTRY PSU
FINISHED GOODS INVENTORY REPORT, MONTH 16                        PAGE   8
*************************************************************************
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	Product 4-0	Product 4-1	Product 4-2
PLANT/DC1 FG INVENTORY			
Beginning Inventory	0	4,318	0
+ Regular Production	0	42,500	26,000
Postponed Production	0	0	0
= Available Inventory	0	46,818	26,000
- Shipments To DC2:			
Surface	0	-8,742	-3,768
Air	0	0	0
Emergency	0	-2,492	-39
- Sales, Region 1		-14,046	-10,211
- Sales, Other Regions		-21,538	-11,982
= Ending Inventory	0	0	0
DC2 FG INVENTORY			
Beginning Inventory	0	2,277	1,014
+ Shipments From DC1:			
Surface	0	6,338	3,321
Air	0	0	0
Emergency	0	2,492	39
Postponed Production	0	0	0
= Available Inventory	0	11,107	4,374
- Sales, Region 2		-11,107	-4,374
+ Delayed Shipments	0	2,404	447
= Ending Inventory	0	2,404	447

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FIRM 4:  ??????????????????????????????????????????????      INDUSTRY PSU
PROCUREMENT INVENTORY REPORT, MONTH 16                           PAGE   9
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	Alpha	Beta	Gamma	Delta	Epsilon
PLANT & DC1					
Beginning Inventory	0	0	3,079	1,804	3,436
+ Purchases, Surface	342,500	342,500	19,201	10,522	26,538
+ Purchases, Air			20,000	12,500	32,500
+ Purchases, Emergency	0	0	1,061	2,768	7,760
= Available Inventory	342,500	342,500	43,341	27,594	70,234
- Production:					
Product 4-0	0	0			
Product 4-1	-212,500	-212,500	-42,500	0	-42,500
Product 4-2	-130,000	-130,000	0	-26,000	-26,000
- Postponed Production			0	0	0
- Replacement Parts			-841	-1,594	-1,734
+ Purchases, Delayed			799	1,978	5,962
= Ending Inventory	0	0	799	1,978	5,962
DC2					
Beginning Inventory			2,817	1,935	3,921
+ Purchases, Surface			367	294	470
+ Purchases, Air			400	350	600
+ Purchases, Emergency			0	0	0
= Available Inventory			3,584	2,579	4,991
- Postponed Production			0	0	0
- Replacement Parts			-243	-345	-435
+ Purchases, Delayed			33	56	130
= Ending Inventory			3,374	2,290	4,686

```
************************************************************************
FIRM 4:  ??????????????????????????????????????????????      INDUSTRY PSU
SERVICE CENTER OPERATIONS REPORT, MONTH 16                       PAGE  10
************************************************************************
```

	All Regions	Region 1	Region 2	Region 3
ACTIVITY REPORT				
PRODUCT 4-1				
Calls	52,903	15,479	12,148	25,276
CSR Cost/Call	11.89	10.00	12.00	13.00
PRODUCT 4-2				
Calls	35,466	14,473	5,879	15,114
CSR Cost/Call	11.61	10.00	12.00	13.00

```
********************************************************************************
FIRM 4:  ??????????????????????????????????????????????      INDUSTRY PSU
OTHER DECISION VARIABLES REPORT, MONTH 16                        PAGE  11
********************************************************************************

==========================
PROCUREMENT, RAW MATERIALS
==========================
DC1:  Alpha           342,500
DC1:  Beta            342,500

===================                          Supplier
PROCUREMENT, SUB-     ------------------------------------------------------
ASSEMBLY COMPONENTS         A       B       C       D       E       F       G
===================   ======= ======= ======= ======= ======= ======= =======
DC1: Gamma, Surface         0       0       0  20,000
DC1: Gamma, Air             0       0       0  20,000
DC1: Delta, Surface                 0       0  12,500       0       0
DC1: Delta, Air                     0       0  12,500       0       0
DC1: Epsilon, Surface                          32,500       0       0       0
DC1: Epsilon, Air                              32,500       0       0       0
DC2: Gamma, Surface         0       0       0     400
DC2: Gamma, Air             0       0       0     400
DC2: Delta, Surface                 0       0     350       0       0
DC2: Delta, Air                     0       0     350       0       0
DC2: Epsilon, Surface                          600       0       0       0
DC2: Epsilon, Air                              600       0       0       0

=============
MANUFACTURING                 4-0     4-1     4-2
=============               ------- ------- -------
Production                        0  42,500  26,000

==========================                       Carrier
TRANSPORTATION, PLANT/DC1     ---------------------------------------------
SHIPMENTS TO OTHER DCs              I       J       K       L       M       N
==========================    ======= ======= ======= ======= ======= =======
To DC2: Product 4-1, Surface        0       0       0       0       0   8,742
To DC2: Product 4-2, Surface        0       0       0       0       0   3,768

======================
INFORMATION TECHNOLOGY
======================
IT Synchronization With Carriers?        000000
IT Synchronization With Suppliers?       0000000
Procurement Transactions Report?         0
Product Cost Report?                     0
Replacement Parts Demand Report?         0
Transportation Cost Report?              0
Transportation Report?                   0
```

```
********************************************************************************
FIRM 4:  ??????????????????????????????????????????????      INDUSTRY PSU
FORECASTING ACCURACY REPORT, MONTH 16                              PAGE  12
********************************************************************************
```

	Region	Forecast	Actual	Accuracy
Product 4-1, Channel 1	1	6,268	7,103	88.2%
Product 4-1, Channel 2	1	5,417	6,943	78.0%
Product 4-1, Channel 1	2	5,383	6,200	86.8%
Product 4-1, Channel 2	2	4,416	4,907	90.0%
Product 4-1, Channel 1	3	10,003	11,756	85.1%
Product 4-1, Channel 2	3	8,336	9,782	85.2%
Product 4-2, Channel 1	1	5,664	5,622	99.3%
Product 4-2, Channel 2	1	5,318	4,589	84.1%
Product 4-2, Channel 1	2	2,244	2,399	93.5%
Product 4-2, Channel 2	2	2,040	1,975	96.7%
Product 4-2, Channel 1	3	4,937	6,426	76.8%
Product 4-2, Channel 2	3	4,509	5,556	81.2%

SUMMARY: For 12 forecasts, average forecasting accuracy is 87.1%

Note: Forecasts count within the calculation of forecasting accuracy only if the "actual" value being forecast is greater than 100 for sales volumes (to not penalize you for "small" forecasts). Otherwise, the relevant values of "forecast" and "actual" are only reported for reference purposes, but such forecasts are not counted for forecasting accuracy scoring. This is the reason why the number of forecasts referenced in "SUMMARY" may be less than the detailed line-by-line reporting of forecasts.

SALES HISTORY	Month 11	Month 12	Month 13	Month 14	Month 15	Month 16
REGION 1						
Product 4-1H, Ch#1	6,268	4,421	8,141	5,404	4,983	7,103
Product 4-1H, Ch#2	5,417	5,529	5,986	5,709	4,674	6,943
Product 4-2M, Ch#1	5,664	4,653	7,275	5,769	7,703	5,622
Product 4-2M, Ch#2	5,318	6,113	3,883	5,199	4,166	4,589
REGION 2						
Product 4-1H, Ch#1	5,383	5,451	5,695	5,793	4,698	6,200
Product 4-1H, Ch#2	4,416	4,421	4,466	5,647	4,373	4,907
Product 4-2M, Ch#1	2,244	2,040	2,293	2,212	2,796	2,399
Product 4-2M, Ch#2	2,040	2,316	2,264	2,019	2,847	1,975
REGION 3						
Product 4-1H, Ch#1	10,003	11,566	6,862	11,361	12,949	11,756
Product 4-1H, Ch#2	8,336	8,396	9,118	9,741	10,698	9,782
Product 4-2M, Ch#1	4,937	6,048	6,633	5,459	6,016	6,426
Product 4-2M, Ch#2	4,509	4,566	3,288	5,031	3,685	5,556

```
*******************************************************************************
FIRM 4:  ??????????????????????????????????????????????????      INDUSTRY PSU
SET-TOP BOX INDUSTRY BULLETIN, MONTH 16                              PAGE  13
*******************************************************************************


Welcome to the month 16 issue of the Set-Top Box Industry Bulletin.
Notable set-top box industry developments are highlighted in the Bulletin.


INDUSTRY NEWS HEADLINES

  Total industry PSU profits were   4,148,204 this month.
  Firm 5 leads industry PSU in market share (17.6%).
  Firm 4 has the second-highest market share in industry PSU (17.6%).

  Industry PSU inventory investment decreased from   9,429,047 to
    7,875,167 this month.

  Total industry PSU research study spending was         0 this month.


DISTRIBUTION CENTER ACTIVITY

  No distribution centers were opened this month.

  No distribution centers were closed this month.


PRODUCT LAUNCHES AND "UNLAUNCHES"

  No products were introduced this month.

  No products were "unlaunched" (dropped) this month.
```

Chapter 14: Research Studies

"Time spent in reconnaissance is seldom wasted." – Sun Tzu, 4BC

This chapter describes the available LINKS research studies. These research studies provide further information about competitors and about the set-top box markets. These studies are typical of the kinds of research resources that exist in manufacturing-based industries, and the associated costs are typical of the approximate magnitude of the costs associated with such research studies in real industries. However, there's no reason to believe that every one of these research studies is appropriate and useful at all times or worth the associated costs. You'll have to decide whether these research studies are worth their stated costs.

Research studies requests are submitted along with your other decision variable changes. Although LINKS research studies are ordered prior to the beginning of the next month, research studies are executed during and after the next month, as appropriate. Thus, research studies reports always reflect the just-completed month's experience.

In the following research study descriptions, sample output illustrates the style and formatting of research study output. **These samples are only for illustrative purposes.** The output should not be viewed as providing any specific insight into your particular set-top box industry.

Which research studies should you purchase? When should you purchase these research studies? Two snappy but uninformative responses would be "purchase exactly the research studies that you need and no others" and "it depends." Unfortunately, these responses are not very constructive counsel. Heavy-duty anticipatory thinking is needed before deciding on research study purchases. Bruce Henderson, noted strategist, author, and management consultant, offers the following insightful process-based suggestion for conducting research: *"Define the problem and hypothesize the approach to a solution intuitively before wasting time on data collection and analysis. Do the first analysis lightly. Then, and only then, redefine the problem more rigorously and reanalyze in depth. Don't go to the library and read all the books before you know what you want to learn."* The problem "reanalysis" stage is particularly relevant since that is where research studies may play a role, once you have determined that the information provided in the research studies may provide useful insight into the problem at hand.

There are no universal answers about appropriate, needed, and desirable research studies, other than the broad principle that research is about uncertainty reduction. What don't you know? How important is it to "know" these things? Is there any research that might be conducted in a timely fashion to reduce this uncertainty?

In thinking about research studies strategy and tactics, some broad generalizations are possible:

- Excellent strategy can only be developed based on excellent analysis and thinking. Since research provides the raw data to perform excellent analysis, research should be an important component of your LINKS decision-making process. Do not relegate your research studies pre-ordering decisions to the last five minutes of team meetings. Rather, treat research studies ordering decisions as a fundamental part of your whole LINKS decision-making process.
- Plan ahead. To identify patterns and trends, you will probably need to order some research studies on a more-or-less regular basis. A formal research studies plan should be a part of

your management planning process.

- Systematize the post-analysis of research studies. This might involve, for example, the continual updating of databases, charts, or graphs to reformat the raw LINKS research studies results into more meaningful and useful forms.
- Share insights derived from particular research studies with all of your LINKS team members. These may require research studies' "experts" to assume coaching roles with research studies "novices." This is a natural state of affairs. Given the complexity of LINKS, it is not possible to be an "expert" on everything.

Research Study #1: Benchmarking - Earnings

Purpose: This research study provides earnings benchmarks for your industry. The current-month earnings, cumulative-to-date earnings, and current-month dividends of each firm in your industry are reported. In addition, a variety of financial market statistics are reported.

Information Source: These data are based on public information.

Cost: $500.

Sample Output

```
========================================================================
RESEARCH STUDY # 1 (Benchmarking - Earnings                            )
========================================================================

                              Current   Cumulative      Current
                           Net Income   Net Income    Dividends
                           ----------  -----------  -----------
Firm 1                        2,974,292    5,788,265      892,287
Firm 2                        3,472,461    6,234,171    1,041,738
...

Financial Market Statistics [stock price, shares outstanding (millions),
earnings per share, dividends per share, market capitalization ($millions)]
                 ------  ------  ------  ------
                 Firm 1  Firm 2  Firm 3  Firm 4
                 ------  ------  ------  ------
StockPrice       120.00  131.80  117.63  123.96
Shares             2.0M    2.0M    2.0M    2.0M
EPS                1.49    1.74    1.44    1.57
DPS                 .45     .52     .43     .47
MarketCap          240M    264M    235M    248M
```

Research Study #2: Benchmarking - Balance Sheets

Purpose: This research study provides summary balance sheet benchmarks for your industry. These balance sheets must be requested for specific firms in your industry.

Information Source: These summary balance sheets are provided by your research supplier based on public information.

Cost: $1,000 per firm.

Additional Information: These summary balance sheets contain the level of information available from public sources. For example, aggregate inventory levels are reported, but there is no disaggregation of aggregate inventory information by product.

Sample Output

```
========================================================================
RESEARCH STUDY # 2 (Benchmarking - Balance Sheets                      )
========================================================================

--------------------
FIRM 2 BALANCE SHEET
--------------------
ASSETS:
  Cash                                                      1,686,016
  Marketable Securities                                    24,186,533
  Finished Goods and Postponed Production Inventory        25,661,228
  Plant Investment                                         50,000,000
  Procurement Inventories                                   1,398,909
...
```

Research Study #4: Benchmarking - Procurement

Purpose: This research study provides procurement benchmarks for your industry. Each firm's current sub-assembly component suppliers are listed in the output of this research study. In addition, estimated market shares are reported for each sub-assembly component (SAC) supplier for each SAC.

Sample Output

```
================================================================================
RESEARCH STUDY # 4 (Benchmarking - Procurement                                  )
================================================================================

Firm 1 Sub-Assembly Component Suppliers:    A   B   D
Firm 2 Sub-Assembly Component Suppliers:    D   G
Firm 3 Sub-Assembly Component Suppliers:    D
...

            SAC Procurements:  Market Shares For Suppliers A-G
          ------------------------------------------------------
            A       B       C       D       E       F       G
          ------  ------  ------  ------  ------  ------  ------
Gamma      28.0%   25.3%   46.6%    0.0%                          100.0%
Delta               9.4%   12.8%    0.0%   38.4%   39.4%          100.0%
Epsilon                           12.0%   35.7%   33.4%   18.9%  100.0%
```

Information Source: This research study is based on information sharing and pooling agreements among all firms in the set-top box industry administered by the Set-Top Box Industry Trade Association.

Cost: $3,000.

Research Study #5: Benchmarking - Manufacturing

Purpose: This research study provides manufacturing benchmarks for your industry. This research study reports the distribution (in % terms) of total production for each firm across the categories of postponed production and regular production.

Information Source: This research study is based on information sharing and pooling agreements among all firms in the set-top box industry administered by the Set-Top Box Industry Trade Association.

Sample Output

```
================================================================================
RESEARCH STUDY # 5 (Benchmarking - Manufacturing                                )
================================================================================

                          Postponed      Regular    Emergency
                          Production   Production   Production
                          ----------   ----------   ----------
Firm 1                         18.6%        74.3%         7.2%
Firm 2                          .0%       100.0%          .0%
...
```

Cost: $5,000.

Research Study #6: Benchmarking - Distribution

Purpose: This research study provides distribution benchmarks for your industry. For each firm, distribution center existence and postponed production status at each regional distribution center are reported.

Information Source: This research study is based on information sharing and pooling agreements among all firms in the set-top box industry administered by the Set-Top Box Industry Trade Association.

Cost: $5,000.

Sample Output

```
================================================================================
RESEARCH STUDY # 6 (Benchmarking - Distribution                                 )
================================================================================

                            Region 1     Region 2     Region 3
                           ----------   ----------   ----------

Firm 1 DCs?                      Yes          Yes          Yes
Firm 2 DCs?                      Yes          Yes           No
...

Firm 1 Postponed?                Yes           No          Yes
Firm 2 Postponed?                 No           No           No
...
```

Research Study #7: Benchmarking - Transportation

Purpose: This research study provides transportation benchmarks for your industry. This research study reports firm-specific transportation cost breakdowns (as %s) for raw materials, sub-assembly components, plant-to-DC shipments, DC-to-customer shipments, and replacement parts shipments to customers. In addition, this research study provides plant-to-DC shipping benchmarks for your industry by providing each firm's current plant-to-DC carriers. Estimated market shares are reported for each carrier in each region.

Sample Output

```
=====================================================================
RESEARCH STUDY # 7 (Benchmarking - Transportation                    )
=====================================================================

                                    Sub-   Plant-To-   DC-To-   Replace
                          Raw     Assembly  Customer  Customer   Parts
                    Materials Component Shipments Shipments Shipments
                    --------- --------- --------- --------- ---------
Firm 1 Transportation $s        .0%     33.5%     13.8%     50.2%      2.5%
Firm 2 Transportation $s        .0%     33.5%     13.5%     50.7%      2.3%
...

Firm 1 Plant-To-DC Carriers:    J
Firm 2 Plant-To-DC Carriers:    I   J   N
...

           Shipments:  Market Shares For Carriers I-N
          ----------------------------------------------
            I       J       K       L       M       N
          ------  ------  ------  ------  ------  ------
Region 2    0.0%    0.0%   22.7%   14.4%   50.5%   12.4%  100.0%
Region 3   20.9%   39.0%   10.3%    9.6%   20.2%    0.0%  100.0%
```

Information Source: This research study is based on information sharing and pooling agreements among all firms in the set-top box industry administered by the Set-Top Box Industry Trade Association.

Cost: $5,000.

Research Study #9: Benchmarking - Generate Demand

Purpose: This research study provides generate demand benchmarks for your industry. Price and marketing statistics (min|mean|max) for each product category, market region, and channel are provided.

Information Source: This research study is based on information sharing and pooling agreements among all firms in the set-top box industry administered by the Set-Top Box Industry Trade Association.

Cost: $5,000.

Sample Output

```
=====================================================================
RESEARCH STUDY # 9 (Benchmarking - Generate Demand                   )
=====================================================================

                          Month 55     Month 56     Month 57     Month 58
                         ----------- -----------  -----------  -----------


-----------
HYPERWARE
REGION 1
min/ave/max
-----------
CHANNEL 1:
  Price [$]           435 520 657  431 554 689  437 542 662  429 542 662
  Mktg [$K]           100 161 300    0 183 300    0 157 300    0 181 326
CHANNEL 2:
  Price [$]           440 495 540  440 496 550  440 499 550  440 496 550
  Mktg [$K]             0  85 150   75 134 282    0 139 299    0 147 326

-----------
METAWARE
REGION 1
min/ave/max
-----------
...
```

Research Study #10: Benchmarking - Info Tech & Research Studies

Purpose: This research study provides information technology and research studies ordering benchmarks for your industry.

Information Source: This research study is based on information sharing and pooling agreements among all firms in the set-top box industry administered by the Set-Top Box Industry Trade Association.

Cost: $1,000.

Additional Information: The research study ordering frequencies are based on the last two months. Only research studies with non-zero ordering frequencies are reported in this research study output.

Sample Output

```
========================================================================
RESEARCH STUDY #10 (Benchmarking - Info Tech & Research Studies       )
========================================================================

                                  Firm Firm Firm Firm Firm Firm Firm Firm
                                    1    2    3    4    5    6    7    8
                                  ---- ---- ---- ---- ---- ---- ---- ----

IT Synchronization With Carriers   No   No   No  Yes   No  Yes   No   No
IT Synchronization With Suppliers  Yes  No   No  Yes   No   No   No   No

Procurement Transactions Report    No   No   No   No  Yes   No   No  Yes
Product Cost Report                Yes  No   No   No   No  Yes  Yes  Yes
...

------------------------------------------------------------------
Research Study Ordering Frequency Across All Firms in Industry A
------------------------------------------------------------------
 1 Benchmarking - Earnings                          4.8%
 8 Benchmarking - Service (CSR Usage)               9.5%
...
```

Research Study #11: Benchmarking - Operating Statistics

"There is no finish line." – Nike Corporation motto

Purpose: This research study provides a variety of operating statistics benchmarks for your industry. Various "Corporate P&L Statement" figures are reported as percentages of revenues for your firm and for three industry aggregates (min|mean|max).

Information Source: This research study is based on information sharing and pooling agreements among all firms in the set-top box industry administered by the Set-Top Box Industry Trade Association.

Cost: $2,500.

Sample Output

```
========================================================================
RESEARCH STUDY #11 (Benchmarking - Operating Statistics               )
========================================================================

                          Firm 8      Minimum      Average      Maximum
                       ----------  ----------  ----------  ----------

P&L OPERATING STATISTICS
  Revenues                100.0%      100.0%      100.0%      100.0%
  Product Costs            50.7%       44.3%       49.1%       50.7%
  Replacement Parts          .6%         .5%         .6%         .7%
  Transportation Costs     10.2%        8.0%        9.7%       10.5%
  Duties & Tariffs          7.9%        7.0%        8.0%        8.9%
  Gross Margin             30.5%       30.5%       32.6%       38.2%
  Administrative O/H        5.7%        4.7%        5.6%        6.0%
  Marketing                 4.5%        3.8%        4.7%        6.0%
  Service                   4.7%        3.6%        4.5%        4.9%
  Total Fixed Costs        25.7%       22.0%       24.9%       27.2%
  Operating Income          4.8%        4.8%        7.8%       13.7%
  Net Income                2.9%        2.9%        4.4%        7.3%
```

Research Study #12: Market Statistics

Purpose: This research study provides a variety of market statistics for each region for the last four months:

- Industry demand (final customer purchases) and unfilled orders are reported for hyperware and metaware set-top box categories.
- Overall market shares for each firm are provided for each of the last four months. These market shares are based on end-user customer purchase volumes and not on manufacturer orders.
- End-of-month retail-channel (channel 1) inventory holdings for active products are reported in two ways: units and months of inventory (expressed relative to the current month's retail-channel sales volume).
- Estimates of retail-channel (channel 1) margins for active products are reported. Note that "margin" is retail-channel sales volume times the retail-channel markup.

Information Source: This research study is compiled by your research vendor using a variety of sources.

Cost: $2,500.

Sample Output

RESEARCH STUDY #12 (Market Statistics)

	Month 11	Month 12	Month 13	Month 14
INDUSTRY DEMAND				
Region 1:				
Hyperware Demand	60,231	59,075	59,244	59,165
Hyperware Unfilled	0	0	0	0
Metaware Demand	29,940	31,385	31,145	30,422
Metaware Unfilled	0	0	0	0
Region 2:				
...				
...				
OVERALL MARKET SHARES				
Firm 1	18.0	26.6	25.3	20.7
Firm 2	19.5	17.4	18.8	17.9
...				
RETAIL CHANNEL INVENTORY [Units]				
Region 1:				
Product 1-1H	2,128	2,260	2,257	2,653
Product 2-1H	2,178	2,377	2,345	2,266
...				
Region 2:				
...				
...				
RETAIL CHANNEL INVENTORY [Months of Inventory at Current Sales Volume]				
Region 1:				
Product 1-1H	0.38	0.33	0.40	0.39
Product 2-1H	0.51	0.37	0.45	0.40
...				
Region 2:				
...				
...				
RETAIL CHANNEL MARGIN				
Region 1:				
Product 1-1H	1,459,436	1,608,804	1,743,830	1,244,650
Product 2-2M	1,462,715	1,278,837	1,342,770	1,296,460
...				
Region 2:				
...				
...				

Research Study #14: Regional Summary Analysis

Purpose: This research study provides a regional summary analysis for each specified market region, including current-month market shares, prices, and perceptions of product quality, service quality, availability, and (overall) product performance of all active products:

- "Product Quality" is perceived product quality, reflecting customers' perceptions of a product's configuration and its reliability and performance in actual usage. Failure of sub-assembly components in usage (after purchase) would presumably be reflected in reductions in product quality perception.
- "Service Quality" is perceived service quality, reflecting customers' perceptions of a product's service quality. Service quality derives from experiences with each firm's regional call centers.
- "Availability" is perceived product availability, reflecting customers' perceptions of a product's top-of-mind awareness, channel presence, distribution accessibility, ease of access, convenience to purchase, and general presence/prominence in the market place.

Information Source: Perceived product quality, perceived service quality, and perceived availability are based on a survey of set-top box customers. These perceptual ratings are the percentages of survey respondents rating product quality, service quality, and availability as "excellent" on a 4-point "poor"-"fair"-"good"-"excellent" rating scale.

Cost: $5,000 per region.

Additional Information: Your set-top box manufacturing firm sells to retailers in channel #1, not directly to final end-user customers. Retailers in channel #1 maintain inventory of your set-top box products as well as selling your products to their customers. Thus, final end-user customers sales volume and market share in channel #1 (for example, as reported in Research Study #14) aren't equal to your firm's sales volume and market share to the retailers in channel #1 due to inventory holdings of retailers in channel #1.

These market shares are region-wide market shares and not channel-based market shares. That is, these market shares are the relative sales volume across all channels in a region. You may wish to calculate your own channel-specific market shares, if you are interested in your market share only within a specific channel.

Channel #1 ("Retail") results reflect final end-user customer activity. Thus, the prices reported

Sample Output

RESEARCH STUDY #14 (Regional Summary Analysis)

REGION 1
HYPERWARE

	Volume	Market Share	Price	PQ	SQ	Av
Channel 1						
1-1	15,906	9.9-	707+	41	21-	54+
4-1	531	0.3	465	2	19	1
5-1	9,391	5.9	439	9	29+	38
6-1	7,291	4.6	417-	8	41+	23-
7-1*	32,519	20.3+	699+	58+	28	54+
8-1	16,096	10.1	650	34-	18-	43
Channel 2						
1-1	13,238	8.3-	670+	40-	18-	10-
2-1	6,881	4.3+	380-	8	9-	12-
5-1	12,162	7.6+	392	9	32+	23
6-1	7,427	4.6	390-	8	39+	12-
7-1*	25,428	15.9+	650+	59+	32+	35+
8-1	13,225	8.3-	653	35	20-	26

REGION 1
METAWARE

	Volume	Market Share	Price	PQ	SQ	Av
Channel 1						
1-2	3,323	3.3-	918+	44-	20-	55+
3-2	12,860	12.7-	708-	72-	29	55
5-2r	4,717	4.6	745	35+	28+	44+
6-2u	11,206	11.0+	799-	74+	38+	49
7-2	8,895	8.8+	843-	96	32	43
8-2	4,382	4.3	699+	33+	22+	39
Channel 2						
1-2	5,851	5.8	755+	46	20-	35+
2-2	2,012	2.0	775	23+	9	8
3-2	14,992	14.8	680-	76	28	35
4-2	2,107	2.1	650	19+	19	8
5-2r	4,995	4.9	625	33	32+	26+
6-2u	11,702	11.5+	720-	75+	41+	35
7-2	12,786	12.6	730-	93	30	34
8-2	1,661	1.6	625	32	20	15-

Notes:
(1) "Volume" is sales volume in units.
(2) Other variables listed above are market share, end-customer price ("Price"), perceived product quality ("PQ"), perceived service Quality, ("SQ"), and perceived availability ("Av").
(3) Changes of more than 2%, $20, 2%, 2%, and 2%, respectively, in these variables from the previous month are flagged with "+" (increase) and "-" (decrease) signals after the numerical values.
(4) "r" after a firm#-product# denotes a reconfigured product this month.
(5) "u" after a firm#-product# denotes a product with unfilled orders.
(6) "*" after a firm#-product# denotes a reconfigured product that has unfilled orders.

are the prices paid by final end-user customers. These prices include the retailers' markups on the manufacturers' prices.

Research Study #20: Customer Satisfaction

Purpose: This research study provides customer satisfaction estimates of all products in all channels in all regions.

Information Source: Customer satisfaction is based on a customer survey of current users. Customer satisfaction is the percentage of respondents rating their overall product satisfaction as "excellent" on a 4-point "poor"-"fair"-"good"-"excellent" rating scale.

Cost: $10,000.

Sample Output

RESEARCH STUDY #20 (Customer Satisfaction)

	Month 33	Month 34	Month 35	Month 36
REGION 1				
CHANNEL 1:				
Product 1-1H	23.0	18.8	27.2	25.8
Product 3-1H	16.0	22.8	26.8	23.4
...				
CHANNEL 2:				
Product 1-2M	28.5	38.8	26.9	22.4
Product 2-1H	22.9	28.7	23.5	23.8
...				

Research Study #24: Price Sensitivity Analysis

Purpose: This research study provides a price sensitivity analysis for a specific product in a specific region (or all regions) and a specific channel (or all channels).

Information Source: This research study is based on surveys of customers, using advanced marketing research techniques.

Study Details: These price sensitivity analyses isolate the impact of price on market share, while holding other market share drivers constant (product quality, service quality, and availability perceptions). With no user-specified price input, the nine price levels in this study are automatically centered around the current price (the "Reference Price") of the product in each region and channel. Values of -20%, -15%, -10%, -5%, 0% (i.e., current price), +5%, +10%, 15%, and +20%, relative to the product's "Reference Price," are used.

If price is left at its default value (0), then Research Study #24 is executed with the existing product centered around the channel-specific current price of the specified product. Otherwise, the user-specified price (with the specified price being the "Reference Price") is used. Market share predictions are provided for all tested prices in Research Study #24.

In this research study, "Your Price" is the manufacturer price. Your manufacturer price is the price that you input for this research study. In a retail channel (like channel #1), the LINKS software automatically estimates the "Market Price" (including the retail markup) that is presented to the final end-user customer in each price sensitivity analysis. In a direct channel (like channel #2), the manufacturer price is, of course, the final end-user customer price.

Cost: $20,000 per price sensitivity analysis (per product per region per channel). If you execute this research study for all products, regions, and channels in a 2-product, 3-region, and 2-channel LINKS environment, the total cost would be $240,000.

Sample Output:

```
========================================================================
RESEARCH STUDY #24 (Price Sensitivity Analysis                          )
========================================================================

PRODUCT 6-1H PREDICTED GROSS MARGINS IN REGION 1, CHANNEL 1 [HYPERWARE]
Configuration:  H35322
Reference Price:   290
```

Market Price	$ 351	$ 373	$ 395	$ 417	$ 438	$ 459	$ 481	$ 503	$ 525
Your Price	$ 232	$ 247	$ 261	$ 276	$ 290	$ 304	$ 319	$ 333	$ 348
Your Cost	$ 171	$ 171	$ 171	$ 171	$ 171	$ 171	$ 171	$ 171	$ 171
Your Margin	$ 60	$ 75	$ 89	$ 104	$ 118	$ 132	$ 147	$ 161	$ 176
Sales Volume	30,577	25,879	21,985	19,002	16,459	14,269	12,513	11,086	10,533
Market Share	9.9%	8.4%	7.1%	6.2%	5.3%	4.6%	4.1%	3.6%	3.4%
Margin Chang	-49.2%	-36.4%	-24.6%	-11.9%	0.0%	11.9%	24.6%	36.4%	49.2%
MS Change	85.8%	57.2%	33.6%	15.4%	0.0%	-13.3%	-24.0%	-32.6%	-36.0%
Net Change	-5.5%	-0.1%	0.7%	1.8%	0.0%	-3.0%	-5.3%	-8.1%	-4.5%
Gross Margin (in $000s)	$1,834	$1,940	$1,956	$1,976	$1,942	$1,883	$1,839	$1,784	$1,853

```
These estimated per-unit costs of $171.09 include these cost components:
     Product Costs                $144.47
     Order Processing Costs       $  4.00
     Replacement Parts Costs      $ 11.62
     RFID Costs                   $ 11.00
     Duties & Tariffs             $  0.00
```

Limitations: A maximum of four (4) research studies of this type may be executed each month. Each of these price sensitivity analysis research study requests must reference a single product and one or all regions and channels. This research study may only be conducted for products that are already actively distributed in a region and channel. This research study may not be used for products prior to their introduction into a region and/or channel.

Additional Information: These market share predictions and subsequent estimates of gross margins are based on the assumption that competing products don't change their generate demand programs. Obviously, large price changes will tend to evoke competitive responses.

The reported market shares in Research Study #24 are long-run estimates of market shares if you continue with all of your current customer-facing initiatives (configurations, marketing spending, service levels, etc.) as they are now and so do competitors. Market infrastructure issues (like current inventory holdings of retailers and unfilled order status) are not considered. Only your price is "manipulated" in Research Study #24. Thus, these Research Study #24 estimates of market share will not correspond exactly to your current actual market shares (as reported, for example, in Research Study #14).

Research Studies Decisions

Firm		Month	

1	Benchmarking - Earnings	
2	Benchmarking - Balance Sheets	Firm(s)?
4	Benchmarking - Procurement	
5	Benchmarking - Manufacturing	
6	Benchmarking - Distribution	
7	Benchmarking - Transportation	
9	Benchmarking - Generate Demand	
10	Benchmarking - Info Tech & Research Studies	
11	Benchmarking - Operating Statistics	
12	Market Statistics	
14	Regional Summary Analysis	Region(s)?
20	Customer Satisfaction	

24	Price Sensitivity Analysis	Product?	Region?	Channel?	Price?
		Product?	Region?	Channel?	Price?
		Product?	Region?	Channel?	Price?
		Product?	Region?	Channel?	Price?

***Notes**:*

(1) Circle the number of each research study that you wish to order. If additional information is required for a research study, provide that information in the designated space(s).

(2) When region and/or channel numbers are required, enter a single region number and/or a single channel number. Use region "0" and channel "0" as designations to run a research study for all regions and/or all channels, respectively. See the research study descriptions for details about the associated multi-region and multi-channel costs.

Reminders

Research study requests are for one month only. If you wish to reorder a research study in a subsequent month, you must reenter that research study request.

Chapter 15: Performance Evaluation

The various performance measures within the LINKS multi-factor quantitative performance evaluation scorecard are designed to monitor all key elements of performance assessment: efficiency (input usage); effectiveness (output quality); productivity (conversion of inputs into output); firm-wide profitability; and, external performance (e.g., change in market share and customer satisfaction perceptions).

Multiple measures of performance evaluation may lead to conflicts. Short-run and long-run trade-offs are obvious. For example, by reducing inventories and support spending (marketing and service spending), current costs decrease and profits tend to increase. However, in the long-run, these might be exactly the wrong things to do to maximize long-run profitability. Subtler trade-offs arise in potentially conflicting performance measures that move in opposite directions. For example, inventory reductions save costs on the inventory and manufacturing fronts but may lead to shortages to meet the levels of customer demand in the distribution centers. Balancing all of these conflicting trade-offs is the challenge for management.

The LINKS scorecard is perhaps better described as a boardroom-level scorecard. It focuses on top-line boardroom kinds of financial, operational, and customer performance measures and sub-measures. The LINKS scorecard includes the measures and weights described in Exhibits 19-21. Each firm in your set-top box industry submits their raw data to the Set-Top Box Trade Association, which provides your firm's personal scorecard every month.

The LINKS scorecard is based on a ranking of performance on each sub-measure. These rank-order comparisons across all competing firms within your industry avoid the undue influence of particularly extreme values of individual sub-measures. This LINKS scorecard is a within-industry performance evaluation system. Comparisons across industries are problematic due to variations in environmental and competitive milieu. Your firm receives weighted points for each competitor for whom your performance on a sub-measure is better. For some of the sub-measures, "better" means a lower sub-measure value (e.g., the "Ratio of Controllable Procurement and Manufacturing Costs To Revenues" is a lower-is-better sub-measure). For example, if your firm's ratio of "Net Profits" to "Revenues" is better than three other firms' ratios, your firm receives 9 points. (Of course, the top-performing firm on "Net Income" to "Revenues" ratio in a 6-firm industry would receive 15 points.) In general, the maximum available points on any sub-measure are W*(N-1) where "W" is the sub-measure's weight and "N" is the number of firms in the industry. Points accumulate each month throughout the LINKS exercise.

To avoid an overemphasis on minor month-to-month variations in the calculation of the ranking of firms on the performance sub-measures in the LINKS scorecard, minor differences in the sub-measures are treated as ties in the calculation of ranking points. The thresholds for differences to be treated as meaningful are listed in Exhibits 19-21 for each sub-measure. For example, differences of 0.2% or less for "Ratio of Net Income to Revenues" are considered to be statistically insignificant, and firms within 0.2% of each other would be treated as being tied. Thus, two firms with ratios of Net Income to Revenues of 4.5% and 4.6% would be treated as being tied in the calculation of ranking position and associated points received in any month.

Exhibit 19: Scorecard Financial Measures

Sub-Measures	Weight	Sub-Measure Details
Ratio of Net Income to Revenues	3	Current profitability is the best overall signal of business performance, hence its high weight. Firms are "tied" if their scores are within 0.2% of each other.
Change in Ratio of Net Income to Revenues	1	Improvement in profitability is important but less important than current profitability. Firms are "tied" if their scores are within 0.2% of each other.
Return on Assets	2	Return means "Net Income" (from the "Corporate P&L Statement") and investment equals "Total Assets" (from the "Balance Sheet"). This ratio is expressed in annualized terms. Firms are "tied" if their scores are within 0.5% of each other.
Net Asset Turns	1	Ratio of revenues to net assets. Net assets are assets minus loans. This measure reflects the desirability of higher revenues relative to the assets deployed to yield these revenues. This ratio is expressed in annualized terms. Firms are "tied" if their scores are within 0.2 of each other.

Exhibit 20: Scorecard Operational Measures

Sub-Measures	Weight	Sub-Measure Details
Inventory Turnover	2	Ratio of product costs to average inventory value (average of the current and the previous months). If average inventory value is zero, then Inventory Turnover is defined to be 100. Firms are "tied" if their scores are within 0.2 of each other.
Fill Rate	1	The percentage of orders that are filled. "Unfilled orders" occur when available inventory is less than orders in a month. Firms are "tied" if their scores are within 0.5% of each other.
Failure Rate	-1	Ratio of replacement parts demand to sales volume (orders). Firms are "tied" if their scores are within 0.5% of each other.
Ratio of Controllable Procurement and Manufacturing Costs to Revenues	-1	Controllable procurement and manufacturing costs include "Disposal Sales," "Emergency Procurement," "Inventory Charges," "Procurement FC," and "Production FC." Firms are "tied" if their scores are within 0.2% of each other.
Transportation Costs Per Unit Sold	-1	Equal to total transportation costs divided by total units sold (orders). Firms are "tied" if their scores are within 0.5 of each other.
Forecasting Accuracy	2	Forecasting accuracy is a relatively pure signal of management skill and expertise (in this case, in the area of understanding customers and customer demand generating forces). Firms are "tied" if their scores are within 0.5% of each other.
Ratio of (Marketing + Service Spending) to Revenues	-1	Service spending is service outsourcing costs. Marketing spending is an easy way to boost short-run sales volume without necessarily contributing to long-run profitability. Relative to revenues, spending less in marketing and service is desirable. Firms are "tied" if their scores are within 0.2% of each other.

Exhibit 21: Scorecard Customer Measures

Sub-Measures	Weight	Sub-Measure Details
Change in Market Share	1	Change in market share is an overall measure of customer reaction to the firm's offerings. ("Market share" equals customer purchases in all channels and regions.) Firms are "tied" if their scores are within 0.1% of each other.
Customer Satisfaction	2	Customer satisfaction measures the performance of a product from the perspective of purchasers. Thus, it's a clear measure of customer performance and a long-run leading indicator of repeat purchasing behavior and customer retention. Average customer satisfaction across all products, channels, and regions is used here. Firms are "tied" if their scores are within 0.5% of each other.

Notes To Exhibits 19-21: Positive "weights" are associated with sub-measures where "more is better" and negative "weights" are associated with sub-measures where "less is better." "Change" measures are based on month-to-month changes.

Chapter 16: Planning, Management, and Advice

"The journey is the reward." – Steve Jobs, Apple Computer Founder

Planning occurs throughout the LINKS exercise. Your decisions are your plans. But that's not the whole story. How are plans developed? And, much more importantly, how are good plans developed? Planning and plans are the consequence of careful analysis and formulation of appropriate strategies and tactics. Your plan is, therefore, the natural consequence of considerable prior analysis and thinking. This analysis-planning-implementation-evaluation sequence iterates through time as the results of your plans are revealed in the market place (and in your financial and operating statements).

The essence of planning involves answering these questions (and in this order):
(1) What is happening?
(2) How are we doing?
(3) How and what are "they" (our major competitors) doing?
(4) What factors are important for success?
(5) What are we going to do? Why? With what effect? At what cost?
(6) Who - specifically - is to do what to make the plan work?
The SWOT Analysis Worksheet on the following page is the classic strengths-weaknesses-opportunities-threats template to organize your thinking under the "What is happening?" and "How are we doing?" questions.

Based on extensive observations of the performance of thousands of past LINKS participants, these general suggestions and summary-advice nuggets are of well-proven value:

- Read and re-read this LINKS participant's manual (there's lots of good stuff in it).
- Regularly think about general business and management principles and how they might relate to and work within LINKS.
- You don't have to know everything about the LINKS set-top box industry at the beginning of the exercise, but you must consistently increase your knowledge-base through time.
- "Share toys" (i.e., work hard at sharing your useful fact-based analyses and important insights with all members of your LINKS team). "Knowing" something important personally is only a part of the LINKS management challenge. Exploiting that knowledge effectively throughout all of your LINKS team's deliberations, with and through your whole LINKS team, is the key to harvesting the maximum ROI from your data, facts, analysis methodologies, insights, and knowledge.
- Get the facts and base your decisions on the facts, not on wishes, hopes, and dreams.
- Coordinate demand and supply by continually striving to see the whole demand-chain and supply-chain within the LINKS set-top box industry. Don't focus myopically on a single part of the LINKS demand-chain without regard for how it relates to, and is influenced by, other LINKS parts and to the "whole" of LINKS. The source of the "LINKS" name is the simulation's focus on managing the interrelationships, the linkages, among all supply-chain elements.

Good luck and try to have fun in LINKS. It's all about learning and, in a "learning marathon" like LINKS, everyone can cross the finish line in a personal-best time.

SWOT Analysis Worksheet

Strengths	Weaknesses
What are your firm's strengths relative to your competitors? What are your most important strengths? Why?	*What are your firm's weaknesses relative to your competitors? What is impeding you from achieving your desired results? Prioritize your weaknesses.*
Opportunities	**Threats**
How can you convert these strengths, weaknesses, and threats into opportunities for your firm? What considerations are most important for your success?	*What organizational, competitive, and environmental threats do you face now and in the near future?*

Appendix: Web-Based LINKS Access

LINKS has no software to download/upload/install. Point your favorite web browser at the LINKS Simulations website to interact with LINKS

http://www.LINKS-simulations.com

and then access the LINKS Simulation Database using your firm's case-sensitive passcode. **You'll be e-mailed your LINKS firm's passcode just before your LINKS event begins.**

LINKS uses e-mail to communicate with all LINKS participants. Please ensure that your preferred e-mail software is configured to receive e-mail messages from domains ending with:

@ChapmanRG.com @LINKS-simulations.com @LINKS-simulations.info

Your may wish to consult your personal information technology advisor to ensure that your e-mail software is configured appropriately to receive LINKS e-mail from these domains.

While the LINKS Simulation Database works with all web browsers, Microsoft's Internet Explorer is recommended. **LINKS website access requires a Java-enabled browser.**

Output Retrieval After a LINKS Round: You'll be advised via e-mail when LINKS game-run results are available on the LINKS Simulations website. Links within the LINKS Simulation Database permit you to access your Word doc and Excel results after a game run.

Inputs For the Next LINKS Round: When you're ready to input decisions for the next LINKS round, access the LINKS Simulation Database and make your input changes.

- **While any number of members of a LINKS firm may access the LINKS Simulation Database simultaneously to "browse," only one team member at a time can input new decisions.** If multiple members of a LINKS firm attempt to make inputs simultaneously, problems can arise; all decision inputs might not be saved successfully on the LINKS server with simultaneous inputs from multiple members of a LINKS firm.
- You may make some inputs now and others later. Only your final LINKS inputs at the input submission deadline for your LINKS industry are included in the next LINKS round.
- Within the LINKS Simulation Database, current decision values are displayed on the input screens. You only need to make changes. All LINKS decision variables are "standing orders" and remain in effect until changed. However, you must input specific instructions each LINKS round for ordering research studies. Otherwise, research studies will be executed only once since "standing orders" don't exist for research studies.
- Inputs are checked for input integrity, including upper and lower bounds on permissible numeric inputs. Invalid entries result in an error message reporting valid minimums and maximums. And, informative messages are reported at the bottom of each web screen.
  - **Save Input Changes** on a LINKS input web screen before moving to another input screen in the LINKS Simulation Database. Review reminder, warning, and error messages reported at the bottom of the regenerated web screen after the inputs are processed by the LINKS web server.

- **Decision Inputs Audit**: To provide decision inputs auditing support, the LINKS Simulation Database includes a Decision Inputs Audit.

Accessible on the initial login and Exit web screens in the LINKS Simulation Database, the Decision Inputs Audit checks a firm's current decision inputs for potential problems and inconsistencies. This LINKS Simulation Database audit function is not an audit of the individual quality of each decision input (e.g., there's no attempt to assess whether a price of $345 is good or bad). But, possible problems are flagged for attention. For example, forecasts that haven't been changed since the last decision round are noted in the audit display because forecasts are normally updated every decision round.

Accessing LINKS Results Files Via a Browser on a Public Computer: Web browsers leave "tracks" to previously accessed web-pages in browser history files. If you access LINKS results files on a public computer (e.g., in a public PC lab), others could access your results too via the browser history.

Instructions for cleaning the cache in Internet Explorer follow. Other web browsers have similar browser-cache cleaning protocols.

If you access LINKS results files on a public computer, follow these steps to clear Internet Explorer's browser history (cache):

1. Exit/close Internet Explorer after accessing your LINKS results file.
2. Re-start Internet Explorer.
    a. Click on "Tools" and then "Internet Options."
    b. On the "Internet Options" screen, look for the "Browsing History" sub-section. Check "Delete browsing history on exit" (it may already be checked).
    c. Click the "Delete" button in the "Browsing History" sub-section.
    d. Check the "History" box on the "Delete Browsing History" screen (it may already be check).
    e. Click the "Delete" button at the bottom of the "Delete Browsing History" screen.
    f. Wait until the "Internet Options" screen re-appears.
    g. Click the "OK" button.
3. Exit/close Internet Explorer.

These steps clear the browsing history from Internet Explorer on any computer and preserve the security and privacy of your LINKS results files.

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