

User Scenario: Supply Chain

Part II: User Scenarios

Overview

[Return to Top](#)

A [Supply Chain](#) covers the entire system of producing and delivering a product or service, from the initial sourcing of raw materials to the final delivery to end consumers. In other words, the supply chain defines the entire production process, including all the adjunct activities involved at each step of the supply chain. It includes the information flow, natural resources transformed into useful materials, human resources, and any other components (i.e., packing materials, shipping containers, energy consumption) that are perceived as part of the final finished product or service.¹⁾

A very important part of understanding is to conduct an external analysis of the Supply Chain, including documenting all the steps in the Supply chain, the flow of products, goods and services into the step and the processing accomplished in the step. The Supply Chain and the external analysis of the supply chain are essential for strategic planning for any participant in the Supply Chain.

Each step in a supply chain can a separate industry (i.e., producers of raw materials, transport companies, warehousing, and retail). In large corporations such as Walmart, the “separate industries” may actually be part of the same corporation. Although related, the Supply Chain and the [Value Chain](#) are different. For example, the Supply Chain might consider all the steps from raw material to final product while the Value Chain only covers the portion of the Supply Chain that a corporation has control over and/or what steps it feels it can add value to the final product.

In other words, the 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.²⁾ Within the Supply chain, there is often a many-to-many relationship between parties along the chain. In other words, one producer may service multiple distribution centers, one Distribution center may service multiple grocery store chains.

The following are some of the restrictions or benefits apply to Supply Chains in General³⁾⁴⁾:

- Identification and Listings of Hazardous Waste⁵⁾
- Restriction of Hazardous Substances⁶⁾
- Registration, Evaluation, Authorization and Restriction of Chemicals⁷⁾⁸⁾
- Conflict minerals as defined under the Dodd-Frank Act⁹⁾
- Waste from Electrical and Electronic Equipment¹⁰⁾
- Traceability of pharmaceuticals and medical equipment¹¹⁾
- Electronic Records and Electronic Signatures¹²⁾
- Protection of Workers, peonage, slavery and Trafficking in Persons¹³⁾¹⁴⁾
- [USDA Specialty Crop Block Grant Program \(SCBGP\)](#)

- [General Data Protection Regulation \(GDPR\)](#)
- [Data Protection Act 2018](#)
- [California Consumer Privacy Act \(CCPA\)](#)
- **Note:** Obviously, depending on the industries associated with the Supply Chain, there will be industry specific regulations that apply (e.g., [Health Insurance Portability and Accountability Act \(HIPAA\)](#)).

Problem Statement

[Return to Top](#)

Sal is an organic strawberry farmer with fields in Mexico, USA and Canada. He supplies fresh strawberries to consumers in all three countries. The strawberries are eaten “as-is” or they can be combined into other products such as desserts, yogurts, ice cream, or even freeze dried and added to breakfast cereals. Although Sal can control many aspects of strawberry production from field site location, seed selection and irrigation; he does not own the [Supply Chain](#) and is only the very the starting point of a long and complicated chain that includes farm workers, shuttle vehicles and drivers, warehouse workers, packaging companies, cold storage facilities, produce brokers, trucking companies, Health and Safety and Quality Inspectors, large fruit processing and distribution centers, delivery vehicles, retail outlets, consumer discretionary providers (i.e., restaurants, etc) and ultimately the end consumer.

Sal also wants provide the highest quality strawberries in terms of health and safety, taste and appearance to his customers. Therefore, he would like his products on a supply chain that understands the requirements of fresh fruits and vegetables, especially strawberries. He wants a Supply Chain that follows the recommendations of the [California Strawberry Commission Best Handling Practices for Fresh Strawberries](#)¹⁵⁾. For example:

Maintaining strawberry temperature as close as possible to the optimum temperature range of 32°F to 34°F will maximize strawberry quality and shelf life in several ways including:

- *Slowing the growth of plant pathogens (Botrytis; Rhizopus, etc.)*
- *Reducing the respiration rate*
- *Minimizing water loss*

Additionally, Supply Chain needs to support many-to-many relationships. For example, Sal may provide strawberries to multiple packaging companies. Also, the distribution center may supply multiple retail outlets (i.e., different restaurants, grocery stores and fruit stands).

Existing Simplified System without DIDO

[Return to Top](#)

The following is an extremely simplified system that is meant to provide an overarching framework for

using DDOs to solve [Supply Chain](#) problems. It is not meant to be completely accurate but is provided for illustrative purposes. Others are encouraged to use this as a starting point for more complicated reality based scenarios.

Activities

[Return to Top](#)

The following is only a simplified list of the steps involved in providing Sal's strawberries from field to table. Its a long supply chain with each step adding risk the quality of the strawberries and/ or the safety of the strawberries.

1. The strawberries are grown in a field. Only some of the risks are controllable. For example, feral swine can run through the field¹⁶⁾
2. The strawberries are placed in reused field baskets / boxes
3. The boxes are moved from the field to a small truck where they are hauled to a central packing house for cleaning, grading, and packaging.
4. The packaged strawberries are then backed in larger boxes and placed on a pallet
5. The palletized strawberries are moved to cold storage
6. The strawberries are sold/purchased by wholesalers
7. The strawberries are loaded on to refrigerated trucks for distribution to owners cold storage facility
8. The Strawberries are inspected for quality
9. The strawberries are placed in a Cold Storage warehouse with other products owned by the wholesaler
10. The strawberries are loaded onto trucks bound for the retail outlets (i.e., grocery stores, fruit stands, restaurant, etc.
11. The Consumer selects the Strawberries and places them in a cart or basket and goes to checkout
12. The Consumers purchases are put in bags and placed into a car to be taken home
13. The strawberries are placed into the consumer's refrigerator along with other new purchases and with products already in the refrigerator
14. The strawberries are consumed, usually as raw fruit at the table or as snacks

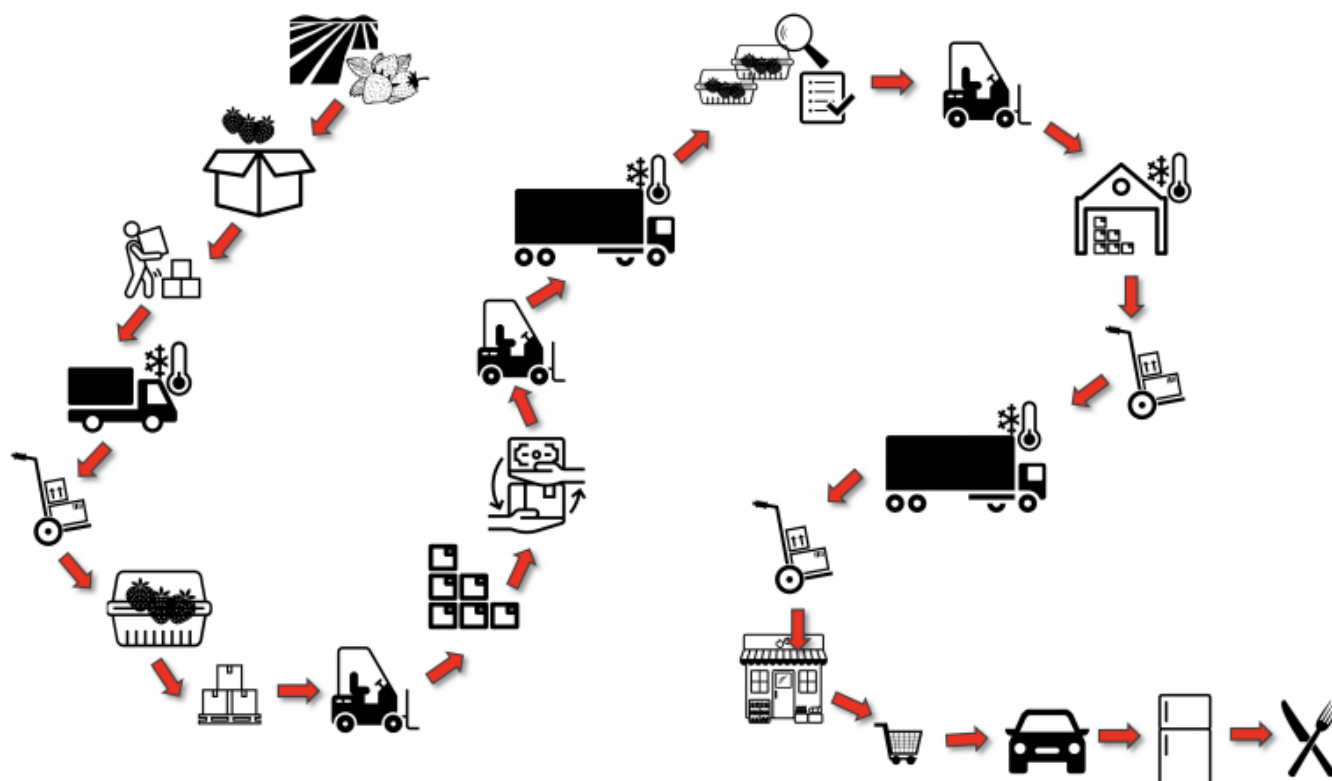


Figure 1: A simple, idealized traditional Supply Chain - Field to table for Strawberries

When record keeping gets added to the Supply Chain, the complexity can be overwhelming. Fortunately, from a supply chain perspective, most of the time the records end up being superfluous, but when there are problems with food safety the records are essential in tracking down the cause of the problem. In agriculture, as you move towards the source of the Supply Chain, many of the records are non-digital.

*Most farms collect data in some form. Much of this may be in personal notebooks and mandatory compliance forms. Precision farming equipment, machinery, and mobile and desktop apps also collect agricultural data.*¹⁷⁾

In addition to the Health and Safety aspects of record keeping in the Supply Chain there are other important uses for the data. For example, improvements in efficiency that effect time to market, quality of the products delivered, or reducing wastage.

- **Note:** The data logging and storage of data in the diagram is intended only for discussion purposes of the Supply Chain and not a specific implementation. This is particularly true when portions of the Supply Chain become Value Chains.

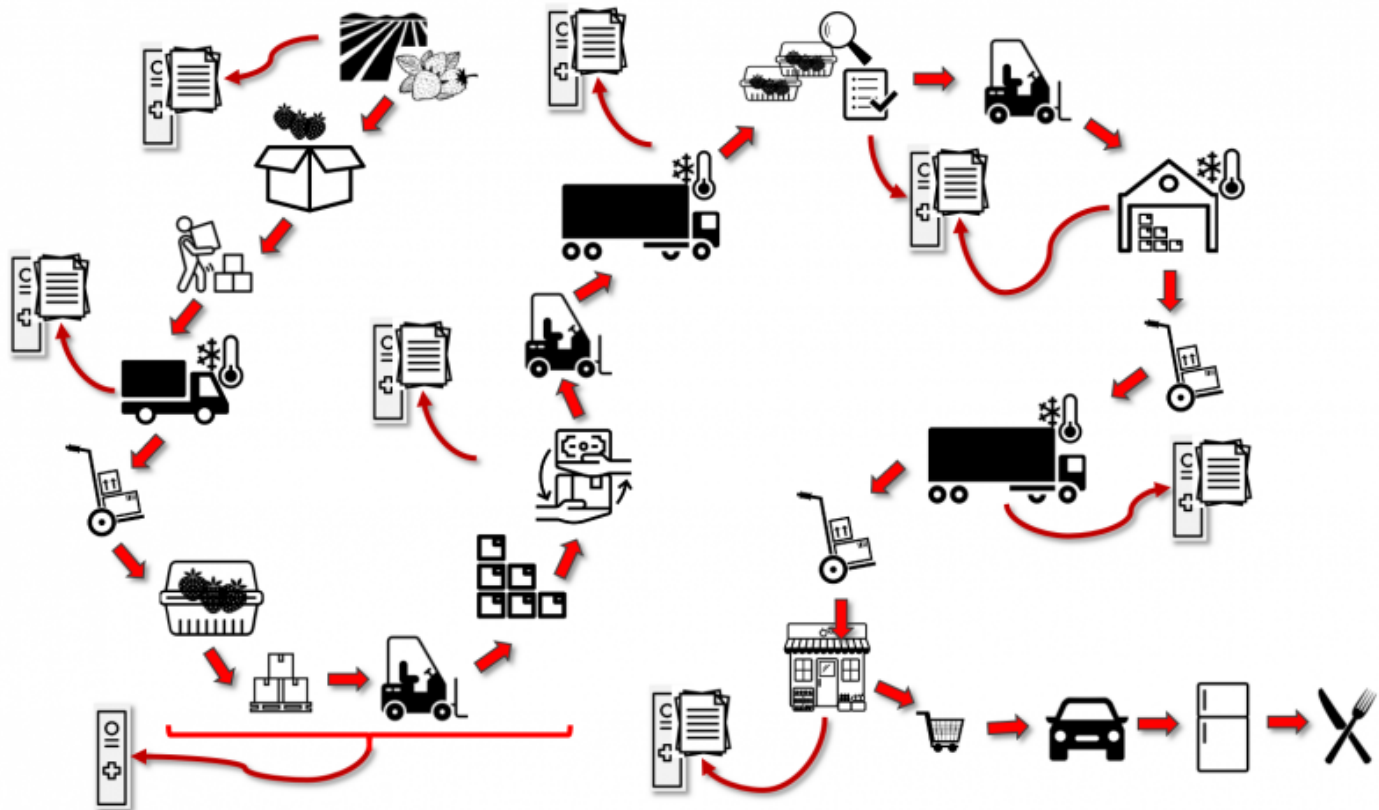


Figure 2: A simple, idealized traditional Supply Chain with record keeping

Issues

[Return to Top](#)

Although this scenario is about strawberries which may not be considered as a critical food resource, it does represent many agricultural issues for commodities such as grain, meat or dairy. It can also be reflective of non-

1. Supply chain records are spread across many individuals and companies covering wide geographic areas crossing numerous international borders covered by international law, trade unions and treaties.
2. Pedigree and Provenance have different levels of granularity. For example, wanting to know the source of food may be
 1. strictly geopolitical (i.e., embargoes),
 2. it may religious (i.e., Halal and Kosher)
 3. it may be medical (i.e., nut allergies)
3. The breadth and depth of the supply chain may vary according to product classifications. For example, Organic can reach back to before the product is harvested and cover the source of the seeds, the number of years the fields has had no pesticides or inorganic fertilizers added to it. Another example would be Genetically Modified Organisms (GMO) might even extend to neighboring fields because the Non-GMO products might be inadvertently pollinated by crops in neighboring fields
4. This scenario does not cover ancillary information such as insurance, bonding, customs, import/export regulations or signed receipts for products

5. This scenario does not cover the data sharing aspects of the Supply Chain. In Value Chain there is often a single company with single key responsibility for the data (i.e., Walmart or Amazon)
6. This scenario represents most of the components within the Supply Chain as a federation, and consequently there can be problems with inconsistent:
 1. Security enforcement
 2. Automated signatures
 3. Data Models or versions of models (e.g., version 1.0 of definition of a field versus version 2.0)
 4. Supply Chain nomenclature (what is a field, truck, crate, warehouse, etc.)
 5. Domain specific nomenclature (what is a strawberry, box of strawberries, flat of strawberries, organic, non-GMO, etc).
7. This scenario has a lot of “parts” and flows. Each part and each flow introduce risk to the success of the Supply Chain
8. Any centralized or even decentralized data stores also represent a risk to the data from hacking, breaches or to ransomware

Theoretical Simplified System Using DIDO

[Return to Top](#)

Activities

[Return to Top](#)

The following activities are based on the assumption that a Supply Chain system is implemented using a DIDO. The other assumption is that the Supply Chain records belong to the participant in the Supply Chain and not an outside Value Chain participant. Although each participant, controls and is ultimately responsible for their records, it does not mean that the information can't be federated to all the participants in the Supply Chain.

It is only a simplified list of the steps involved in providing fresh, high quality strawberries from the field to the table so to speak.

1. Sal joins a Fresh Fruit Supply Chain Cooperative DIDO
2. Sal records information about the field to the DIDO (i.e., location, soil type, crop history, etc
3. Sal records current growing season materials and supplies (i.e., kind of crop, seed source, fertilizers, water source, etc.).
4. Sal records current growing season activities (i.e., plowing time, plating time, cultivating time, watering details such as time of watering, duration, liters applied, source of water, etc) and harvesting.
5. Sal records the pickers, the amount of time they work and the Kilograms they picked.
6. Sal hires a trucking service to take the produce from the fields and the processing and packaging center and receives a receipt for his produce
7. The Processing Center washes, grades and packages the strawberries, packages the strawberries into packages, boxes the packages into boxes, inventories the boxes and stores

- them into cold storage
8. The Processing Center sells the strawberries to a Distribution Center
 9. The Processing Center loads the strawberries onto to a refrigerated truck for cartage to the Distribution Center
 10. The Distribution Center unloads the trucks and stores the strawberries into a cold storage facility.
 11. The Distribution Center receives orders for Fruit from retailers
 12. The Distribution Center fulfills the order from fruit (including the strawberries) and places all the fruit onto a pallet
 13. The Distribution Center places the pallets into a delivery vehicle and delivers them to the retail outlet
 14. The Retail outlet can be:
 1. A Store or Fruit Stand
 2. A restaurant
 3. A food processing plant (i.e., an Ice cream manufacturer
 15. The consumer obtains the strawberries or a product with strawberries in it

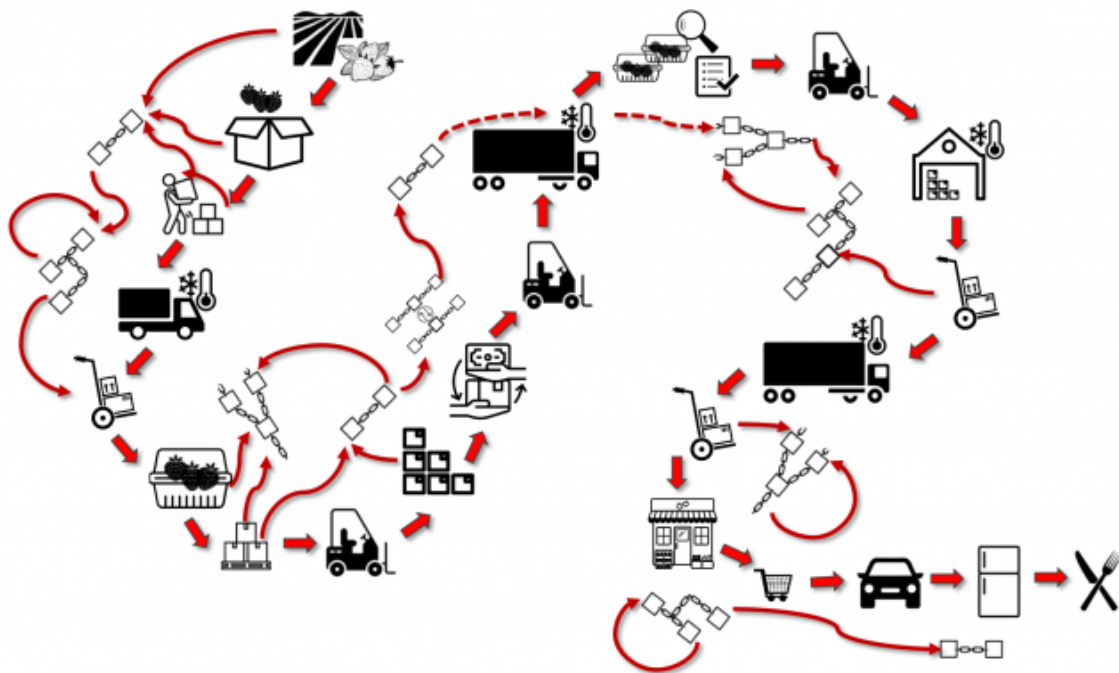


Figure 3: A simple, idealized theoretical record flow for a Strawberry Supply Chain.

Issues

[Return to Top](#)

- [issue_03](#)
- [issue_02](#)

1. **Retail Outlet Provider** - A Retail Outlet Provider person or establishment that sells the produce directly to the Human Consumers. Some examples are grocery stores, fruit stands, convenient stores, kiosks, etc.
2. **Discretionary Providers** - A Discretionary Providers are places where the products are sold as part of something else to the Human Consumers. Some examples are

restaurants, ice-cream stores, etc.

3. **Human Consumer** - The Human Consumers are the people that actually buy the products and consume them.
 4. **Processing Consumer** - The Processing Consumers are people or establishments that buy the products and further process them into other products such as ice-cream products, jams, jellies, or candies.
1. needs to identify a Community of Interest (Col) that cov
 2. He joins an agriculture Community of Interest (Col) with a membership that reflect the problems that are unique to the community (i.e., the Domain). The Col selects a DIDO platform to use and work to have Domain specific Smart Contracts developed to address the COL's needs. For example, the COL define Smart Contracts describing Fruit Lot, a Field or Plot that have properties for Organic, GMO, etc. They also create Smart Contracts that represent the Owner and the Operator of the Field or the Plot. In addition, they describe Smart Contracts that represents farming actives (i.e, plowing, plant variety, "feeding", watering and harvesting, etc.) for the field or plot. Associated with the activity are a group of individuals that conducted the activity as well as a list of materials used during the activity.
 3. After the harvest, Sal is ready to send the produce to market. He hires outside firm to load and drive the produce to market. Sal clones an anonymized subset of his blockchain to the delivery person as a side-chain or as a stream of the main DIDO. he driver accepts the Side-chain and adds the appropriate information about the people who loaded the truck and the specifics about the truck. The Truck has its own side-chain that is added to to the side chain provided by Sal. It includes specifics about the truck driver and the truck (i.e., what was its last few loads, when was the truck cleaned last). While in transit, the refrigerated deliver truck keeps track of environment conditions within the truck (e.g., temperature, humidity) and the total transportation time.

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