Sub-Segment 3.2 Distribution Channels

Introduction

Physical distribution has three primary concerns.

- receiving parts or finished goods
- storing them until they are required
- and then delivering them to the customer.

The transfer of material from facility to facility, and ultimately to the customer, is the responsibility of the firm's distribution channel. A bottleneck in this process could have detrimental consequences, such as increasing lead time for completion of a product, which raises costs and reduces margins, and could potentially lose the sale and future patronage. Therefore, the company must not take this activity too lightly and should plan accordingly.

The functions of physical distribution include inventory management (which we have addressed in the first sub-segment), order processing (which is a function of information flow), materials handling, transportation and warehousing. Warehousing is the set of activities involved in receiving and storing goods and then preparing them for reshipment.

As a supply chain manager, you will have to address several important distribution decisions. This include which transport mode to use, the physical architecture of your distribution system (including the number and location of distribution warehouses) and whether to own or contract-out warehousing and transport.

As part of this introductory segment, we will address transportation and warehousing in more detail. In addition, we will discuss how physical distribution systems can be structured and implications for SCM when firms move from a domestic to an international distribution structure.

Transportation
There are many different types of transportation available to businesses. The most common are seen in the figure below. The figure also shows multi-modal configurations. When two types or modes are combined, you have multi-modal transport methods. For example, stocking trucks on a railcar for long distance shipping is called piggybacking.

Other methods do exist, but their application is minuscule in scope when compared to the above. For example, in large urban areas, bike couriers are more practical, due to the congestion of roads and proximity of customers. Even pipelines, which companies use for transportation of crude oil and natural gas from source to refineries, are limited in the availability. Thus, air, truck, rail and water and the key transport methods used in most businesses.

*Trucks* have the advantage of being flexible. They also provide low loss and damage transport along with tracking, accuracy and a wide geographical coverage. Another advantage is that there is still heavy price competition in the trucking industry, thus driving down costs. Unfortunately, weather and traffic conditions and delay truck shipments.
Railroads advantages are that they provide inexpensive transport for carload size lots. However, goods require more packing material and must allow for rough handling. While rail transport can be somewhat slow, the cost savings can be fairly substantial. Firms should also look to freightforwarders, piggybacking trucks and doublestacking containers for more opportunities for cost savings.

Water transport is ideal for goods that are heavy, low-value, and non-perishable but that has high fixed costs. Of course weather can be a problem and add to transport times. However, containerization (the process of combining several unitized loads into a single well-protected load) and improved ports allow for expansion in new products and markets.

Air transport is the transport method with the highest costs. Thus, it is only suitable for high value, urgent or perishable items. Of course, weight and locations are limited. However, it saves on inventory holding costs because of the reduced transport times. This method is becoming more important in international trade.

Each of these transport methods is important. Depending upon the architecture of the supply chain, one method may be used exclusively, or a mixed-modal strategy may be utilized, based upon the service requirements of the company and the benefits of the options. For intercontinental transportation, Ocean Freight and Air are the only options available. While the ocean liner is very economical, it is extremely slow, often taking weeks or months to reach its destination. On the other end of the spectrum, Air transportation is very fast, but at great expense. For transportation across land mass, rail or truck are the preferred methods of transportation. Although sea and air are still options, they represent the extremes of transport and provide marginal benefits on cost and time compared to rail and truck, respectively.

Comparing rail to truck, the following rules generally apply; truck transportation is faster than rail, and rail transportation is cheaper that truck. Rail has a greater capacity that truck, so it is used to move large quantities of good or materials, while trucks are used for the
transportation of smaller quantities. Considering this, the company should utilize the method that provides the greatest benefit for them, given their objectives. If they are cost conscience and time is not a factor, then rail would be the best alternative. If time is the main factor, then truck would be best. There are a few exceptions to this rule, especially internationally. In Europe, where the geography is more condensed and regulations permit high speed rail systems, rail is preferable to truck on both time and cost. In developing countries, the road infrastructure may be so poor that rail is again preferable to truck. Knowledge of the infrastructure in the area of operations is key to determining the best transportation methodology.

In addition, outsourcing should be considered for particular aspects in the distribution channel. While a company may have the equipment to transport materials from a manufacturing plant to the distribution center, it may not have the logistical capability to then deliver to its many customers. If it is international, then there might be a possibility that they lack the resources to effectively handle transportation in that country.

**Delivery Methods**

Once transportation decisions have been made, then delivery schedules must be set up. For most transportation modes there are two basic types of deliveries: direct and milk run.

**Direct Deliveries**

As the name implies, direct deliveries move goods from one origin facility to one receiving facility. Routing in this case is straight forward and usually consists of choosing the shortest direct path. Because of the direct nature of the transport, intermediary steps such as warehousing, shipment combination, etc, are removed. In most cases, the most efficient way to structure direct deliveries are through the use of EOQs (discussed in the previous sub-segment). The ideal situation is when the EOQ size is equivalent to the transportation shipment sizes. For example, assume that the receiving facility is requested shipments in EOQ size lots. If the receiving facility gets its
deliveries by truck and the EOQ is the same size as the truck load (TL), then you get the best economies of scale. If the EOQ is not the same as a TL, then the cost savings are not as great. For example, if the EOQ is bigger than a TL, then the receiver will have to receive multiple shipments from each suppliers and have the extra handling costs associated with that.

**Milk Runs**

In by gone days, the milk man would deliver from a dairy store to multiple houses. Hence a milk run is one which delivers from a central origin to multiple locations. Milk runs are more complex than direct shipments. For example, decisions about quantities have to be made up front. If a location needs EOQs of different products that are smaller than a truck load, then multiple orders of different products can be combined to reach truck load size. Once this is determined, decisions must be made concerning the frequency of deliveries. Finally, scheduling must be done. The decision as to the order in which deliveries will be made can be extremely complex and go beyond the scope of this segment. Methods include the savings matrix technique and the assignment or transportation model.

**Delivery Sources**

Customer deliveries can be made from either single product locations or from distribution centers. Single product locations are ideal if you are dealing with high volumes of product with predictable demand. In that case the production facility or warehouse can deliver to customers in large bulk quantities thus allowing for large economies of scale.

However, distribution centers (DCs) tend to be the primary facilities for most physical distribution structures because bulk quantities of different products must be combined in multiple ways and quantities to serve a large number of customers which may be located a great distance from the suppliers. DCs can warehouse inventory for future shipment or they can be used for crossdocking. This is a technique that was pioneered by Wal-Mart and has been embraced by many other firms. Because of its widespread use, we will assess it in more detail.
Crossdocking –

When it comes to distribution techniques, crossdocking can be a strategic weapon in a successful physical distribution design, which is heavily dependent upon execution and integration. Crossdocking can be viewed in several different ways. One might view it as combining both warehouse and distribution center functions. Another way of viewing it is as warehousing without inventory.

Crossdocks are essentially transshipment facilities to which trucks arrive with goods that must be sorted, consolidated with other products, and loaded onto outbound trucks. Outbound trucks may be headed for a manufacturing site, a retail outlet, or another crossdock, depending on the specific application.

Types of crossdocking:
The term “crossdocking” has been used to describe several different types of operations, all of which involve the rapid consolidation and shipment of products:

- **Manufacturing crossdocking:** receiving and consolidating inbound supplies to support Just-In-Time manufacturing. For example, a manufacturer might lease a warehouse close to its plant in order to prepare subassemblies or consolidate kits of parts. Because demand for the parts is known, say from the output of an MRP system, there is no need to maintain stock.

- **Distributor crossdocking:** consolidating inbound products from different vendors into a multi-skew pallet, which is delivered as soon as the last product is received. For example, computer distributors often source components from different manufacturers and consolidate them into one shipment in merge-in-transit centers, before delivering them to the customer.

- **Transportation crossdocking:** consolidating shipments from different shippers in the LTL and small package industries to gain economies of scale.

For small package carriers, material movement in the crossdock is by a network of conveyors and sorters; for LTL carriers it is mostly by manual handling and forklifts.

- **Retail crossdocking:** receiving product from multiple vendors and sorting onto outbound trucks for different stores. Crossdocking has been cited as a major reason Wal-Mart surpassed K-Mart in retail sales in the 1980s.

- **Opportunistic crossdocking:** in any warehouse, transferring an item directly from the receiving dock to the shipping dock to meet a known demand.

Ways to successfully implement cross docking:

- Vendor cooperation
• Integrated information system with vendors
• High visibility and control
• Strong quality control program for the inbound
• Partnership with the vendors

If the vendor prepares the order, a higher level of confidence in the quality of the product and the accuracy of the order is required, and bears higher costs. As the vendor provides a higher, more dependable level of service, it puts them in a partnership relationship that typically leads to increased business. Having one inventory in one facility suits a make to stock (push) environment, while a decentralized system works well for a make to order (pull) environment.

Advantages of Crossdocking:
• Reduced handling costs
• Reduced inventory carrying costs
• Reduced cycle time/improved transit time
• Improved flexibility in opting for transportation mode
• Improved customer service
• Reduced space utilization

Architecture
Depending upon the goals of the organization, there are many different types of ways that the supply chain’s distribution system may be structured. If the firm is attempting to provide a high level of customer service with quick delivery times, then they may opt to have a decentralized hierarchy with many distribution centers scattered across the country. While this may incur additional costs, such as increased inventory and overhead from the additional facilities, it will almost ensure that they will be able to achieve their goals. If cost is the main driver, then a centralized warehouse and distribution network may be preferred, as this type of structure will allow for cost savings at the expense of delivery times.
Also, given the nature of the company's industry and products, the distribution system must be accommodating to factors of production. For industries that produce products with bulky raw materials that undergo a weight losing process, manufacturing plants and distribution centers must be relatively close to the source of these inputs. Conversely, products that are subject to weight gaining activities, where it is more economical to move the components than the final product, must be located towards the end of the supply chain near the consumer. Examples of these two concepts can be better explained by the steel industry and aerospace, where due to the bulk of iron ore, steel plants are located near the strip mines, and due to the size of jet fighters once finished, they are usually located near military facilities. A more extreme example of the latter would be the NASA program, where the space shuttle manufacturing facility is located approximately 3 miles away from the launch pad.

To summarize, when structuring your logistics and supply chain network, every structure is a variant of the extremes of centralized and decentralized. Both extremes have advantages. The key is to focus on the needs of your particular firm and its strategic position. Your distribution system’s structure should follow from that.

Advantages of centralization include:

- Risk Pooling / Variance Reduction Effect
- Economies of Scale
- Economies of Scope
- Learning / Experience Curve
- Coordination Advantages

Advantages of decentralization include:

- Product / Process Improvements
  - Proximity to suppliers
- Customer Satisfaction
  - Proximity to markets/customers
Cost Savings
- Sourcing, Production, Logistics
- Financing

Risk Diversification / Portfolio Effect
- Technology Risk
- Financial Risk

There are additional factors to consider if the supply chain is to branch across several countries. Manufacturing plants ideally would be located in countries with low labor costs, Distribution Centers and warehouses should be located in counties where customers are located and have responsive logistical infrastructure. Costs associated with the transport of materials and goods among these countries should be negligible to the benefits that occur with this dispersed layout.

Organizational Change
Altering an international supply chain’s distribution system, for example in order to implement crossdocking, can involve significant organizational change. As discussed in the previous sub-segment, in order to implement any new system, every business process needs to be analyzed and the impacted supply chain members should be included in order to overcome any resistance to change.

Steps for successfully altering an international supply chain’s distribution system include:
- Conducting a comprehensive analysis of the infrastructure costs and customer service levels by channel, inventory levels, and product flow.
- Developing a strategy to meet customer expectations, product availability, and delivery timing with lower operating costs.
- Listing out the assumptions to be made at the planning stage
- Adopt a risk management approach early in the process
- Develop the target infrastructure to create a simpler and cost effective supply chain that was scaleable
• Expecting the unexpected
• Having the right personnel at the right place
• Planning for change by balancing skills to unlock the complex combination of people and skills
• Develop a thorough organizational structure by balancing internal and external resources via:
  o Steering group
  o Program management group
  o Business change group
  o Project management group
  o Project working group

Simple as many of these principles are, many will recognize just how often the basics are ignored, thus burning through a large investment with no hope of a realistic return. The too difficult or politically unacceptable projects might hold the secret to unlocking value. However, before embarking on any major distribution restructuring, a supply chain manager should determine the following:

The company must have adequate resources
• At senior management level
• And at all subsequent levels according to where you are in the overall process

Whatever the change in any business
• People are at the center of it
• Things will go wrong that never plan to
• Things usually get worse before they get better
• You must maintain a sense of perspective through careful planning

Clear metrics of success and benefits, as well as a method of tracking those successes must be established and visible to all. The role of risk management (safety net) is never to
be underestimated. Once these things are taken into consideration, the transition into a
new system can take place more easily and effectively.

Outsourcing in Distribution
As previously discussed, outsourcing is being used a great deal in SCM. One of the
major areas of SCM outsourcing is distribution, specifically logistics.

Third Party Logistics (3PL)
There are many benefits to using third party logistics to handle many logistical functions
that go beyond cost, such as more flexibility and increased customer satisfactions. It
allows for the company to not have to maintain a vast logistical network and tie up capital
for assets. For example, Dell Computers has no internal delivery service to their
customers, but by outsourcing to UPS, they are able to deliver machines to their
customers overnight at a lower cost than they could ever provide.

4PL
Fourth Party Logistics (4PL) have evolved out of the outsourcing trend of third party
service providers. 4PL offer expanded services in comparison to 3PLs, which only deal
with one aspect of the clients business (logistics), while 4PLs often deal with inventory
and vendor management. The result is a better solution for the client, with more reliable
service and results. As a practical matter, most 3PLs have morphed into 4PLs.

Freight forwarding
When dealing with international shipments, there are several extra facets to
transportation, such as customs. This complicates the process and adds additional
paperwork. As a result, many companies have outsourced international shipments to
freight forwarders. Companies that already have an expansive logistics capability, such as
FedEx and DHL, offer freight forwarding in these counties, often will little existing
infrastructure. This allows for companies to not have to spend an exorbitant amount of
money to develop their logistical capabilities in that country and provide a high level of
International Distribution and SCM

There are many benefits to moving operations offshore. Free trade zones are attractive locations for companies to develop manufacturing facilities, whereas they are able to avoid duties and tariffs on the inputs of production that are not resold into the host county. Companies are able to exploit the lower labor costs and other incentives, and still are able to produce the product and ship it anywhere they so desire.

Another reason for international expansion is the proximity to emerging markets. Developing countries often provide a lucrative opportunity to these firms, which are willing to forgo initial profits to reap greater returns further down the line. In these cases, the firms employ a market share strategy and wager that once the country becomes rather affluent, they will have a sizable foothold in the country and recover their initial costs.

However, expansion into foreign countries often brings about new issues regarding the supply chain. Several of the constants that are taken for granted in the United States are not present in many other nations. Within the United States, the logistics capabilities are second to none. The existence of a vast highway system allows for freedom of movement to all parts of the country. These also extend into neighboring countries to an extent, allowing for easy transportation by a single mode. In addition, there is an expansive rail network that allows for economical transportation of large quantities of goods to the major cities. Seaports have been built in all the major costal cities, allowing for massive import/export operations and international trade. Lastly, airports are scattered across the nation, allowing overnight delivery to any part of the country. Some air service providers even offer deliveries within hours from one side of the country to the other, and to the major cities in-between. Also, there is an elaborate telecommunication network that allows for the flow of information. Cellular, Broadband, Wi-Fi, and Satellite communications allow for companies to exchange and track information regarding their products. Computers are networked together, so that people in different departments and
even different cities can easily access information about a particular product.

Internationally, few nations have the capability discussed above, and as a result, companies must adapt to the differences in their host country. Many countries lack the infrastructure, making transportation difficult. Such is the case in China, where two-thirds of the roads are unusable for modern trucks. As a result, its chemical industry is suffering, despite efforts of chemical manufacturers in China and the World Trade Organization. Utilities in many countries are not as sophisticated as those in the US, and manufacturers may have to contend with rolling blackouts or brownouts. Infrastructure may not be as developed as well, and firms must account for that variability in their transit times. For example, many countries do not have cellular service, and lack the advanced communications for computers. Some countries, such as Russia after the revolution, even had problems with basic telephone service.

In addition, the culture and political landscape may not be very hospitable in those countries as initially thought. In Japan, bribery is considered a part of business, and a necessity in order to remain competitive. This is in stark contrast to business practices in the United States, a plight that the US Olympic committee became all too familiar with after its bid for the winter games in Salt Lake City. Many Muslim countries have laws discriminating against women, so the company would be wise to take that into consideration before sending female expatriates overseas. Also, there might be some political instability that would affect the supply chain. Imagine a company losing a billion dollar facility to foreign nationals, such as the case of ChevronTexaco, who temporarily lost control of its refinery operations in Nigeria after unarmed village women stormed pipeline stations. Such an action would have a severely detrimental affect on the entire network, and the company itself.

Thus, from a practical perspective SCM managers must accept that different aspects of managing inventory and distribution change when the distribution network moves from a domestic to a global structure. To summarize, higher inventories are a given because of the longer lead times and increased uncertainty. The lead times are longer because
distances are longer, transportation is more costly and multiple modes are often required. As borders are crossed, delays are encountered as new documentation is needed.

Multiple borders and countries also bring up the issues of managing physical distribution facilities and employees with different cultures, laws and languages. A simple issue such as taking an order can be complex when the order processing center is in a different country than the ordering and the languages involved are different. All these issues combine to mean that service tends to be slower and more costly as buffer inventories are increased to keep service levels high. These issues are summarized in the figure above.

**Focus on Practice: European Methods of Integration**

Europe has felt the effects of complex and overly complicated supply chain systems which have in the past required distribution centers in every country. These large, intricate systems have presented several problems for companies as they strive to stay competitive in the global marketplace. Several drivers are leading European companies towards integration of their physical distribution systems:
• Profit levels failing to meet management objectives
• Operational performance varying widely by brand, business, or unit
• Customer service levels not contributing to competitive differentiation
• Inventory levels high and rising higher with a poor demand-supply balance
• Suppliers and consumers not well linked to the overall company operations
• Companies in industries with rapid growth in the late 1990’s
• Companies in traditionally low growth sectors
• Companies with multiple brands running separate operations
• Multiple subsidiaries of multinational corporations

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Sub-segment 3.3 EOQ Problem Set: A Microscope into Supply Chain Tradeoffs.

During this course, we have discussed the fact that one of the key aspects of SCM is relationships. These interactive relationships among the various members of the supply chain mean that a decision by one member can directly and severely impact another member. During this particular segment we have discussed EOQ. You will be taking another course in inventory management that will address EOQ in detail. However, as a way of illustrating how to perform EOQ analysis and also how SCM decisions can impact various members of the supply chain, consider the following EOQ example.

<table>
<thead>
<tr>
<th>Total cost =</th>
<th>Annual carrying cost</th>
<th>+</th>
<th>Annual ordering cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>TC = ( \frac{Q}{2} H )</td>
<td>+</td>
<td>( \frac{D}{Q} S )</td>
<td></td>
</tr>
</tbody>
</table>

- \( Q \) - Lot size of the order
- \( H \) - Average annual holding cost per unit
- \( D \) - Annual demand
- \( S \) - Cost per order

\( Q/2 = \text{Average inventory on hand} \)
\( D/Q = \text{Number of orders per year} \)

Figure 1 Necessary EOQ Formulations

The EOQ formula takes the Total Cost formula above and determines which quantity \( Q \) minimizes both the carrying and ordering costs. Graphically, this can be seen in figure 6.
The way to find this optimal Q is to take the total cost curve, take the first derivative with respect to Q and set it equal to zero. Solving for Q gives the Qopt listed at the top of figure 6. Given this information, we can now solve some problems and see what the implications are of various EOQ strategies.

**EOQ Problem Set**

A local retiree who is a woodworker has contracted to manufacture a small wooden souvenir item for sale at the hospitality booth at the local visitors’ center. The manager of that booth is agreeable to the craft shop delivering finished goods at the shop owner’s convenience. The items are relatively small and lightweight, so the primary cost of shipping is the relatively fixed cost of a trip across town. Relevant data for the shop are as follows:

- Annual demand (D) = 3500 units
- Ordering (shipping) cost (S) = $12 per order (this ordering cost basically consists of loading the items into a 1956 GMC pickup
truck and filling it up with gas for the round trip drive from the outskirts of town where the retiree lives.)

- Holding cost (H) = $.50 per unit per year. (this cost is low because it consists of the retiree storing the souvenirs in the basement of his house)

At first, the manager of the hospitality booth doesn’t care when the deliveries occur. Thus the retiree decides to deliver the items in such a way as to reduce his total costs. Remembering his EOQ equations from his former job, he does the following:

- \( Q_{\text{opt}} = \sqrt{\frac{2DS}{H}} = \sqrt{\frac{2 \times 3500 \times 12}{.5}} = 410 \)

Thus, the retiree will wait until they have built 410 souvenirs then load of the truck and drive to the store. Now given this optimal Q, what are the retiree’s total annual costs?

- The ordering cost is \( DS/Q = 3500 \times 12/410 = $102 \)
- The holding cost if \( QH/2 = 410 \times .5/2 = $102.5 \)
- The total cost is \( DS/Q + QH/2 = $102 + $102.5 = $204.50 \)

This continues for a while until the manager at the hospitality booth gets tired of receiving shipments at different times from all the vendors. The manager then asks all the vendors to make deliveries once a month. Before agreeing, the retiree runs the numbers to check the overall costs of this new requirement.

First the retiree must determine what the new Q is. Since \( D/Q = 12 \) (once a month), and demand has not changed, the retiree determines that the new Q is 292 instead of 410. Given that the following is true

- The ordering cost is \( DS/Q = 3500 \times 12/292 = $144 \)
- The holding cost if \( QH/2 = 292 \times .5/2 = $72.92 \)
- The total cost is \( DS/Q + QH/2 = $144 + $72.92 = $216.92 \)
The difference between this cost and the first optimal cost is $216.92 - $204.50 = $12.42, so the retiree decides to agree to the managers request.

The manager of the hospitality booth has been taking MBA courses at Wright State University and learns about the wonders of JIT. The manager realizes that if all his suppliers made deliveries once a week then he wouldn’t need the back room to store inventory. Instead, he could knock out the wall and nearly double his sales floor, possibly increasing sales. Or he could not use the back room at all and sell it to someone else to reduce costs. Either way he comes out ahead. Thus, he tells all the suppliers to make deliveries once a week.

The retiree goes back and assesses the costs of once a week delivery.

First the retiree must determine what the new Q is. Since D/Q = 52 (once a week), and demand has not changed, the retiree determines that the new Q is now 67. Given that, the following is true

- The ordering cost is DS/Q = 3500*12/67 = $624
- The holding cost if QH/2 = 67*.5/2 = $16.83
- The total cost is DS/Q + QH/2 = $624 + $16.83 = $640.83

The difference between these costs and the first (optimal) costs is $640.83 – $202.50 = $436.33. The retiree realizes that once a week delivery would eat up all the profit he is making. Since he is only doing this for fun, the retiree decides not to supply the hospitality booth any more but to devote his leisure time to fishing.

This particular EOQ example illustrates the issues involved with JIT. The entire concept of JIT has been heralded for years as a way for firms to reduce inventory and thus reduce costs. This allows firm to increase ROI and other financial measures. As a general rule, larger firms have embraced JIT concepts and asked their suppliers (usually smaller firms) to provide them with JIT deliveries. While large firms view JIT positively as a means to
reduce costs, as a general rule, smaller firms have a different view of JIT. They refer to it as “I get to hold your inventory”—and the accompanying costs. Thus, supply chain managers need to understand that when implementing any new system (forecasting, planning and control, or distribution) they need to be aware of what the impact of that system will be to both upstream and downstream supply chain players. By incorporating those players in the initial planning and assessment, alternatives may be found. Even if no alternative are found, at least the other members of the supply chain will know what is coming in plenty of time to adapt to the requisite changes.