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**Technical Manual  
on  
'SUPPLY CHAIN MANAGEMENT'**

Compiled by  
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## Content

Sl.no	Name of the Resource Person	Topics
1	Dr.S.D.Sivakumar Director, ABD	FARMER PRODUCER ORGANIZATIONS DRIVEN SUPPLY CHAIN MANAGEMENT
2	Dr.N.Venkatesa Palanichamy, P&H(ARM)	SUPPLY CHAIN MANAGEMENT IN AGRICULTURE
3	Dr.K.Uma, Professor	TRANSPORTATION IN A SUPPLY CHAIN
4	Dr.A.Rohini, Professor	DEMAND FORECASTING IN SUPPLY CHAIN
5	Dr.P.Balaji, Associate Professor	DRIVERS OF SUPPLY CHAIN PERFORMANCE
6	Dr.M.Chandrakumar, Associate Professor	ROLE OF WAREHOUSING AND DISTRIBUTION CHANNELS IN A SUPPLY CHAIN MANAGEMENT
7	Dr.S.Hemalatha, Associate Professor	HUMAN CAPITAL REQUIREMENT FOR SUPPLY CHAIN
8	Dr.N.Deepa, Associate Professor	VALUE CHAIN FINANCING
9	Dr.K.Divya, Associate Professor	RECENT TRENDS IN SUPPLY CHAIN
10	Dr.D.Murugananthi, Assistant Professor	INFORMATION TECHNOLOGY IN SUPPLY CHAIN
11	Dr.P.Balaji, Associate Professor	FIELD VISIT TO LAWRENCEDALE AGRO PROCESSING INDIA (P) LTD, METTUPALAYAM

# **FARMER PRODUCER ORGANIZATION DRIVEN SUPPLY CHAIN MANAGEMENT**

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## **Supply Chain Management**

Supply Chain Management can be defined as the management of flow of products and services, which begins from the origin of products and ends at the consumption of products. It also comprises movement and storage of raw materials that are involved in work in progress, inventory and fully furnished goods. Supply chain management basically merges the supply and demand management. It uses different strategies and approaches to view the entire chain and work efficiently at each and every step involved in the chain. Every unit that participates in the process must aim to minimize the costs and help the companies to improve their long term performance, while also creating value for its stakeholders and customers. This process can also minimize the rates by eradicating the unnecessary expenses, movements and handling.

The real measure of supply chain success is how well activities coordinate across the supply chain to create value for consumers, while increasing the profitability of every link in the supply chain. In other words, supply chain management is the integrated process of producing value for the end user or ultimate consumer.

## **PORTER SUPPLY CHAIN MODEL**

Michael Porter's supply chain framework helps to analyze specific activities throughout the supply chain in which firms can create value and competitive advantage. Porters model includes various value chain activities like Primary and supporting activities.

### **Primary activities**

Primary activities relate directly to the physical creation, sale, maintenance and support of a product or service. They consist of the following

#### **1. Inbound Logistics**

These are all the processes related to receiving, storing, and distributing inputs internally. Supplier relationships are a key factor in creating value in inbound logistics.

#### **2. Operational activities**

These are the transformation activities that change inputs into outputs that are sold to customers. Here, operational systems create value which includes machining, processing, packaging, assembly, equipment maintenance and testing.

#### **3. Outbound Logistics.**

Outbound Logistics deliver firm product or service to its customer.

These activities includes collection, storage and distribution systems which may be internal or external to the organization.

#### **4. Marketing and Sales.**

The activities associated with getting buyers to purchase the product, including: channel selection, advertising, promotion, selling, pricing, retailmanagement, etc. Here, the sources of value includes the benefits that a firm offer to its customer.

#### **5. Service.**

Service includes the activities that maintain and enhance the product's value, including customersupport, repair services, installation, training, spare parts management, upgrading, etc.

### **Supporting activities**

These activities support the primary functions. For example, procurement supports operations with certain activities, but it also supports marketing and sales with other activities.

**1. Procurement** Procurement of raw materials, servicing, spare parts, buildings, machines, etc.

#### **2. Technology Development**

It includes technology development to support the value chain activities. Such as: Research and Development, Process automation, design, redesign.

#### **3. Human Resource Management**

This includes how well a company recruits, hires, trains, motivates, rewards, and retains its workers. People are a significant source of value, so businesses can create a clear advantage with good HR practices. The activities associated with recruiting, development (education), retention and compensation of employees and managers.

#### **4. Firm Infrastructure**

These are a company's support systems and the functions that allow it to maintain daily operations. Accounting, legal, administrative, and general management are examples of necessary infrastructure that businesses can use to their advantage. Companies use these primary and supporting activities as "building blocks" to create a valuable product or service.

### **Farmer producer organizations**

A Farmer Producers Organization (FPO) is a registered organization owned and controlled by their farmer members. The purpose of farmer producer organization is to meet the common needs of its members by providing required services to them. FPOs are engaged in different activities in agriculture and allied sectors. As FPOs are formal

organizations, they need to have their office/ infrastructure, staff, systems and governed by the Board of Directors.

### **Need of an FPO for Farmers**

- Farmers in India face tremendous hardships like Small Size of landholdings. Nearly 86% of farmers are small and marginal with average land holdings in the country being less than 1.1 hectares. Good quality seeds are out of reach of small and marginal farmers mainly because of exorbitant prices of better seeds.
- Depletion and exhaustion of soils resulting in the low productivity demand good fertilizers, manures, biocides etc.
- Lack of proper irrigation facilities and less or no accessibility to large scale mechanisation of agriculture.
- Challenges in marketing their products due to lack of economic strength. In the absence of sound agricultural marketing facilities, the farmers have to depend upon local traders and middlemen for selling their farm produce which is disposed of at an extremely low price.
- Scarcity of capital for agricultural activity forces farmers to borrow money for stimulating the production.

Therefore farmer producer organizations helps in the collectivization of such small, marginal and landless farmers in order to give them the collective strength to deal with such issues.

### **Role of FPO**

- The main aim of farmer producer organizations is to ensure better income for the producers through an organization of their own.
- FPO will promote best practices of farming, maintain marketing information system, diversifying and raising levels of knowledge and skills in agricultural production and post-harvest processing that adds value to products
- Supply quality production inputs like seed, fertilizer, pesticides and such other inputs at reasonably lower wholesale rates.
- Make available need based production and post-production machinery and equipment like cultivator, tiller, sprinkler set, combine harvester and such other machinery and equipment on custom hiring basis for members to reduce the per unit production cost.
- Make available value addition like cleaning, assaying, sorting, grading, packing and also farm level processing facilities at user charge basis on reasonably cheaper rate. Storage and transportation facilities may also be made available.
- Undertake higher income generating activities like seed production, bee keeping, mushroom cultivation etc.
- Undertake aggregation of smaller lots of farmer-members' produce; add value to make them more marketable.

- Facilitate market information about the produce for judicious decision in production and marketing.
- Facilitate logistics services such as storage, transportation, loading/unloading etc. on shared cost basis.
- Market the aggregated produce with better negotiation strength to the buyers and in the marketing channels offering better and remunerative prices

### **Supply Chain Planning in Farmer Producer Organizations**

The supply chains of different agricultural commodities in India, however, are fraught with challenges stemming from the inherent problems of the agriculture sector. The agri supply chain system of the country is determined by different sartorial issues like dominance of small/ marginal farmers, fragmented supply chains, absence of scale economies, low level of processing/value addition, inadequacy of marketing infrastructure etc. To overcome these obstacles, Farmer producer organizations should be organised in such a manner and develop their own supply chain for procuring their member produce, so that economics of scale can be realised in marketing which might benefit their farmer members and help them purchase inputs at whole sale price.

As a farmer producer organization, they have to plan their Supply chain activities in the aspects of the demand and supply view. In order to understand customers' demands, a market research should be done by every FPO's. The second thing to consider is awareness and updated information about the market price and provide fair price to farmer produce by reducing the supply chain stages.

Supply chain planning phase includes right from production stage to forecasting market demand and determining which markets will receive finished goods and supplying right products to right customers at right time. All the supply chain participants involved with the farmer producer organizations should make efforts to make the entire process as flexible as they can. A supply chain design phase is considered successful if it performs well in short-term planning.

### **Supply Chain Integration**

Supply-chain business-process integration involves collaborative work between buyers and suppliers, joint product development, common systems and shared information. According to Lambert and Cooper, operating an integrated supply chain requires a continuous information flow, Customer - relationship management, Customer - service management, Demand -management, Order fulfilment, Supplier - relationship management, Product development and commercialization, Returns management. In Today's world, integrated supply chains are enabling organizations to reduce inventory and costs, add product value, extend resources, accelerate time to market and retain customers.

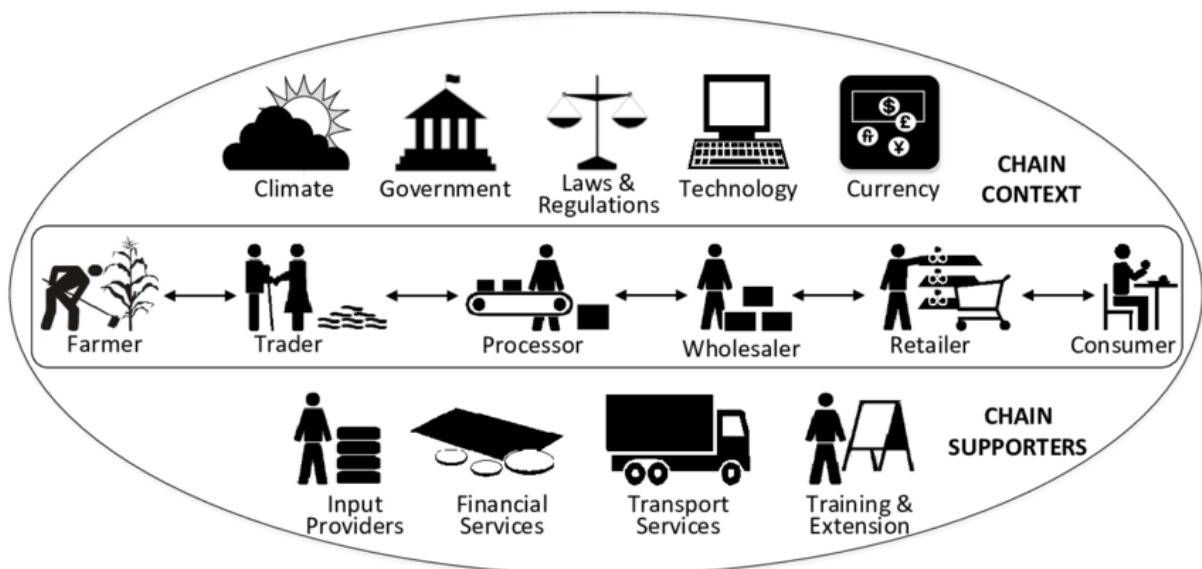
Efficient supply chain management implies managing the relationships between the businesses responsible for the efficient production and supply of products from the farm

level to the consumers to meet consumers' requirements reliably in terms of quantity, quality and price.

### Supply Chain Management in Farmer producer organizations

Organization of agriculture along the value-chain framework has been conceived as one of the strategies to bring more efficiency in the agricultural sector. Small and marginal producers do not have the volume individually (both inputs and produce) to get the benefit of economies of scale. Besides, in agricultural marketing, there is a long chain of intermediaries who very often work non transparently leading to the situation where the producer receives only a small part of the value that the ultimate consumer pays. In the case of modern integrated value chains, producers gain from increased knowledge, better quality and food safety, reduced costs and losses, higher sales and greater value-addition in production. However, there are apprehensions about the capability of smallholders to adjust to the emerging environment because of several operational constraints they face in production and marketing. Therefore farmer producer organization can step forward to integrate supply chain actors under a single channel by eliminating intermediaries like wholesalers, traders.

Through aggregation, the primary producers can avail the benefit of economies of scale. They will also have better bargaining power vis-à-vis the bulk buyers of produce and bulk suppliers of inputs



**Fig 1: Agricultural supply chain**

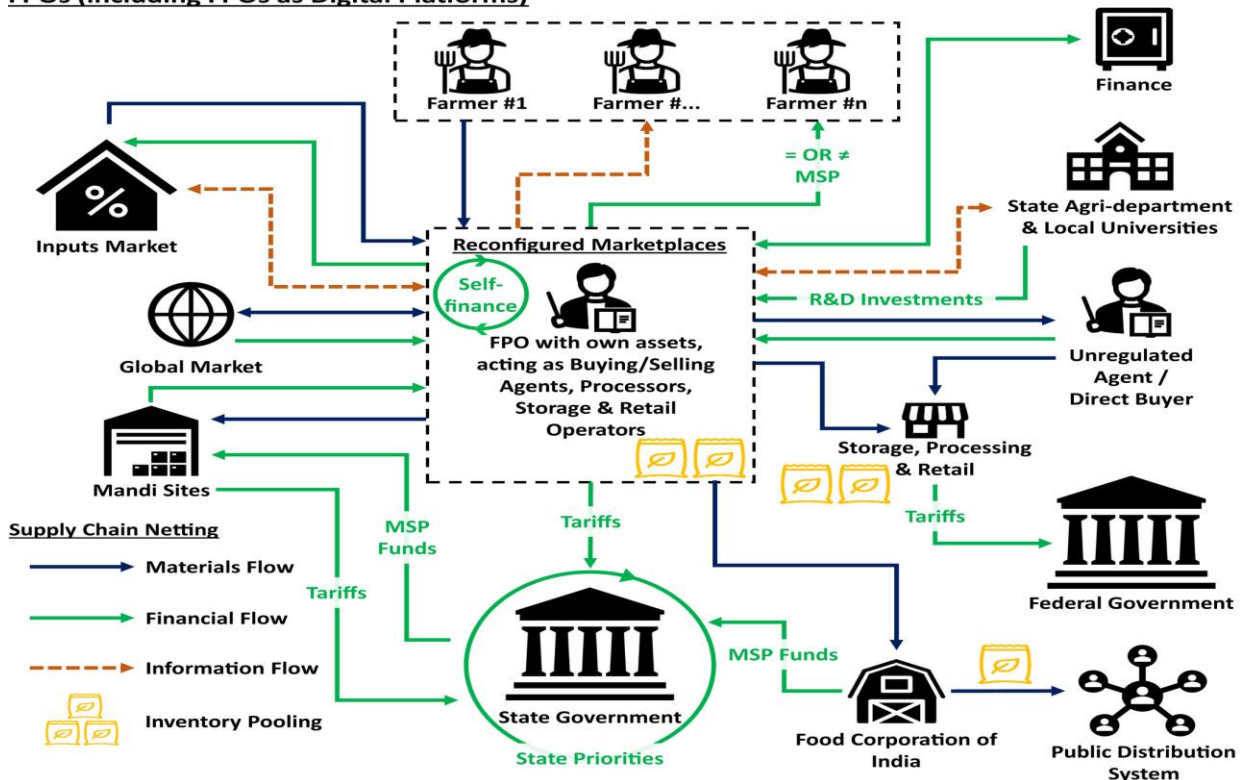
### FPO Integrated Supply chain management

Farmers buy in retail and sell in wholesale losing at both the ends. So, an FPO should learn to buy in wholesale (Inward logistics) and sell in retail or up markets (Outward logistics), for its farmer members. While the new-age technology is gradually improving the agricultural output, there is a great need for efficient post-harvest practices and this can be

achieved by Farmer producer organizations. It's time to instill supply chain practices that benefits the stakeholders while ensuring farmer's benefits. Moving forward, there is a greater need for farmers to shift towards sustainable and tech-based solutions that bring efficiency to the supply chain and add value to the agricultural economy.

Farmer producer organizations can integrate supply chain activities by creating backward linkages like procuring inputs from seed companies, fertilizer and pesticides companies and supplying to member farmers and forward linkages like supplying processed and value added produce to retail market, wholesale market, export market and to direct consumers.

**FPOs (including FPOs as Digital Platforms)**



**Fig 2 : Supply chain actors and their role in FPO Integrated Supply Chain Management**

FPOs can transform market places by reconfiguring supply dynamics (Figure 2), procuring inputs at commodity prices using their buying power and being producer-owned enhancing value capture through bargaining power, scale, and direct access to markets, including supply to international commodity buyers, retailers, and customer-centric platforms.

**Service Provided By FPO**

**Marketing Services**

The FPO will do the direct marketing after procurement of agricultural produce. This will enable members to save in terms of time, transaction costs, weighment losses, distress sales, price fluctuations, transportation, quality maintenance etc.

**Technical Services**



FPO will promote best practices of farming, maintain marketing information system, diversifying and raising levels of knowledge and skills in agricultural production and post-harvest processing that adds value to products.

### **Networking Services**

Making channels of information (e.g. about product specifications, market prices) and other business services accessible to rural producers; facilitating linkages with financial institutions, building linkages of producers, processors, traders and consumers, facilitating linkages with government programs.

### **Value Chain Thinking in Practice**

The very foundational objective of an FPO is adding value to the produce as against selling the raw product directly in the market. Value chain thinking begins from the farmer's point of view as well as from the consumer's point of view. Farmer's point of view refers to the scope of developing the value chains based on existing gaps in processes or activities/products of the farmers. As this is planned from the viewpoint of farmers this can be called as supply driven value chain.

Alternatively, consumers' points of view may mean the scope of identifying the consumer preferences and working backwards to the farmers, which is a demand driven value chain. An ideal Value chain is a combination of both. However, it is advisable for an FPO to begin looking into supply driven value chain i.e., from the producer to the consumer as it is a low hanging fruit and easily implementable. Once an FPO reaches an advanced stage, it can start working on its VCA backwards.

### **Market Plan and Risk Analysis**

Once the Business Opportunities are identified, analysis should be made on markets. i.e., market for selling the inputs to its members and non-members and market for selling its products. Many Farmer producer organization struggle to find potential markets for their produce. Sometimes even the availability of potential markets is enough as they lack professional approach to markets. Due to this, they prefer to restrict themselves to input businesses with their share holder farmers and non share holders as it is a low hanging fruit and risk free. The role of marketing gets very important as an farmer producer organization matures from selling the primary products to secondary and tertiary products or processed goods. To sustain in the business, it is advised to cater to the needs of both members as well as non-members albeit

### **Assessment of Market Opportunities**

Assessment should begin with analyzing the strengths and weaknesses of an FPO in terms of its product/service, access to consumers and the capability to reach different segments of the market. This can be done by Understanding the markets and profiling the customers, understanding about the product quality, pricing and features.

### **Robust Supply Chain Model**

Supply Chain and Market are closely existing entities. FPO should have a robust supply chain model in place before attempting to approach markets. The key informants about of a robust supply chain model are,

- Total saleable quantity in the given season/week/sale period
- Specifications about packing/labelling/branding etc.
- Grading and quality specifications meeting the market best standards of that commodity
- Weekly/daily/monthly volume of saleable quantity out of total saleable quantity,
- Point or place of delivery (Ex-delivery point)
- Transport details
- Expected Price
- Payment terms

Without the above informants firmly in place, any attempt by an FPO to approach markets, may sometimes be a less remunerative exercise and on occasions may even result in a failure.

#### **Post Sales Service that an FPO can offer**

- Terms of replacement of goods
- Compensation for damaged goods
- Insurance in transit
- Risk free transport without damage

#### **Capacity Building of Members of FPOs/FPCs**

- Capacity Building of any form of farmer organization assumes greater importance to enhance the efficiency and bring peer group pressure among members of the group for effective functioning.
- The role of promoters is crucial in orienting and capacity building of these organizations. Capacity building for promotion of leadership and motivation among the elected Board of Directors is crucial.
- The members of the Executive Committee should be given training in Leadership, federation concept, federation Management, financial Management, linkages, input and output management etc. It is also equally important to build the capacity of grass root functionaries i.e. members of FPCs/FPOs.
- The idea of capacity building is to encourage rural communities to understand their personal and group styles of managing themselves and to improve their planning, implementation, and monitoring skills.
- Capacity Building should be given to understand the farmer producer company rules and regulations, business plan of the organizations, Government schemes, leadership, basic accounting and record keeping and develop robust supply chain model.

Small Farmers Agribusiness Consortium is supporting these the farmer producer organizations through empanelled Resource Institutions, which provide various inputs of

training and capacity-building, and linking these bodies to input suppliers, technology providers and market players. The investment in the capacity of FPOs will be spread over years.

Credit Support by NABARD is also available for capacity building and market interventions. Capacity building should broadly cover any activity relating to functioning of a producer organization. The various types of capacity building initiatives which can be supported under the fund are as follows:

- Skill development in order to enable the members produce goods both in farm and non-farm sector,
- Business planning
- Technological extension through classroom training,
- Exposure visits, agricultural university tie ups, expert meetings, etc.
- Any other capacity building initiative which directly benefits the producer organizations.

#### **Emerging Opportunities in Marketing of FPOs Product**

- Targeting the Peri-urban markets - India's burgeoning peri urban markets could be potential target markets for the FPOs digital marketing. Today villagers are buying goods from ecommerce websites such as Amazon and Flipkart. It should also not be ignored that villagers are prudent consumers demanding niche products at reasonably lower price.
- Brand Equity - FPOs should try to develop their own brand with good brand management plan. This helps in long term for business growth.
- Mounting products through Retail Chains - Currently there does not seem to be any product range that is not covered by online retailers. A long-term partnership with retail chains could be a good marketing strategy
- Reverse Logistics - When the FPO products are reaching distant up markets, the transportation burden can be reduced through reverse logistics

#### **Key features of best performing FPO's**

- Active patronage and quality services as per the member needs
- Robust internal systems
- Market, finance and technical linkages
- Effective supply chain management
- Highly effective governance
- Professional management
- Leadership and cooperative trusteeship

# SUPPLY CHAIN MANAGEMENT IN AGRICULTURE

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## Introduction

Supply chain can be defined as the network of organizations involved through upstream and downstream linkages in the distribution channel, to carry out/conduct different processes and activities, that add value to the products and services that are to be delivered to the ultimate consumer. In other words, a supply chain consists of multiple firms, both in upstream (i.e., supply) and downstream (i.e., distribution) in a distribution channel. It is the planning and control of the flow of total material from suppliers to manufacturers to distributors and finally to the end users.

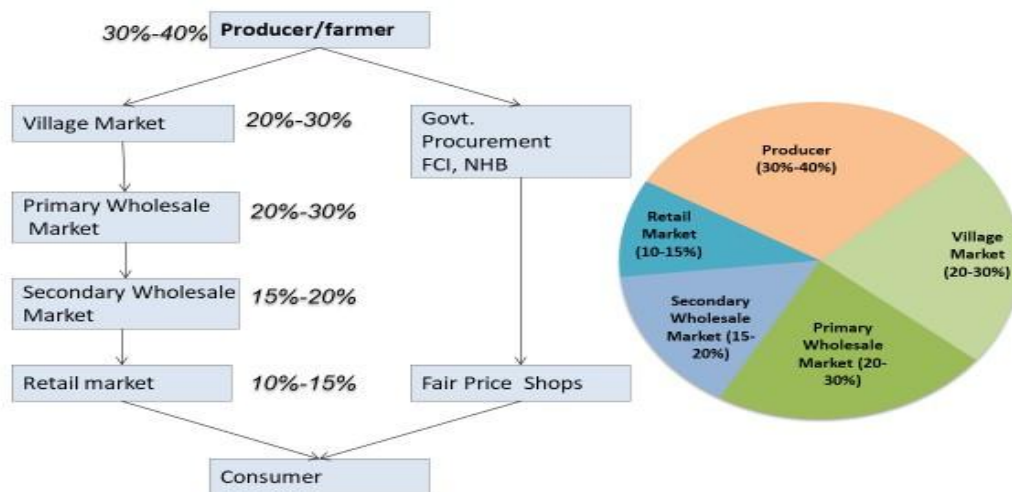
In India, the existing supply chains for agricultural produce involve many intermediaries, who eat up all the share of about 75 percent of the total net margin accruing to the entire supply chain. From a farm gate to a consumer, the produce is passed through several different distribution channels. That is, the produce grown in the farmer's field reach the end consumer through a long chain of intermediaries. These intermediaries carry out various functions, such as transfer of ownership of commodities, its movement, quantity and quality maintenance, payment to the farmers and commodity delivery to the buyer. All the links from farmers to end user of the commodity constitute supply chain of agricultural produce. In India, mainly three types of supply chain models are followed for agricultural produce in general and for fruits and vegetables sector in particular i.e. traditional supply chain model, hub and spoke model, and value chain model.

## Traditional Supply Chain Model

Traditional supply chain model is a complex route for the logistical flow of agri-produce, which is predominantly followed currently in traditional retail marketing. Players involved in this model are agents (commission agents), auctioneers, wholesalers, traditional retailer of all types of formats, family run 'mom and pop' stores, roadside shops, pavement shops and cart vendors apart from farmers and customers. Agents,

auctioneers, and wholesalers are traders in marketing of agri-produce mainly vegetables. Farmers are the cultivators of produce and source of vegetable supply. Agent and auctioneers are first level of middlemen in vegetable supply chain and transfer vegetable from producers to wholesalers. Numbers of transfers of ownership as well as transshipments of vegetable depend upon the number of agents present in between farmers and wholesalers.

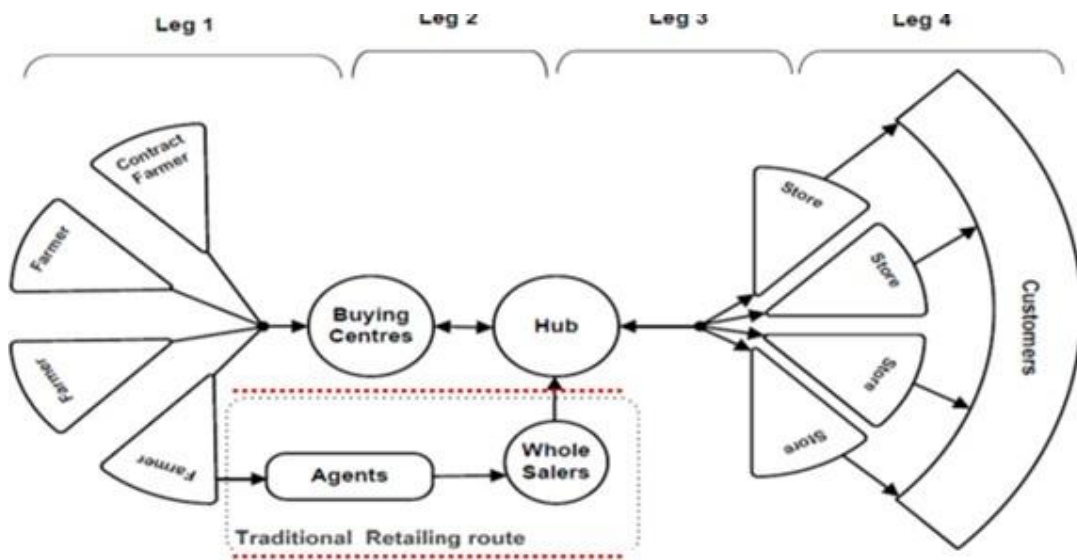
### Traditional Supply Chain For Agri-Produce in India



### Hub and Spoke Model

The hub and spoke model is followed by organized retailers like Food Bazaar (Pantaloon Retail (India) Ltd), Spencer's Retail and More (Trinethra Super retail Ltd) for fruits and vegetables. Fewer players are involved in this model compare to the traditional retailing model. Farmers, organized retailers, wholesalers and customers form this chain. Buying centres, hub and stores (retail outlets) are operational units of the organized retailers. Small farmers and contract farmers who execute a trade contract with the organized retailers are the primary source of supply of agri-produce to the organized retailers. The buying centres purchase the agri-produce directly from the farmers and transport to the hubs. A hub is served by one or more buying centre and a buying centre serves one or more hubs. Hub may also buy small volume of fruits and vegetables from the local wholesale market to balance demand supply gap. Hub in turn distributes these produce to stores attached to it. A store is served by only one hub. Store sells fruits

and vegetables in retail quantity to the customers. The produce travels in four phases, namely farmers to organized retailer's buying centres, buying centre to hubs, from hub to retail stores and retail outlet to customer. Farmers transport produce from farming location to the buying centres. The transport of produce in the second phase from buying centres to hub is arranged by buying centre. Mode of transport is airconditioned trucks. Fresh produce is transported in the third phase from hub to stores and shelf-life expiring fruits and vegetables are returned from stores to hub. The shelf-life expired produce are sold to cart-vendor. Customers buy and pick up agri-produce from the organized retail stores in fourth phase. The modes of transport maybe motorcycle, car and public transport vehicles.

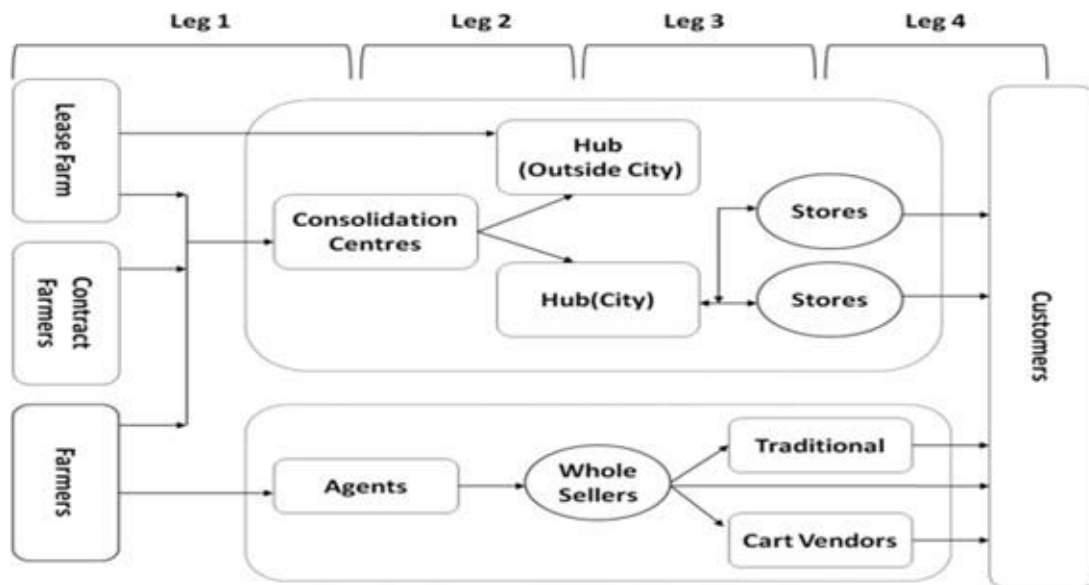


**Hub and Spoke Model for Fruits and Vegetables**

### Value Chain Model

Currently, very few organized retailers follow a Value Chain Business Model (VCM). Organized retailers like Reliance Fresh (Reliance Retail Ltd) follows VCM for procurement of produce directly from farmers and sell to customers by avoiding intermediaries. This model is based on its core growth strategy of backward integration and progressing towards building an entire value chain starting from the farmers to the end consumers. Only a few players are involved in this model compared to the Traditional Retailing Model or organized retailer's Hub and Spoke Model. Farmers, organized retailers, and customers are the players who form this value chain. Farmers, organized retailer's operational units,

consolidation centres, hub (distribution centres) and retail outlets stores and customers are the players participating in this Model. Small farmers, contract farmers and lease farmers are the primary source of supply of agri-produce to the organized retailers. Contract farmers and lease farmers are farmers who execute a trade agreement with the organized retailers for sale of vegetables.



**Value Chain Model for Fruits and Vegetables**

Vegetables move from farm locations to customers in four phases, farmers to consolidation centres, consolidation centres to hub, hub to retail outlets (stores) and stores to customers. Independent farmers supply their produces to the consolidation centres; contract farmers and lease farmer's produce is picked up by consolidation centres. One consolidation centre supplies vegetables to multiple hubs, depending upon the product. Hubs get direct delivery from the contract farming locations. These models specifically focus on retail supply chain mainly of fruits and vegetables from farm gate without any involvement of processing.

### Challenges faced by Agriculture Supply Chains

There are a number of challenges faced by the supply chains of agricultural commodities, as listed below –

- Cold chain issues;
- Fragmented supply chain issues;

- Linkage and integration issues;
- Infrastructural issues;
- Packaging issues;
- Technological issues;
- Farmer's knowledge and awareness issues;
- Quality and safety issues;
- Processing issues;
- Supply chain efficiency issues;
- Financial issues;
- Post-harvest losses issues;
- Transportation issues; and
- Information issues.

These challenges can be addressed through interventions like strengthening of requisite infrastructure under Public Private Partnership (PPP) mode, establishment of FPOs and linking them to market, strengthening backward and forward linkages, establishment of loading centres, proper regulatory framework regarding food quality and food safety issues, providing buy back arrangements, capacity building for market players and liaison between different stakeholders in agricultural marketing.

Supply chain is a concept of management which consists of multiple firms, both in upstream and downstream in a distribution channel. In India, supply chains are characterised by long chain of intermediaries absorbing major share of the total net margin created. In India, mainly three types of supply chain models are followed for agricultural produce namely traditional supply chain model, hub and spoke model and value chain model. These models specifically focus on retail supply chain from farm gate without any involvement of processing. Various challenges are faced by these models which can only be addressed by following a sound strategy covering aspects like development of infrastructure under PPP, linking farmers and their organisations with market, sound backward and forward linkages and proper policy support.

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# THE ROLE OF TRANSPORTATION IN A SUPPLYCHAIN

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Transportation refers to the movement of product from one location to another as it makes its way from the beginning of a supply chain to the customer. Transportation is an important supply chain driver because products are rarely produced and consumed in the same location. Transportation is a significant component of the costs incurred by most supply chains.

Seven-Eleven Japan is a firm that has used transportation to achieve its strategic goals. The company has a goal of carrying products in its stores to match the needs of customers as they vary by geographic location or time of day. To help achieve this goal, Seven-Eleven Japan uses a responsive transportation system that replenishes its stores several times a day so that the products available match customers' needs. Supply chains also use responsive transportation to centralize inventories and operate with fewer facilities. For example, Amazon relies on package carriers and the postal system to deliver customer orders from centralized warehouses. Transportation has allowed Netflix to operate a movie rental business without any stores.

The *shipper* is the party that requires the movement of the product between two points in the supply chain. The *carrier* is the party that moves or transports the product. For example, when Netflix uses USPS to ship its DVDs from the warehouse to the customer, Netflix is the shipper and USPS is the carrier. Besides the shipper and the carrier, two other parties have a significant impact on transportation: (1) the owners and operators of transportation infrastructure such as roads, ports, canals, and airports and (2) the bodies that set transportation policy worldwide. Actions by all four parties influence the effectiveness of transportation.

To understand transportation in a supply chain, it is important to consider the perspectives of all four parties. A carrier makes investment decisions regarding the transportation equipment (locomotives, trucks, airplanes, etc.) and in some cases infrastructure (rail) and then makes operating decisions to try to maximize the return from these assets. A shipper, in contrast, uses transportation to minimize the total cost (transportation, inventory, information, sourcing, and facility) while providing an appropriate level of responsiveness to the customer. The effectiveness of carriers is influenced by infrastructure such as ports, roads, waterways and airports.

Most transportation infrastructure throughout the world is owned and managed as a public good. It is important that infrastructure be managed in such a way that levies are available for

maintenance and investment in further capacity as needed. Transportation policy sets direction for the amount of national resources that go into improving transportation infrastructure. Transportation policy also aims to prevent abuse of monopoly power; promote fair competition; and balance environmental, energy, and social concerns in transportation.

Supply chains use a combination of the following modes of transportation:

**Air-** Major airlines that carry both passenger and cargo. Small, high-value items or time-sensitive emergency shipments that have to travel a long distance are best suited for air transport.

**Package carriers-**

*Package carriers are transportation companies such as FedEx, UPS, and the U.S. Postal Service, which carry small packages ranging from letters to shipments weighing about 150 pounds. Package carriers are the preferred mode of transport for online businesses such as Amazon and Dell.*

**Truck-** The trucking industry consists of two major segments—Full truckload (FTL) or less than truckload (LTL). Trucking is more expensive than rail but offers the advantage of door-to-door shipment and a shorter delivery time. LTL is suited for shipments that are too large to be mailed as small packages.

**Rail-** Rail carriers incur a high fixed cost in terms of tracks, locomotives, cars, and yards. A significant trip-related labor and fuel cost is independent of the number of cars (fuel costs do vary somewhat with the number of cars) but does vary with the distance traveled and the time taken. The price structure and the heavy load capability make rail an ideal mode for carrying large, heavy, low-value shipments that are not time sensitive or high-density product over long distances.

**Water-** Water transport is ideally suited for carrying large bulk commodity shipments loads at low cost. But the slowest of all the modes, and significant delays occur at ports and terminals.

**Pipeline-** Pipeline is used primarily for the transport of crude petroleum, refined petroleum products, and natural gas.

**Intermodal-** *Intermodal transportation is the use of more than one mode of transport to move a containerized freight often using truck/water/rail combinations, particularly for global freight. For global trade, intermodal is often the only option.*

The effectiveness of any mode of transport is affected by equipment investments and operating decisions by the carrier and the available infrastructure and transportation policies. The carrier's primary objective is to ensure good utilization of its assets while providing customers with an acceptable level of service. Carrier decisions are affected by equipment cost, fixed operating cost, variable operating costs, the responsiveness the carrier seeks to provide its target segment, and the prices that the market will bear.

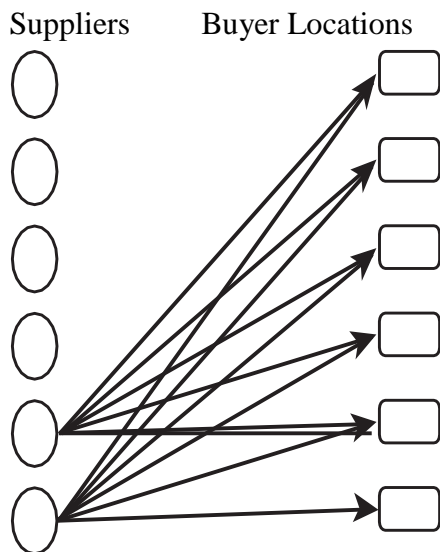
## Transportation Infrastructure and Policies

Roads, seaports, airports, rail and canals are some of the major infrastructural element that exist along nodes and links of a transportation network. In almost all countries, the government has either taken full responsibility or played a significant role in building and managing these infrastructure elements.

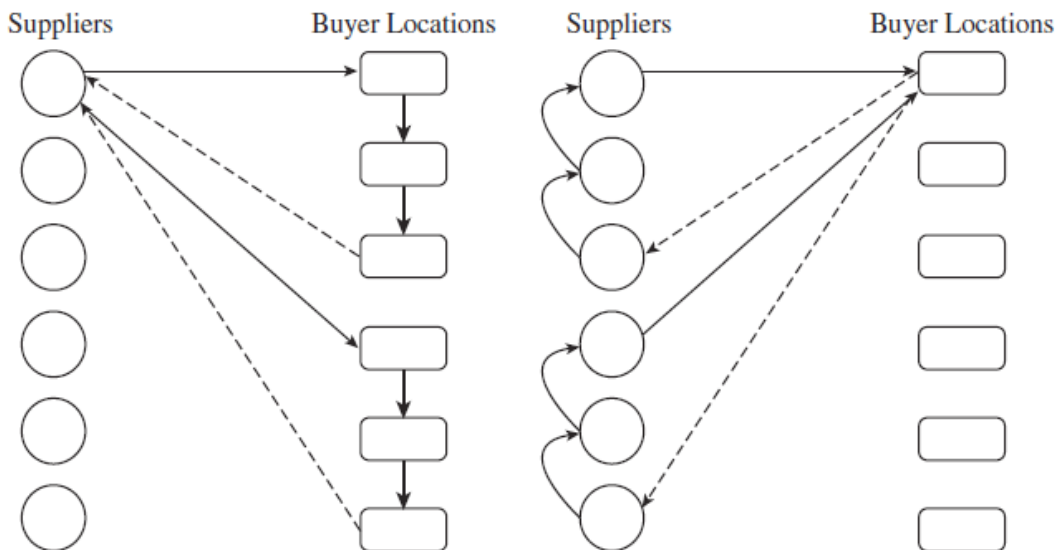
## Design Options For a Transportation Network

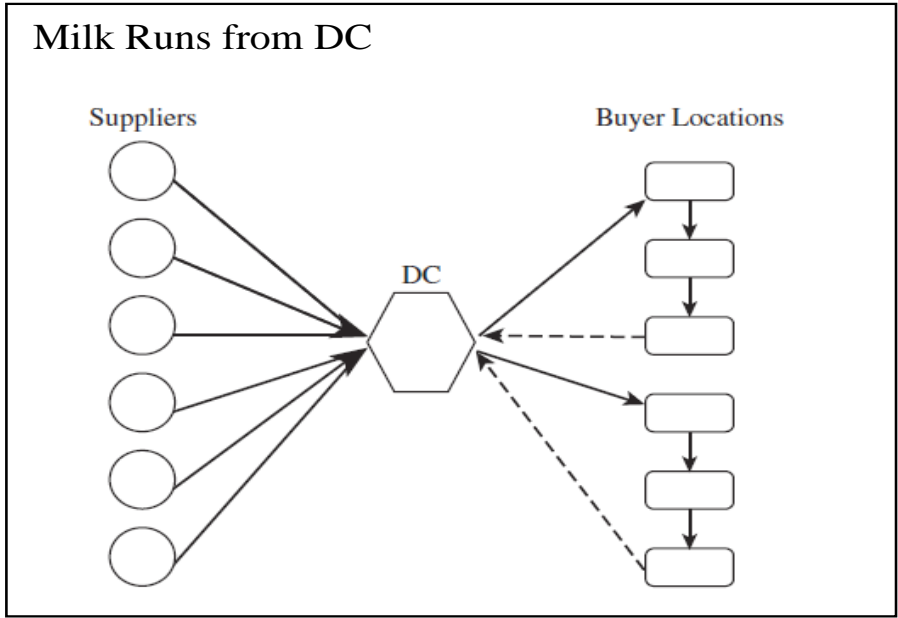
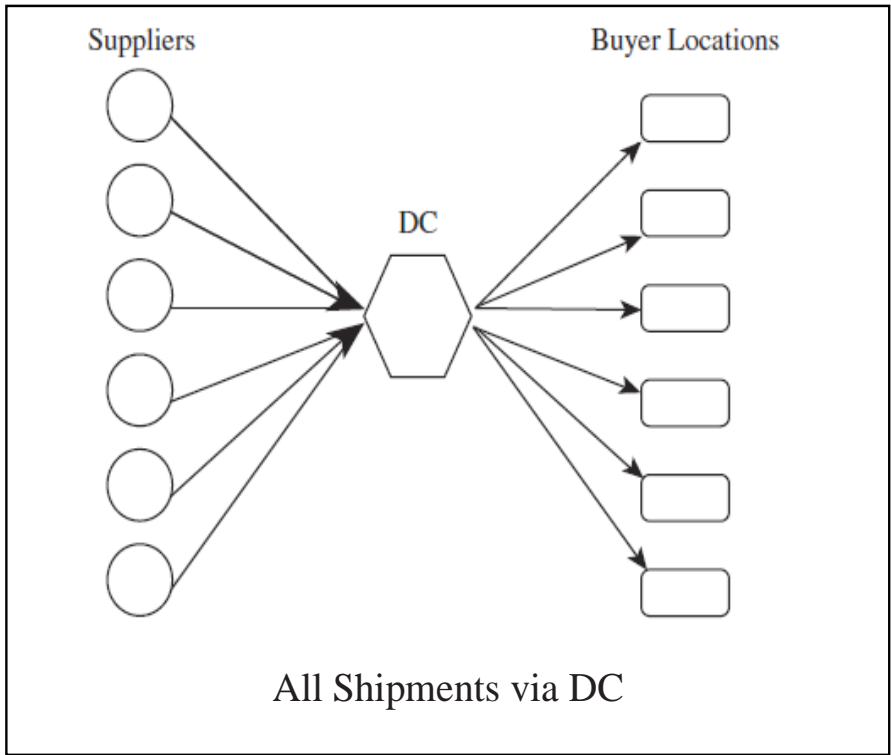
### Direct Shipment Network

#### Direct Shipment Network to Single Destination



#### MilkRunsfromMultipleSuppliersortoMultipleBuyerLocations





### Pros and cons of different Transportation networks

Network Structure	Pros	Cons
Direct shipping	No intermediate warehouse Simple to coordinate	High inventories (due to large lot size)  Significant receiving expense
Direct shipping with milk runs	Lower transportation costs for small lots  Lower inventories	Increased coordination complexity
All shipments via central DC with inventory storage	Lower inbound transportation cost through consolidation	Increased inventory cost Increased handling at DC
All shipments via central DC with cross-dock	Low inventory requirement  Lower transportation cost through consolidation	Increased coordination complexity
Shipping via DC using milk runs	Lower out bound transportation cost for small lots	Further increase in coordination complexity
Tailored network	Transportation choice best matches need so find individual product and store	Highest coordination complexity

### Trade-Offs in Transportation Design

All transportation decisions made by shippers in a supply chain network need to take into account their impact on inventory costs, facility and processing costs, the cost of coordinating operations, and the level of responsiveness provided to customers. For example, Amazon's use of package carriers to deliver products to customers increases transportation cost but allows Amazon to centralize its facilities and reduce inventory costs. If Amazon wants to reduce its transportation costs, the company must either sacrifice responsiveness to customers

or increase the number of facilities and resulting inventories to move closer to customers.

The cost of coordinating operations is generally hard to quantify. Shippers should evaluate different transportation options in terms of various costs and revenues and then rank them according to coordination complexity. A manager can then make the appropriate transportation decision. Managers must consider the following trade-offs when making transportation decisions:

- Transportation and inventory cost trade-off
- Transportation cost and customer responsiveness trade-off

### **Transportation and Inventory Cost Trade-Off**

The trade-off between transportation and inventory costs is significant when designing a supply chain network. Two fundamental supply chain decisions involving this trade-off are

- Choice of transportation mode
- Inventory aggregation

#### **Choice of Transportation Mode**

Selecting a transportation mode is both a planning and an operational decision in a supply chain. The decision regarding carriers with which a company contracts is a planning decision, whereas the choice of transportation mode for a particular shipment is an operational decision. For both decisions, a shipper must balance transportation and inventory costs. The mode of transportation that results in the lowest transportation cost does not necessarily lower total costs for a supply chain. Cheaper modes of transport typically have longer lead times and larger minimum shipment quantities, both of which result in higher levels of inventory in the supply chain. Modes that allow for shipping in small quantities lower inventory levels but tend to be more expensive. Apple, for example, air freights several of its products from Asia. This choice cannot be justified on the basis of transportation cost alone. It can be justified only because the use of a faster mode of transportation for shipping valuable components allows Apple to carry low levels of inventory and still be responsive to its customers.

Faster modes of transportation are preferred for products with a high value-to-weight ratio (aniPadisa good example of such a product) for which reducing inventories is important, whereas cheaper modes are preferred for products with a small value-to-weight ratio (e.g., furniture imported by IKEA) for which reducing transportation cost is important. The choice of transportation mode should take into account cycle, safety, and in-transit inventory costs

besides the cost of transportation. The purchase price must also be included if it changes with the choice of transportation mode (perhaps because of a change in lot sizes). Ignoring inventory costs when making transportation decisions can result in choices that worsen the performance of a supply chain.

### **Inventory Aggregation**

Firms can significantly reduce the safety inventory they require by physically aggregating inventories in one location. Most online businesses use this technique to gain advantage over firms with facilities in many locations. For example, Amazon has focused on decreasing its facility and inventory costs by holding inventory in a few ware houses, where as book sellers such as Barnes & Noble have to hold inventory in many retail stores.

Transportation cost, however, generally increases when inventory is aggregated. If inventories are highly disaggregated, some aggregation can also lower transportation costs. Beyond a point, however, aggregation of inventories raises total transportation costs. Consider a book store chain such as Barnes & Noble. The inbound transportation cost to Barnes & Noble is due to the replenishment of bookstores with new books. There is no outbound cost because customers transport their own books home. If Barnes & Noble decides to close all its bookstores and sell only online, it will have to incur both inbound and outbound transportation costs. The inbound transportation cost to warehouses will be lower than to all bookstores. On the outbound side, however, transportation cost will increase significantly because the outbound shipment to each customer will be small and will require an expensive mode such as a package carrier. The total transportation cost will increase on aggregation because each book travels the same distance as when it was sold through a bookstore, except that a large fraction of the distance is on the out bound side using an expensive mode of transportation. As the degree of inventory aggregation increases, total transportation cost goes up.

Inventory aggregation is a good idea when inventory and facility costs forma large fraction of a supply chain's total costs. Inventory aggregation is useful for products with a large value-to-weight ratio and for products with high demand uncertainty. For example, inventory aggregation is valuable for new products in the PC industry, because PC's have a large value-to-weight ratio and demand for new products is uncertain. Inventory aggregation is also a good idea if customer orders are large enough to ensure sufficient economies of scale on out bound transportation. When products have a low value to weight ratio and customer orders are small, however, inventory aggregation may hurt a supply chain's performance because of high transportation costs.

Compared to PCs, the value of inventory aggregation is smaller for best-selling books that have a lower value-to-weight ratio and more predictable demand.

### **Trade-off between Transportation Cost and Customer Responsiveness**

The transportation cost as supply chain incurs is closely linked to the degree of responsiveness the supply chain aims to provide. If a firm has high responsiveness and ships all orders within a day of receipt from the customer, it will have small outbound shipments resulting in a high transportation cost. If it decreases its responsiveness and aggregates orders over a longer time horizon before shipping them out, it will be able to exploit economies of scale and incur a lower transportation cost because of larger shipments. Temporal aggregation is the process of combining orders across time. Temporal aggregation decreases a firm's responsiveness because of shipping delay but also decreases transportation cost.

### **Tailored Transportation**

Tailored transportation is the use of different transportation networks and modes based on customer and product characteristics. Most firms sell a variety of products and serve many different customer segments. For example, W.W. Grainger sells more than 200,000MRO supply products to both small contractors and large firms. Products vary in size and value and customers vary in the quantity purchased, responsiveness required, uncertainty of the orders, and distance

In the following sections, we describe various forms of tailored transportation in supply chains.

### **Tailored Transportation by Customer Density and Distance**

Firms must consider customer density and distance from warehouse when designing transportation networks. The ideal transportation options based on density and distance are shown below

When a firm serves a high density of customers close to the Distribution Centre, it is often best for the firm to own a fleet of trucks that are used with milk runs originating at the DC to supply customers, because this scenario makes good use of the vehicles and provides customer contact. If customer density is high but distance from the warehouse is large, it does not pay to send milk runs from the warehouse because empty trucks will travel a long distance on the return trip. In such a situation, it is better to use a public carrier with large trucks to haul the shipments to across dock center close to the customer area, where the shipments are loaded onto smaller trucks that deliver product to customers using milk runs. In this situation, it



may not be ideal for a firm to own its own fleet. As customer density decreases, use of an LTL carrier or a third party doing milk runs is more economical because the third-party carrier can aggregate shipments across many firms because of economies of scale that result from larger shipments. Thus, a firm must consider the trade-off between responsiveness and transportation cost when designing its transportation network, as illustrated.

**Transportation Options based on Customer Density and Distance**

Conditions Favoring Aggregation or Disaggregation of Inventory

	Aggregate	Disaggregate
Transport cost	Low	High
Demand uncertainty	High	Low
Holding cost	High	Low
Customer order size	Large	Small

**Transportation Options based on Customer Density and Distance**

	Short Distance	Medium Distance	Long Distance
High density	Private fleet with milk runs	Cross-dock with milk runs	Cross-dock with milk runs
Medium density	Third-party milk runs	LTL carrier	LTL or package carrier
Low density	Third-party milk runs or LTL carrier	LTL or package carrier	Package carrier

**Tailored Transportation by Size of Customer**

Firms must consider customer size and location when designing transportation networks. Large customers can be supplied using a FTL carrier, whereas smaller customers will require an LTL carrier or milk runs. When using milk runs, a shipper incurs two types of costs:

- Transportation cost based on total route distance
- Delivery cost based on number of deliveries

The transportation cost is the same whether going to a large or small customer. If a delivery is to be made to a large customer, including other small customers on the same truck can save on transportation cost. For each small customer, however, the delivery cost per unit is higher than

for large customers. Thus, it is not optimal to deliver to small and large customers with the same frequency at the same price. One option firms have is to charge a higher delivery cost for smaller customers. Another option is to tailor milk runs so that they visit larger customers with a higher frequency than smaller customers. Firms can partition customers into large (L), medium (M), and small (S) based on the demand at each. The optimal frequency of visits can be evaluated based on the transportation and delivery costs.

### **Tailored Transportation by Product Demand and Value**

The degree of inventory aggregation and the modes of transportation used in a supply chain network should vary with the demand and value of a product, as shown below. The cycle inventory for high-value products with high demand is disaggregated to save on transportation costs because this allows replenishment orders to be transported less expensively.

<b>Product Type</b>	<b>High Value</b>	<b>Low Value</b>
High demand	Disaggregate cycle inventory. Aggregate safety inventory. Inexpensive mode of transportation for replenishing cycle inventory and fast mode when using safety inventory.	Disaggregate all inventories and use inexpensive mode of transportation for replenishment
Low demand	Aggregate all inventories. If needed, use fast mode of transportation for filling customer orders.	Aggregate only safety inventory. Use in expensive mode of transportation for replenishing cycle inventory.

### **The Role of IT in Transportation**

The complexity and scale of transportation makes it an excellent area within the supply chain for the use of IT systems. The use of software to determine transportation routes has been the most common IT application in transportation. This software takes the location of customers, shipment size, desired delivery times, information on the transportation infrastructure (such as distances between points), and vehicle capacity as inputs. These inputs are formulated into an optimization problem whose solution is a set of routings and a packing list for each vehicle that minimize costs while meeting delivery constraints.

Along with routing, vehicle load optimization software helps improve fleet utilization. By accounting for the size of the container and the size and sequence of each delivery, this software develops a plan to pack the vehicle efficiently while allowing for the greatest ease of unloading and/or loading along the route. Synchronization between the packing and routing

software is important because how much is packed on a truck affects the routing, while the routing obviously affects what is packed on a truck.

IT also comes into play in the use of global positioning systems (GPS) for tracking real-time location of vehicles and electronic notification of impending arrivals. The availability of current information also allows for real-time dynamic optimization of transportation routes and deliveries. Electronic notifications and tracking improve customer service and preparedness throughout the supply chain.

IT in transportation has been around for the longest and has the largest number of vendors in supply chain software. There has also been a large amount of in-house development that has focused on transportation management.

### **Risk management in transportation**

There are three main types of risk to consider when transporting a shipment between two nodes on the network:

1. The risk that the shipment is delayed
2. The risk that the shipment does not reach its destination because intermediate nodes or links are disrupted by external forces
3. The risk of hazardous material

In each case, it is important to identify the sources of risk and their consequences and plan suitable mitigation strategies.

Delay arises either because of congestion along links such as roads or nodes such as ports and airports. When congestion is the cause of delay, mitigation strategies for the shipper include moving inventories closer to the destination, using alternative lanes, and building a buffer into the lead time. Congestion delays can be mitigated by designing a network with multiple routes to the destination and changing routes in real time based on congestion. Congestion delays can also be mitigated through the use of congestion pricing by the owner of the transportation node or link. Delay may also arise because of the limited availability of transportation or infrastructure capacity. Such delays are more likely when the assets are owned by a third party that is serving multiple customers. These delays may be mitigated by owning some transportation capacity or by signing long-term contracts for transportation capacity with the third party. Given the high cost of owning these assets, it is best to do so for parts of the network where utilization is high.

Disruption at transportation links or nodes may occur because of natural events such as hurricanes or human-made events such as terrorism. The best mitigation strategy in this case is to design alternative routings into the transportation network. Companies such as UPS and

Fed Ex helped clients design alternative routes if there were other factories they could move production to. Similarly, during the California dock workers' strike in 2002, many companies arranged for alternative ports to bring in product.

When considering both delay and disruption risk, it is important to identify sources that are likely to be correlated across the network. For example, the events on September 11, 2001, caused a disruption in air transportation across the entire United States. Alternative routings were useless as mitigation strategies in this case because no alternative route was available. For such correlated sources of risk, the only option is to decrease the probability of such a disruption.

Align transportation strategy with competitive strategy Consider both in-house and outsourced transportation Use technology to improve transportation performance Design flexibility into the transportation network

### **Understand the role of transportation in a supply chain.**

Transportation refers to the movement of product from one location to another within a supply chain. The importance of transportation has grown with the increasing globalization in supply chains and the growth in online sales because both trends increase the distance products travel. Transportation decisions impact supply chain profitability and influence both inventory and facility decisions within a supply chain.

### **Evaluate the strengths and weaknesses of different modes of transportation.**

The various modes of transportation include water, rail, intermodal, truck, air, pipeline, and package carriers. Water is typically the least expensive mode but is also the slowest, where as air and package carriers are the most expensive and the fastest. Rail and water are best suited for low-value, large shipments that do not need to be moved in a hurry. Air and package carriers are best suited for small, high-value, emergency shipments. Intermodal and TL carriers are faster than rail and water but somewhat more expensive. LTL carriers are best suited for small shipments that are too large for package carriers but much smaller than a TL.

### **Discuss the role of infrastructure and policies in transportation.**

Infrastructure such as ports, roads, and airports has a significant impact on transportation. Given its inherent monopolistic nature, most transportation infrastructure requires public ownership or regulation. In the case of public ownership, pricing based on average cost leads to over utilization and congestion. It is important to use some form of congestion pricing under which users are forced to internalize the increase in network cost they cause.

**Identify the relative strengths and weaknesses of various transportation network design options.**

Networks are designed to either ship directly from origin to destination or move the product through a consolidation point. Direct shipments are most effective when large quantities are to be moved. When shipments are small, use of an intermediate warehouse or DC lowers transportation cost by aggregating smaller shipments even though it takes longer and is more complex. Shipments may also be consolidated with milk runs either picking up from multiple locations or dropping off in multiple locations.

**Identify trade-offs that shippers need to consider when designing a transportation network.**

When designing transportation networks, shippers need to consider the trade-offs among transportation cost, inventory cost, operating cost, and customer responsiveness. The supply chain goal is to minimize the total cost while providing the desired level of responsiveness to customers.

## DEMAND FORECASTING IN A SUPPLY CHAIN

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### Supply chain

A supply chain consists of all parties involved, directly or indirectly, in fulfilling a customer request. The supply chain includes not only the manufacturer and suppliers, but also transporters, warehouses, retailers, and even customers themselves. Within each organization, such as a manufacturer, the supply chain includes all functions involved in receiving and filling a customer request. These functions include, but are not limited to, new product development, marketing, operations, distribution, finance, and customer service.

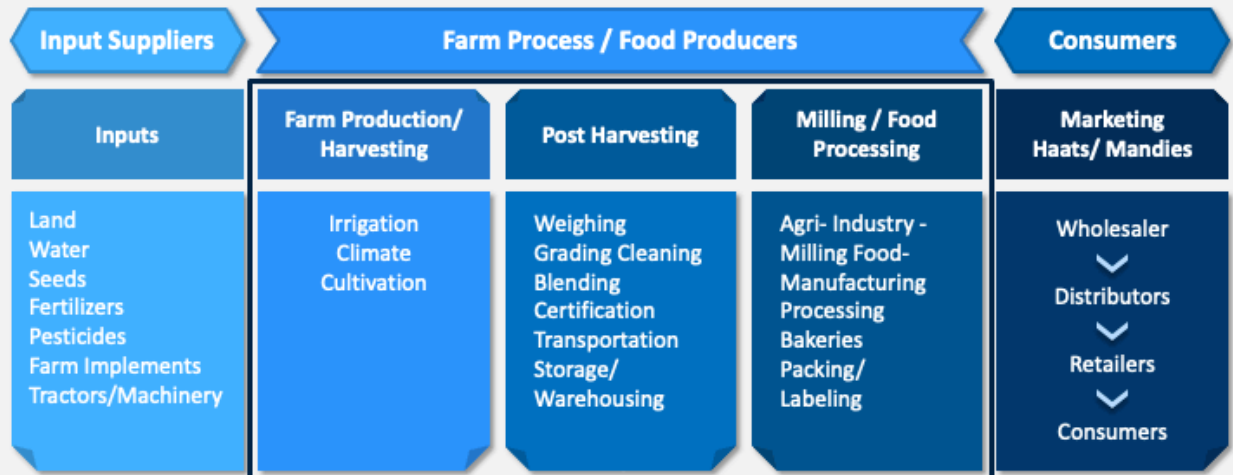
### Drivers of supply chain

To understand how a company can improve supply chain performance in terms of responsiveness and efficiency, we must examine the logistical and cross-functional drivers of supply chain performance: facilities, inventory, transportation, information, sourcing, and pricing. These drivers interact to determine the supply chain's performance in terms of responsiveness and efficiency.



# AGRICULTURE VALUE CHAIN

## Agriculture Supply Model



### Demand Forecasts

Demand forecasts form the basis of all supply chain planning. Consider the push/pull view of the supply chain. All push processes in the supply chain are performed in anticipation of customer demand, whereas all pull processes are performed in response to customer demand. For push processes, a manager must plan the level of activity, be it production, transportation, or any other planned activity. For pull processes, a manager must plan the level of available capacity and inventory but not the actual amount to be executed. In both instances, the first step a manager must take is to forecast what customer demand will be. Mature products with stable demand, such as milk or paper towels, are usually easiest to forecast. Forecasting and the accompanying managerial decisions are extremely difficult when either the supply of raw materials or the demand for the finished product is highly unpredictable

## CHARACTERISTICS OF FORECASTS

1. Forecasts are always inaccurate and should thus include both the expected value of the forecast and a measure of forecast error.
2. Long-term forecasts are usually less accurate than short-term forecasts; that is, long-term forecasts have a larger standard deviation of error relative to the mean than short-term forecasts.
3. Aggregate forecasts are usually more accurate than disaggregate forecasts, as they tend to have a smaller standard deviation of error relative to the mean. For example, it is easy to forecast the gross domestic product (GDP) of the United States for a given year with less than a 2 percent error. However, it is much more difficult to forecast yearly revenue for a company with less than a 2 percent error.
4. In general, the farther up the supply chain a company is (or the farther it is from the consumer), the greater is the distortion of information it receives. Collaborative forecasting based on sales to the end customer helps upstream enterprises reduce forecast error.

## COMPONENTS OF A FORECAST AND FORECASTING METHODS

A company must be knowledgeable about numerous factors that are related to the demand forecast, including the following:

- Past demand
- Lead time of product replenishment
- Planned advertising or marketing efforts
- Planned price discounts
- State of the economy
- Actions that competitors have taken

A company must understand such factors before it can select an appropriate forecasting methodology. For example, historically a firm may have experienced low demand for chicken noodle soup in July and high demand in December and January. If the firm decides to discount the product in July, the situation is likely to change, with some of the future demand shifting to the month of July. The firm should make its forecast taking this factor into consideration.

Forecasting methods are classified according to the following four types:

1. **Qualitative:** Qualitative forecasting methods are primarily subjective and rely on human judgment. They are most appropriate when little historical data are available or when experts have market intelligence that may affect the forecast.



**2. Time series:** Time-series forecasting methods use historical demand to make a forecast. They are based on the assumption that past demand history is a good indicator of future demand.

**3. Causal:** Causal forecasting methods assume that the demand forecast is highly correlated with certain factors in the environment (the state of the economy, interest rates, etc.).

**4. Simulation:** Simulation forecasting methods imitate the consumer choices that give rise to demand to arrive at a forecast. Using simulation, a firm can combine time-series and causal methods to answer such questions as: What will be the impact of a price promotion? What will be the impact of a competitor opening a store nearby? Airlines simulate customer buying behavior to forecast demand for higher fare seats when there are no seats available at the lower fares.

## **BASIC APPROACH TO DEMAND FORECASTING**

The following five points are important for an organization to forecast effectively:

1. Understand the objective of forecasting.
2. Integrate demand planning and forecasting throughout the supply chain.
3. Identify the major factors that influence the demand forecast.
4. Forecast at the appropriate level of aggregation.
5. Establish performance and error measures for the forecast.

### **Time series forecasting methods**

**Naive model:**

$$F_{t+i} = Y_t$$

The naïve model is useful and will perform most satisfactorily when the actual historical data is very short and contains no systematic pattern, or a pattern that is changed very slowly.

**Mean Forecast model:**

$$F_{t+i} = \bar{Y}$$

The mean forecast model will perform most satisfactorily when the actual historical data is fluctuated around a constant or stationary value.

**Average change model**

$$F_{t+i} = Y_t + \text{Average of changes}$$

$$\text{Average of changes} = \frac{(\Delta Y_{t-1} + \Delta Y_t)}{2}$$

Or the current predicted value is

$$F_t = Y_{t-1} + \frac{(\Delta Y_{t-2} + \Delta Y_{t-1})}{2}$$

### Average Percent Change model

$$F_{t+i} = Y_t + \text{Average of percent changes}$$

$$\text{Average of percent changes} = \frac{(\Delta Y_{t-1} / Y_{t-1}) + (\Delta Y_t / Y_t)}{2}$$

### Simple average moving (SMA)

The idea of moving average is to find the trend of irregular data. Assume that a future value will equal an average of past values:

$$F_t = SMA(n)_t = \frac{(Y_{t-n} + \dots + Y_{t-3} + Y_{t-2} + Y_{t-1})}{n}$$

Where X is the actual value of a series, and F is the forecasted value. An **n**-period moving average denotes that each new forecast moves ahead one period by adding the newest actual and dropping the oldest actual.

### Weight Moving Average (different weighting for different observation)

It is normally true that the immediate past is most relevant in predict the immediate future. For this reason, weighted moving average (WMV) place more weight on the most recent observations.

$$F_t = WMA4 = [0.4Y_{t-1} + 0.3Y_{t-2} + 0.2Y_{t-3} + 0.1Y_{t-4}]$$

**Advantages:**

The weights placed on past can be varied. However, a determination of the optimal weights can be costly. This type of model is most useful when the historical data are characterized by period-to-period changes that are approximately the same size.

**Limitations of the WMA models:**

They do not model seasonality and trend. It is very difficult to determine the optimal number of periods because the RSE may not be the best critical values and costly to determine the optimal weight. Therefore the WMA is not frequently used.

**Single Exponential Smoothing**

Forecast require only three piece of data, the most recent actual, the most recent forecast, and a smoothing constant. The smoothing constant ( $\alpha$ ) determines the weight given to the most recent past observations and therefore controls the rate of smoothing or averaging.

$$F_t = \alpha Y_{t-1} + (1 - \alpha)F_{t-1}$$

The current forecast equals to a weighted average of the most recent actual value and the most recent forecasted value. The first actual value is chosen as the forecast for the second period.

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# DRIVERS OF SUPPLY CHAIN PERFORMANCE

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To understand how a company can improve supply chain performance in terms of responsiveness and efficiency, we must examine the logistical and cross-functional drivers of supply chain performance:

- Facilities
- Inventory
- Transportation
- Information
- Sourcing and
- Pricing.

These drivers interact to determine the supply chain's performance in terms of responsiveness and efficiency.

The goal is to structure the drivers to achieve the desired level of responsiveness at the lowest possible cost, thus improving the supply chain surplus and the firm's financial performance. First, we define each driver and discuss its impact on the performance of the supply chain.

## 1. Facilities

Facilities are the actual **physical locations** in the supply chain network where product is stored, assembled, or fabricated. The two major types of facilities are

- production sites and
- storage sites.

Decisions regarding the role, location, capacity, and flexibility of facilities have a significant impact on the supply chain's performance. For example, in 2009, Amazon increased the number of warehousing facilities located close to customers to improve its responsiveness. In contrast, Blockbuster tried to improve its efficiency in 2010 by shutting down many facilities even though it reduced responsiveness. Facility costs show up under property, plant and equipment, if facilities are owned by the firm or under selling, general, and administrative if they are leased.

## 2. Inventory

Inventory encompasses all

- raw materials,
- work in process, and
- finished goods.

The inventory belonging to a firm is reported under assets. Changing inventory policies can dramatically alter the supply chain's efficiency and responsiveness.

For example, W.W. Grainger makes itself responsive by stocking large amounts of inventory and satisfying customer demand from stock even though the high inventory levels reduce efficiency. Such a practice makes sense for Grainger because its products hold their value for a long time. A strategy using high inventory levels can be dangerous in the fashion apparel business where inventory loses value relatively quickly with changing seasons and trends. Rather than hold high levels of inventory, Spanish apparel retailer Zara has worked hard to shorten new product and replenishment lead times. As a result, the company is very responsive but carries low levels of inventory. Zara thus provides responsiveness at low cost.

### 3. Transportation

Transportation entails **moving inventory from point to point** in the supply chain. Transportation can take the form of many combinations of modes and routes, each with its own performance characteristics. Transportation choices have a large impact on supply chain responsiveness and efficiency.

For example, a mail-order catalog company can use a faster mode of transportation such as FedEx to ship products, thus making its supply chain more responsive, but also less efficient given the high costs associated with using FedEx.

### 4. Information

Information consists of **data and analysis** concerning facilities, inventory, transportation, costs, prices, and customers throughout the supply chain. Information is potentially **the biggest driver of performance** in the supply chain because it directly affects each of the other drivers. Information presents management with the opportunity to make supply chains more responsive and more efficient.

For example, Seven-Eleven Japan has used information to better match supply and demand while achieving production and distribution economies. The result is a high level of responsiveness to customer demand while production and replenishment costs are lowered. Information technology-related expenses are typically included under either operating

expense or assets.

## **5. Sourcing**

Sourcing is the activity such as production, storage, transportation, or the management of information of a supply chain. At the strategic level, these decisions determine what functions a firm performs and what functions the firm outsources. Sourcing decisions affect both the responsiveness and efficiency of a supply chain.

For example, After Motorola outsourced much of its production to contract manufacturers in China, it saw its efficiency improve but its responsiveness suffer because of the long distances. To make up for the drop in responsiveness, Motorola started flying in some of its cell phones from China even though this choice increased transportation cost.

## **6. Pricing**

Pricing affects the behavior of the buyer of the good or service, thus affecting supply chain performance.

For example, if a transportation company varies its charges based on the lead time provided by the customers, it is likely that customers who value efficiency will order early and customers who value responsiveness will be willing to wait and order just before they need a product transported. Differential pricing provides responsiveness to customers that value it and low cost to customers that do not value responsiveness as much. Any change in pricing impacts revenues directly but could also affect costs based on the impact of this change on the other drivers.

### **Other drivers**

Supply chain management includes the use of logistical and cross-functional drivers to increase the supply chain surplus.

Cross-functional drivers have become increasingly important in raising the supply chain surplus in recent years. It is important to realize that the drivers do not act independently but interact to determine the overall supply chain performance. Good supply chain design and operation recognize this interaction and make the appropriate trade-offs to deliver the desired level of responsiveness.

### **Working of Cross-functional drivers**

Let us understand the working of these drivers with an example, the furniture industry in the United States. Low-cost furniture sourced from Asia is available at many discount retailers. The primary goal of this supply chain is to deliver a low price and

acceptable quality. Variety is typically low and retailers such as Wal-Mart stock inventory of finished goods. The low variety and stable replenishment orders allow furniture manufacturers in Asia to focus on efficiency. Given the available inventory, low-cost modes of transportation from Asia are used. In this instance, relatively low-cost inventory at the retailer allows the supply chain to become efficient by lowering transportation and production costs.

In contrast, some U.S. furniture makers have chosen to focus on providing variety. Given the high variety and high prices, keeping inventory of all variants at a retailer would be very expensive. In this case, the supply chain has been designed so that the retailer carries little inventory. Customers place their orders with the retailer by seeing one variant of the furniture and selecting among the various options. The supply chain is made responsive by using information technology to convey order information effectively, structuring flexible manufacturing facilities to be able to produce in small lots, and using responsive transportation to deliver the furniture to the customer. In this instance, responsive facilities, transportation, and information are used to lower inventory costs.

### **Strategic fit and strong financial performance**

The key to achieve strategic fit and strong financial performance across the supply chain. The key is to structure the supply chain drivers appropriately to provide the desired level of responsiveness at the lowest possible cost. Some of the examples are:

Doherty et al. (2010) point out that supply chain performance affects nearly 35 percent of the financial performance of apparel retailers. As a percentage of sales, they state that markdowns, representing 10–30 percent of sales, and lost sales, representing 5–10 percent of sales, are the dominant drivers of retailers' financial performance. They further state that transportation represents 2–5 percent, warehousing 1–3 percent, store product handling 3–5 percent, and inventory costs 2–5 percent of sales. While the precise fraction will vary for different supply chains, it is evident that supply chain performance along the six drivers has a significant influence on a firm's financial performance. Before we discuss each of the six drivers in detail, we put these drivers into a framework that helps clarify the role of each in improving supply chain performance.

Toyota and Honda: Both Toyota and Honda use facilities decisions to be more responsive to their customers. These companies have an end goal of opening manufacturing facilities in every major market that they enter. While there are other benefits to opening local facilities, such as protection from currency fluctuation and trade barriers, the increase in responsiveness plays a

large role in Toyota's and Honda's decision to place facilities in their local markets. The flexibility of Honda facilities to assemble both SUVs and cars in the same plant allowed the company to keep costs down in the downturn of 2008. While competitors' SUV production facilities were idle, Honda facilities maintained a high level of utilization.

Amazon.com: Amazon attempts to provide a wide variety of books (among other products) to its customers. Best-selling books are stocked in many regional warehouses close to customers for high responsiveness. Slower moving books are stocked at fewer warehouses to lower the cost of inventory at the expense of some responsiveness. Some of the slowest moving books are not held in inventory but are obtained from the publisher/distributor or printed on demand when requested by a customer. Amazon changes the form, location, and quantity of inventory it holds by the level of sales of a book to provide the right balance of responsiveness and efficiency.

Blue Nile: Blue Nile is an online retailer of diamonds that has used responsive transportation with FedEx to ship diamonds to customers in the United States, Canada, and several countries in Europe and Asia. Given the high value of diamonds, Blue Nile offers free shipping for the overnight delivery. Responsive shipping, however, allows Blue Nile to centralize its inventory of diamonds and also eliminate the need for expensive storefronts. In spite of the high transportation costs, Blue Nile has very low costs compared to bricks-and-mortar retailers because of the low facility and inventory expenses. Blue Nile is thus able to offer significantly lower prices than its bricks-and-mortar competition.

Andersen Windows: Andersen Windows, a major manufacturer of residential wood windows located in Bayport, Minnesota, has invested in an information system that enables the company to bring customized products to the market rapidly. This system, called "Window of Knowledge," allows distributors and customers to design windows to custom-fit their needs. Users can select from a library of more than 50,000 components that can be combined in any number of ways. The system immediately gives the customer price quotes and automatically sends the order to the factory if the customer decides to buy. This information investment not only gives the customer a much wider variety of products, it also allows Andersen to be much more responsive to the customer, as it gets the customer's order to the factory as soon as the order is placed.



Cisco: Cisco has outsourced almost all of its manufacturing. It does, however, have a sourcing strategy that varies by product type. For low-end products such as routers for home networks, Cisco aims for efficiency. These routers are produced and packed in China and shipped in bulk for sale in the United States. Cisco aims for the lowest cost manufacturing location and economies of scale in transportation because the targeted market segment values low cost. For high-end products, in contrast, Cisco outsources to contract manufacturers in the United States. These manufacturers are not low cost, but they are responsive and can serve the rapidly evolving needs of the high-end market.

Amazon.com Amazon offers its customers a large menu of prices for products that are purchased from the company. For example, in July 2008, a person purchasing two books worth \$30 could use standard shipping (ships in 3–5 business days) at a cost of \$4.98, two-day shipping (ships in 2 business days) at a cost of \$13.97, one-day shipping (ships in 1 business day) at a cost of \$22.97 or use free shipping (ships in 7–14 business days). The pricing menu allows Amazon to attract customers with varying levels of desired responsiveness. Whereas customers paying for one-day shipping impose a high degree of uncertainty on Amazon, customers opting for free shipping can be used to level out the workload at the warehouse over time. Amazon can thus use its pricing to provide responsiveness to those who value it while using customers who want a low price to help it improve its efficiency.

### **Key financial measures of firm performance.**

The key financial measures of firm performance include return on equity; return on assets; accounts payable turnover; profit margin; asset turnover, accounts receivable turnover; inventory turns; property, plant and equipment turns; and cash-to-cash cycle.

### **Major drivers of supply chain performance.**

The major drivers of supply chain performance are facilities, inventory, transportation, information, sourcing, and pricing.

### **Role of each driver in creating strategic fit between the supply chain strategy and the competitive strategy.**

A company achieving strategic fit has found the right balance between responsiveness and efficiency. Each driver affects this balance. Having more facilities generally makes a chain more responsive, while having fewer, central facilities creates

higher efficiency. Holding higher levels of inventory increases the responsiveness of a supply. Supply Chain Drivers and Metrics chain, while keeping inventory low increases the chain's efficiency. Using faster modes of transportation increases a chain's responsiveness, while using slower modes generally increases efficiency. Investing in information can vastly improve the supply chain performance on both dimensions. This investment, however, must be made based on the strategic position supported by the other drivers. Appropriate sourcing decisions raise supply chain profits by assigning supply chain functions to the right party, which brings higher economies of scale or a higher level of aggregation of uncertainty. Pricing can be used to attract the right target customer segment. Differential pricing can be used to attract customers who value responsiveness as well as customers who want efficiency. The supply chain can then be structured to provide responsiveness to some customers while improving overall efficiency.

**key metrics that track the performance of the supply chain in terms of each driver.**

Facility-related metrics are capacity, utilization, theoretical flow/cycle time of production, actual flow/cycle time, flow time efficiency, product variety, volume contribution of top 20 percent SKUs/customers, processing/setup/down/idle time, and average production batch size. Inventory-related metrics are average inventory, products with more than a specified number of days of inventory, average replenishment batch size, average safety inventory, seasonal inventory, fill rate, and fraction of time out of stock. Transportation-related metrics are average inbound transportation cost, average incoming shipment size, average inbound transportation cost per shipment, average outbound transportation cost, average outbound shipment size, average outbound transportation cost per shipment, and fraction transported by mode. Information-related metrics are forecast horizon, forecast error, seasonal factors, variance from plan, and ratio of demand variability to order variability. Sourcing-related metrics are days payable outstanding, average purchase price, range of purchase price, average purchase quantity, fraction on-time deliveries, supply quality, and supply lead time. Pricing-related metrics are profit margin, days sales outstanding, incremental fixed cost per order, incremental variable cost per unit, average sale price, average order size, range of sale price, and range of periodic sales. Each of these metrics directly or indirectly impacts the financial metrics and the responsiveness to customers.

# ROLE OF WAREHOUSING AND DISTRIBUTION CHANNELS IN SUPPLY CHAIN MANAGEMENT

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**Supply chain management** is the area of business administration that directly concerns the consumers. It is essential in ensuring customer satisfaction and loyalty. This area covers several business operations such as warehousing and distribution. To succeed in supply chain management, it is important to excel in those aforementioned business operations.



Supply chain management's goal is to maintain an uninterrupted flow of goods, from the collection of raw materials to manufacture to distribution of the final product. When it comes to managing all the moving parts, warehousing plays an important role in streamlining the supply chain.

## Warehousing

A warehouse is a large, spacious and secured building intended for commerce and government use. It functions as a storage place for large quantities of goods. Warehousing is not simply about storage though. It also covers the administration and manual labour required in storage such as delivery, documentation, examination, and certification.

There are three types of warehouses: public, owned by third party logistics (3PL) and company-owned. The government through its arm uses public warehouses to store shipments and contrabands they confiscated temporarily. The business sector usually resorts to company-owned or 3PL-owned warehouses to meet their storage needs. Wholesalers, exporters,

importers and manufacturers are the common clients of warehousing service providers. Raw materials and finished goods alike are kept in warehouses.

There are different reasons for warehousing. The cheese making and wine-making (also known as viniculture) industries require an extensive time to produce their products. Warehouses are good places for their products to mature.

This business operation also ensures the sufficiency of supply. As a result, the prices of the goods involved are less likely to fluctuate.

Warehousing may also cover the completion of goods before distribution. The components and packing materials are just delivered to the building. The assembly and packing of the goods will be done in the warehouse. By doing so, the product cover will still look new and enticing upon delivery to distribution centers. If you pack the goods before bringing them to the warehouse, the packaging may be damaged while on the way.

Too many factors can interrupt the supply chain and delay final deliveries, which is why we should take extra care picking the right warehouse. If we take advantage of all that warehousing has to offer, we can improve our supply chain's efficiency.

### **Location**

In life, location is everything. When it comes to supply chain management, a warehouse's location is even more crucial, as it can make or break the supply chain.

When picking a warehouse, we need to ask:

- Is the warehouse near a port of entry?
- Is it near major transportation hubs, like airports and highways?
- How quickly can get the products from port to warehouse to the road?
- Where is the warehouse in relation to point of entry and the end-location of my products?

To maintain the flow of goods and prevent interruptions to distribution, we should look for a warehouse that is strategically located along the supply route. You want to ensure you can quickly get your goods to the warehouse and eventually to a transportation hub (be it an airport, a seaport, or a highway) that will take them to their final destination. Choose wrong, and you're adding time to your delivery schedule.

### **Services**

Some warehouses only offer storage, and others require strict contracts that require you to store a minimum number of goods for a certain amount of time. Look for a warehouse that offers flexible scheduling and value-added services so you can repack supplies for the next step of distribution, label and divide based on where each shipment is going, and more. That will save you time and money. In other words: streamline the process and operate efficiently.

### **Public warehousing**

Look for a warehouse that offers flexible contracts and space so you can store as much or as little as you want, only for the time that you need—no longer.

### **Packing and repacking**

Some of the most important services warehouses can offer in order to optimize supply chains are:

- Repackaging (breaking down your supply into smaller groupings based on where final shipments are going)
- Repalletizing (moving goods to new pallets for final shipments)
- Stretch-wrapping (to keep goods safe as they make their way to their final destination)

### **Labeling**

Labeling for the recipients of your goods is a value-added service that can save you time and energy and makes your shipments ready for their final recipients without you having to lift a finger.

### **Storage**

Depending on what goods you're transporting, you may need temperature-controlled storage. Or perhaps you have delicate chemicals that need special storage, or you're moving a type of resin that cannot be stored next to certain chemicals found in common cleaning agents.

Look for a warehouse that uses an [advanced warehouse management system](#) (WMS) that allows them to track which goods are stored where and optimize inbound and outbound shipments. When you find a warehouse that uses an advanced WMS, you know you're working with a company that will keep your supply chain going.

### **Distribution**

In the business language, distribution refers to the delivery of finished goods to buying centers such as shopping centres, markets and retailer stores. Some manufacturers deliver their goods

directly to their accredited retailers. This is advantageous if the retailers' business establishments are just nearby the manufacturers' places.

Direct delivery of goods to retailers can save you from warehousing costs. However, if you are far from distribution centers, you have to deal with trucking costs and inventory frequently.

Thus, it is safe to say that [warehousing and distribution go hand-in-hand in providing a more cost-effective way of delivering goods](#). There are even businesses that literally combined these two business operations.

Some warehouses are also utilized as a buying or retailing center while maintaining its original function. In fact, the Germans still have warehouse-like department stores. The architecture of some of these buildings is one of the causes for their dual functions. Excessive beautification of warehouses makes them appealing for shopping.



On their way from producers to end users and consumers, products pass through a series of marketing entities known as a **distribution channel**.

The Functions of Distribution Channels

Why do distribution channels exist? Why can't every firm sell its products directly to the end user or consumer? Why are go-betweens needed? Channels serve a number of functions.

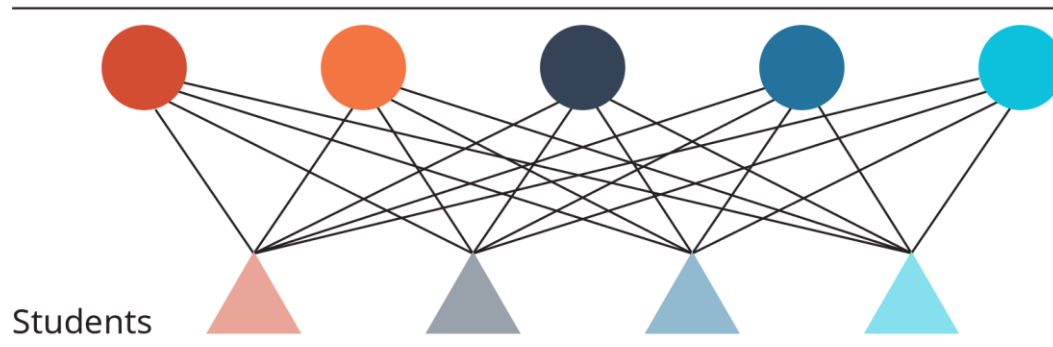
### **Channels Reduce the Number of Transactions**

Channels make distribution simpler by reducing the number of transactions required to get a product from the manufacturer to the consumer. For example, if there are four students in a course and a professor requires five textbooks (each from a different publisher), a total of 20 transactions would be necessary to accomplish the sale of the books. If the bookstore serves as a go-between, the number of transactions is reduced to nine. Each publisher sells to one

bookstore rather than to four students. Each student buys from one bookstore instead of from five publishers

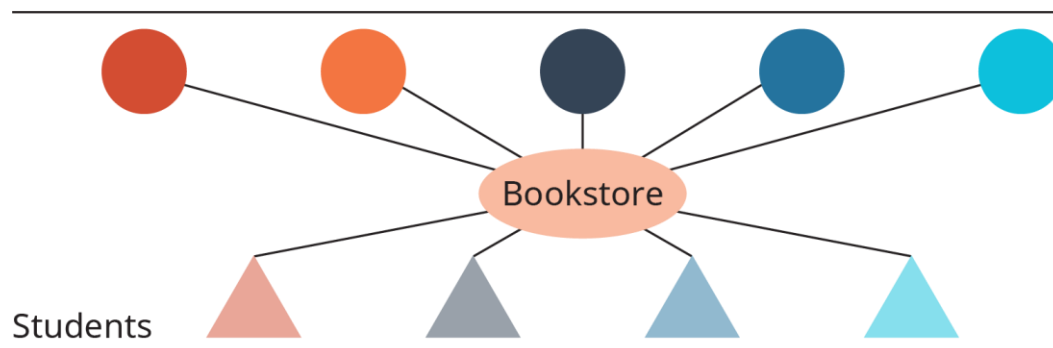
**Without a Marketing Intermediary:  
5 publishers × 4 students = 20 transactions**

Publishers



**With a Marketing Intermediary:  
5 publishers + 4 students = 9 transactions**

Publishers



Dealing with channel intermediaries frees producers from many of the details of distribution activity. Producers are traditionally not as efficient or as enthusiastic about selling products directly to end users as are channel members. First, producers may wish to focus on production. They may feel that they cannot both produce and distribute in a competitive way. On the other hand, manufacturers are eager to deal directly with giant retailers, such as Walmart, which offer huge sales opportunities to producers.

### **Channels Ease the Flow of Goods**

Channels make distribution easier in several ways. The first is by *sorting*, which consists of the following:

- **Sorting out:** Breaking many different items into separate stocks that are similar. Eggs, for instance, are sorted by grade and size. Another example would be different lines of women's dresses—designer, moderate, and economy lines.
- **Accumulating:** Bringing similar stocks together into a larger quantity. Twelve large Grade A eggs could be placed in some cartons and 12 medium Grade B eggs in other cartons. Another example would be to merge several lines of women's dresses from different designers together.
- **Allocating:** Breaking similar products into smaller and smaller lots (allocating at the wholesale level is called **breaking bulk**.) For instance, a tank-car load of milk could be broken down into gallon jugs. The process of allocating generally is done when the goods are dispersed by region and as ownership of the goods changes.

Without the sorting, accumulating, and allocating processes, our modern consumer society would not exist. Instead, there would be home-based industries providing custom or semicustom products to local markets. In short, society would return to a much lower level of consumption.

A second way channels ease the flow of goods is by locating buyers for merchandise. A wholesaler must find the right retailers to sell a profitable volume of merchandise. A sporting-goods wholesaler, for instance, must find the retailers who are most likely to reach sporting-goods consumers. Retailers have to understand the buying habits of consumers and put stores where consumers want and expect to find the merchandise. Every member of a distribution channel must locate buyers for the products it is trying to sell. Channel members also store merchandise so that goods are available when consumers want to buy them. The high cost of retail space often means many goods are stored by the wholesaler or manufacturer.

### **Impact of Improper warehousing and distribution**

Major and minor mistakes alike in warehousing and distribution can result to high losses. Incorrect storage can damage the goods. If the damaged goods are sold, they will either be sold in a much lower price or not be sold at all. The manufacturers will not be able to get back their investments.

Failure to deliver the goods to the right destinations will cause the business to cover another round of delivery costs to do two things: to bring back the wrong goods and to deliver the right ones. Due to delays, goods can get damaged and intended recipients may not want to accept and pay for the delivery.



Another adverse effect of wrong warehousing and distribution is that it can destabilize the prices of goods. If there is not enough supply due to the incompetence of the warehousing management, the prices of goods may rise to meet the unchanged demand of the consumers.

## **HUMAN CAPITAL REQUIREMENT FOR SUPPLY CHAIN**

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### **Introduction**

Human capital is a term given by Nobel laureates Becker and Huselid. What is human capital? and how it differs from human resource .This basic understanding is important to know the requirement of human capital for any business activity.Human resource refers to manpower/ employees who work for an organisation. This term replaced personnel which has its origin from the first industrial revolution. The end of second world war resulted in drastic changes in the world leading to second industrial revolution. Loss of human lives, destruction of livelihood due to second world war led the human race in a new path of growth and rejuvenation. New range of industries emerged to satisfy the growing needs of people.The requirement of personnel both in terms of quality and quantity also increased for different work needs of a business organisation. Globalisation during 1991 opened the gates for new business in India from the outside world. Entry of new set of firms resulted in more challenges , leading to increased requirement of new talents. More competition in business absorbed more personnel and each firm started struggling to retain their personnel. In this scenario the perspective of the business firms about their personnel also changed. Previously they used to conceive the workers as machines who have to respond at their command. But from the year 1990s the era human resource replaced personnel to refer the manpower of a business firm.

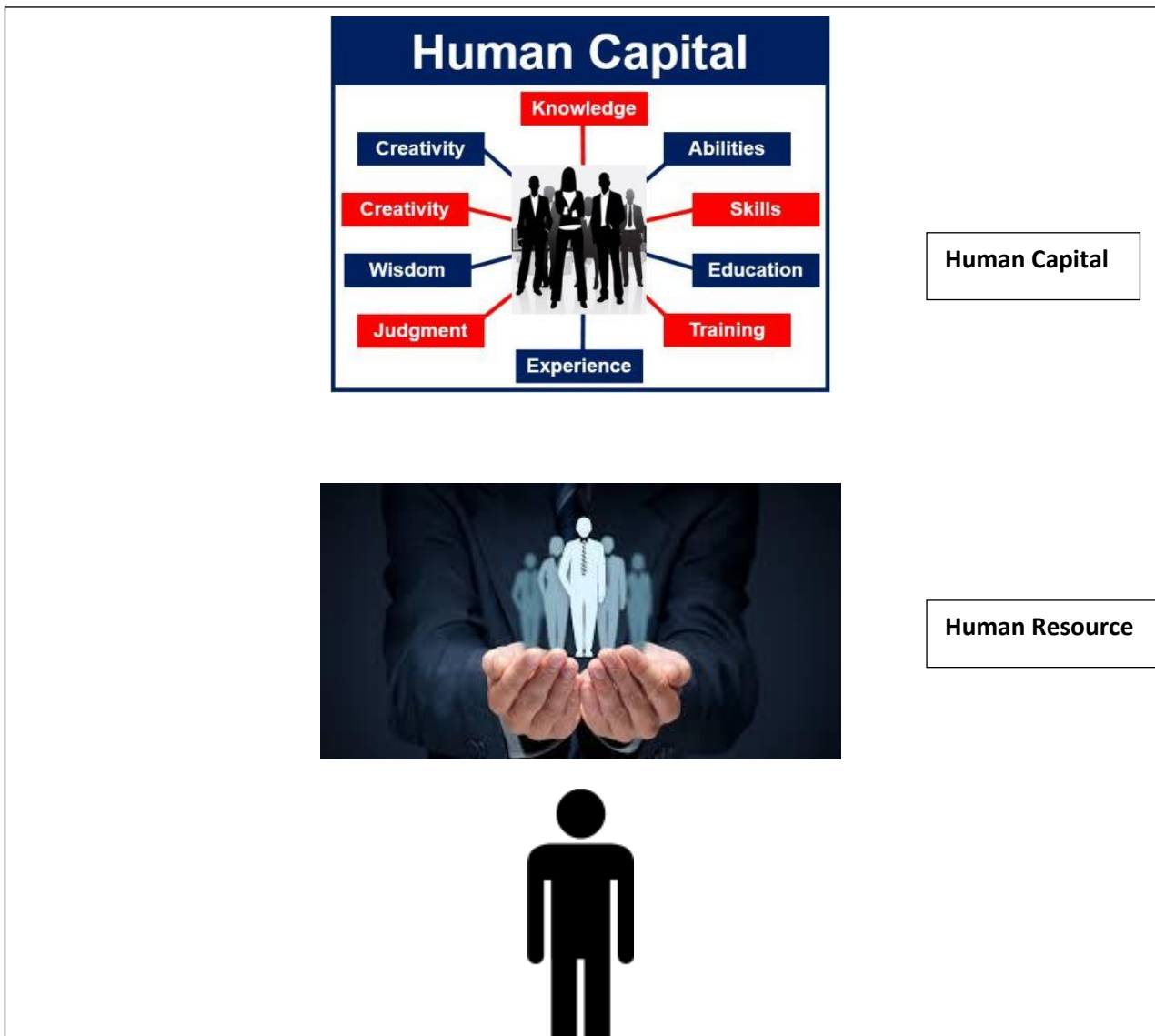
Human Resource refers to the employees of any organization/ firm. The term human resource indicates the importance of employees for a firm/organization. It indirectly conveys that the human resource should be considered as a valuable asset and care should be taken to make them happy and comfortable.

## *Human Resource Management*

For any business activity, a system or organisation is essential, when the size of business increases. In the initial stage, one or a few human resource is enough, but in due course need for more human resource increases. Then getting the required human resource will be a special task for any organisation, as individual small business has grown to a business firm/ organisation. For any business firm/ organisation, after its growth human resource management will become a main function in line with marketing, finance, etc.

Human Resource management involves five main activities as follows

- Planning human resource
- Acquiring human resource
- Developing human resource
- Evaluating human resource
- Maintaining human resource



## **Human Resource**



### **Fig 1 Transformation from Personnel to human capital**

Planning refers to identifying the required number of human resource for various job positions. Acquiring refers to searching and selecting the required human resource. Developing refers to training the human resource for better performance. Evaluating human resource refers to appraising the human resource and maintaining refers to protecting the human resource. These activities are done by human resource experts who are specialised in human resource management. Human resource refers to employees and human capital refers to the stock of knowledge, skill and ability/attitude of all the employees. Human capital is an intangible asset which helps an organisation to perform. Hence for a developing organisation it is wise to assess the requirement of human capital instead of the number of human resource.

#### **Human capital Requirement**

What knowledge, skill, experience is needed to achieve the objectives?

The answer for the above question should be the basis for a business firm when it starts searching for candidates. Planning helps to know the answer for the above question and procuring helps in getting human resource with the required knowledge, skill and ability/attitude (KSA). Hence planning and procuring human resource are the important activities which will result in best human capital. Based on the level of the job in an organisation, the percentage of knowledge, skill and ability/attitude can be determined.

While screening the candidates for a job differentiate them into three types *Viz*, performer, potential, neither potential nor performer.

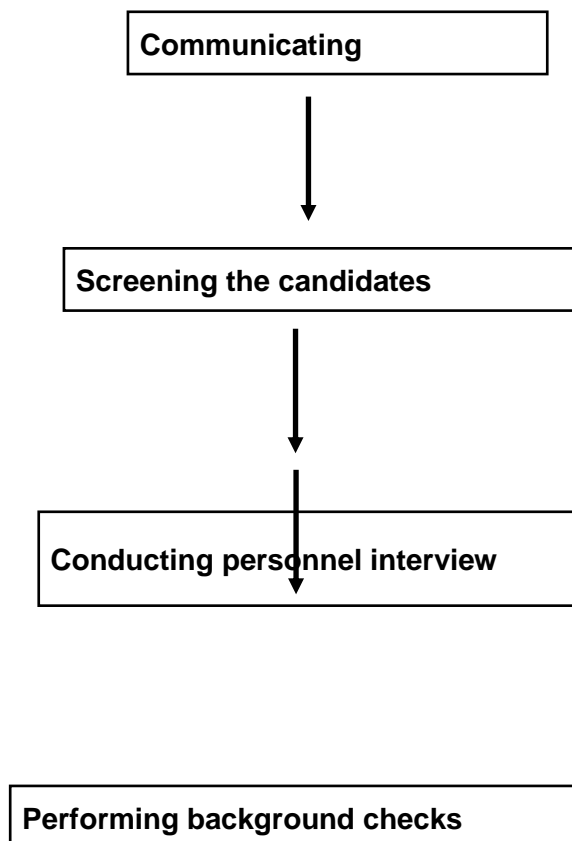
**Performer:** Performer candidate is like ready to eat food. They can immediately start working after joining a firm. They need only orientation to have an understanding about the firm and the job. They can kick start their job within few days . But they are costly

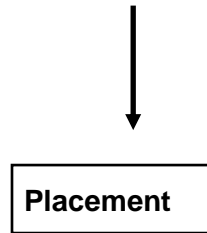
as. their package will be high. But they will become star performers and add value to the existing human capital.

Potential : Potential candidates are like good soil, when trained properly will become performers. Such candidates when given correct training and mentoring definitely will add value to the existing human capital of a firm.

Neither potential nor performer: Last category are neither potential no performer. They are not fit and can be rejected. If such candidates are selected, they will just follow the words and work . They are mere followers and can be selected if the job does not need a potential or performer.

The basic understanding of the candidates will help in judging into the above mentioned three types.Educational qualification and the institute / college will convey the basic knowledge level of a candidate. Similarly experience in the field is another criteria for judging the knowledge level of the candidate. Attitude refers to the evaluation style of a candidate about a person, event, product, etc. Knowledge, skill and attitude/ability requirements for a job can be clearly defined based on the industry.





**Fig 1. Procuring human resource**

Procuring human resource involves the steps indicated in fig 2. Communicating is the first step in procuring which intimates the vacancy to the eligible candidates. Screening helps in understanding the candidate 's educational qualification, experience, special skills from the bio-data. Proper screening eliminates unfit candidates. Personal interview helps in testing the candidates attitude, skill and knowledge. Background checks should be conducted if the the candidate found to be suitable for the job. Back ground checks help in knowing the candidates personal background. Finally if found fit , placement can be confirmed. Planning and procuring plays a vital role in adding the human capital of an organisation. These two steps serve as a foundation for enriching the human capital. Hence the above mentioned facts may be adopted for getting best human resource for an export business.

# Value Chain Financing

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Value chain finance refers to financial products and services that flow to or through any point in a value chain that enable investments that increase actors' returns and the growth and competitiveness of the chain. Whereas financial transactions within a value chain are not new (production finance could be considered "value chain finance"), several emphases distinguish a value chain finance approach. These include improving finance at specific points in the value chain to increase the competitiveness of the entire value chain and involving multiple actors and leveraging relationships to lower or mitigate risk. Taking a value chain approach entails considering the risks and returns of the finance supplier along with the risk and returns of the value chain actor demanding finance.

The term **value chain finance** (VCF) refers to the use of a value chain and the way in which it supports participants by tailoring services and products to one or more points in a value chain in order to reduce the risk and cost of financing, and increase the efficiency of the value chain as a whole. VCF can help meet the growing need for agricultural finance and investment in response to consumer demand for more processed or value-added products. From a development perspective, governments and support agencies must ensure that the financial systems in their countries are able to meet the financial demands arising from the growth of modern value chains.

The main idea behind Value Chain Financing is to bridge the gap between unexplored markets and financial institutions

It can improve quality and efficiency in financing agricultural chains by:

- Identifying the financing needed to strengthen the chain;
- Tailoring financial products to suit the needs of the participants in the chain;
- Reducing financial transaction costs through the direct discounting of loan payments at the time of product sale; and
- Using value chain linkages and knowledge of the chain to mitigate risks to the chain and its partners

## Types of value chain finance

Value chain finance can be of three types:

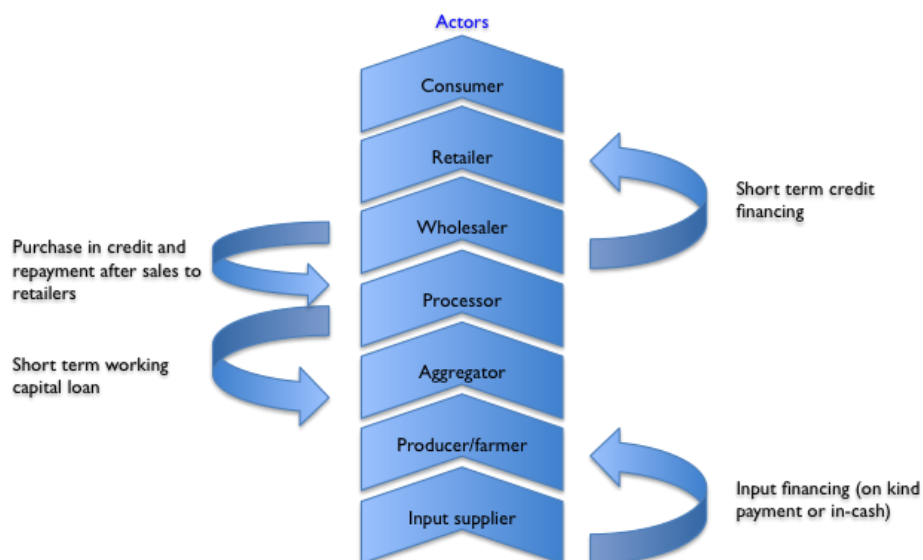
- Self-finance value chain finance
- Direct informal “within chain” value chain finance
- Indirect formal financial services “from outside the chain” value chain finance

### 1. Self-finance value chain finance

Self-finance value chain finance is the financing mechanism wherein the farmers/producers finance the production by themselves. Under this financing mechanism, they usually utilize the retained earnings or savings and/or borrow from friends and family to finance the production. In most such mechanisms, the exploitation of producers by intermediaries and other players in the value chain is minimized; however due to limited amount of financing available, the producers’ potential to realize full production and value from the production process is also minimized.

### 2. Direct informal “within chain” value chain finance

Direct value chain or within chain finance refers to the financing arrangement whereby actors of the value chain finance the activities of chain. In such a financing mechanism, the input suppliers extend credit support to the producers in kind such as seeds, fertilisers, equipment etc.



The producer in turn repays to the input suppliers either in kind (grains, agricultural produce) or in cash (obtained from the sale of the produce) at the time of harvest. In cases, this kind of financing mechanism can be of intricately complex in nature where the aggregators and processors extend credit support to the input suppliers who further extends credit support to the producers. The direct value chain finance consist of short term loans to ensure a smooth flow of products and to keep the activities going and the value chain functioning. This arrangement largely rests on the trust between the input suppliers and the producers.

### **Pros and Cons of Direct informal “within chain” value chain finance**

#### **Pros**

- Low costs to the producer as lenders charge nominal interest on the borrowings
- Low risk as parties trust each other
- Tailor made financing based on producers’ requirements
- Improved chain efficiency as the producer gets a guaranteed buyer (in cases where the loan repayment happens in kind)
- Alternative financing mechanism for producers lacking access to formal credit
- Expanding product sales through better yields via improved inputs

#### **Cons**

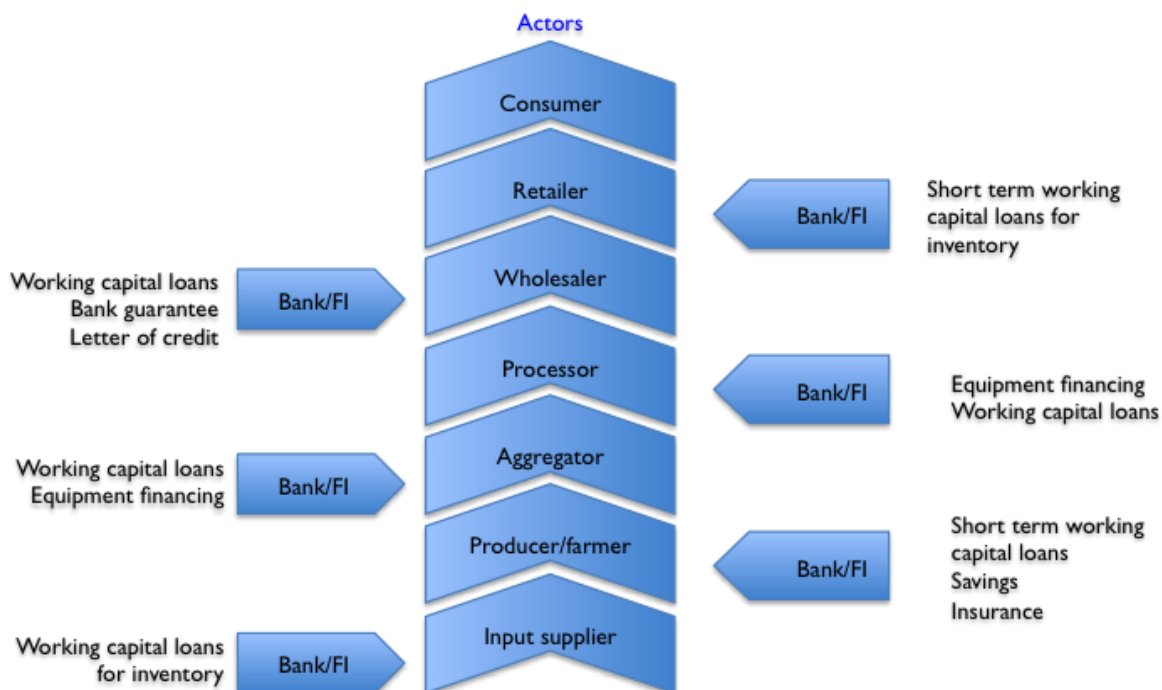
- Producers have obligation to sell the produce as soon as the harvesting is done to repay to the input suppliers. Usually just at the time of harvesting, the prices are low due to high supply levels and thus producers realize lesser value.
- Producers are not extended the benefits of cash discount for purchase of inputs
- Producers run the risk of dependency on the lenders
- No access to long-term loans for investment and equipment financing
- Lack of transparency in the arrangement

### **3. Indirect formal financial services “from outside the chain” value chain finance**

Indirect formal financial services “from outside the chain” is a financing arrangement whereby financial institutions, non-actors in value chain, finance the chain. The financial institutions become supporters of the chain in one-to-one relationships with players in the chain. As different levels in the value chain require varying scales of financial services, the nature /



type of financial institutions involved in the chain also varies with the level of the chain. In such a financing arrangement, as external formal financial institutions are involved in financing the value chain, it is called “outside the chain” finance or formal finance. The indirect finance may take various forms such as loans, savings, insurance and/or remittances. This mechanism usually is a longer-term financing mechanism as compared to direct finance and it generally involves larger amounts of money.



The key benefits of such a mechanism is that the financing is transparent in nature and risks of exploitation are considerably less. However, there are limitations in this mode of finance such as: high transaction costs, lack of information of creditworthiness of different players, lack of flexibility in designing tailor made solutions and inadequacy of formal finance. Indirect value chain finance is a response of formal financial institutions to the limitations of financing within the chain, which offers limited opportunity of capital infusion to allow the chain to grow and expand. Further, as the informal financing is mostly short-term, seasonal, cyclical and focused, the churn of capital is lower as compared to formal finance and hence does not allows the value chain players to fully realize the potential. Lack of long-term loans limit the producers, processors and other actors in the chain to build assets. Thus, formal value chain finance offers the players access to external financing whether from banks or from non-bank financial

institutions to expand and strengthen the chain by freeing up resources. Formal financing may happen at any level or stage of the value chain such as production, aggregation, processing and distribution.

In the Asian context, most of the financing by banks and financial institutions happens at the upstream level of the value chain wherein the financial institutions advance loans to the chain leaders such as processors and wholesalers who in turn bring in liquidity in the chain. However, off late due to government and donor interventions, innovative financing mechanisms have been developed to cater to the needs of the producers as well.

### Pros and cons of outside the chain finance

Pros	Cons
<ul style="list-style-type: none"> <li>• Medium to long term financing for inputs, supplies, investment and equipment financing</li> <li>• Tailor made repayment schedules to suit the needs of producers and other value chain actors</li> <li>• Transparent mechanism as financial institution/bank keep transactions on record</li> <li>• Market-based structure results in less monopolistic or predatory relationships</li> <li>• More efficient due to unbundled services</li> <li>• Access to greater range of services - (including savings, transfers and investment credit)</li> </ul>	<ul style="list-style-type: none"> <li>• High cost of lending to the producers</li> <li>• Time consuming as banks/financial institutions carry out their due-diligence</li> <li>• Requires collateral to stand as security of the loan</li> <li>• Financiers have less access to information about value chain (information asymmetries)</li> <li>• Less ability of financiers to enforce credit contracts (through loan agreements)</li> </ul>

### Financing Instruments for Value Chain

#### Aggregator Credit

Aggregator credit is a direct informal financing mechanism where the aggregator finances the production activity by advancing a loan to the producer that is repaid after harvest, in kind. Under this arrangement, the aggregator secures product procurement by financing the production. This is beneficial to the producers as well as they get readily accessible finance for production and have a guaranteed buyer for the agricultural produce. Usually such a financing mechanism is for a short-term and is seasonal in nature.

## **Input Supplier Credit**

This kind of direct informal financing mechanism rests on the trust equation between the input supplier and the producers. Under this mechanism, input suppliers advance agricultural inputs such as seed, chemicals and equipment to producers and agree to be repaid at harvest or any mutually decided point in time either in kind (agricultural produce) or in cash (generated from the sales of produce). Towards the cost associated with such short-term loans, the input suppliers do not offer cash discounts to the producers on purchase of inputs. The benefits and disadvantages of such an arrangement are similar to the aggregator credit model discussed above.

## **Marketing company credit**

In marketing company credit financing arrangement, a marketing company, processor or other company provides credit in cash or in kind to farmers, aggregators or other value chain enterprises. The mode of repayment is most often in kind. Upstream buyers are able to procure the produce and lock in purchase prices and in exchange, producers and others in the value chain receive access to credit and supplies and secure a market for selling their products.

## **Lead firm financing model**

In lead firm financing arrangement, a lead firm either provides direct finance to value chain enterprises including producers, or guaranteed sales agreements enabling access to finance from third party institutions. Lead firm financing, often in the form of contract farming with a buy-back clause, provides farmers with finance, technical assistance and market access, and ensures quality and timely products to the lead firm.

Lead firm financing model is also known as contract farming. These services differ from aggregator, input supplier and marketing company credit wherein the farmer produces crop or raw material under a buyback agreement and all requirements at the production stage are financed by the lead firm. Apart from inputs and working capital, the lead firm financing extends to other domains of the production cycle such as extension services, high quality crop seeds, technology transfer, training and supervision of production. Lead firm plays a more central role in the production cycle and has a strong grip on production. This is usually done as the lead firm is concerned about the reliable supply of good quality raw material.

## Warehouse Receipts Financing

This is an innovative mechanism of direct informal finance whereby producers or other value chain enterprises in possession of produce, it may safely keep their produce at a certified warehouse. This certificate acts as collateral to access a loan from third party financial institutions. The credit risk mitigate in such a financing arrangement is the marketable produce stored at an independent warehouse where the lender has a charge till the loan is fully repaid.

Warehouse receipts financing is a highly sophisticated financing mechanism as compared to the aggregator credit, input supplier or lead firm financing models as the warehouse where the commodities are stored are neutral, independent and third party entity in the arrangement. The warehouse assure producers and lenders of security, safe storage and reliability of commodity on which the lender places a lien so that it cannot be sold without the proceeds first being used to repay the outstanding loan. Producers are assured of the ownership of the commodity unless they default on the loan and can use the mechanism to sell to buyers offering better prices by transferring the receipt to the buyer, repaying the loans; subsequently the buyer can take delivery of the commodity at the warehouse. Taxes, storage fees, loan principal and interest are deducted before delivery is made by the warehouse. Warehouses are also insured to protect depositors and lenders against losses due to disasters or criminal activity. Warehouses may purchase insurance policies or build up an indemnity fund to cover the cost of such losses.

The benefits of such a mechanism to the producer is the ability to increase both yields and average prices for the produce; access reliable, safe and quality storage thus reducing post-harvest losses (due to spoilage and pest infestation); and sell their produce some time after the harvesting season (during which prices are lower due to abundant supply) and get a higher price. The key disadvantage of such a model is the reliability of warehouse certification.

## Structured finance instruments

Class	Products
Regular finance	Term loans Farmers' finance cards

	Overdraft Credit line Equipment, assets and vehicle finance
Receivables finance	Trade receivables finance Factoring
Physical assets collateralization	Repurchase agreements (Repos) Financial leasing (lease-purchase)
Risk mitigation products	Forward contracts Futures
Financial enhancements	Securitization Credit guarantee

### **Regular finance**

In the Asian context, regular finance is the most widely used mechanism to finance agricultural value chains.

**Term loan:** Most agricultural finance is done using the instrument named as term loan. Term loans for agricultural finance are of short or long term duration wherein the banks and financial institutions allow the borrower to repay regularly or in bullet/balloon payments.

**Farmers' finance cards:** Farmers' finance card is a financial product similar to a credit card to facilitate short term credit access to the farmers/producers from financial institutions. This financial product helps the farmers to finance the input and production cycle needs such as seeds, fertilizers pesticides and also withdraw some cash to meet their production related requirements.

**Overdraft:** An overdraft is a type of account where the accountholder is allowed to withdraw even after his account balance reaches zero. Banks often offer this account to producers to help them in managing their operating expenses. The limit of the overdraft is predefined by the bank.

The borrower is charged interest only on the overdrawn amount. An overdraft account offers a very convenient option for managing liquidity requirements for running a business.

**Credit line:** Credit line is a financial instrument offered by banks, which essentially provides the borrower with an entitlement to avail the required amount of credit at his/her convenience within a predefined credit limit. The borrower pays interest only for the amount actually withdrawn during the time period. This product provides very high flexibility to the borrower in managing his routine operational expenses. Credit lines can be both secured and unsecured depending on the bank's policy and borrower's credit worthiness.

**Equipment, assets and vehicle finance:** Under this instrument a business entity can pledge its balance sheet assets (Equipment, property, receivables, inventory etc.) to avail quick loan from a financial institution. This is a very convenient method for fulfilment of any short term liquidity requirements of a company. The assets work as a security for the lending organization. Further, under similar arrangements, the borrower purchases an asset financed by the bank which the bank owns as a security till the loan is repaid completely.

## **Challenges and Opportunities of Value Chain Financing**

### **Opportunities**

There are multiple benefits which flow from successful value chain financing arrangements. Through its ability to reduce risk and enhance incentives, value chain finance can enable the sustainable delivery of services, for example ensuring that farmers, brokers and wholesalers have continuous access to a line of products they need that are delivered in a timely manner and meet certain specifications. These arrangements can also improve working relationships (e.g., between buyers and suppliers) and facilitate intra-chain information that lowers the actual or perceived risks of lending. A successful arrangement can often provide a demonstration effect which may prompt larger-scale players and formal financial actors to enter into a new market once the investment opportunities are realized.

### **Challenges**

One challenge for value chain finance actors is the provision of longer-term loans for capital investments. Most value chain actors supply short-term working capital to clients that require limited monitoring, collateral or paperwork. As with formal financial institutions, value

chain actors often struggle with weighing the risks and rewards of offering investment loans. Value chain actors who directly provide financing are also faced with challenges of working in a sector they know little about. There may be costs associated with becoming involved in the lending process; they assume risks for repayment if a guaranteed borrower does not fulfill the repayment obligation; and they risk diverting time and resources away from other activities that might provide a greater return and in which they have more skills and experience. Furthermore, value chain finance takes place within a market system and is based on commercial transactions between value chain actors. The viability of many value chain finance mechanisms can be limited by low or unreliable end-market demand for a product, mistrust among actors, and unsupportive regulatory and policy environment. Contract enforcement and side-selling are common issues that undermine many buyer-based finance mechanisms. Additionally, production and price risks can be major deterrents to finance if they are not provisioned for with other risk mechanisms.

# RECENT TRENDS IN SUPPLY CHAIN MANAGEMENT

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Supply chains are main components that ensures the business can provide on-time delivery of products and services, especially with changing consumer demands and supply chain disruptions.

The recent trends in supply chain management (SCM) can give a real update of knowledge in the area of supply chain management. SCM encompasses a broad range of activities and requires more attention. Through the software, managers can optimize supply chains, keep them running as smoothly as possible, and prevent disruptions that affect customer service.

Trends in supply chain management and improvement of the supply chain, with new business models gaining traction (SupplyChain247, 2018). Supply chain technology trends are robotics, IoT, and blockchain, which are all projected to make the supply chain faster and less prone to disruptions (Supply Chain Management Review, 2018).

## ❖ **Green Supply Chains**

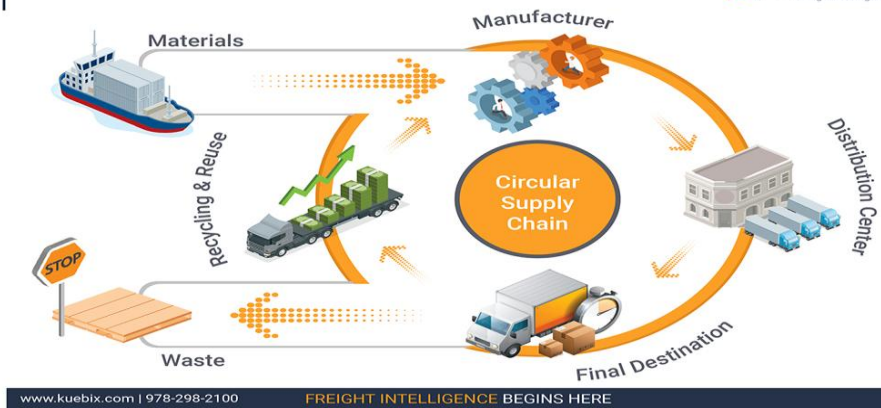
Growing consumers' growing efforts to be more environmentally responsible push the supply chain to become less harmful to the environment. Green logistics is one of the many supply chain trends affecting warehousing. Eco-friendly warehouses, for instance, feature advanced energy management systems that use timers and gauges to monitor the usage of electricity, heat, water, and gas all over facilities (Inbound Logistics, 2018). These systems help prevent excessive waste of resources. With green consumerism on the rise, more companies are expected to implement eco-friendly supply chain processes in the coming years.

## ❖ **Circular Supply Chains are the Future**

To deal with the rising costs of raw materials and their volatile availability, many companies are opting to break down their products and turn them back into their raw material form. Looping the supply chain can help cut down costs, past the initial costs of putting new processes in place. With a circular supply chain, companies can spend less on raw materials and, in turn, enjoy a reduced risk of price volatility. Moreover, a circular supply chain creates less waste, helping companies reduce their overall impact on the environment.



## Understanding the Circular Supply Chain



### ❖ More Supply Chain Integrations

In future even more components being added into the supply chain, as firms look to make partnerships and build integrations with third parties. Partnering up with third-party services can help companies reduce costs while improving customer service.

Integrations are particularly useful for shippers who often use a combination of sea and land transportation for their products. With integrated services, delivery times become shorter, and customer service improves. As a result, more supply chain managers will be partnering up with third-party logistics providers (3PLs) and 3PL-based technologies. These integrations will enable supply chain managers to overcome the limitations of in-house technology solutions.

### ❖ Workforce Globalization and Challenges

A study predicted that 80% of manufacturers will have multi-country operations by 2020 (Capgemini, 2020). Factors such as the need for more knowledge workers influence the demand for workforce globalization. Knowledge workers are those capable of handling complex processes like analytics, procurement processing, and provision of services.

Advanced IT systems, collaboration software, and sophisticated logistics setups make globalization easier for companies.

### ❖ Shorter Product Life cycle

As product lifecycles and clock speeds become shorter, supply chains must evolve to become faster and more efficient. Many companies today use a single supply chain for all products, despite the differences in these products' life cycles. In the future, companies will have to develop different supply chains to accommodate these varying lifecycles and remain profitable.

The shorter product life cycle requires companies to streamline processes to have regular demand for new products.

#### ❖ **Increase of Elastic Logistics**

Supply chains need to be flexible and responsive to market fluctuations as well. As a result, more businesses are adopting a flexible approach to logistics. Elastic logistics allow the supply chain to easily expand or shrink according to current market demands. Technologies such as artificial intelligence allow supply chains to adjust as needed with minimal disruptions (Material Handling & Logistics, 2019).

Elastic logistics provides flexibility to many variables in the supply chain, including sailing schedules, carrier space, container usage, and route optimization. The adjustability helps companies' better handle potential issues such as overstocking and unoptimized space in vessels. As a result, businesses can enjoy greater stability and remain competitive despite market fluctuations.

#### ❖ **Standard Certification Process for SCM**

Professional associations also provide certification programs for aspiring supply chain managers (American Purchasing Society). They focus on specific activities, technologies such as IoT allow for the development and integration of a cohesive system that defines SCM. A standard certification process for SCM will ease the deployment of new systems and services. It will also help fill the current skills gap in the supply chain profession.

#### ❖ **Transparent and Visible in the Supply Chain**

Rising consumer concerns over the impact of modern business on society create a need for companies to be more transparent about supply chain externalities. But more visibility is needed on the impact of the supply chain on other aspects of society. The shifting nature of global trade and its corporate requirements may also result in mandatory corporate disclosures for a variety of supply chain practices.

Disclosing information about these aspects of their supply chain can help companies enhance brand image among consumers and prepare for compliance with regulatory requirements if necessary.

#### ❖ **Block chain tools for handling information**

Block chain technology can help make the entire supply chain more transparent to minimize disruptions and improve customer service. Through block chain, all components of the supply chain can be integrated into a single platform.

Carriers, shipping lines, forwarders, and logistics providers can use the same platform to update companies and customers of the product journey. Invoicing and payments can be made from the same system. This integration streamlines the entire supply chain and helps supply chain managers to identify issues before they occur.

Blockchain also provides unparalleled protection for information, as the technology's decentralization methodology protects data from being edited. All users must agree to updates or edits to the data before they're implemented.

#### ❖ **Adoption of IOT**

Aside from blockchain, more companies are implementing IoT devices to enhance the visibility of their supply chains (Blume Global). IoT technology in warehouses and retail outlets can also improve visibility in production, inventory management, and predictive maintenance.

By increasing visibility across components of the supply chain, IoT devices can also help businesses optimize their assets and ROI. Creating a digital supply network aligned with one's business strategy and with risk management procedures in place will help companies to build resilience to mitigate the impact of disruptive events like the COVID-19 pandemic (Deloitte, 2020).

Many businesses will also leverage the power of IoT by integrating the technology with core business applications such as business intelligence software. These integrations will enable analytics for the information gathered by IoT devices, allowing companies to make data-driven decisions on supply chain strategies.

#### ❖ **Robotic Automation of the Supply Chain**

Robotics currently play a huge role in transforming supply chains and SCM. More firms today are using drones and driverless vehicles to streamline logistics operations. Companies and consumers can expect drones to become fully capable of making deliveries of small goods. Self-driving cars are also likely to be more advanced by 2020, with capabilities to make automated traffic decisions.

In warehouses, autonomous mobile robots will see more use in speeding up menial, labour-intensive tasks. Combined with efficient warehouse management software, robots can drastically improve the supply chain's productivity.

The technology is intended to augment human efforts by speeding up simple, repetitive tasks. By relegating these tasks to machines, human workers can focus on higher-value tasks that have a more direct effect on business growth and customer experience.

#### ❖ **Automation Through AI, AR, and VR**

Artificial intelligence (AI) will also play an essential role in making supply chains more efficient. The technology can be used to automate procedures using algorithms based on data from previous processes. Automation makes supply chains more efficient by eliminating human errors.

Augmented reality (AR) and virtual reality (VR) also pose various possibilities in improving the efficiency of supply chains. For instance, AR devices allow workers to multitask more effectively. Companies can also use these devices to enhance product development efforts by predicting potential product uses in a realistic setting.

#### ❖ **More Agile Supply Chains**

To ensure stability and maintain high service levels, companies must make sure that their supply chains are agile enough to cope with natural disasters and the shifting availability and costs of raw materials.

Supply chain managers can take advantage of supply chain modeling solutions to predict scenarios and identify potential problems. This way, they can plan the best responses to disruptions.

#### ❖ **Optimization of supply chain for efficiency**

The supply chain is changing, and SCM isn't as simple as it used to be. However, advancements in technology give business owners plenty of ways to optimize their supply chains to ensure everything runs as smoothly as possible.

These supply chain trends can also ensure that supply chain disruptions have minimal effect on your business.

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## **ROLE OF INFORMATION TECHNOLOGY IN AGRI SUPPLY CHAIN**

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A supply chain involves all parties in fulfilling a customer request and leading to customer satisfaction, a value chain is a set of interrelated activities a company uses to create a competitive advantage The entire chain is also affected by a range of cross-cutting inputs and processes, including natural and human resources, capital, technology, and policy (Hawkes, 2009). Creating a profitable value chain requires alignment between what the customer wants, i.e., the demand chain, and what is produced via the supply chain (Feller *et al.*, 2006).

Information is essential for making good supply chain decisions because it provides the broad view needed to make optimal decisions. IT provides the tools to gather this information and analyze it to make the best supply chain decisions.

Availability and analysis of information to drive decision making is a key to the success of a supply chain. To support effective supply chain decisions, information must have the following characteristics:

### **1. Information must be accurate.**

Without information that gives a true picture of the state of the supply chain, it is difficult to make good decisions. That is not to say that all information must be 100 percent correct, but rather that the data available paint a picture that is at least directionally correct.

### **2. Information must be accessible in a timely manner.**

Accurate information often exists, but by the time it is available, it is either out of date or it is not in an accessible form. To make good decisions, a manager needs to have up-to-date information that is easily accessible.

### **3. Information must be of the right kind.**

Decision makers need information that they can use. Often companies have large amounts of data that are not helpful in making a decision. Companies must think about what information should be recorded so that valuable resources are not wasted collecting meaningless data while important data go unrecorded.

#### **4. Information must be shared.**

A supply chain can be effective only if all its stakeholders share a common view of the information that they use to make business decisions. Different information with different stakeholders results in misaligned action plans that hurt supply chain performance.

Each of the supply chain drivers facilities, inventory, transportation, sourcing, and pricing requires information for decisions to be made. Information is the factual component on which decisions about each of the other drivers are based. In essence, information is the glue that holds the entire supply chain together and allows it to function, making information the most important supply chain driver.

A company's supply chain processes can be grouped into three main macro processes. CRM includes processes that enable interaction between an enterprise and its customers. ISCM includes processes focused on the internal operations of an enterprise. SRM includes processes that enable interaction between an enterprise and its suppliers. IT enables these processes as well as the integration across these processes. Good IT systems allow not only the collection of data across the supply chain, but also the analysis of decisions that maximize supply chain profitability.

#### ***Customer relationship management (CRM)***

Processes that focus on downstream interactions between the enterprise and its customers.

#### ***Internal supply chain management (ISCM)***

Processes that focus on internal operations within the enterprise. Note that the software industry commonly calls this "supply chain management" (without the word "internal"), even though the focus is entirely within the enterprise. In our definition, supply chain management includes all three macro processes, CRM, ISCM, and SRM.

#### ***Supplier relationship management (SRM)***

Processes that focus on upstream interactions between the enterprise and its suppliers.

Supplier Relationship Management (SRM)	Internal Supply Chain Management (ISCM)	Customer Relationship Management (CRM)
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#### **The macro process and their processes**

Significant improvement in supply chain performance can be achieved if SRM processes are well integrated with appropriate CRM and ISCM processes. For instance, when designing a

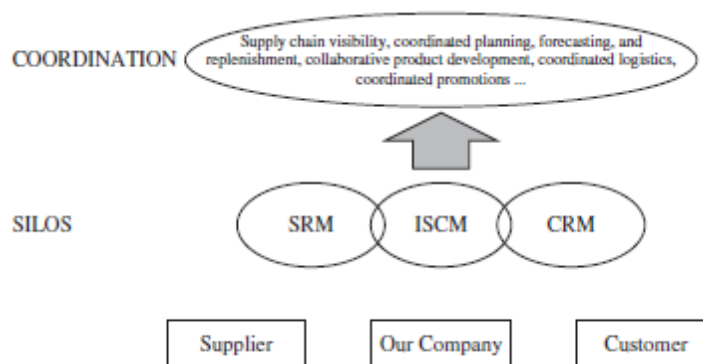
product, incorporating input from customers is a natural way to improve the design. This requires inputs from processes within CRM. Sourcing, negotiating, buying, and collaborating tie primarily into ISCM, as the supplier inputs are needed to produce and execute an optimal plan. However, even these segments need to interface with CRM processes such as order management. Again, the theme of integrating the three macro processes is crucial for improved supply chain performance.

SRM	ISCM	CRM
Design Collaboration	Strategic Planning	Market
Source	Demand Planning	Sell
Negotiate	Supply Planning	Call Center
Buy	Fulfillment	Order Management
Supply Collaboration	Field Service	

The SRM space is highly fragmented in terms of software providers and not as well defined as CRM and ISCM. Among the larger players, SAP and Oracle have SRM functionality in their software. There are many niche players, however, who focus on different aspects of SRM.

### Need of IT in the supply chain

The goal of a successful IT system is ultimately to help coordinate decisions and actions across the supply chain. This can happen only if IT supports the macro processes to coordinate and run as one rather than as disparate silos,



A well organised system of information flow amongst different stakeholders engaged in handling, transportation, storage, processing, packaging, distribution and information processing in the supply chain. The availability of timely information on important processes facilitates decision making on important activities.

The ultimate objective is to achieve consumer satisfaction in terms of timely and adequate availability of goods/services, acceptable quality, suited to consumer convenience and most importantly within affordable price limits. In order to achieve these goals, it is necessary to have a very good coordination between different players in the supply chain to minimise delays, wastages, irregular supplies and ensure quality and efficiency at each level.

1. Networking various players of supply chain through real-time communication linkages inside a supply-chain.
2. Well integrated transport system connected through internet or mobile network for avoiding any information break due to network failure and ensuring dynamic data exchange.
3. Information flow does not depend on a single source of internet/cloud but it is integrated with user centric devices, which results in quality of service and real time information exchange.
4. Decentralised and distributed storage of data with an efficient and secure back up helps in enhancing information base and prevents system failure due to failure of a single server.
5. Continuous and real time updation of logistics information (e.g. data for scheduling, notification) and its access to concerned users improves decision making process.
6. Quick updates are available about any change in ownership or location of food product in the supply chain.
7. Identity of food products is established as per different parameters like commodity, quality standards, batch/lot number, type of packaging, destination/consignee helps in aggregations of the product for providing cost effective logistics services.
8. Digital identity of the food product also helps in tracking its movement across the supply chain.
9. Well secured data networks enhance the trust of various stakeholders on the information supplied by other players in the supply chain thus building trust amongst them.
10. It may happen that the data is stored in different formats due to varying systems/platform/interfaces used by different participants of the supply chain. However, today IT solutions are available for mapping those technically different interfaces to ensure seamless data flow amongst different users of the supply chain.

## **E logistics**

E-logistics, when defined, simply, can be understood as the process of automating/bringing on electronic platform of logistics processes, providing an integrated, end to end solution for movement of a product through the supply chain with an objective of enabling all the participants in the chain to manage their resources pertaining to the product in an efficient way. In agri supply chains, the concept of e-logistics assumes a broader context of information flow among producers, intermediaries, warehouses, firms, transport providers, consumers and other players. Clustering amongst different production units also becomes important in agri logistics considering the prevalence of very small producers widely scattered. Therefore, connectivity in supply chain through e logistics approach will result in better decision making as one will have better information about availability of produce at different places and wider choices as well.



## **Stakeholders on e logistics**

Logistics includes a long range of activities including rendering of services, flow of information, addition of value to products, marketing, order processing, aggregation of stock and many more in an integrated way, ultimately resulting in competitive advantage to a firm and the end consumers.

- E-logistics providers
- Consolidators
- Warehouse operators
- Distribution Centres
- Packaging units
- Last mile delivery operators
- Reverse logistics

## **Process of e logistics**

The integration can be achieved in agri supply chain in the following manner:

**Vertical Integration of producers with the retailers** – The retailers can create electronic links with the primary/secondary processors to directly procure the agri food from them without involving intermediaries. Example – Reliance fresh.

**e-tailing/e shopping** – This is typical Business-to-Consumer (B2C) e-logistics system followed by many companies engaged in online supplies of groceries. In this case the customers place order for supplies of required products in requisite quantities to the concerned supplier electronically, which makes a home delivery of the same.

**Efficient Food Service Response (EFR)** – It is a step further in e Logistics where a supplier agency makes alliance with various partners, makes forward planning to keep required type of agri food in requisite quantity available with them for delivery combined with dynamic e logistics. Different products available with supplying partners (alliance) are identified through technologies like bar coding for a quicker order distribution and consolidation. Such a system improves efficiency of the supply chain by meeting consumer demands of a wide range by delivering the same in the agreed time frame. Common example is online e-commerce companies like Amazon, Flip cart, Big Basket etc.

**Contracting** – It is resorted to coordinate between the food production units logistics providers and the customers to ensure continuous supplies on a long term with all the feedback to the customer about the product safety details, progress of production and delivery details and other logistics records. This is achieved through e-logistics solutions, i.e. integrated data storage, data management and retrieval systems by electronically connecting all the partners. This system greatly helps in reducing various risks viz. financial, product quality/quantity/price, reducing

transaction costs and also creating a system which is capable of meeting fluctuating demands of the customers.

### **Process framework of e logistics**

Typical process of e logistics in a business enterprise involves three key steps namely

- Request for Quotes (RFQ),
- Shipping, and
- Tracking.

The information flow on various transactions is synchronised in such a way that all the players are connected through a digital platform/web service for a dynamic exchange of product movement details across the supply chain. This enables the various players in delivering the indented goods of right quality, right quantity to the end customer within agreed time frame.

The business manager of the enterprise notifies its core products and services in the form of a RFQ to the prospective customers through an e-Commerce server using web service. On receipt of confirmation for desired supplies and other terms from the customer, the purchase order (PO) is generated with an identifier linked to it. Based on the PO details the products details are linked to it to arranged for its shipping or transport. Transport details get updated in the PO and a tracking code is generated which helps the customer and other intermediaries in monitoring the product movement status till the supplies are received by the end customer.

### **Important IT tools in agri supply chain**

#### **Big data analytics**

Big data analytics stands for analysis of large volumes of structured transaction data, plus other forms of semi structured and unstructured data that are generally not covered in the conventional business intelligence and analytics programs. In logistics context such data includes traditional enterprise data from operational systems, traffic & weather data from sensors, monitors/forecast systems, vehicle diagnostics, driving patterns/ location information, financial business forecasts, advertising response data, website browsing pattern data, social media data web server logs, text from customer emails/ survey responses, mobile phone records etc. Big data analytics in logistics provide useful information can be used to optimize routing, to streamline processing, packaging and warehousing functions and to bring in transparency to the entire supply chain. It not only provides a competitive advantage to the logistics provider but benefits all the players of the supply as well.

#### **Sensor based intelligent technology**

While moving sensitive products which require prescribed environmental conditions to retain their quality all through the supply chain apart from monitoring the likely deterioration during the logistics process. To achieve this variety of sensors (e.g. temperature/moisture loggers, pH sensors) are used in the agri-food logistics sector. These sensors are placed on the

goods/packages in such a manner that not only the logistics provider but a customer can also track the condition of the products while on transit. The use of sensors has now become a standard for any company that ships highly perishable goods.

### **Internet of Things (IoT)**

As discussed above, sensor based technologies are available to monitor the condition of goods during transit. However maintaining the ideal conditions becomes a big challenge in the case of multimodal transport situations. To manage these situations Internet of Things tools are applied which use technologies like networked Radio Frequency Identification Device (RFID), wireless sensor networks and near-field communication tools in an integrated manner to provide relevant communication to different players. IoT also enables constant monitoring of the product status and identification of exception based logistics information or deviations from expected conditions from a supply chain perspective.

### **Telematics Systems**

Telematics is derived from two words, telecommunication and informatics. It is defined as the technology which uses telecommunications networks to provide information to and from distant assets. In the context of logistics it relates to the tracking, monitoring and connectivity of vehicles. Integration with GPS and On board diagnostics (OBD) helps in tracking location, speed and internal behaviour of the vehicles. In logistics the telematics systems provide an effective solution for fleet management in terms of monitoring the condition of goods in transit and location, movement and status of vehicles.

Variety of sensors integrated with terminals or mobile devices help in monitoring ambient parameters (e.g. temperature, light, ethylene concentration, etc.). This technology facilitates well organised warehousing of products and efficient logistics to correctly deliver goods. Common telematics applications are vehicle tracking, trailer tracking (Cold-chain freight), and insurance based on driving behaviour and fleet management. As compared to telematics, Internet of Things is a broader platform which provides real time computation based on communication between the various devices and other aggregated systems through an intermediary and by using data analytics. In bigger IoT logistics set up telematics appears to be a part of IoT.

### **Tracking and Tracing tools**

Tracking and tracing tools enable logistics provider to determine the physical position of goods in the supply chain. Important examples of these tools are Radio Frequency Identification Devices (RFID) tags, Global Positioning System (GPS) tracking devices and barcodes. In case

of RFID the tags attached to products are scanned during every movement to keep a track of their location. GPS tracking devices provide more accurate location details but are expensive. The uses of barcodes is comparatively cheaper and simpler but have limitations in providing more details of the location of the goods. Depending on the nature and value of goods as well as type of movements these tools are used alone or in combination.

### **GPS in Agri supply chain**

Global Positioning System or the GPS, on the other hand, is a satellite based radio navigation system which helps in determining the exact location, velocity, and time of movement of goods round the clock in all weather conditions all over the globe. GPS data can be accessed, with equal efficiency, from location be it land, sea or air. It can be accessed across various information technology platforms through any of the devices like a desk top, laptop, tablet or mobile phone.

- Navigation
- Vehicle tracking
- Goods distribution route planning

### **A case study on Bigbasket**

**Bigbasket** - One of the biggest online grocery supermarkets in the Indian nation, BigBasket was established in **2011**, has its primary headquarters in Bengaluru and delivers to many cities in the Indian nation.

Bigbasket gives its users the liberty of placing their order at any time and getting the order delivered at the time they find suitable. The e-grocer offers groceries and food supplies in a number of categories which include fruits & vegetables, food grains, oil, masalas, bakery items, beverages, branded foods, personal care products, household supplies, eggs, meat, fish, etc. Currently, it possesses a highly diverse collection comprising over **20,000 products** across a variety of categories and also features over 1000 brands in its catalog. The startup emerges with a guarantee of the lowest rates and swift delivery services.

#### **Technologies leveraged at Big basket**

Bigbasket is making use of **Artificial Intelligence, Machine Learning, and analytics** to simplify logistics and boost customer experience.

***“We are an e-commerce business where data is the new driving fuel. We leverage data-driven capabilities from several channels. Data is collected from transactions, customer preference, shopping behavior, etc to build a variety of algorithms (statistical algorithm, Deep Learning algorithm, and ML algorithm). All these algorithms are used for different use cases,” - Subramanian M S, Head of Analytics, Bigbasket.***

#### **How Big Basket uses Analytics**

A couple of the analytics tools that Bigbasket leverages are [Tableau](#) which is leveraged for converting complex data to simplified versions and Power BI which is leveraged for interpreting data as well as for sharing insights on it.



### **1. Extracting essential information from the unstructured data**

The Bigbasket team has to deal with a huge section of data that is largely unstructured. This data is obtained from studying the customer's online behaviors and interpreting their transaction records. Hence customer analytics helps the company to comprehend the correlation between delivery matrix and customer loyalty.

### **2. Enabling personalization through analytics**

The analytics team aims at enhancing and personalizing customer experience by facilitating them with all kinds of solutions. It also helps in detecting customers as well as boosting engagements such as communications as well as offers. The analytics aids in studying [customer behavior](#) so that the company can design its personalization according to it.

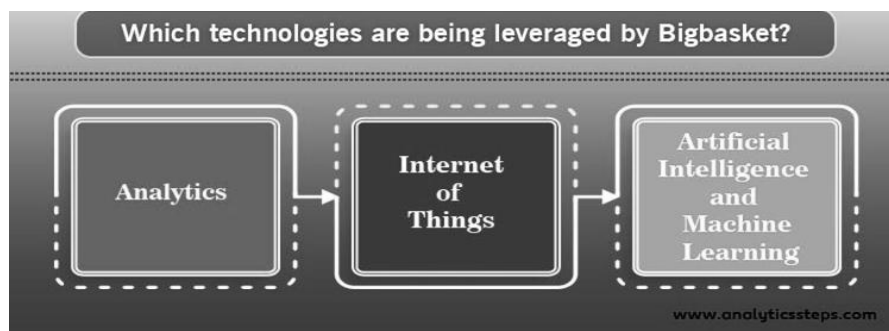
### **3. Reducing inventory from the flux through predictive analytics**

[Predictive analytics](#) helps to make sure that the firm is neither out of stock nor overstocked. This approach implies forecasting the demand, that will aid the supply chain team in their planning abilities such as the drivers, vans, CEEs, and equipment that are employed for various facilities. It also aids in examining the array of orders and volumes so that the team of the supply chain can strategize accordingly.

### **How Bigbasket uses IoT**

Bigbasket also employs applications that are powered by [IoT](#) ensuring the quality as well as the freshness of products like **fruits, vegetables, or other grocery items**. While delivering fresh items from the warehouse to the doorsteps of the customer various issues need to be conquered which include managing the right temperature of the product or dividing hot, frozen, or cold items.

The IoT application aids in interpreting the information about the item to ensure that it is packed in the correct container and to help in balancing the varying temperatures of each individual item throughout the journey, from the [warehouse](#) to the final delivery place.



Artificial Intelligence and Machine Learning are yet another technology that Bigbasket has adopted. The firm has invested in [Artificial Intelligence](#) and [Deep Learning](#) for coming up with smart kiosks which are also termed as "**BB instant**". These kiosks are basically smart machines connected via an app. The customer visits the machine and places their order via the app. The customer can then walk away

immediately with the cart items, while the billing is automated from a cashless domain, in which the customer receives the bill through the app with multiple options for payment available.

The AI system is powered with in-built techniques for recognition, that detect the purchased products by employing image scanning principles through advanced deep learning solutions. The system interprets and gives the right product to the customer and also handles the procedure of availability as well as billing. When it comes to [Machine Learning](#), Bigbasket relies on it as well as on analytics for guaranteeing prompt delivery. The delivery process is now initiated by detecting the common routes and status of vehicles in order to pack multiple order sets.

In order to initiate a flawless, prompt delivery, the team gains insights regarding the best route, the number of vehicles required on a particular route, and the present traffic situations from a variety of data sources. Through informative data channels, the Machine Learning driven model interprets real-time scenarios as well as the requirements of customers. The model aids in handling multi-level track of pickers, reverse pickers, scheduled deliveries, etc.

[Hyper-personalization](#) is another approach that aids in tracing the purchasing pattern. It offers the capacity to facilitate management right at the individual level. The company's well-known Smart basket feature employs Artificial Intelligence and algorithms to comprehend the customer's preference towards buying certain items, which in turn enhances the overall purchasing experience of the customer.

Although Technology is being used for tracking orders, updating delivery details, managing inventory batches, and maintaining the website and its apps, yet as of now it does not find much paramount adoption when it comes to its distribution centers.