Land Use Analysis to Enhance Successful Logistics Activity Center (LAC) Development

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1. Background and Introduction

- Freight mobility is an important element in fulfilling demand. It affects the state economy and is a driving force for maintaining/creating jobs and economic development.
- 67.6 % – increase in the value of freight transported in the U.S. between 2004 and 2014 (USDOT, 2014)

2. Objectives

• Determination of a location criteria for logistics activity center (LAC) development potential

• Identify and prioritize different locations based on their LAC development potential to help guide the appropriate investments for successful LAC development
3. Literature Review

Determining Success Factors for LAC development

• The development of LACs is on the rise to address increasing costs by achieving higher logistics efficiencies

  • Five major categories of success factors for LACs
    1. Strategic location
    2. Economic incentives for development
    3. Champion
    4. Government support
    5. Other factors
  • These factors were applied to evaluate LAC sites identified in the literature and interviews were held with a select-few mega LACs
4. Data

• The previous Ozkul et al. (2015) study suggests that strategic location is a major determinant of the success of an LAC investment

**Strategic location criteria** - availability of or proximity to:

• Seaports (land access)
• Intermodal yards (land access)
• Cargo airports (land access)
• Florida’s Strategic Intermodal System (SIS) Roads (Access Points/Interchanges)
• State and US roads (arterial truck routes)
• Rail tracks (direct access)
4. Data (cont’d)

- A list of primary strategic location factors that contribute to successful LAC development and site selection were determined and analyzed under four subsections:
  
  I. Buffer Distance Criteria
  II. Buffer Weight Criteria
  III. Utility Availability Criteria
  IV. Land Cost Effects Criteria

- Data were obtained using spatial analysis/ArcGIS for the FDOT D7 region

- Each of the facility types was assigned a specific buffer distance which, when input in the ArcGIS, resulted in maps with overlapping areas
5. Theory and Calculations (cont’d)

Buffer Methods

1. Simple (Linear Type)
2. Driving Distance (Network Availability)

5. Theory and Calculations (cont’d)

Buffer Assimilation Process

These pixels contained the “heat” or measure of their proximity to each of the facilities mentioned previously

- Raster images were stacked on top of each other
- The resulting map accounted for all strategic location LAC development criteria as well as the availability of utilities and land cost criteria discussed in the following sections

Raster Calculation

To determine the final Heat Pattern multiple Raster obtained from different facilities are assembled together. The resultant raster would have the influence of all the individual raster data and give a spatial reference of all nearby facilities.
5. Theory and Calculations (cont’d)

Buffer Weight Selection

- The maximum total net weight for a facility (the highest end of “High” LAC development potential) was fixed at 100.
- The total influence of all facilities sum to a specific score for each location on the map, resulting in a measure of LAC development potential of that specific site.

Table 1. Buffer Distances and Corresponding Weights for All Facility Types per LAC Development Potential

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Buffer Type</th>
<th>Buffer Distance (mi)</th>
<th>Buffer Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>High</td>
<td>Moderate</td>
</tr>
<tr>
<td>Rail Track</td>
<td>Simple (Linear)</td>
<td>0.25</td>
<td>0.5</td>
</tr>
<tr>
<td>Rail Intermodal Yards</td>
<td>Driving Distance</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>SIS Roads (Access Points)</td>
<td>Driving Distance</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>State and US Roads (Truck Routes)</td>
<td>Simple (Linear)</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Cargo Airports (Land Access)</td>
<td>Driving Distance</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Seaports (Land Access)</td>
<td>Driving Distance</td>
<td>5</td>
<td>10</td>
</tr>
</tbody>
</table>
5. Theory and Calculations (cont’d)

Availability of Utilities

- To fully account for the LAC development potential of an area, the availability of utilities was determined to be a major element
- A penalty of negative five (-5) points out of 100 possible weight points was applied to sites that did not have utility access (water, sewer, or electricity)

Land Cost Consideration

- Land cost is a highly important aspect behind any successful LAC development initiative
- Each analysis pixel [0.01 square miles (approx. 6.4 acres)] was assigned an average cost
- Existing land price was evenly distributed and high-priced areas were penalized (Table 2)

Exclusion of Unavailable Areas

- Exclusion of areas that are not available for LAC development such as non-vacant lands with existing facilities, military zones, environmentally-protected lands

Table 2. Land Cost Weighting Criteria

<table>
<thead>
<tr>
<th>Class</th>
<th>Cost Per SF</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Cost</td>
<td>$0–8</td>
<td>5</td>
</tr>
<tr>
<td>Moderate Cost</td>
<td>$8–15</td>
<td>0</td>
</tr>
<tr>
<td>Moderate-to-High Cost</td>
<td>$15–50</td>
<td>-50</td>
</tr>
<tr>
<td>High Cost</td>
<td>$50+</td>
<td>-90</td>
</tr>
</tbody>
</table>
5. Theory and Calculations (cont’d)

- The filtering process involved preparing GIS templates that would be used to overlay on the existing LAC development potential heat map, which would return areas that are not suitable.

- **Removed Areas include following:**
  1. Wetlands and Waterbodies
  2. Natural Parks and Reserved Lands
  3. Existing Warehouses
  4. Rail Intermodal Yards
  5. Airports
6. Results and Validation

- The final LAC development potential types were classified into five major groups to capture all LAC development potential categories for all five FDOT D7 counties.

Table 3. Final LAC Potential Categories and Corresponding Range of Total Weight Factors

<table>
<thead>
<tr>
<th>Class</th>
<th>Range of Total Weight Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High</td>
<td>72-100</td>
</tr>
<tr>
<td>High</td>
<td>51-72</td>
</tr>
<tr>
<td>Moderate</td>
<td>26-51</td>
</tr>
<tr>
<td>Minimal</td>
<td>13-26</td>
</tr>
<tr>
<td>Low</td>
<td>0-13</td>
</tr>
</tbody>
</table>
6. Results and Validation (cont’d)

- The initial “heat” maps obtained through assimilating ONLY the strategic location data were continuous (solid).
- With the introduction of utility availability, land cost factors, and removal of unavailable lands, the final LAC development potential heat map was found to be “patchy”.
- Existing FDOT D7 warehouses layer (larger than 25,000 sq. ft. for LAC criteria) obtained from Renaissance Planning was then laid over the final LAC development potential “heat” map for validation.
- Most of the large warehouses were found to be clustered around the “very high” and “high” heat areas obtained through this research, thus highly validating the criteria developed by this research.
6. Results and Validation (cont’d)

Initial LAC Heat Map

Final LAC Heat Map

District 7 Boundary

LAC Map Without Waterbodies/Reserved Lands/Railyards/Airports

0 - 13 (LOW)
14 - 28 (MINIMAL)
27 - 51 (MODERATE)
52 - 72 (HIGH)
73 - 100 (VERY HIGH)
7. Final Site Maps

- The sample final site maps depict sites falling under a specific “LAC development potential heat criteria” and also a specific “LAC or non-LAC compatible land zones”, hence providing a guidance on future LAC development.
- The final site maps depict the following:
  1. LAC development potential “heat” classification
  2. Land use category
  3. Latitude and longitude for the exact location
  4. Nearby roadway intersection
  5. Neighboring LAC compatible lands (if available)
  6. Legend and scale for reference
  7. A Google Earth 3D representation
  8. Approximate area of the land (in acres)
  9. An overall map showing regional location
8. Corridor Analysis

- Certain areas were found to encompass multiple LAC development parcels, which are in close vicinity of each other.
- These clusters were grouped together and a series of 3D Google Earth maps were prepared by the research team to focus on these corridors.
- Each map depicts the major roadways around which the sites with LAC development potential were observed.
- These corridors can be further analyzed for future freight improvement investments due to their high potential of freight activity.

Legend
1. Hillsborough High LAC Development Potential
   Co-ordinates: 27°58’22.55”N | 82°19’48.09”W

Potential LAC Development Zones

Major Freight Corridor

Heat Classification and Coordinates
9. Conclusion

- The methods and findings of this research in determining the LAC development potential of possible sites can be used towards investment allocation and maximization of the return on investment (ROI)

- **Areas with “Very High” potential for LAC development**
  - Located within the influence area of all three major freight generators (seaport, airport with cargo access, and intermodal yard) and abutting major roadways
  - Observed prospective investment locations (West Pinellas County and South/Southeast Hillsborough County)

- **Areas with “High” potential for LAC development**
  - Located within the influence area of at least two out of the three major freight generators and abutting major roadways
  - Observed prospective investment locations (outer layers of West Pinellas County and South/Southeast Hillsborough County)
Corridor Analysis shows clusters of high LAC development potential zones that are in close proximity to one another, hence any kind of freight related infrastructure improvements on these corridors is expected to benefit freight activity in these high freight potential areas/corridors.

Future research can be focused on taking into account major roadway traffic congestion and freight imbalance due to high amount of logistic activity over busy networks.

In addition, the immediate region (I-4 corridor) and/or the entire state of Florida can also be analyzed in a similar fashion since this current study strictly looked at the FDOT District 7 boundary.
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