LIUC

Supply chain design and production systems

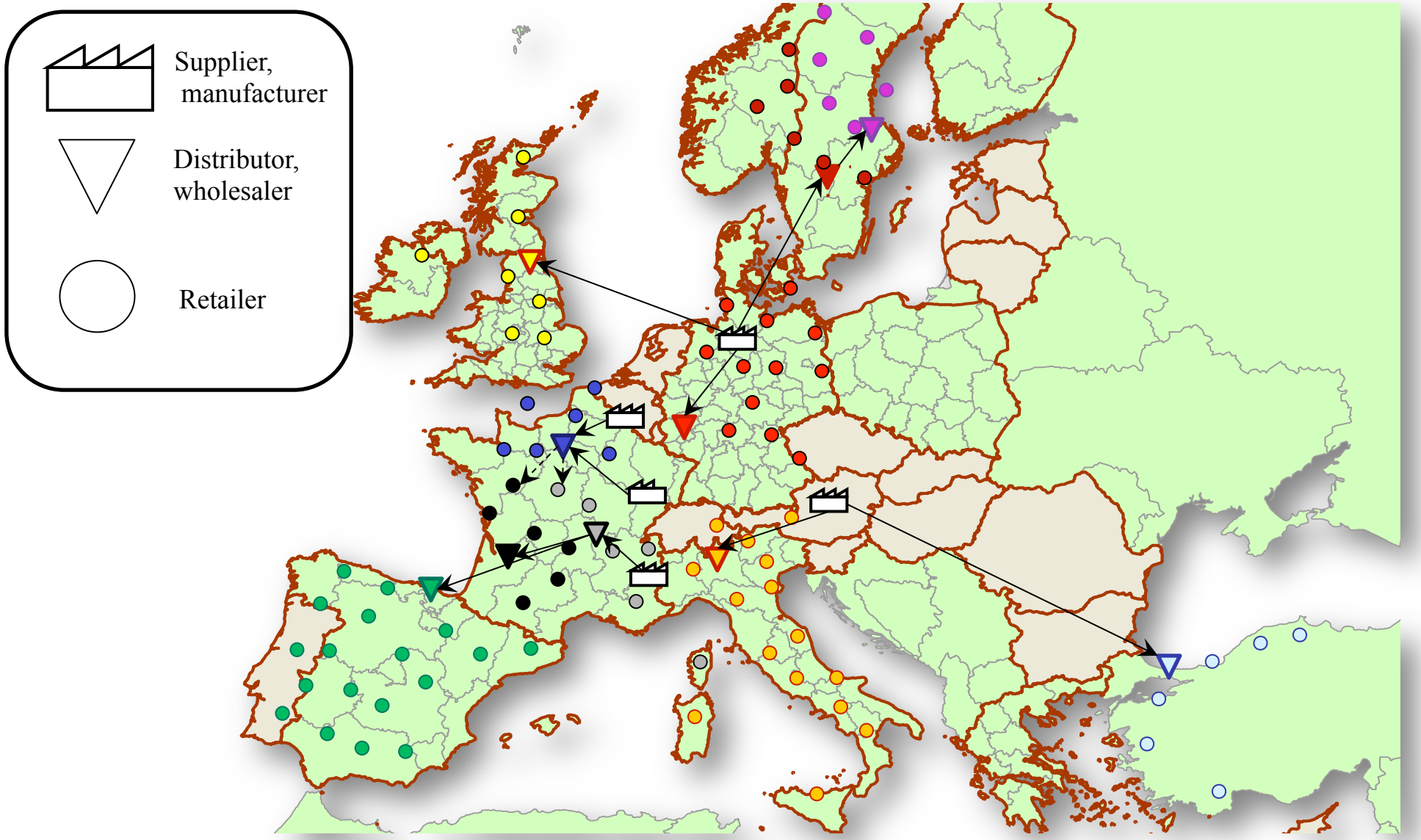
Lesson 2: supply chain design

Luigi Battezzati PhD

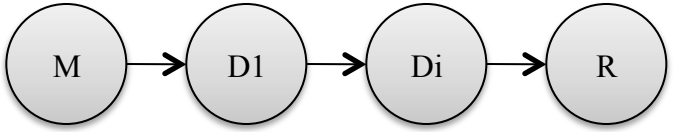
Agenda

- Supply chain design
- Network design
- Production plant localization

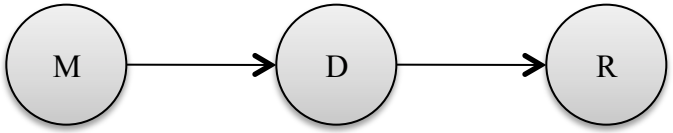
Supply chain topology



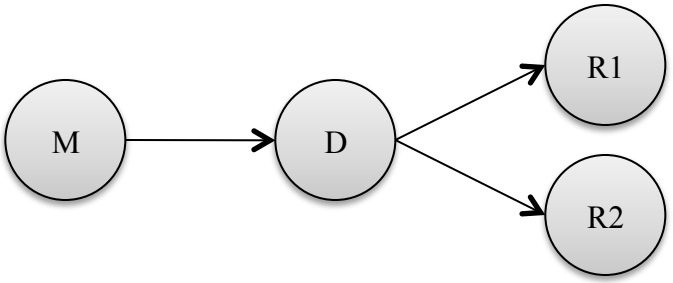
Network design decisions



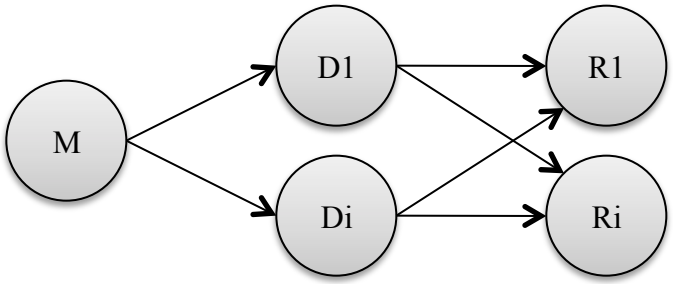
Number of levels (of the logistic network), e.g. a supply chain composed by n retailers and m manufacturers is a two stages supply chain



Distance between nodes



Nodes capacity: this variable represents the decision of supply network design to install a certain production or inventory capacity at a certain node, i.e. how many nodes per level must be activated



Sourcing policy: the number of sources each node will buy from. This means to decide whether to adopt a multiple or a single sourcing strategy

Elements influencing network design decisions

1 Strategic factors

2 Technological factors

3 Macro-economic factors

- 3.1 taxes, customs duties
- 3.2 exchange rates

4 Political factors

- 4.1 political risks

5 Infrastructural/natural factors

6 Competitive factors

- 6.1 externalities
- 6.2 market segmentation

7 DLT

8 Logistics costs

- 8.1 housing, handling and stock costs
- 8.2 transportation costs
- 8.3 production costs

9 Operational risks

The facility location decision

The first concern in deciding location is to analyze the factors that might influence the decision

Several factors can affect such a decision, and the analysis involves comparing these factors in a judicial manner

The **identification of** those **factors** influencing a site selection is also a very challenging problem

Generally, site selection is a collective decision. A group of executives may decide what factors are important

Example of elements usually considered important factors are:
transportation facilities, labor supply, availability of land, nearness to markets, availability of suitable utilities, proximity to raw materials, geographic and weather characteristics, taxes and other laws, community attitudes, national security, proximity to the company's existing plants

Important factors (1/4)

Transportation facilities

Suitable transportation facilities must be available to move personnel, equipment, raw materials, and products to and from the plant. Highways, railways, waterways, and airways are commonly used to transport raw materials and finished products. The volumes and type of raw materials and products often determine the best-suited mode of transportation

Adequate labor supply

Even in the age of computers, automation, and robotics, no company is able to operate without employees. The plant location study must assure that the types and the number of employees who will be needed will be available. Many studies have demonstrated that a plant can drawn its work force from an area easily as large as 75 miles in diameter. Besides this consideration the other elements to be considered are: prevailing wages, existence of competing companies that can cause high turnover or labor unrest, productivity level, education and experience of available potential employees, etc.

Availability of land

Communities that are attempting to attract new industries often provide land at a low cost, but the company must make sure of the suitability of the land (for example, the soil characteristics and topography of the location must be evaluated)

Important factors (2/4)

Nearness to markets

The location of a plant is very important in defining the overall costs of goods and services to the customers. For example, when the transportation cost is high, it is highly desirable that a plant be located in or near the market area (this is typically the case of bulk materials). The same consideration can be done for the by-products

Suitable utilities

Most industrial plants require electricity, heating and cooling, and compressed air and steam. Availability of a cheap fuel source can be very important factor in site selection. Some plants produce their own power and steam by burning oil, gas, wood, or coal. For these plants the availability of an inexpensive fuel supply is almost necessary. For others, an area of the country that has an ample supply of low-cost electricity becomes an attractive alternative. The availability of an adequate water supply is also very important. Plants that consume small volumes of water often purchase it from local public utilities, but those that use large quantities may need a source, such as a river or lake, or an area where a deep water well could be drilled. Waste disposal is also a critical consideration. The proposed site should have adequate facilities for solid, liquid, and gas disposals. The laws of the state and municipality should be carefully examined for defining the economic aspect of the waste disposal. Moreover, also the availability of facilities for flood and/or fire prevention and protection should be evaluated

Important factors (3/4)

Proximity of raw materials

The cost of shipping raw materials and fuel to the plant site can be considerable. Plants that require perishable or bulky raw material, tend to locate near the source of raw materials. Plants in which raw materials lose much of their weight during the manufacturing process, such as steel plants, and paper mills, also often locate as near their raw material sources as practicable

Geographic and weather considerations

The geographic characteristics of the site can affect the building and operating costs. A severely cold climate necessitates additional sheltering for the equipment, whereas a very hot climate requires the plant to have air-conditioning for personnel comfort, and an additional cooling tower for process equipment. Thus, factors such as altitude, temperature, humidity, etc., become important

Taxes and legal considerations

Because taxes form a significant part of operating cost, the types, bases and rates of taxes charged by the state and the local governments must be considered. To attract new industries, many cities and states offer tax incentives. Some taxes to be evaluated are property, income, and sales. Unemployment compensation taxes also vary from state to state. In terms of legal considerations, local regulations concerning real estate, health and safety codes, truck transportation, labor codes, etc. also influence the site selection

Important factors (4/4)

Community considerations

The community (both local authorities and the people) under consideration should welcome the placement of the plant within its area. Successful operation of the plant will require essential services, e.g. police and fire protection, street maintenance, and trash and garbage collection, from the community

National security

Governments sometimes encourage companies that supply strategic materials to locate such that the sources for such products are widely dispersed. In other cases the government may desire to locate a very security-sensitive manufacturing facility within the limits of a government installation

Proximity to an existing plant

Some companies prefer to locate a new facility in the general area of an existing major plant. Doing so facilitates direct supervision by upper-level management of both plant. Moreover, executives and consultants are able to minimize travel time between plants because they are near to each other. However, sometimes it is possible the company wants to locate the new plant far from the other so they do not have to compete with each other for the same labor force

Ranking procedures for site selection (1/3)

- Once the necessary information about alternative locations has been gathered (with reference to each important factor), the advantages and disadvantages of one location over another must be evaluated
- A commonly used aid in selecting from alternative sites is the use of a rating procedure
- Each of the major factors is rated from 0 to 100 relative to its importance
- Each individual location is then rated from 0 to the maximum for each factor
- The scores for the locations will define the final ranking

Ranking procedures for site selection (2/3)

Considerations	Maximum weight	Loc. 1	Loc. 2	Loc. 3
Transportation facilities	100	80	90	90
Labor supply	100	75	80	90
Land	100	80	75	75
Markets	100	60	70	80
Utilities	75	70	70	65
Raw materials	75	50	75	60
Geographic/weather	50	40	40	50
Taxes and legal	50	30	30	40
Community	40	20	40	35
National security	15	10	5	15
Proximity to existing plants	40	30	10	25
TOTAL	745	545	585	**620**

Ranking procedures for site selection (3/3)

- The ranking obtained by this method is largely subjective
- Different approaches can be applied to reduce such a subjectivity: fuzzy methods, minimization of the operational costs, etc.
- Anyway we are talking about Multiple-criteria evaluation problems
- These problems consist of a finite number of alternatives, explicitly known in the beginning of the solution process.
- Each alternative is represented by its performance in multiple criteria.
- The problem may be defined as finding the best alternative for a decision maker (DM), or finding a set of good alternatives.
- One may also be interested in "sorting" or "classifying" alternatives

Multiple-criteria evaluation methodologies

- The are several multiple-criteria decision-making (MCDM)
- The analytic hierarchy process (AHP) is a structured technique for organizing and analyzing MCDM, and it is based on mathematics and psychology.
- The procedure for using the AHP can be summarized as:
    - Model the problem as a hierarchy containing the decision goal, the alternatives for reaching it, and the criteria for evaluating the alternatives.
    - Establish priorities among the elements of the hierarchy by making a series of judgments based on pairwise comparisons of the elements. For example, when comparing potential purchases of commercial real estate, the investors might say they prefer location over price and price over timing.
    - Synthesize these judgments to yield a set of overall priorities for the hierarchy. This would combine the investors' judgments about location, price and timing for properties A, B, C, and D into overall priorities for each property.
    - Check the consistency of the judgments.
    - Come to a final decision based on the results of this process

AHP example

http://en.wikipedia.org/wiki/Analytic_hierarchy_process_%E2%80%94_Leader_example