Explain the role of network Design in Supply Chain with real time example.

Supply chain network design is the process of building and modeling a supply chain to better understand the costs and time associated with bringing goods to market with the resources and locations available.

Some questions that are commonly evaluated as a part of this process are:

- How do I design my supply chain network to deliver the required service at the lowest possible cost?
- Given a fixed network, how do I determine optimal product sourcing and inventory deployment rules to meet anticipated customer demand?
- Given a logistics network and a defined distribution strategy, how can I best use my available transportation resources?

The end goal is to create the most efficient network possible, meet the demand of customers, and ensure the lowest possible cost to serve your network.

This process includes many different variables and models but many of them are tied to location, such as your distribution centers, store network, and possible routes to serve those stores.

Other assumptions, such as number of transportation resources, assumed delivery time, and total route time are also tied to location even though they might not initially appear to be impacted by location. The exact routes and road networks play a major role in how you will ultimately design your routes and assign resources to different clusters of stores.

Evaluating the Publix supply chain network

To show how location intelligence can impact supply chain network design, we analyzed the supply chain network for Publix, a leading grocery store chain in the southeastern United States, with primary operations in Florida.

Publix has over 1,110 stores served by 8 distributions centers.

The company expanded into North Carolina in 2011 and Virginia in 2016 and will likely continue to open new stores in these states.

However, the company has not opened a new distribution center to serve these new locations.

We evaluated Publix store and distribution center locations to understand how Publix is currently serving their stores, where Publix should place a new distribution center, and to quantify the ROI of opening a new distribution center. To do this we used the following data sources and analyses:

- Publix store locations and distribution center locations
- Demographic data from the Data Observatory to see the population served by each store
- Spatial clustering analysis to create logical clusters of stores for each route
- Optimized routing, or the most efficient route from a start/stop location to a set of other locations, to see time and distance of each route

To understand the current supply chain network design we:

1. Created logical clusters of stores using the clustering analysis in CARTO to find logical groups of stores.
2. Next, we assigned these groups to the nearest distribution center, and made some minor adjustments for outliers that needed to be assigned to different distribution centers.
3. We used the same clustering analysis to create logical clusters for each of the routes originating from the distribution center.
4. We used the optimized routing to find the most efficient route from the distribution center, to each of the stores, then back to the distribution center.

This analysis gives us the length of the trip and the drive time for the entire route. After looking at the data, some routes needed to be modified to make sure they could be completed within a standard shift, or if that was not possible, that route would need to be split into two shifts.

Assuming that a drop off takes 30 minutes, we then optimized the routes even further and split some of the routes into smaller routes to ensure we had as many routes as possible that could be completed in one shift.

In the resulting map you can see that to use each route once, it would take:

- 41,554 miles
- 1,134 hours in driving and delivery time
- 101 total routes

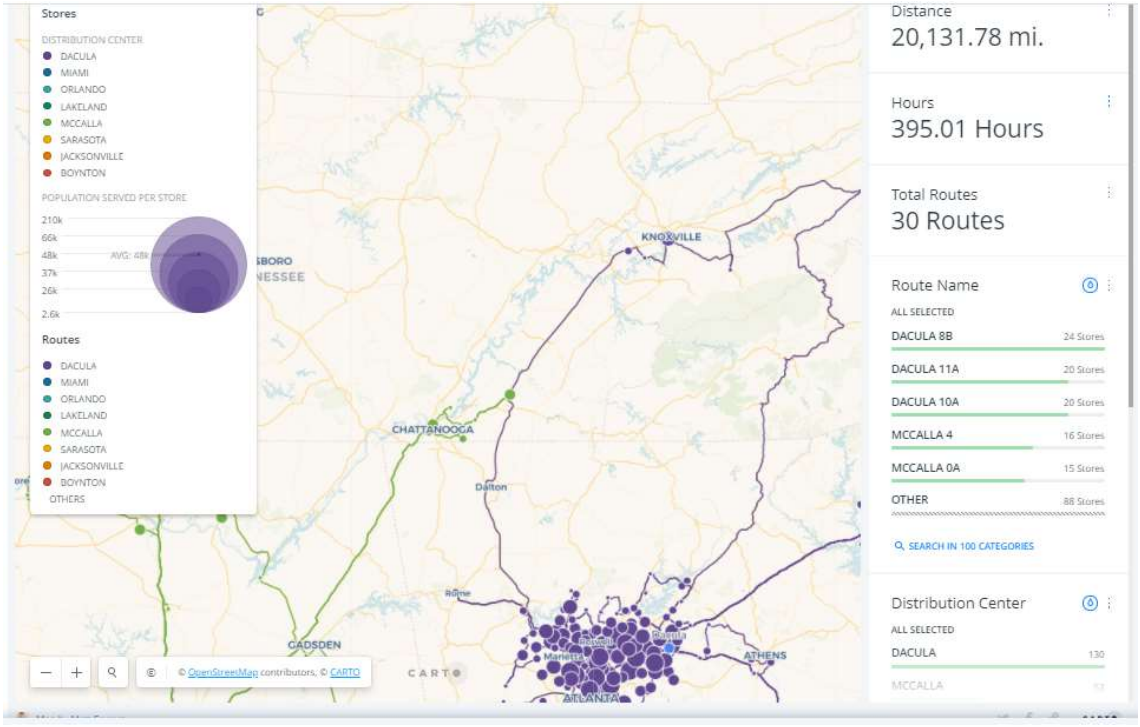
You can see that the Florida routes are shorter and well optimized apart from a few routes, but the Dacula, GA (purple circles) and McCalla, AL (light green circles) distribution center routes are very long and serve a significant amount of stores.

Dacula: 37% of Total Distance, 26% of Total Time, 24 Routes

McCalla: 22% of Total Distance, 14% of Total Time, 12 Routes

Using CARTO we can see some obvious improvements such as McCalla 5 (the green route to Chattanooga), which is better served by the Dacula 6 route (the purple route to Knoxville).

Using the final visualization, we can see that we need to add a distribution center to better serve the stores furthest away from the Dacula, GA distribution center since it serves almost 2 times more stores than any other distribution center.



Adding a new distribution center

After looking at the stores that the Dacula distribution center serves, we will want to place a new distribution center somewhere in North Carolina to serve these stores and to allow for more expansion in North Carolina, South Carolina, and Virginia.

To select this location we looked at data from the Data Observatory, specifically the employment, total population, and roads data to find a large city near major highways with connections around the region.

We narrowed this down to three candidates:

- Raleigh
- Charlotte
- Greensboro