Report on Logistics Network modeling

What Is Logistics Network Modeling

A logistics network is the system a business uses to move goods from their raw state through production and to customers. To create the most efficient and effective logistics networks, businesses must use logistics network modeling.

These simulations measure, evaluate, and optimize the logistics network a business uses.

Learn about the different types of logistics network modeling.

**What Do You Want Your Supply Chain to Deliver?**

* Higher profitability
* Enhanced customer value
* More flexibility and agility
* Greater resilience
* Improved sustainability

What Is Logistics Network Modeling?

Logistics is the movement of goods, and a logistics network is the sequence of systems and operations that work together to design, produce, and bring a product to market. This extends from the extraction or creation of raw materials all the way to the point when the product is delivered to stores or directly to [consumers](https://www.thebalancesmb.com/manufacturers-selling-directly-to-consumers-3975412).

Companies must create new logistics networks every time they launch new products, create a new business model, or enter a new market. When a company is designing its new logistics network, it will take into account all the location elements such as:

* Labor pool
* Distribution and shipping channels
* Government incentives
* Customs requirements
* Security requirements
* Supplier and customer locations

Analyzing these elements allows companies to create models of how the logistics network will function. This provides insight into the outcome of different choices within the network and the likely impact these choices will have on the [supply chain](https://www.thebalancesmb.com/logistics-4161402) and business performance.

How Does Logistics Network Modeling Work?

Models are simulations that a company (or the modeling company they hire) can run to determine how a logistics network will perform. Models allow companies to look at and compare possible outcomes for:

* Network function
* Costs
* Customer service [efficiency](https://www.thebalancesmb.com/how-do-i-measure-on-time-delivery-2221412)

This allows companies to make cost-efficient and productive decisions about their logistics network before going to the expense of implementing it.

Businesses can look at various modeling techniques and decide which one offers them the best insight into their network options. Many will choose to run more than one type of model in order to determine the outcome that provides the best customer service for the lowest cost and the highest profit.

Types of Logistics Network Modeling

There are a number of modeling techniques that can be used, each with its own benefits and pitfalls.

**Optimization Modeling**

Optimization models are based on a mathematical formula intended to determine the procedures that offer the best or optimum solution based on that formula.

This means that there is no subjective input to the model, only assumptions and data. The optimization model looks at data such as the:

* Level of customer service to be obtained
* Number and location of distribution centers
* Number of manufacturing plants
* Distribution centers assigned to a [manufacturing](https://www.thebalancesmb.com/manufacturing-process-2221376) plant
* Inventories that must be maintained

One optimization model that has been used for logistics networks is linear programming, sometimes referred to as LP. This is particularly useful for linking supply and demand limitations of manufacturing plants, distribution centers, and market areas.

Given the goal of minimizing costs, linear programming can define the optimum facility distribution pattern, based on the constraints identified. However, as this uses mathematical formulas, there is no allowance for any subjective input.

**Problem definition and modeling**

Consider a supply chain network, G= (N,A), where N is the set of nodes and A is the set of arcs. Here, N is composed by the set of suppliers, S, facilities, F, and customers, C, i.e., N=S∪F∪C. When given demand forecasting, we not only aim to choose the potential suppliers from the suppliers set and decide which facility to open and finally consider how to distribute the product but also consider the CO2 emission in each process of the whole network. Let us define: Parameters P the set of products di p the demand of customer for product si p the supply of supplier for product cij p transportation cost for product from facility to facility fj setup cost for facility j uj the handling capacity in facility j rj p capacities consumed by handling a unit of product in facility j ℓp j handling cost of product p in facility j Decision variables yj = 1; if facility j is open; 0; if otherwise: xij p the flow of product p from node i to node j zjz the environment protection level in facility j In our paper, a “product” can either represent a specific product or a product category; for simplicity, we assume that suppliers and facilities do not need to consider tariff and directly use the transportation cost and each product do not consider the bill of material. For convenience to express, we only consider CO2 emission as the only environmental influence which is a very popular environment index and can be measured easily. Besides, note that we introduce a new type of decision variable, zj, that has not been considered in classical supply chain network design literature. This variable is associated with facility j and represents the “level” of environmental protection. More specifically, higher value of zj corresponds to a heavier environmental investment but leads to a lower CO2 emission. We define a monotonic increasing function gj(zj) to denote the environmental investment in facility j. The environmental investment can be used to purchase equipment or technology for environmental protection. A higher gj(zj) means that a more sophisticated equipment or technology is installed. Consequently, in long-term, the CO2 emission in facility j for handling product p, denoted by wj p (zj), should be lower. In this paper, we assume that zj is a discrete number and that zj ∈{0,1,2,...,L}.

**Simulation Models**

A simulation model is based on the real world. When the model has been created, you can perform experiments on the model to see how changes made to the model can affect the overall cost of the logistics network.

For example, by changing the constraints on the network, it is possible using a simulation model to see how this affects the cost-effectiveness of the overall network.

For a simulation model to be effective, you need to collect significant amounts of data on variables such as:

* Transportation
* [Warehousing](https://www.thebalancesmb.com/measures-of-warehouse-productivity-2221323)
* Labor costs
* Material handling
* Inventory levels

This allows you to make changes to the constraints and have a model that accurately reflects the changes.

A simulation model is not designed to produce the optimum logistics network, as produced by the optimization model. Instead, it evaluates the changes that were made to the model.

This type of model is useful when companies have made general decisions on the network and want to see what the overall effect of any changes will be.

**Heuristic Model**

Similar to simulation models, heuristic models do not generate an optimum solution for a logistics network.

A heuristic model is used to reduce a large problem to a more manageable size. It does not guarantee a solution, and a number of heuristic models may contradict each other or offer different answers to the same question.

This is not a problem with the models; these different answers can still provide valuable information and be useful to the overall creation of an efficient logistics network.

Heuristic models are often referred to as a "rule of thumb" which can be useful in creating a [logistics](https://www.thebalancesmb.com/creating-a-logistics-strategy-supply-chain-management-2221277) network.

For example, a heuristic model could be used to consider the best site for a distribution center that is at least ten miles from the market area, fifty miles from a major airport, and more than three hundred miles from the next closest distribution center.

A heuristic model will look at all areas that fit the defined parameters and find the most suitable areas.