Supply Chain Management 101

Course No: K02-003

Credit: 2 PDH
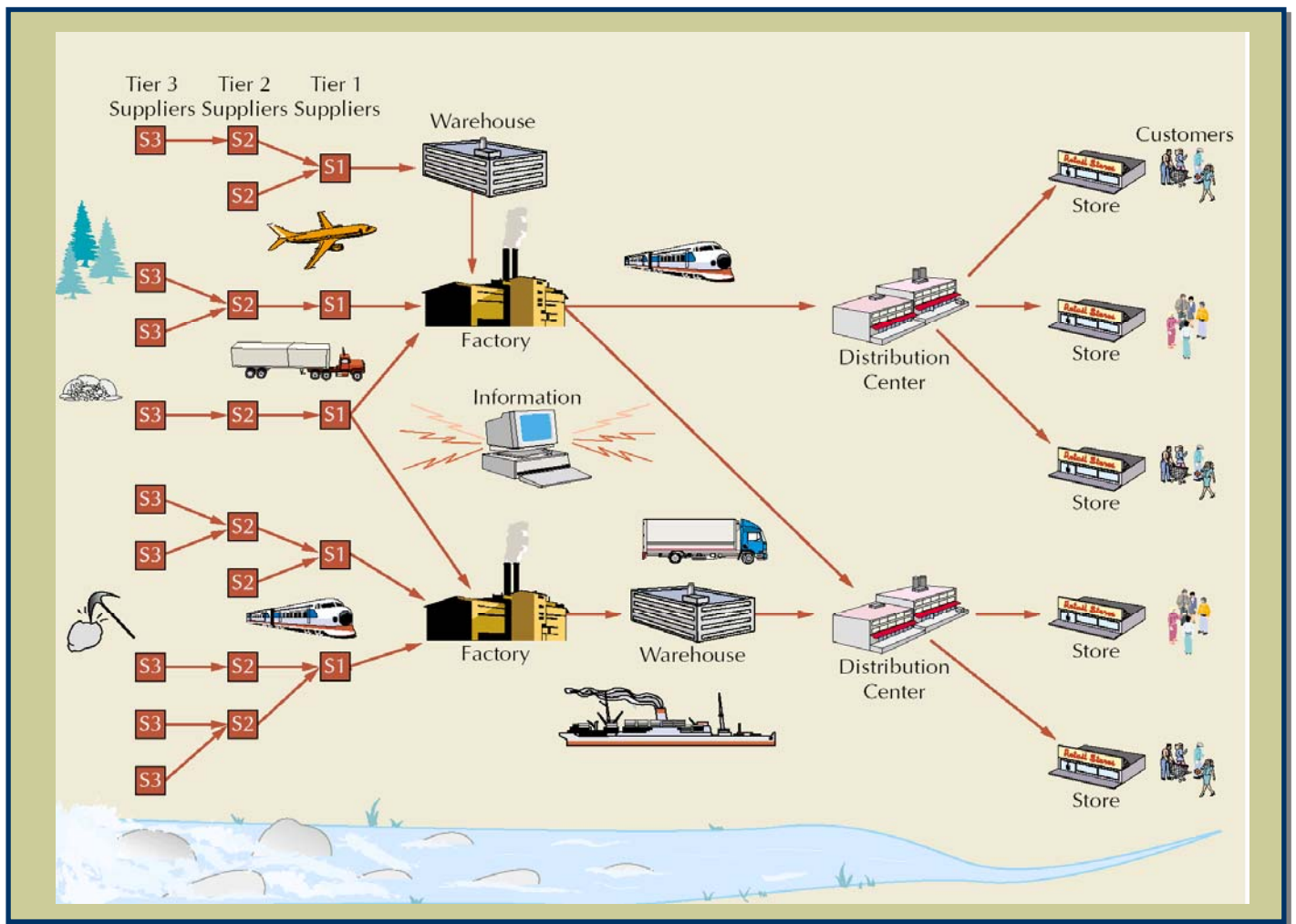
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Supply Chain

Management 101

Richard Grimes

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Learning Outcomes

Students completing this course will be able to:

1. Describe the general flow of a supply chain and list the typical components within it.
2. Explain how the supply chains of manufacturers and service providers differ and are alike
3. Define correctly and use appropriately the various terms associated with supply chain management
4. Learn to use key performance indicators
5. Identify typical uncertainties in a supply chain and suggest ways to protect against them
6. Describe how technology has changed the traditional supply chain and can be used as a tool for success
7. Describe the advantages of trust and communication between various players in the supply chain.

Additionally, students will become conversant with such terms as:

➢ Inventory turns
➢ Days of supply
➢ Value chains
➢ The Bullwhip Effect
➢ Various technological tools used in modern supply chain management
➢ Cash-to-cash cycle
➢ Risk pooling
➢ Demand focused metrics
➢ Internal focused metrics

Intended Audience

This course is intended for project managers, department managers, process leaders, non-professional accounting staff or simply anyone wanting to gain a basic knowledge of how a supply chain works including how to calculate various critical metrics within it.

Overview

The supply chain of a business includes all of the facilities, functions, and activities involving the flow and transformation of goods and services from raw materials to final customer, as well as the associated information flows. It is an integrated group of processes to "source," "make," and "deliver" products.

There are basically two different business models with supply chains: *manufacturers of finished goods* with very distinct flows of materials from suppliers and out to consumers (see the diagram on page 5) and *service companies* whose supply chains are not so easily described because they do not focus on the flow of physical goods but rather on human resources and support services. They are often more compact and less extended than their manufacturing counterparts.

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The key to success of supply chain management whether it is manufacturing or service is DATA. There are three critical elements of using that data that determines the success of a business. It must:

1. Collect it from their customers to learn what they want, how they want it, and when it must be there (the *demand* side of the equation)
2. Interpret it carefully to improve:
    a. Their production, purchasing, and staffing forecasting
    b. Inventory management (enough of the right inventory to meet customer demand but not tie up too much capital in it)
    c. Planning for growth
3. Share it with suppliers to make sure their flow of needed materials stays reliable.
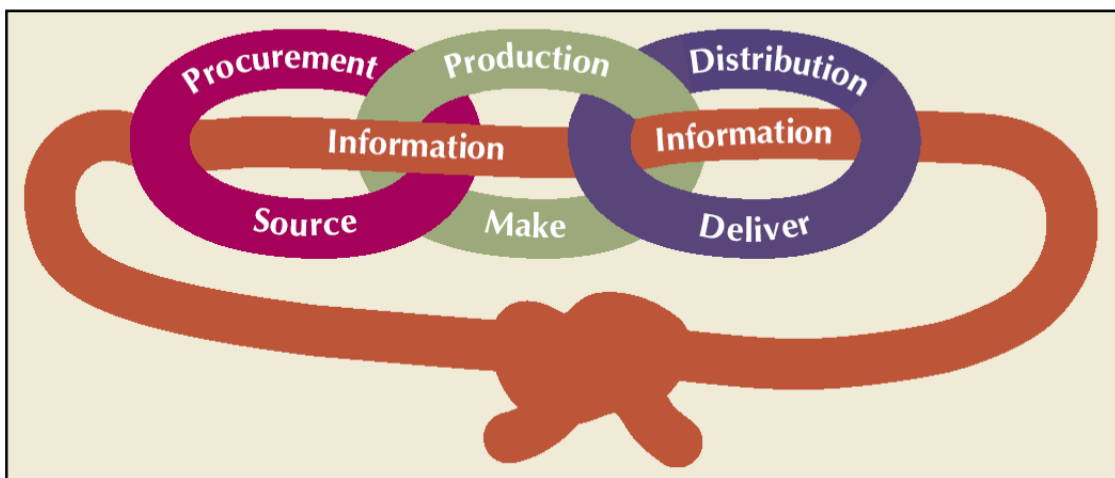
The picture below tells us a lot about the supply chain concept.

Suppliers:

➤ **Tiers** - First tier suppliers provide materials that are ready for the manufacturer without additional processing. Second tier means it needs one more step of preparation before going to the manufacturer and so forth for additional tiers.

➤ **Information –** this is the heart of an effective supply chain as data is exchanged as close to real time as possible between suppliers, the manufacturer, distribution centers, and end-user access at stores.

➤ **Distribution Centers & Outlets to customers** – the customer end also provides the "demand" which helps the factory forecast future needs so they can contact their various tiers of suppliers to begin the cycle.
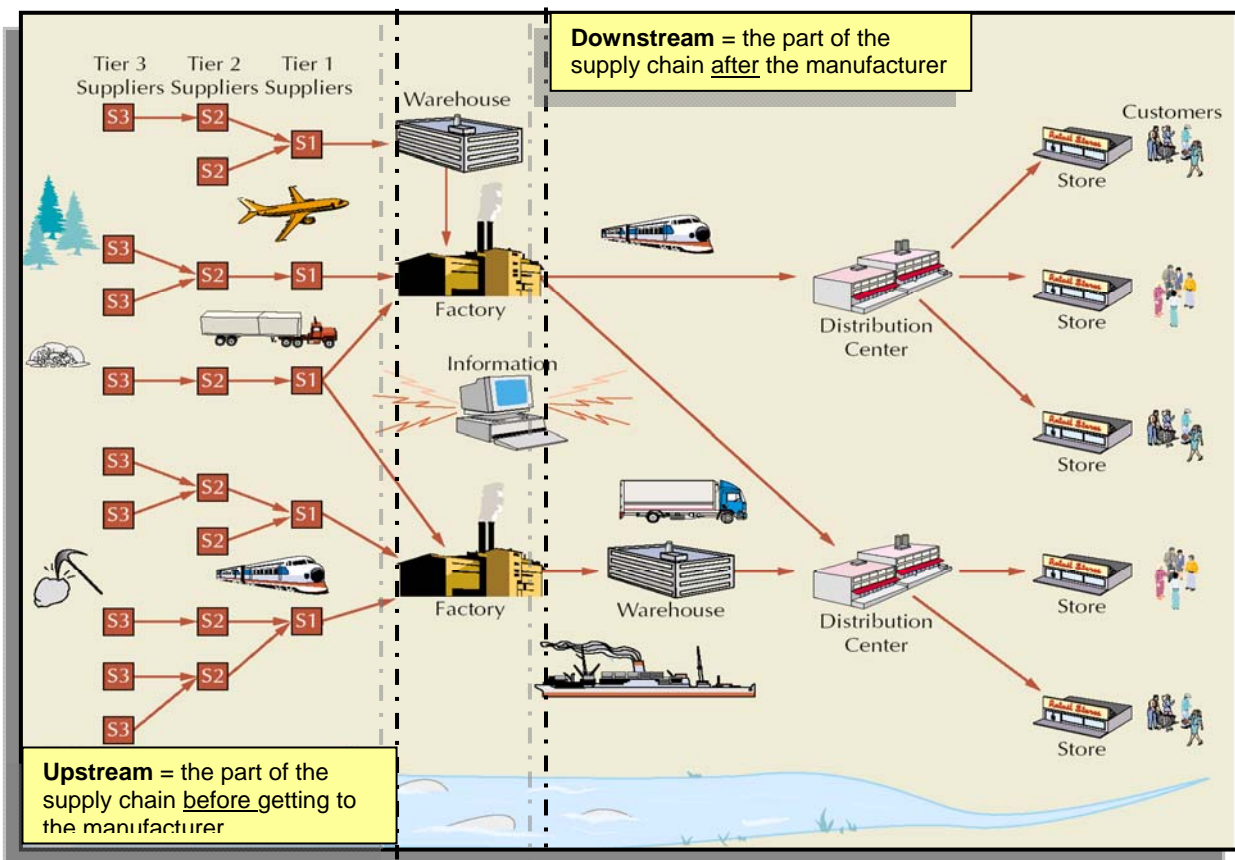
Service Providers

Although we will spend most of this course talking about the supply chain and how it relates to manufacturing, it is important to apply the same model to service providers such as a dentist, a lawn service business, or a community services agency.

A dentist must purchase equipment (and have it serviced as necessary) and supplies such as drugs used in their office procedures and that bag of goodies they always give you after cleaning your teeth with the new toothbrush, dental floss, and maybe a travel-sized tube of toothpaste inside. They are very focused on the human resources aspect of their business because it's their employees who clean the teeth or assist in the more serious dental procedures that interact with their patients and determine, to a large extent, whether the patients stay with them or look for another provider.

The lawn service provider must have sufficient equipment and tools from a supplier plus enough employees to make their business successful. They may not interact with customers as much as a dentist's employees do but customer satisfaction and reliability is still an important element of their job.

The community service provider must also obtain materials (depending on the nature of their services) from suppliers and, using the skills of their employees, apply those materials appropriately in their service to their customers. Any disruption in the flow of their supplies can mean a breakdown of service.

Various "Chain" Terms

The word "chain" has been used in a wide range of references dealing with manufacturing or services and has become fairly universal. This is a breakdown of their current usage for familiarization:

> ➢ **Value chain -** every step from raw materials to the eventual end-user where its "value" increases steadily as a result of something being done to it.

For example, a cabinet manufacturer uses oak as a primary ingredient of his product. Going to the source of that material, we see the logger who cuts down the tree and sends it to a saw mill. This adds value to the wood because it is no longer in the forest but getting closer to becoming a cabinet.

The saw mill adds additional value by cutting the raw tree trunk into boards and pressing the scrap into a thin veneer for cabinet facing. This wood is shipped to the cabinet maker.

The manufacturer adds value by transforming the finished oak lumber into the cabinets which are sent to the retail outlet for the builder/consumer.

The builder adds value to the cabinets by installing them in the new home he is building and staining them to complement the colors in the house.

➢ **Supply chain** – the sum of all activities that get raw materials and subassemblies into manufacturing operation. The ultimate goal is same as that of value chain but it does not emphasize the increasing value of the item at each stop in its trip to the manufacturer: this focuses more on the flow of the materials into and out of the manufacturer.

➢ **Demand chain** – This focuses on the end-users seeking to know more about what their customers want (their "demand" from the manufacturer) in terms of quality, quantity, and delivery time of particular items. The more data they can collect from the demand side means they can improve their forecasting projections.

Better forecasting means being more specific in buying raw materials (thus wasting less) from suppliers and, thus, carry a lower inventory of raw materials in the factory. As the quantity of the data exchange between end-users, manufacturers, and suppliers increases, the greater the opportunities for just-in-time supply delivery. (We will talk more about this later.)

Supply Chain Management (SCM)

Traditionally, each segment of the supply chain – upstream or downstream – tended to focus on its own part of the process. The manufacturer's Accounts Payable (AP) department focused upstream on taking as long as possible to pay suppliers without incurring late charges while Accounts Receivable (AR) spent their time looking downstream to getting paid from consumers as quickly as possible.

Inventories commonly bulged with materials that were no longer needed or were in greater quantities than simply having "safety stock" (an emergency amount of inventory in case we were caught short for some reason) on hand. The costs of carrying that inventory were either not considered or deemed too difficult to calculate accurately. [We will discuss this at greater extent later in this course.]

However, the evolution of technology from telephones, to faxes, to real-time data via the internet has radically changed the way successful manufacturers view the management of their supply chain. Not only does *supply chain data* flow via the internet but *financial data* also moves to and from suppliers, customers, and the bankers who finance it all. In today's world, a successful manufacturer must take a holistic view of the whole supply chain as well as rethink the relationship they must have with their vendors.

Uncertainties in the Supply Chain

In an ideal world:
1. A manufacturer would know exactly what the customer wants, when they expect it and the extent of the quality and quantity demanded
2. The suppliers would always deliver on time and provide the quality and quantity of exactly what we wanted
3. Our customers would always pay on time (or earlier)
4. We would pay our suppliers at the last possible moment before incurring finance charges (and they would be happy to get it)
5. The employees and equipment would always work to maximum productivity
6. We would grow at a steady and predictable rate and our investors would love us.

Obviously, we don't live in an ideal world but it does help us identify some of the obstacles and opportunities keeping us from it. Let's look at these 'ideal world' components and talk about what we can do about them in the real world.

The ideal world: *A manufacturer would know exactly what the customer wants, when they expect it and the extent of the quality and quantity demanded.*

The real world: The goal of SCM is to develop an ability to respond to uncertainty in either the upstream or downstream sides of the equation without creating costly excess inventory. [Some excess inventory is necessary as insurance against supply chain uncertainty. The key is to determine just how much we need without being excessive.]

Typical factors that contribute to uncertainty in the supply chain include:
  ➢ inaccurate demand forecasting
  ➢ long variable lead times
  ➢ late deliveries
  ➢ incomplete shipments
  ➢ product changes
  ➢ batch ordering
  ➢ price fluctuations and discounts
  ➢ inflated orders

One aspect of life in the real world of SCM is the ***Bullwhip Effect*** – what happens when slight demand variability is magnified as information moves back upstream in the data flow from the consumers.

Suppose each participant in the supply chain experiences low confidence in their forecasting abilities based on inaccurate demand data from the ultimate consumer. Suddenly, each begins to look more to their own security when placing orders and hold a little inventory as insurance against this uncertainty. As inventories grow, downstream customer service suffers because the needed goods are being stored, not shipped. Production and delivery schedules are missed while associated costs increase.

Inventories grow at each stage in the chain
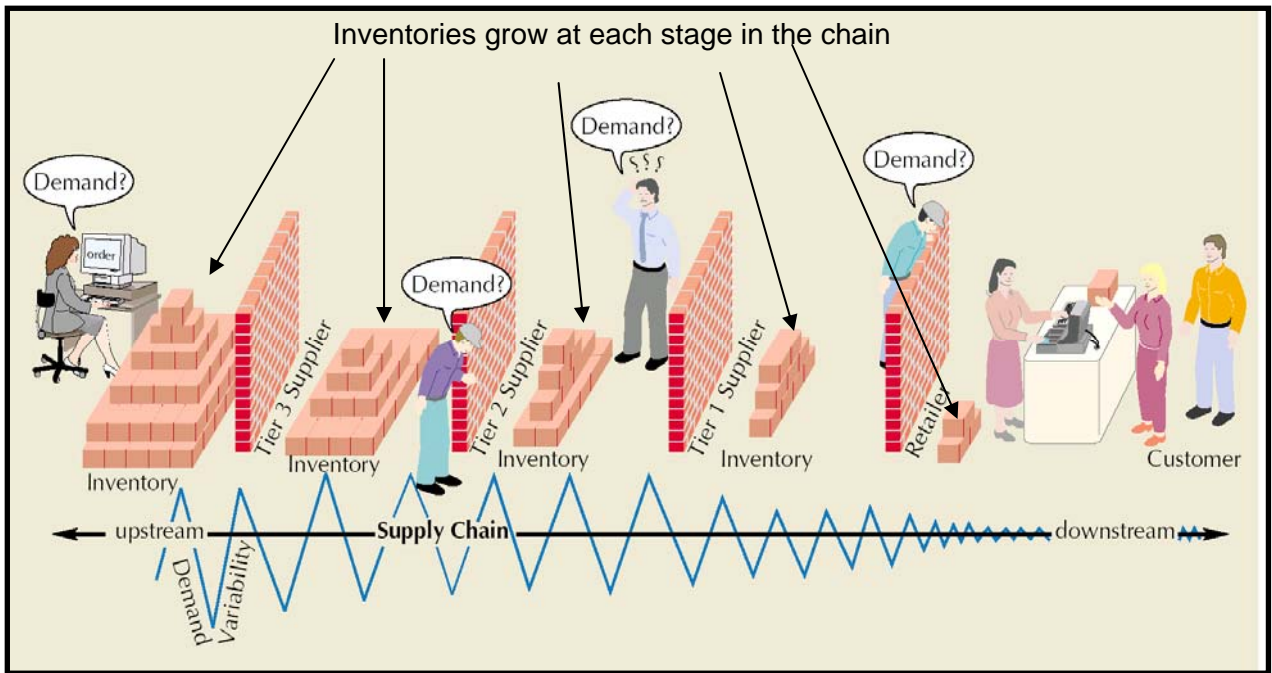
One way to reduce the impact of this bullwhip effect is the concept of "risk pooling": a strategy of spreading the risk among many to reduce the impact on the individuals.

Here are four aspects of that risk pooling strategy:

1. Establish distribution centers between manufacturer and end-seller where inventory can be stored for quicker delivery to stores than waiting for the factory to send it.

2. Reduce the range of parts and variability within components needed for a product which reduces the chances to get a forecast wrong. Also, fewer forecasts can mean fewer errors.

3. Multiple suppliers for a manufacturer can create a flexible capacity situation reducing uncertainty if you don't have to rely on one source: i.e., "don't put all your eggs in one basket."

4. Likewise, the customer can reduce their risks by working with multiple manufacturers of similar products.
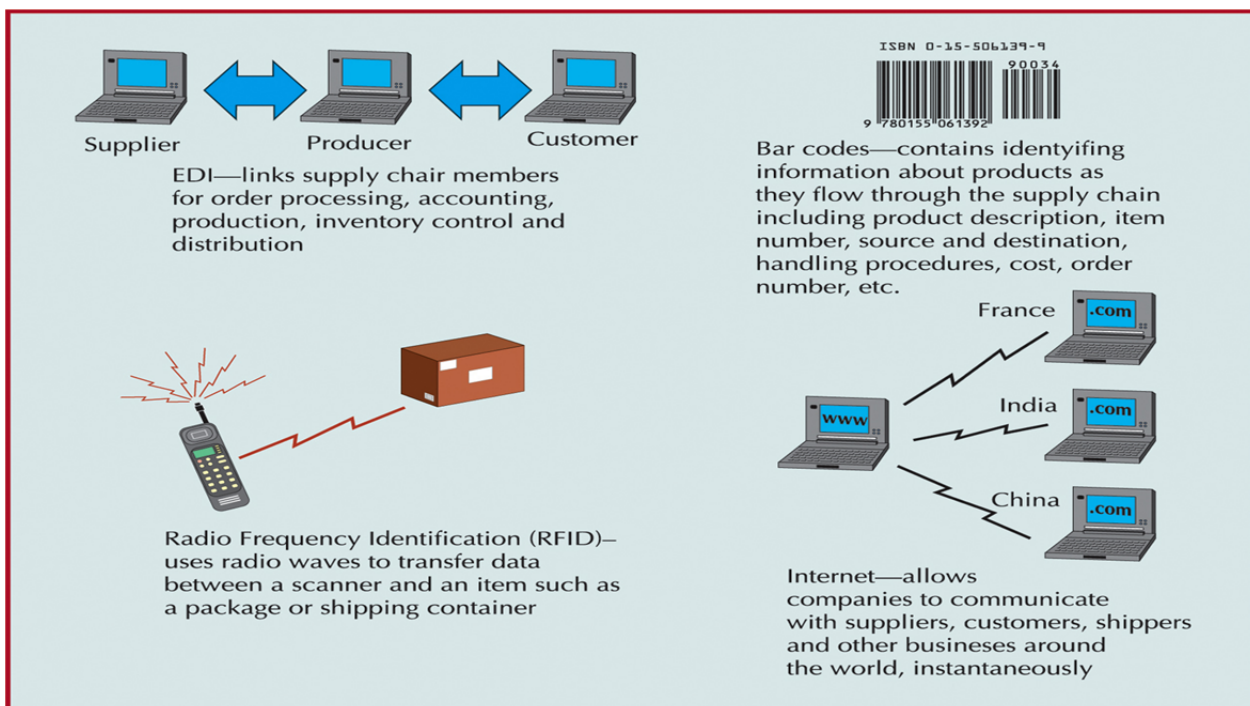
The Impact of Technology

By now, it should be apparent that maximizing communication between all chain members using all of the available tools of technology is the key to successful management of the supply chain. The closer that real-time information is traded between end-users, manufacturers, and their suppliers, the better the supply chain management resulting in, as a minimum:
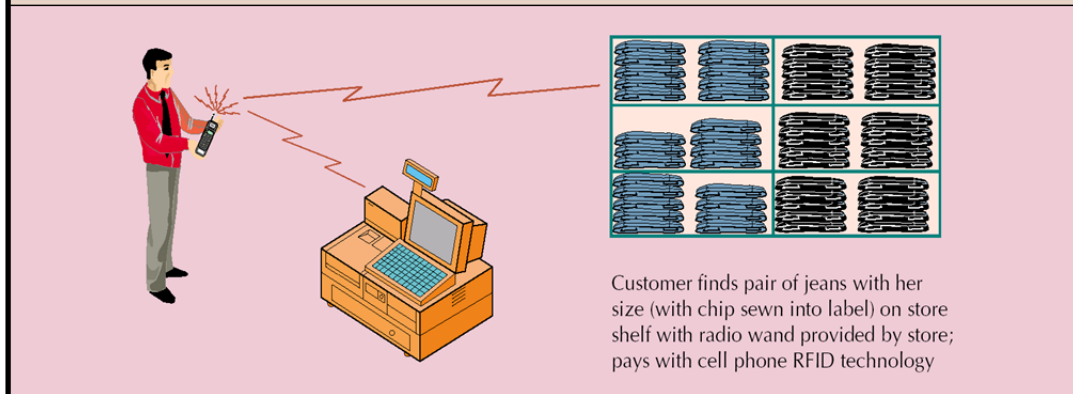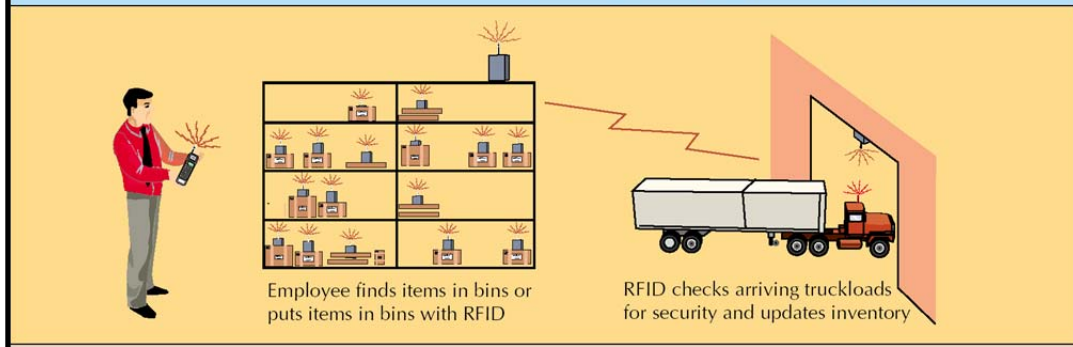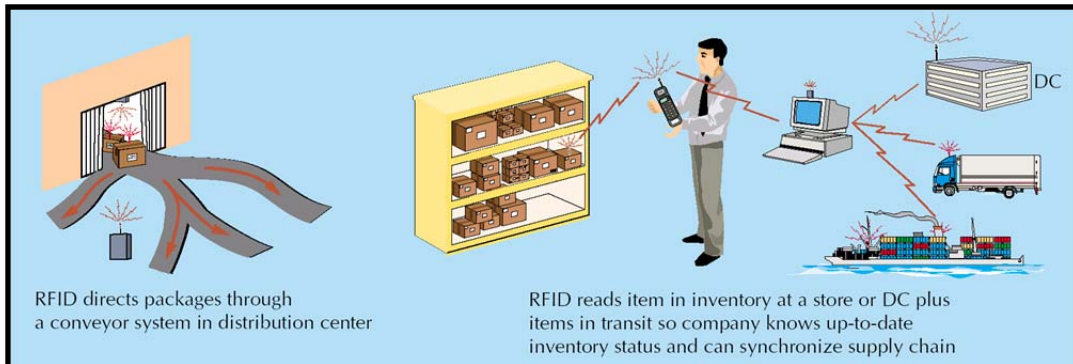
➢ Increased customer service leading to increased demand of the products

➢ Increased sales for producers and suppliers of raw materials to the producers

➢ Reduced inventory costs for all.

Technology tools and strategies in use today include:

➢ <u>E-business</u> - replacement of physical business processes with electronic ones

➢ <u>Electronic data interchange</u> (EDI) is a computer-to-computer exchange of business documents

➢ <u>Bar code and point-of-sale</u> (POS) data creates an instantaneous computer record of a sale

➢ <u>Internet</u> allows companies to communicate with suppliers, customers, shippers and other businesses around the world instantaneously

➢ <u>Build-to-order</u> (BTO) direct-sell-to-customers model via the Internet with extensive communication with suppliers and customer

Supplier — Producer — Customer
EDI—links supply chair members for order processing, accounting, production, inventory control and distribution

ISBN 0-15-506139-9
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Bar codes—contains identyifing information about products as they flow through the supply chain including product description, item number, source and destination, handling procedures, cost, order number, etc.

Radio Frequency Identification (RFID)— uses radio waves to transfer data between a scanner and an item such as a package or shipping container

France .com
India .com
China .com
www

Internet—allows companies to communicate with suppliers, customers, shippers and other businesses around the world, instantaneously

➢ Radio frequency identification (RFID) technology can send product data from an item to a reader via radio waves speeding production, transportation, or inventory maintenance.

RFID directs packages through a conveyor system in distribution center

RFID reads item in inventory at a store or DC plus items in transit so company knows up-to-date inventory status and can synchronize supply chain

Employee finds items in bins or puts items in bins with RFID

RFID checks arriving truckloads for security and updates inventory

RFID keeps track of items on ships and planes leaving global ports or coming into U.S. for security

Customer finds pair of jeans with her size (with chip sewn into label) on store shelf with radio wand provided by store; pays with cell phone RFID technology

Communicating Along the Supply Chain

The ideal world:

➢ *The suppliers would always deliver on time and provide the quality and quantity of exactly what we wanted*

➢ *We would pay our suppliers at the last possible moment before incurring finance charges (and they would be happy to get it).*

The real world – Suppliers must look out for themselves first because if they aren't fiscally healthy, they aren't much good to their customers. Having said that, there are great opportunities for manufacturers and their suppliers to work together closely for their mutual benefits <u>if they can develop a foundation of trust between them.</u>

By now, it should be evident that communications – human and machine - along the supply chain are essential for the success of the chain. This includes:

➢ The use of technology "talking" with each other at each stage of the process

➢ The ability of the humans along the supply chain to trust each sufficiently so when their technology communicates, it exchanges useful information.

As trust develops and communication improves, increased sharing of reliable information among supply chain members can have these beneficial outcomes:

➢ Reduced bullwhip effect

➢ Early problem detection

➢ Faster response

➢ Additional building of mutual trust and confidence - "Trust is historic"

Once we see that we need each other to maximize our potential for success, we can collaborate in planning, forecasting, replenishment, and design which will:

➢ Reduced bullwhip effect (once again)

➢ Lower costs because of less guesswork and improved forecasting (material, logistics, operating, etc.)

➢ Higher capacity utilization for all (fewer machines idle, less unused storage space)

➢ Improved customer service levels which keeps demand high

Additionally, we can work together to coordinated workflow, production and operations, as well as procurement. The results of these efforts can increase:

➢ Production efficiencies for all involved

➢ Faster response to demands

➢ Improved service through the chain

➢ Quicker to market

Finally, as trust among quasi-partners grows, they can adopt new business models and technologies for:

➢ Penetration of new markets

➢ Creation of new products

➢ Improved efficiency

➢ Mass customization which will open new markets

SCM Performance Measurements

So far we have talked about what the supply chain is, the importance of communications between participants along it, and now we'll look at applying metrics as a way of monitoring our management of it.

We will look at measurements from two distinct perspectives:

➢ **Internal focused** – how well do we manage what we can control of the supply chain

➢ **Customer focused**; i.e., the DEMAND side of the chain

Internal Focused

Some metrics for the supply chain costs only come from the actual numbers of a real company. We will identify them and tell you what to look for. The metrics for supply chain asset management are universally used and we will include the formulas for practice calculation.

Supply chain costs include:

> - **Supply chain management costs** – the direct and indirect cost to plan, source, and deliver products and services
> - **The cost of goods sold** – the direct costs of material and labor to produce a product or service
> - **Value-added productivity** – (gross revenue – direct material cost) / # of employees
> - **Warranty / returns processing costs** – direct and indirect costs associated with returns including defective, planned maintenance, and excess inventory.

Supply chain asset management includes:

> - **Average aggregate value of inventory** = <u>This is the total value AT COST of all items held in inventory including raw materials, work-in-progress (WIP), and any finished goods.</u> [We use 'at cost' as a method of consistency because the sales price of the finished goods can vary widely across a wide range of discounts that can be given to bulk buyers.]
>
>   **We calculate it by summing all inventory items and multiplying that by the average number of units on hand at any one time multiplied by the unit value.**

The Benster Vacuum Cleaner Company wanted to do these calculations.

Last year, the cost of goods sold was $142.5 million. It has this average value of production materials, work-in-progress, and finished goods inventory:

- Production materials $3,045,138*
- WIP   9,573,055*
- Finished goods inventory   7,004,733*

   Total avg. aggregate value of inventory $19,622,926

*the numbers are the average numbers of units on hand in each category multiplied by the unit value.

- **Number of times the inventory turns over** = Cost of goods sold / aggregate value of the inventory. The more you sell inventory, the more revenue you generate so you can pay employees, stock holders, investors and buy more inventory so you can sell more and so on. The more the inventory turns means the more money is churning through your business. Higher numbers are better.

   Inventory turns = $142.5 million / $19,622,926 = **7.26**

- **The days or weeks of inventory supply you have –** The amount of inventory you have on hand at any given time = average aggregate value of inventory / (annual cost of goods sold / 365 days or 52 weeks)

   If you run out of inventory before the next shipment arrives, you aren't generating a cash flow. At the other extreme, if you have too much inventory, you have excessive capital tied up in it that you can't use for anything else. The key here is to have enough plus a "safety surplus" to keep the money flowing but not too much that limits your available capital.

   Days of supply = $19,622,926/($142.5 million/365) = **50.3**

   Weeks of supply = $19,622,926/($142.5 million/52) = **7.2**

➢ **The Cash-to-cash cycle (C2C) of your money** - Measures the number of days between the initial cash outflow as accounts payable (AP) when you pay your suppliers to the subsequent cash inflow as accounts receivable (AR) when you collect the money from customers. This is *measured in days, not dollars,* and helps people with financial backgrounds like accountants, bankers, some shareholders, or potential investors get a snapshot of how the company is managing its cash.
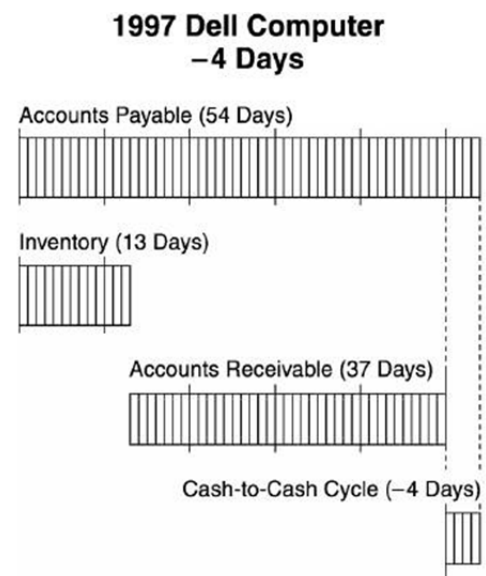
> Inventory days of supply + AR – AP = **C2C**

Expressing your company's SCM as C2C also helps with negotiating terms for AP with suppliers and AR with customers without divulging actual dollar amounts and balancing supply chain transactions to obtain overall efficiencies.

Here is a diagram of how Dell computers used the concept initially to become such a power in the made-to-order manufacturing business.[1]

This tells us that in 1997, Dell:
➢ Took an average of 54 days to pay suppliers without incurring late charges
➢ They had 13 days' inventory on hand
➢ They took an average of 37 days to get paid by customers
➢ Their C2C was -4 days meaning they were using other people's money for an average of 4 days per cycle.

**1997 Dell Computer
−4 Days**

Accounts Payable (54 Days)

Inventory (13 Days)

Accounts Receivable (37 Days)

Cash-to-Cash Cycle (−4 Days)

They worked hard to improve their data communications with customers and suppliers. This meant improved forecasting which lead to more precise inventory needs and delivery dates.

2001 Dell Computer −30 Days

Accounts Payable (66 Days)

Inventory (4 Days)

Accounts Receivable (32 Days)
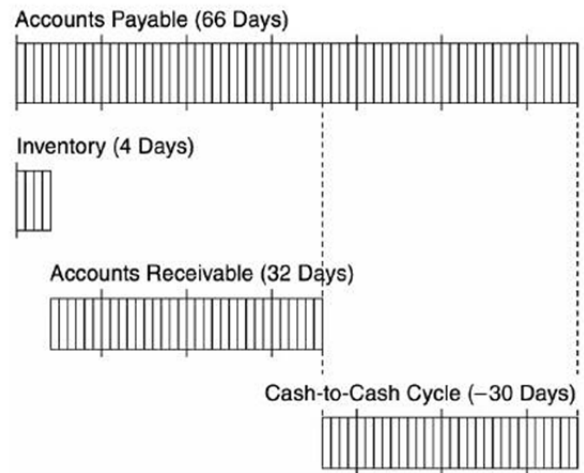
Cash-to-Cash Cycle (−30 Days)

This allowed their on-hand inventory to shrink tying up less money there and making more available to grow the business.

They gradually increased the time until they paid bills while speeding collections – primarily through credit card payments via secure websites.

Their C2C grew to -30 days meaning they were using other people's money more than seven times as long as they were just four years earlier. Another way of looking at it is they are *making money off the money* for 30 days before having to pay it out!

A review of 12 years of data from the Research Insight of more than 22,000 public companies indicated a direct correlation between shorter cash-to-cash cycles and higher profitability for 75% of industries[2]

Demand Focused

These metrics are critical when looking toward the customer. Remember, nothing good ever comes from unhappy customers!

Your supply chain reliability is based upon these three elements:
- ➤ **Delivery performance** – the percentage of orders delivered IN FULL and ON TIME to the customers
- ➤ **Fill rate** – the percentage of orders shipped within 24 hours of receiving the order
- ➤ **Perfect order fulfillment** – the percentage of orders delivered on time, in full, perfectly matched with the order with no errors.

NOTE: All three assume there are no damages to the product and no returns.

<u>Supply chain responsiveness</u> is based on the order fulfillment lead time. That is, the number of days between receipt of the customer's order and product delivery.

<u>Supply chain flexibility </u>is about:

➢ **Supply chain response time** – this is the number of days needed for your supply chain to respond to an unplanned significant change in demand without a cost penalty. A "significant change in demand" means suddenly the customer wants more or less than you expected and there are no surcharges from your suppliers or late charges by the customer for delivery problems caused by the bullwhip effect. (Do you remember that back on page 10?)

➢ **Production flexibility** – the number of days needed to achieve an unplanned 20% change in orders without a cost penalty.

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[1] Hutchinson, Paul D.; Farris, M. Theodore II; Anders, Susan B. <u>Cash-to-Cash Analysis and Management</u>. *The CPA Journal*; Aug 2007; 77, 8. 42.

[2] Ibid.