Spatial Decisions: Support for Praxair’s National Logistics Center

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Table of Contents

• About Praxair
• Old System vs. New System
• System requirements
• Some involuntary detours
• Our current system
About Praxair

A $5 Billion global company and growing

Atmospheric Gases
• Oxygen
• Nitrogen
• Argon

Process Gases
• Carbon Dioxide
• Hydrogen
• Helium
• Electronic Gases

Surface Coatings
• Wear resistant
• High temperature

Praxair operates in 44 countries around the world
Praxair’s Bulk Gas Distribution

Praxair USA has

– 70 production/distribution facilities
– 700 tanker trucks
– 700 railcars
– 1,400 drivers
– 11,000 customers
Praxair’s Bulk Gas Distribution

Trucking statistics

– drive 85 mm miles a year
– make 35,000 to 40,000 deliveries per month
– 7 X 24 hours of operation
Delivery Optimization

• Praxair manages customers’ inventory
  – we need to decide when to deliver and how much to deliver

• Two crucial pieces of data
  – use rate (to predict how much will be delivered)
  – time of travel (to predict when a truck would arrive)

• More accurate time of travel predictions allow more efficient management of inventory
Former System

- Customers and production facilities were geocoded using zip-code centroids
- Estimated mileage/duration was calculated using the law of cosines
- Did not allow visualization of planned trips or spatial decision support
New System (Justification)

• Geocoding based on street addresses
• Travel time and mileage estimates calculated using road network
• Works in Canada
• Foundation for better decision support tools
• Allows a spreadsheet to be viewed as a map
System Performance

- User expects map rendering to occur instantaneously, willing to settle for 1 to 2 seconds
- Must work in remote locations, (e.g. 56k modem)
- Point-to-point solves with turn-by-turn directions for the United States and Canada
System Maintenance

• Want to avoid labor intensive processes
• Purchase as much of the system as possible (street data / solver algorithms)
• Need to be able to customize data easily
  – Hazardous materials routing
  – Commercial vehicle limitations
Involuntary Detours

- The Majors
- The Zones
- Almost all the streets
- The drawbacks of a 32-bit operating system
Just the Majors

- Brilliant simplicity
- Only use the major roads
  - gets rid of 85% of the segments
  - nice, small network
  - easy to maintain
Drawbacks

• Turn-by-turn directions less than complete
• Travel time estimates within 30 minutes, not so great
• Some trips between customers don’t even use major roads
• Field deliveries
Zone Solution

• Divide country into zones and solve locally
• Contains all roads, so all customers are accessible
• Turn-by-turn directions go all the way to the customer
Zone Graphic
It worked, but not really

- Travel time estimates much better
- Tricky solution for solving long-distance trips
- Creating the system was extremely labor-intensive
- Maintaining the system equally difficult
Single Network Development

• Easy to build and maintain
• Still has all the roads
• Long-distance solves do not require special attention
• We were able to easily include Canada
Still not perfect

- Did I mention that Windows is a 32-bit operating system….
- Network file size limitations (we only remove 2.3 million segments)
- Memory limitations when building the networks
- Memory limitations when solving on the network
System Description

• Production data server
  – 8-700 Mhz
  – 8 GB RAM
  – 550 GB RAID-5 HD

• Production application server
  – Win2K Terminal Server
  – 4-400 Mhz
  – 4 GB RAM
What we solve

- Plant to customer locations
- Alternate plants to customers
- Customers to all neighbors
  - radial
  - path buffer
- Field deliveries
Front End Description

- VB MapObjects client
- ActiveX components
- Used by proprietary applications
- Allows some simple queries
- Provides some simple decision support tools
- Provides planners with ability to see tours and their spatial relationship with customers
Screen Shot
Screen Shot
Screen Shot
Questions
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