Saving Money and Optimizing Routes with ArcLogistics

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Routing and Scheduling

• Problem
  • Routing people, goods, and services at specific times of day for the lowest cost

• Solution
  • Lower Overall Costs (Vehicle and Labor)
    • Drive fewer miles
    • Lower fuel costs
  • Increase On-Time Arrivals
    • Improve customer service and satisfaction
Precursor - Sears Home Delivery & Technician Routing

- “What if”
  - Can you route trucks?
  - Goals… More stops on fewer trucks
- Vehicle Routing Problem with Time Windows
- Sequencing and Route Improvements
- GIS & Operations Research techniques
- Additional Benefits & Research Areas
  - Consolidated Distribution Centers
  - PickPath - Routing Forklifts inside Warehouse
    - What if: 12 additional picks per forklift per hour
- Result = $42 million annual savings
Benefits of ArcLogistics

• Without Optimized Routing:
  • Inefficient Routes
    • Use more vehicles, labor, and fuel than necessary
    • Missed time windows

• With Optimized Routing
  • Greater On-Time Service
  • Tighter Time Windows
  • Maximize vehicle capacity
  • Reduced Labor & Overtime
  • Balanced Workloads
  • Honor existing zones or territories
  • Provide specialized services
  • Accommodate last-minute changes
  • Manual Override – can assign specific orders to vehicles
Who Uses ArcLogistics

• Government
  • Car/Van Pools, Paratransit, Parole Officers, Special Pickups, Property Appraisers, Inspectors

• Commercial
  • Deliveries, Technicians, Couriers, Office Supply, Shuttle Services, Food & Beverage

• Utilities & Telecom
  • Work Crews

• Medical / NonProfit
  • Home Health Care, In-Hospital Care, Meals on Wheels
Good Candidates for ArcLogistics

• Product or Service Delivery
  • Moving Goods or People
  • Mobile Assets or Workers
• Small to medium size fleet
  • 10-100 vehicles
  • Vehicles capacities and specialties
• About 1,000 stops a day
  • Work Orders with Specific Time Windows
  • Requirements for Special Skills or Equipment
• Routes Generated Ahead of Time
• Dynamic - Last Minute Changes and New Orders
May Not Be Suited For

- 200+ vehicles at a time
- 2,000+ stops at a time
- Long Haul Trucking
- Static Routes
- Postman or Sanitation Routing
  - Every house on both sides of street
ArcLogistics Technology

- ArcGIS Engine 9.3
- Network Analyst
  - Network Dataset
  - Vehicle Routing Problem Solver
- Routing Project stored as File Geodatabase
ArcLogistics
Recent and Future Changes

• With 9.2, Network Analyst could only solve one single route at a time
  • Traveling Salesman Problem (TSP)
• ArcLogistics and Network Analyst 9.3 now share the same solver capable of solving multiple routes at the same time
  • Vehicle Routing Problem (VRP)
  • ArcLogistics provides user interface and tools
  • Creates OD matrix (nStops X nStops) to solve
• Next release will be Web-based Service
Setup

- Navteq or Tele Atlas Roads
  - Or your own roads in Network format
- Define Start and End Locations / Depots
- Define Vehicle Properties
  - Capacity (Passengers or Goods)
    - Number, Volume, Weight
  - Special Services or Equipment
- Costs
  - Fixed Costs (vehicle rental)
  - Costs Per Mile (mileage reimbursement)
  - Hourly Rates: Labor and Overtime
- Optional: Distribution Zones or Territories
Setup

Business Rules

• Preferences
  • Highways
  • Bridges
  • Toll Roads
  • Turn Policies
  • Road Rules
Least Cost Routing Solution

- ArcLogistics generates least cost solutions for routing and scheduling
- Available Vehicles
  - Capacity
  - Specialties
  - Start Time, End Time, Breaks
  - Costs: Fixed, Per Mile, Labor
- Work Order Constraints
  - Time Window / Appointment Times
  - Special Skills or Equipment Needed
Interface

Views: Tree, List, Map, Time
Locations

- Distribution Center Location Properties
Vehicles

• Vehicle Properties for each Vehicle
  • Capacities
  • Operating Costs
  • Specialties
  • Start/Stop

<table>
<thead>
<tr>
<th>Name</th>
<th>Driver</th>
<th>Start Range</th>
<th>Specialties</th>
</tr>
</thead>
<tbody>
<tr>
<td>BB1</td>
<td>Jeff</td>
<td>6:00:00 AM - 8:00,...</td>
<td>BB</td>
</tr>
<tr>
<td>BB2</td>
<td>Lou</td>
<td>6:00:00 AM - 8:00,...</td>
<td>BB</td>
</tr>
<tr>
<td>SD1</td>
<td>Karl</td>
<td>6:00:00 AM - 8:00,...</td>
<td>SD</td>
</tr>
<tr>
<td>SD2</td>
<td>Zach</td>
<td>6:00:00 AM - 8:00,...</td>
<td>SD</td>
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<tr>
<td>SD3</td>
<td>Jake</td>
<td>6:00:00 AM - 8:00,...</td>
<td>SD</td>
</tr>
<tr>
<td>SD4</td>
<td>Luke</td>
<td>6:00:00 AM - 8:00,...</td>
<td>SD</td>
</tr>
<tr>
<td>SD5</td>
<td>Yannick</td>
<td>6:00:00 AM - 8:00,...</td>
<td>SD</td>
</tr>
<tr>
<td>SD6</td>
<td>Greg</td>
<td>6:00:00 AM - 8:00,...</td>
<td>SD</td>
</tr>
</tbody>
</table>
Routing Preferences

- Lowest Cost vs. Meet Time Windows
- Transit Time for Paired Orders
- U-Turn Policies
- Restrictions
- Barriers
Driver Territories / Zones

- Import Polygon Feature Class
- Create Zone Center Points
Barriers

- Can create point and Polygon barriers to navigation
- System will route around obstacles
Work Order Table

- Work Order Table – multiple formats
  - mdb, dbf, xls, txt
- Each order record is a stop
  - Address for Pick Up or Drop Off
  - Time Window / Appointment Time
- Paired Orders
  - Pick up in one place and drop off at another
- Curb Approach
- Any Special Service or Equipment Required

<table>
<thead>
<tr>
<th>Street</th>
<th>Postal</th>
<th>CustomerN</th>
<th>FromTime1S</th>
<th>ToTime1S</th>
<th>ServiceTime</th>
<th>TotalWeight</th>
<th>TotalVolumn</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 WHISPERIN</td>
<td>2828</td>
<td>H278</td>
<td>2:00:00 PM</td>
<td>5:00:00 PM</td>
<td>60</td>
<td>125</td>
<td>50</td>
<td>Stove &amp; Refrig</td>
</tr>
<tr>
<td>15 BLUE MIST D</td>
<td>2838</td>
<td>K564</td>
<td>2:00:00 PM</td>
<td>5:00:00 PM</td>
<td>60</td>
<td>125</td>
<td>50</td>
<td>Stove &amp; Refrig</td>
</tr>
<tr>
<td>9 BEECH ST</td>
<td>2860</td>
<td>H872</td>
<td>2:00:00 PM</td>
<td>5:00:00 PM</td>
<td>30</td>
<td>75</td>
<td>20</td>
<td>Washer</td>
</tr>
<tr>
<td>77 MEADOW ST</td>
<td>2860</td>
<td>L231</td>
<td>2:00:00 PM</td>
<td>5:00:00 PM</td>
<td>30</td>
<td>75</td>
<td>20</td>
<td>Stovetop</td>
</tr>
<tr>
<td>60 NORTON ST</td>
<td>2860</td>
<td>J323</td>
<td>11:00:00 AM</td>
<td>2:00:00 PM</td>
<td>30</td>
<td>75</td>
<td>20</td>
<td>Washer</td>
</tr>
<tr>
<td>3 BRIARWOOD</td>
<td>2860</td>
<td>J611</td>
<td>11:00:00 AM</td>
<td>2:00:00 PM</td>
<td>30</td>
<td>125</td>
<td>20</td>
<td>Refrigerator</td>
</tr>
<tr>
<td>7 BLUE MIST DF</td>
<td>2838</td>
<td>D236</td>
<td>11:00:00 AM</td>
<td>2:00:00 PM</td>
<td>30</td>
<td>75</td>
<td>20</td>
<td>Washer</td>
</tr>
<tr>
<td>10 DOUGLAS HK</td>
<td>2814</td>
<td>J611</td>
<td>8:00:00 AM</td>
<td>11:00:00 AM</td>
<td>60</td>
<td>125</td>
<td>50</td>
<td>Stove &amp; Refrig</td>
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</table>
**Special Needs - Paired Orders**

- **Note Specialties and Curb Approach**

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Delivery Type</th>
<th>Arrive Time</th>
<th>Order No.</th>
<th>Customer No.</th>
<th>Curb Approach</th>
<th>Specialties</th>
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<tbody>
<tr>
<td>8</td>
<td>Pickup</td>
<td>8:10:00 AM</td>
<td>3455</td>
<td>340036</td>
<td>Right side</td>
<td>Wheel</td>
</tr>
<tr>
<td>12</td>
<td>Delivery</td>
<td>8:19:00 AM</td>
<td>3455</td>
<td>340036</td>
<td>Either side</td>
<td>Wheel</td>
</tr>
<tr>
<td>5</td>
<td>Pickup</td>
<td>7:47:14 AM</td>
<td>2918</td>
<td>2010767</td>
<td>Either side</td>
<td>Vest</td>
</tr>
<tr>
<td>9</td>
<td>Delivery</td>
<td>8:16:00 AM</td>
<td>2918</td>
<td>2010767</td>
<td>Either side</td>
<td>Vest</td>
</tr>
<tr>
<td>1</td>
<td>Pickup</td>
<td>7:30:25 AM</td>
<td>3223</td>
<td>2060286</td>
<td>Right side</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Pickup</td>
<td>7:33:24 AM</td>
<td>3607</td>
<td>1500812</td>
<td>Right side</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Delivery</td>
<td>7:39:53 AM</td>
<td>3607</td>
<td>1500812</td>
<td>Either side</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Delivery</td>
<td>7:40:53 AM</td>
<td>3223</td>
<td>2060286</td>
<td>Either side</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Pickup</td>
<td>7:56:44 AM</td>
<td>2971</td>
<td>2141964</td>
<td>Either side</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Pickup</td>
<td>8:02:25 AM</td>
<td>2884</td>
<td>2143648</td>
<td>Right side</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Delivery</td>
<td>8:17:00 AM</td>
<td>2971</td>
<td>2141964</td>
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<td></td>
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<tr>
<td>11</td>
<td>Delivery</td>
<td>8:18:00 AM</td>
<td>2884</td>
<td>2143648</td>
<td>Either side</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>7:11:15 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>8:24:30 AM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Paratransit – Paired Orders

- Paired Order
- Note desired drop off time window

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Arrive Time</th>
<th>Order No.</th>
<th>Customer No.</th>
<th>Name</th>
<th>Time Window</th>
<th>Street</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8:47:09 AM</td>
<td>Chr219</td>
<td>325875</td>
<td>Vehicle Depot</td>
<td>7:00:00 AM - 6:00...</td>
<td>9 Tramore Rd</td>
</tr>
<tr>
<td>2</td>
<td>9:15:38 AM</td>
<td>Chr219</td>
<td>6 ROSE GARTH</td>
<td>Christian</td>
<td>6 ROSE GARTH</td>
<td>6 ROSE GARTH</td>
</tr>
<tr>
<td>3</td>
<td>9:27:47 AM</td>
<td>Chr219</td>
<td>Cork Univers</td>
<td>9:20:00 AM - 9:50...</td>
<td>BISHOPSTOWN</td>
<td>BISHOPSTOWN</td>
</tr>
<tr>
<td>4</td>
<td>9:50:00 AM</td>
<td>Rey234</td>
<td>012177</td>
<td>Reynolds</td>
<td>9:20:00 AM - 9:50...</td>
<td>BISHOPSTOWN</td>
</tr>
<tr>
<td>5</td>
<td>10:07:26 AM</td>
<td>Doy922</td>
<td>120062</td>
<td>Doyle</td>
<td>Wide Open</td>
<td>12 CULL NA GF</td>
</tr>
<tr>
<td>6</td>
<td>10:24:47 AM</td>
<td>Doy922</td>
<td>Cork Univers</td>
<td>10:10:00 AM - 10:4...</td>
<td>BISHOPSTOWN</td>
<td>BISHOPSTOWN</td>
</tr>
<tr>
<td>7</td>
<td>10:36:20 AM</td>
<td>Oco882</td>
<td>881722</td>
<td>O'Connor</td>
<td>Wide Open</td>
<td>149 GLENHEIG</td>
</tr>
<tr>
<td>8</td>
<td>10:48:11 AM</td>
<td>Oco882</td>
<td>Cork Univers</td>
<td>10:20:00 AM - 10:5...</td>
<td>BISHOPSTOWN</td>
<td>BISHOPSTOWN</td>
</tr>
<tr>
<td>9</td>
<td>11:00:04 AM</td>
<td>Yau200</td>
<td>009512</td>
<td>Yauch</td>
<td>Wide Open</td>
<td>9 AUGUSTA DF</td>
</tr>
<tr>
<td>10</td>
<td>11:12:37 AM</td>
<td>Yau200</td>
<td>Bon Secours...</td>
<td>10:50:00 AM - 11:2...</td>
<td>COLLEGE ROA</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>11:14:37 AM</td>
<td>Lunch</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>11:50:00 AM</td>
<td>Cox930</td>
<td>Cork Univers</td>
<td>11:50:00 AM - 12:2...</td>
<td>BISHOPSTOWN</td>
<td>BISHOPSTOWN</td>
</tr>
<tr>
<td>13</td>
<td>12:15:12 PM</td>
<td>Cox930</td>
<td>083154</td>
<td>Cox</td>
<td>Wide Open</td>
<td>16 Oliver Plunk</td>
</tr>
<tr>
<td>14</td>
<td>12:50:00 PM</td>
<td>Cox930</td>
<td>Cork Univers</td>
<td>12:50:00 PM - 1:20...</td>
<td>BISHOPSTOWN</td>
<td>BISHOPSTOWN</td>
</tr>
</tbody>
</table>
## Order Properties

### Beverage Distribution

<table>
<thead>
<tr>
<th>Se...</th>
<th>Arrive Time</th>
<th>Name</th>
<th>Order No.</th>
<th>Service Time</th>
<th>Time Window</th>
<th>Street</th>
<th>City</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6:45:45 AM</td>
<td>Distribution</td>
<td>15</td>
<td>6:00:00 AM - 8:00:...</td>
<td>642 E M St</td>
<td>Colton</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>7:08:30 AM</td>
<td>7-ELEVEN 20...</td>
<td>32269002</td>
<td>45</td>
<td>Wide Open</td>
<td>1150 W 11TH ST</td>
<td>SN BERN...</td>
</tr>
<tr>
<td>3</td>
<td>7:58:34 AM</td>
<td>SUPER MAX</td>
<td>37829001</td>
<td>45</td>
<td>4:20:00 AM - 11:59...</td>
<td>3076 FREMONT...</td>
<td>SN BERN...</td>
</tr>
<tr>
<td>4</td>
<td>8:43:45 AM</td>
<td>GROG SHOP</td>
<td>37684001</td>
<td>45</td>
<td>Wide Open</td>
<td>3070 N FEP...</td>
<td>SN BERN...</td>
</tr>
</tbody>
</table>
List View
Route Details

- Routes (top)
  - Number Stops
  - Cost per Route
  - Total Mileage

- Stops (bottom)
  - Arrival Time
  - Time Window
Map View

• Each route color coded
• Stop sequence labeled
Map View
ArcWeb Services

• Weather
• Traffic
Time View

- Each Horizontal Bar is a Route
- Stop duration indicated by solid blocks
- Color coded to match routes on map
- Start Time, Breaks, End Time in black
- Time Violations highlighted in red
- Tool Tips show stop information
Report Options

Various Report options for Dispatcher, Manager, Loading and Drivers

- Dispatcher Summary
- Manager Summary
- Load Report
- Route Manifest
- Predicted Violations Report
- Route Manifest w/ Overview Map
- Route Manifest w/ Maps & Directions
Route Manifests

- Route Manifest reports for each driver
  - Overview Map
  - Travel directions
  - Stop Sequence
  - Work Order Information
  - Appointment Time
  - ETA
Export Routes to ArcLogistics Navigator

• GPS In-Vehicle Navigation software from ESRI
• Transmit Route and Updates (Email)
  • Alerts driver to new routes
• Interactive Map
• Turn By Turn Directions
  • Verbal and On Screen
• Re-routes to original route
  • Honor restrictions and business rules in the field
  • Adhere to exact streets identified in route
  • Reduce off-route miles
  • In case of road obstruction, driver can manually alter plan
• Windows
  • Handheld or dash-mounted mobile device
• Routes from ArcLogistics or ArcGIS Network Analyst
• ArcGIS Mobile and ArcPad in field
“What If” Scenarios

• Model different scenarios in separate Projects and Routing Folders

• Scenarios – What would happen if...
  • I used more or fewer vehicles
  • Labor or gas prices change
  • Hours of operation change
  • We moved our distribution facility
Case Study
San Diego Regional Center

- Services for persons with disabilities
- Red Cross eliminated transportation
- Initially tracked pickups by MapBook page
- With ArcLogistics
  - Went from 4.4 to 5.8 trips per hour
  - Avoid route overlap by different contractors
  - Increased efficiency for transportation contractors
Case Study
Star Tribune, Minneapolis-St. Paul

• Delivery routes calculated periodically as conditions change
• Before: 3 employees 4 hours a day for a month to route 3,700 stops on 39 trucks
• 2 week startup with ArcLogistics
• Payback in 2.5 months
• 5 Year Net Savings $672,740
Cost Savings - ROI

• Save 10-30% a year with ArcLogistics
  • Gas
  • Mileage
  • Vehicle Maintenance
  • Labor

• Save another 10% with ArcLogistics Navigator

• Recover investment in months
  • Order volume, fleet size
Benefits

• Lower Overall Costs
  • Save Money

• More Efficient Routes
  • Drive Fewer Miles
  • Save on Gas

• Optimized delivery sequences help reduce loading / unloading times

• Honor Time Windows
  • Improve Customer Service
Added Benefits

• Use Fewer Vehicles
• Save on Maintenance
• Lower Carbon Footprint
About Geographic Systems LLC

• We are an ESRI Business Partner
  • ESRI Authorized ArcGIS Instructor
  • Consultant & Value Added Reseller
    • ArcView & ArcGIS Extensions
    • ArcLogistics & ArcLogistics Navigator

• We sell and configure ArcLogistics & ArcLogistics Navigator

• For more information:
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