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Geog 4230

XYZ Logistical Analysis Phase 1

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Problem Statement

The XYZ Corporation is a rapid delivery services provider. They have been subcontracted by retail and e-commerce companies to fulfill orders. The XYZ Corporation is tasked with fulfilling a one hour package delivery. They have been tasked with handling the last mile logistics. Last mile logistics is the last step in the delivery process. This is where products are shipped either by small parcel or package carriers. Last mile logistics enables consumers to receive their products much faster than traditional delivery and is more cost effective for companies as well. With companies such as Amazon and other large e-commerce companies promising instant or same day delivery, this creates competition and shows how effective last mile logistics can extremely benefit a company. XYZ is tasked with being able to pick the product, pack the product and delivery the product to the consumer within an hour window. This allows for a maximum of a thirty-minute delivery time. XYZ is looking to join the market within the Dallas-Fort Worth Metropolitan area. It will need to construct its entire distribution infrastructure from scratch. XYZ also must figure out where their target customers reside. Their ideal customers are more affluent middle aged consumers and young educated consumers with promising careers. XYZ will look to be more effectively located to better serve locations where

customers with above average national incomes are located. XYZ is also trying to effectively cover the Dallas-Fort Worth Metropolitan area using up to five distribution centers. These distribution centers will need to be located within industrial zoning areas and have a minimum square footage of 100,000 square feet.

XYZ is trying to figure out who are their customers and where are they located. This will lead to what are the best suited areas for distribution centers to provide the best service to these customers within the thirty-minute delivery time frame. XYZ will also need to figure out how the current road networks and future road construction plans will affect their delivery time. The questions to be solved are:

Who are XYZ's target customers? Where are these customers located within the Dallas-Fort Worth Metropolitan area? Where are the locations best suited to service its customers within the target delivery time that have the appropriate zoning and can accommodate a minimum of 100,000 square feet? How will current and future construction plans impact delivery time? How will peak hour congestion impact delivery time?

Specific Goals for Analysis

XYZ's initial goal is to find where their customers are located and specifically where are the customers with above average incomes located. To do this XYZ will need to gather data on the population of the Dallas-Fort Worth Metropolitan area. These needs require zip code data and average income data. The end goal for this is to form geodemographic segmentation. This

will enable XYZ to figure out where their target customers are located and provide insight into how household income is distributed across the Dallas-Fort Worth Metropolitan area. It will also see if there is clustering of these target customers or if there are target neighborhoods.

XYZ will then need to narrow down facility choices to a maximum of five facilities. These facilities will need to have adequate parking for employees and can efficiently be accessed by delivery vehicles. These distribution centers need to be highly accessible to the neighborhoods and customers that fit the specification of their target customer. Right now, the goal is on where are the best suitable areas with these facility requirements and not on specific facilities.

Current and future construction will have some sort of impact on delivery time. XYZ will need to figure out whether any of these areas coincide with current or future construction projects. XYZ should also be interested in how congested certain road networks are during peak hours. Knowledge on current and future congestion during peak hours can help assist XYZ in formulating delivery routes which include alternative routes during these peak hours.

Relative GIS Techniques and Methodologies

There are at least two components needed to find out where all customers located within the Dallas-Fort Worth Metropolitan area are located and where are XYZ's target customers located. These two components are zip code data and average annual income data. By getting

this information you can figure out each person or household that lives in a zip code located within Collin, Dallas, Denton, or Tarrant county. These are the four counties that generally make up the Dallas-Fort Worth Metropolitan area. An easier way to figure out XYZ's target neighborhoods and customers is to use Esri's Tapestry Segmentation system in Esri's Business Analyst. Esri's Tapestry Segmentation system is broken up into sixty-five classifications. These classifications create neighborhoods and are based on demographic and socioeconomic factors. This tool allows you to profile your customers. There are multiple methods used to divide the 65 classifications into summary groups. The two methods useful for XYZ's interest are Lifemode and Urbanization. Lifemode creates 12 summary goals based on lifestyle and life stage (esri.com/tapestry: 3). Urbanization creates 11 summary goals based on geographic and physical features along with income (esri.com/tapestry: 3). This system can help provide insight into the lifestyle traits of your target customers. It can help gain insight into untapped markets and into market potential. It can also assist in finding the best locations for new facilities.

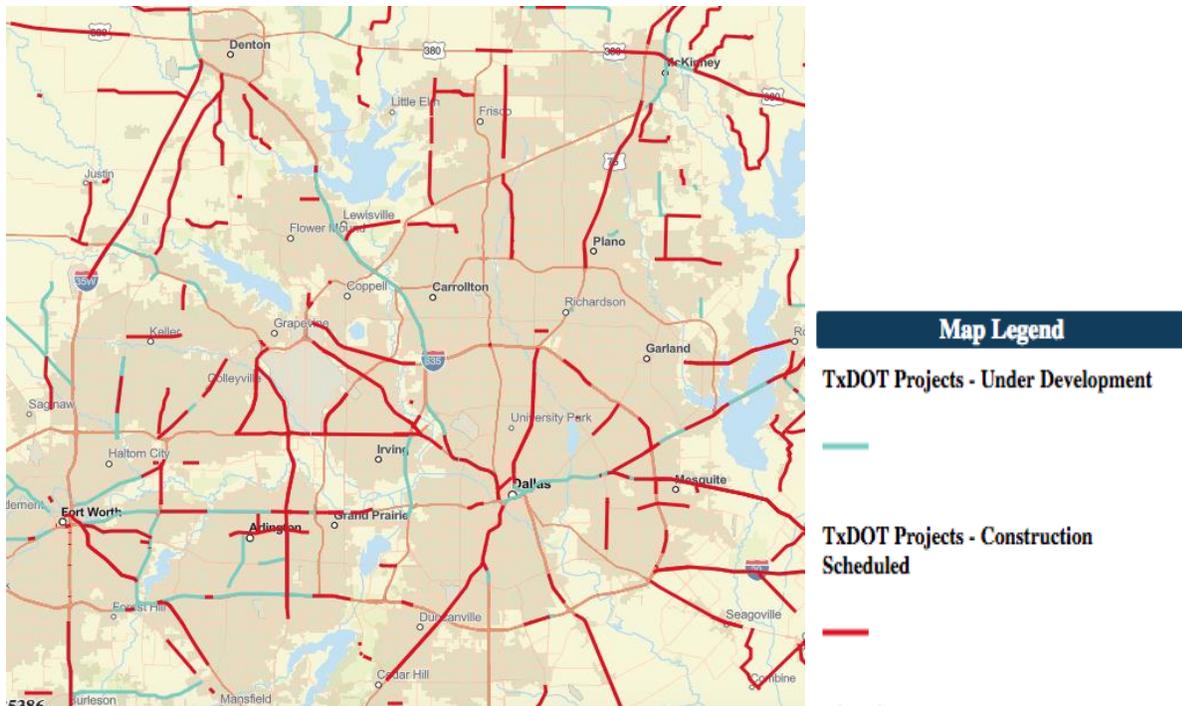
An alternative method to this would be to create an area of influence using maptitude. You would use the straight-line catchment area methodology. This defines the zone that is geographically closest to a location. To create this, you would use the zip code layer within maptitude as your working layer and using the straight-line option within the analysis tool. You would have to set up the demographics to include average annual income or another identifier of income. This would create a thematic map showing how income is distributed over the Dallas-Fort Worth Metropolitan area.

The Costar database has an array of useful information regarding how suitable a property is. They offer data on individual properties which include square footage, price, building specifications such as the number of loading docks, public transportation located nearby, market conditions, demographics, and even traffic data of nearby road networks. This is useful information and can even be used as a tool in deciding which facilities to choose. Some considerations when choosing property are location, price, and timing. Location includes site and situation. The site is the actual business location itself. The situation is the geographic context for a given site. To have a great business you need both site and situation to be suitable. Price can ultimately impact whether the project is a success or failure. If you pay too much for property the risk of the project failing is multiplied. Price is compared to the intended land use and returns anticipated from the project. Price is also a relative idea. A high price can mean an above average potential. However, a low price can mean deteriorating potential for the property. Timing must also be taken into effect as well. Investment geographies and conditions are constantly changing. There are good and bad times to enter the market. If something has worked in the past at a given situation does not mean it will work now or in the future.

XYZ needs to find the best suitable locations for its facilities to accommodate its customers the best. Using location allocation solution options combined with drive time rings within maptitude is the best technique to use. To start you would use the P-median problem. This would locate a maximum of five facilities to minimize the total distance traveled. The focus of this is to maximize the efficiency of the entire service provision system. The problem with this is that it does not consider the thirty-minute drive time range or no guaranteed service standards. Drive time rings can be created to see which customers are located within the thirty-minute

window. You would need to create three ten minute rings to see how well the five locations created would cover your customers. The maximal covering location problem can be used to address the needs where the P-median problem came up short. The maximal covering location problem would still locate five facilities but would maximize the number of customers covered for service within a drive time range or service standard. Even with this method it is still possible to provide poor service to the minority of customers. This can be a concern but the main goal is to satisfy the needs of the target customers not every customer. However, you can use the set covering location problem to determine the number of facilities needed to cover a region to achieve a given drive time range or service standard for every customer. The set covering location problem can be extremely useful in determining if it is more cost effective to have less than five facilities or it can provide insight that an additional facility will be needed to adequately service all XYZ's customers within the Dallas-Fort Worth Metropolitan area.

The layout and future plans for road networks can have a huge impact on fulfilling the thirty-minute deliver time window. Once the locations for each facility are found we can consider their location relative to current or future road construction. You can overlay the locations of the facilities on a map of road networks which identify current and future traffic projects. You can create a buffer around the roadways with current and future traffic projects using the buffer tool in mapititude. A one and a half -mile radius is a good measure to see if any of the facility locations coincide with current and future traffic projects. The information on current and future traffic projects is available on the Texas Department of Transportation's website. This can impact the ability of delivery transportation to access major road networks such as interstates and highways.



Texas Department of Transportation map showing current construction projects and construction projects scheduled for the DFW area.

Choosing correct delivery routes will define whether the thirty-minute delivery window is met. Current peak hour congestion and future peak hour congestion should be considered when choosing the appropriate delivery routes. This information is available on the Texas Department of Transportation’s website. To combat congestion, you can use a T-matrix. The T-matrix allows you to identify all the possible ways of getting around the transportation network. To figure out which alternative route best suites your needs you can use a total accessibility matrix. This will allow you to compare the total accessibility of each alternative route. This will give insight into which alternative route will best fit the delivery route needs.



Texas Department of Transportation current peak hour congestion map



Texas Department of Transportation future peak hour congestion map

Another important aspect of delivery is the order in which delivery stops are made. You can use the traveling salesman problem to help solve this. This method essentially provides the best suitable order for stops along a given route. However, this is limited to a certain problem size.

Data Needs

The data needs for the customers and target customers can be found in using the United States Census. A good start to finding this data would be looking through 2010 census data. More current data can be found by using the American Fact Finder through the United States Census' website. However, the most current data available is from 2017. To get the most accurate information available perhaps a private data source will need to be accessed to get up to date information about location, income, and other indicators of customer's lifestyles that can be used in the Esri Tapestry Segmentation system.

Most property data is available through the Costar database. Information on price, square footage, location, parking structure, access for transportation, quality ratings, even the companies who built the facilities are available through Costar. This information combined with Texas Department of Transportation data can help provide insight into the situation of a location. Economic data can also help provide insight into the current market situation.

Location data will need to consist of zip codes, longitude, and latitude. This can be attained through the Costar database. For each given property, the database provides an address and the coordinates of the property. Data on new sub-divisions or housing neighborhoods will be needed. Shapefiles may as well be needed for these locations to map them in mapitude or in ArcGIS. An alternative to this could be to create a shapefile using QGIS which would give you the approximate location of the property.

Most of the road network data is available on the Texas Department of Transportation's website. This includes current road infrastructure, current and future construction projects, current and future congestion, and traffic volume. Some additional data needs could be toll prices and how toll prices fluctuate. This can be useful to see if using tollways could be cost effective. This data may be available through the North Texas Tollway Authority.

Overall Plan

The first stage is to figure out the geodemographic segmentation of XYZ's customers. This will show where the more affluent neighborhoods are and where to prioritize suitable service. This will be attained by using Esri's Tapestry Segmentation system. Once the customer market is configured, then we can start looking at facility location. By using the location allocation tools such as the P-median problem, maximal covering location problem, and the set covering location problem we will figure out where the best suitable locations for the facilities in relation to the customers are located. Once that is figured out we can start looking at properties that are for sale or for lease with the necessary requirements. When property location is decided then you will look at construction and traffic congestion to see if they will have any negative impacts on delivery time. Finally, the delivery routes will be designed to sufficiently fulfill the thirty-minute delivery time. Traffic congestion will also be considered and alternative delivery routes will be considered.

Citation

https://www.txdot.gov/apps/statewide_mapping/StatewidePlanningMap.html

<http://ftp.dot.state.tx.us/pub/txdot-info/tpp/maps/congestion/2016.pdf>

<http://ftp.dot.state.tx.us/pub/txdot-info/tpp/maps/congestion/2036.pdf>

Esri Tapestry Segmentation Reference Guide