A methodology for finding an optimal tramline location using multi criteria analysis - A case study in Geneva

Problem definition
Due to future densification of employments and residents in Geneva the public transport (PT) is in need of extension to mitigate negative externalities in an area without a tramway (the status quo).

Methodology
1. Problem analysis
   • Evaluate current needs (problem definition)
   • State the research objective
   • Find alternative scenarios (fig. 1)
   • Find actors involved (table 1)
   • Define criteria + weights for each actor (table 1)

   Table 1: Weighting table for each criterion and actor
<table>
<thead>
<tr>
<th>Criteria</th>
<th>Stakeholders</th>
<th>Residents</th>
<th>Commuters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catchment area</td>
<td>0.09</td>
<td>0.09</td>
<td>0.13</td>
</tr>
<tr>
<td>Environmental impact</td>
<td>0.13</td>
<td>0.31</td>
<td>0.11</td>
</tr>
<tr>
<td>Accessibility</td>
<td>0.14</td>
<td>0.12</td>
<td>0.31</td>
</tr>
<tr>
<td>Land use</td>
<td>0.13</td>
<td>0.32</td>
<td>0.09</td>
</tr>
<tr>
<td>Connectivity</td>
<td>0.19</td>
<td>0.10</td>
<td>0.28</td>
</tr>
<tr>
<td>Costs</td>
<td>0.32</td>
<td>0.06</td>
<td>0.09</td>
</tr>
<tr>
<td>Credibility Ratio (CR)</td>
<td>0.037</td>
<td>0.018</td>
<td>0.023</td>
</tr>
</tbody>
</table>

2. Data analysis
   • Collect data
   • Spatial analysis
     ▪ Using Geographical Information Systems (GIS): catchment area, connectivity, noise level, land use, costs
     ▪ PT accessibility simulations
     ▪ Using VISSIM & TransCAD software
   • Multi Criteria Analysis (MCA)
     ▪ Credibility analysis (CR<0.1, see table 1)
     ▪ Electre 1s (Find the most preferable scenario.)
     ▪ Sensitivity analysis (Check for consistency of the analysis. If the results show inconsistency, steps of the analysis should be revised.)

3. Visualization of analysis
   • Follow a structured approach to not miss information.
   • MCA is a useful tool for PT planning because it includes different scenarios, actors and criteria and it is possible to measure the credibility of the results.
   • Following the methodology scenario #5 (Boulevard Emile-JAQUES-DALCROZE) is most preferable using the defined weights, preferences and actors.

4. Results representation
   • To find a methodology to do a multi-criteria analysis.
   • To apply this methodology on seven possible scenarios (including scenario 1, the status quo) for a tramway location in the area of Les Tranchées, Geneva (fig. 1).

Methodology (see fig. 4)
1. Follow a structured approach to not miss information.
2. MCA is a useful tool for PT planning because it includes different scenarios, actors and criteria and it is possible to measure the credibility of the results.

Case study
Following the methodology scenario #5 (Boulevard Emile-JAQUES-DALCROZE) is most preferable using the defined weights, preferences and actors.