UNIT-12

Supply Chain Systems Design

Learning Outcomes

By the end of this unit the learner will be able to:

- ✓ Describe the Importance of Location in supply Chain Design
- ✓ Explain the procedures for the Selection of Geographic Region

Unit 12

Importance of Location

Location Decisions

The Facilities Locationdetermines the best geographic places for the diverse elements in a supply chain. Location decisions are essential whenever a business opens new facilities.

If an organisation makes an error and opens its facilities in unfavourable location –after spending millions of pounds – it cannot just close down and move to an improved place. Working in the wrong location can give very poor performance, but moving can be equally difficult. The only solution, of course, is to decide the right location in the first place.

The right location does not promise success, but the erroneous location will surely guarantee failure. This is why you do not see nightclubs in housing areas where most of the people are retired, big petrol stations on country lanes where they don't get a chance to attract passing consumers, factories in city centres where their expenses are too high, or oil refineries far away from ports where inner transport would be too costly.

Nonetheless, you can discover examples of businesses running in the wrong place – and going out of business. Sometimes, people do not know that a place is poor, and some sites around town centres have a series of cafes or clothes shops closing down soon after they have opened. Some organisations overlook that, location decisions are for the long term and are dominated by short-term benefits, such as, development grants, provisional rent reductions, and tax breaks. Such sweeteners can be striking, but they hardly ever form the basis of fine decisions. You can also observe cases where companies make the right decisions, but conditions change –like garages that were in good locations before a new bypass opened.

Location decisions are always difficult, and businesses have to think many factors. Some of these can be calculated – or at least predicted – such as operating costs, taxes, wage rates, currency exchange rates, distance from present locations, number of competitors, development grants, reliability of supplies and population. Other factors are no quantifiable, such as the class of infrastructure, political steadiness, social attitudes, trade relations, legal system, and prospective developments of the economy, etc.

There are other trends, which are growing in popularity, such as, a rising number of out-of-town malls, supermarkets, and retail estates. The main trend towards shorter supply chains implies that layers of mediators are disappearing, and logistics is intense in fewer facilities.

Alternatives to Locating New Facilities

Choosing a superior location is one of the most ordinary problems that organisations face. There are quite a few reasons why they require considering location, including:

- The end of a lease on the present premises;
- Expansion into further geographic areas;
- Changes in the site of customers or suppliers;
- Changes to operations – like an electricity corporation moving from coal generators to gas
- Upgrading facilities – for instance - introducing innovative technology
- Changes to transport – such as, an exchange from rail transport to roadway transport
- Changes in the transportation network – such as, the opening of the Channel Tunnel or Road Bridge between Sweden and Denmark
- Mergers or acquisitions giving duplicate operations, must be rationalised. In practice, when a business wants to change its facilities – either get bigger, move locations, or close down – it has three alternatives:
- Expand or change present facilities, at a present location;
- Open supplementary facilities at another site while keeping all particular facilities; or
- Close down present operations and move.

As a rule of thumb, approximately 45% of companies develop on the same site, similar number open extra facilities, and 10% close down present operations and move. The most radical alternative of totally relocating often has extremely high costs and is troublesome. The most traditional option of expanding existing facilities involves small risk and can provide economies of scale.

The following list gives five alternatives in order of escalating investment:

1. Licensing or franchising: local businesses make and provide the company's products in return for a share of the profit.
2. Exporting: the business makes the product in its present facilities and sells it to a distributor functioning in the new market.
3. Local distribution and sales: the business makes the product in its present facilities, but sets up its own circulation and sales force in the new market.
4. Local assembly and finishing: the business creates most of the product in existing facilities, but opens narrow facilities in the new market to finish or accumulate the final product.
5. Full local production: the corporation opens full facilities in the new market. If it opens new local facilities, a corporation has the advantages of more command over products and the supply chain, superior profits, evasion of import tariffs and quotas, and closer links with restricted customers.
6. On the other hand it has more outlay, risk and multifaceted and unsure operations. The best choice depends on a lot of factors, such as the capital available, organisation's approach towards risk, target return on investment, present operations, timescale, transport costs, local knowledge, tariffs, trade restrictions, and accessible workforce.

Choosing the Geographic Region

Overall Approach -

The facility location is concerned with a hierarchy of decisions. At the top of this, there are wide decisions regarding which geographic areas to work in. Then, there are more local views that think option countries or areas within this area. Then, we look more intimately at option towns and cities within this area. Finally, we think of different sites within a chosen town.

The broad decisions concerning geographical regions and countries come from the company strategy. An organisation with a plan of global operations or growth must constantly look for new locations.

The supply chains turn out to be more complex, but logistics has to be so well-organized that lower production costs are not filled by higher logistics costs. A trouble with moving to areas with low cost operations is that they may present higher total costs than expected. Many people suppose that low wage rates mean low total cost. This is not essentially true, as low wages can be escorted by very low output.

Another difficulty is that transport costs vary quickly, and rises can make them more significant than operating costs. Large, well-organized steel mills in Taiwan, Japan, and South Korea, for instance, have low operating costs – but importing coal and iron ore, and transportation of finished steel is so costly that their delivered price is high.

Maybe the overruling consideration is that costs might not be a leading factor in location. A logistics plan may focus on quality, speed of response, flexibility, reliability, customer service and so forth, rather than least cost.

Considerations in Choosing Regions

Organisations have to think a lot of factors when choosing the common regions to work in.

The following list includes some of the most important:

- **Location of customers: Service providers must usually be close to their consumers – which** are why you discover shops, libraries, buses, restaurants, solicitors, and banks, etc. on in the town centres. The similar arguments hold for manufactured products which have a lofty cost of delivery to end customers – which is why there are lots of local bakers, brewers, dairies and double glazing factories. Sometimes being close to consumers is mainly important, as with just-in-time operations.

Location of suppliers and materials: producers are more likely to place near to supplies of raw materials, chiefly if these are heavy or large. This is why coal burning power stations are close to coalmines and pulp mills are near to timber forests.

- **Culture:** It is easier to develop into an area that has a similar language, culture, laws and costs, than to expand into a totally foreign area. A business currently operating in Belgium would find it easier to develop in France than in, say, Korea. The decision to build Disneyland Europe near Paris gives one instance where moving a winning American operation to a European culture met with less initial success than expected.
- **Government attitudes:** National and local government regulations can badly affect an area's charisma. Investment in Hong Kong, for instance, has fallen since its return to rule by China. A lot of governments offer inducements for companies to move into an area – but others are less warm, maybe trying to direct foreign influences on the economy.
- **Direct costs:** These are the costs of operations, including materials, wages, overheads and utilities. They can differ widely. The most striking locations offer a blend of low direct costs and elevated performance. Often there is equilibrium, with higher output coming at higher cost. A lot of organisations would like to locate in high cost areas to get the other advantages they bring.
- **Indirect costs:** There can be numerous indirect costs of doing business, including local taxes and charges on the payroll like social pension, insurance, and social costs. There might also be controls on business ownership (often including a controlling local partner), currency exchange and repatriation of profits.
- **Exchange rates:** These can come into view as indirect costs, but they are less predictable. What seems like a high-quality location one year can become much less striking after a shift of currency values.
- **Social attitudes:** Some countries put more stress on the welfare of community rather than others and there might be higher union membership or stress on individual rather than corporate benefits. Other areas do not essentially approve 'high productivity' methods and there might be high absenteeism and staff turnover.
- **Organisation:** An organisation can maintain a close check on new operations by controlling these from present headquarters and giving neighbourhood operations very little independence. This is, though, inflexible, and it does not let local organisations to become accustomed to their own conditions or expand skills. A substitute is to delegate decisions.
- **Operations:** If you go into a McDonald's hamburger café anywhere in the world you will see almost identical operations. It is easier to manage operations in this way, but it loses the advantages of local knowledge and practices. Other organisations merge into the local surroundings and acclimatize their operations so they are more familiar to their host countries.

Two different approaches to location decisions are:

1. **Infinite set approach** – which uses arithmetical arguments to find the most excellent location, assuming that there are no limits on site accessibility

2. **Feasible set approach**– where there are just a small number of feasible sites and an organisation has to select the best.

Feasible Set Approaches

Costing Models -

Feasible set approaches recognize existing sites, compare them, and find the most excellent. An obvious examination calculates the whole cost of working from every location and finds the cheapest. In practice, a lot of costs of running a facility are permanent despite of its location. Then instead of looking at the entire cost, we can think of those costs that vary mainly the transport and operating costs.

Total variable cost = Operating cost + Inward transport cost + Outward transport cost of a facility

Locations near to consumers have higher costs of inner transport, and those near to suppliers have higher costs of outer transport, so the finest location is likely to be in between. An obvious trouble, though, is that we do not know the genuine costs before we in fact open a facility.

If we can simply use the costs for comparisons, we may as well build the calculations as simple as possible. For instance, the operating costs in near locations may be virtually the same, so we can eliminate these from the equation and focus on transport costs.
It is hard to find the precise cost of delivering to any particular consumer, so we can suppose that the transport cost is comparative to the distance moved.

Rectilinear Distance = Difference in + Difference in

X co-ordinates Y co-ordinates

Then we can use this simple measure to identify the location with the smallest total value of load x rectilinear distance moved.

We can use a version of this assessment model to discover the best number of facilities. The argument runs as follows.

- If a business concentrates its activities in a few major locations – such as, major logistics centres – inward transport comprised of large deliveries made to a little facilities and the cost is low. Though, the few facilities are, on average, further away from consumers and the outward transport cost is high.
- If there are a great number of spread-out facilities – like retail shops – inward transport comprised of small deliveries to more destinations and the cost is high. The facilities are, on average, nearer to consumers, so they have the advantages of higher consumer service and lower outward transport cost.

Costing models can offer useful comparisons, but they have faults, including the complexity of finding precise costs, data that depends on book-keeping conventions, costs that differ over time, customer locations not being identified in advance, and so on.

It is often better to shun these problems and employ some other method for comparison. The most general alternative is a **Scoring Model**. Scoring Models stress the factors that are significant for locations, but which cannot simply be enumerated.

Even if we cannot count the significant factors, we still want to identify them.

A complete list of factors includes:

In the region and country -

- availability, skills, and productivity of workforce;
- local and national government policies, regulations, grants, and attitudes;
- political stability;
- economic strength and trends;
- climate and attractiveness of locations;
- quality of life – including health, education, welfare, and culture;
- location of major suppliers and markets;
- infrastructure – particularly, transport and communications; and
- the culture and attitudes of people.
- *In the city or area -*
- population and population trends;
- availability of sites and development issues;
- number, size, and location of competitors;
- local regulations and restrictions on operations;
- community feelings; and
- local services, including transport and utilities.

On the site -

- amount and type of passing traffic;
- ease of access and parking;
- access to public transport;
- organisations working nearby;
- total costs of the site; and
- potential for expansion or changes.

This is the foundation of Scoring Models, which have the following five steps:

Step 1 -decide the applicable factors in a decision

Step 2 -give every factor the highest possible score, which shows its significance

Step 3 -consider every site in turn and give a real score for every factor, up to this maximum;

Step 4 -add the sum score for every location and find the highest amount; and

Step 5 - discuss the end result and make a concluding decision.

Important Factors for Scoring Models

The list of significant factors and weight given to each clearly depends on the circumstances. Manufacturers desire economies of scale by building great facilities that are often close to raw materials.

Then, decisions regarding the location for a new factory are dominated by:

- availability of a labour force with suitable skills;
- labour relations and social attitudes;
- environment and class of life for employees;
- proximity of suppliers and services;
- quality of infrastructure; and
- governmental policies toward industry

Their decisions, concerning location, put more stress on:

- population density;
- socio-economic characteristics of the population near-by;
- location of competitors and other services;
- location of other attractions like retail shops;
- ease for passing traffic and public transport;
- ease of access and suitable parking; and
- visibility of site.

Network Models

There are a lot of databases of road networks that mechanically find the most excellent routes between two points, like Microsoft AutoRoute Express and Softkey Journey Planner. Typically, you provide the postcode of starting and final locations, and the package finds the straight, fastest or cheapest route, or route with some other features.

Such systems can be placed into vehicles, and joint with global positioning and traffic monitoring systems to discover the best route from any existing position to an endpoint.

Single Median Problem

A standard analysis shows that the best location is always in a town. This makes the problem much easier, as we just have to evaluate locations in every town and recognize the one that gives the finest value for some measure of performance. A common determination is average travel distance or time, and looking for the shortest is called the **single median problem.**

The easiest means to find out the single median begins with a matrix of the straightest distances between towns. In practice, we can find out this from route planning software, or using some substitute measure like the straight-line or rectilinear distance.

Covering Problem

Sometimes, the standard distance or time to a facility is less significant than the greatest time.

The suppliers often assure deliveries within one working day. This is an example of the **covering problem.**

There are two forms of the covering problem. In the first version, we are searching for the sole location that gives the most excellent service to all towns

The second version states a level of service that must be attained. This may need an ambulance to reach your destination within ten minutes, or a parcel to be delivered within two hours. The problem is then to discover the number of facilities essential to achieve this, and their best locations.

Location Planning -

A more official process has the following five steps:

Step 1 -recognize the features, which are required in a new location, decided by the business and logistics strategies, arrangement of the supply chain, customers, aims, and other appropriate factors. Look for countries and regions that can best supply these.

Step 2 -Within the selected region, use an endless set approach – like the centre of gravity or a similar model – to find the most excellent area for locations.

Step 3 -Search around this region to find a possible set of accessible locations.

Step 4- Use a practicable set approach –like costing model or scoring model – to compare these alternatives.

Step 5- Discuss all obtainable information and come to a choice.

To be more particular, we can employ the following process:

1. **Inspect the general aims**- looking at the logistics plan and other plans to recognize the aims and objectives of logistics in terms of consumer service, timing, costs, and so on.
2. **Do a logistics review**- describing the particulars of the present logistics system, including the location of facilities, network connecting these, measures of performance, and industry benchmarks.
3. **Recognize mismatches**- where there are differences between the objectives (from step 1) and real performance (from step 2).
4. **Examine options for overcoming the mismatch**- looking in broad terms to see where and how the arrangement of the supply chain can be enhanced.
5. **Location decisions**- having set the common features of the supply chain, look in point at the facilities required. Use suitable models to find the most excellent locations and sizes for these facilities.
6. **Confirm the locations**- making certain that the locations recognized in step 5 actually are best, and work with the arrangement identified in step 4.
7. **Implement and check the solutions**- doing whatever is essential to implement the changes and progressing to ensure performance.

Further Reading:

- ✓ ***Hosang Jung, Fengshan Frank Chen, Bongju Jeong, (2007), Trends in Supply Chain Design and Management: Technologies and Methodologies***
- ✓ ***Marc Goetschalckx, (2011), Supply Chain Engineering***
- ✓ ***William R. Killingsworth, (2011), Design, Analysis, and Optimization of Supply Chains: a System Dynamics Approach***