WHERE ARE THE TRUCKS?
USING GPS DATA TO DRIVE PORT DECISION-MAKING

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AGENDA

- Introduction
- Project Background
- Drayage Model
- Analysis Tools
- In-Depth Example
- Conclusion
- Questions
 INTRODUCTION

• Who We Are: Port Metro Vancouver
  • Canada’s largest gateway, handling 19 percent of the value of Canada’s total trade in goods
  • Third largest tonnage port in North America
  • Most diversified port in North America
    • Business sectors include automobiles, breakbulk, bulk, container and cruise
  • Facilitates trade with more than 160 world economies
  • Handled 140 million tonnes of cargo in 2014
  • Responsible for more than 16,000 hectares of water, and more than 1,000 hectares of land and assets along ~350 kilometres of shoreline
INTRODUCTION

• Port Metro Vancouver Jurisdiction
INTRODUCTION

• **Who We Are: TranSystems Corporation**
  • Serving the transit industry since 1966
  • Nearly 1,000 professionals in 40 offices throughout the United States
  • Listed in Engineering News Record as the country’s 17th largest transportation firm and 10th largest bridge firm
  • Comprehensive experience with other port authorities, such as: Port of Long Beach, Port Everglades, Port of Tacoma
INTRODUCTION

• Who We Are: TranSystems Corporation
  • Dedicated Operations Planning and Analysis practice area
    • Utilizes simulation modeling and other analytical methods to evaluate transportation projects, facility improvement and goods movement strategies.
    • Specializes in integrating other technologies into our modeling including GIS, databases, ESRI Arc Map
  • Modeling approach allows us to analyze entire transportation systems
    • Not just as a standalone gate or traffic model
    • Where multiple modes and facilities can be integrated to test impacts of operating rules and policy
• Project = Smart Fleet program, a Port initiative
  • Started in 2013, with three goals:
    1) Improve efficiency & reliability of terminal operations
    2) Reduce greenhouse emissions from trucks
    3) Strengthen the Port’s competitive advantage
• Four phases of program (we will cover first two):
  1) GPS installation
  2) Drayage Model software implementation
  3) Truck Licensing System (TLS) reform
  4) Common reservation system implementation
PROJECT BACKGROUND

- Program timeline so far

EARLY 2012
- Container Drayage Efficiency Pilot Program
  - 300 trucks
  - 16% of fleet

EARLY 2013
- GPS Program Expansion Drayage Model Project
  - 1000 trucks
  - 50% of fleet

MID-2014
- GPS units installed on all container fleet
  - 2000 trucks
  - 100% of fleet
PROJECT BACKGROUND

• GPS installation
  • GPS points are recorded in response to certain events
  • Ignition On
  • Ignition Off
  • Start Moving
  • Stop Moving
  • Turn
  • Enter/Leave Geofence
  • Time (5-minute intervals)
PROJECT BACKGROUND

- Geofences are areas of significant container activity
- Terminals and offdock facilities shown below
• Significant GPS attributes collected:
  • Longitude
  • Latitude
  • Truck ID
  • Speed
  • Direction
  • Street Name
  • Address Number
  • Received On (Date/Time)
  • Trigger Event
• Drayage Model software
  • Decision-support tool with several different components
    • Reports truck movement and evaluates potential changes in regional transportation policies/regulations
    • Forecasts and analyzes potential impacts to stakeholders
    • Assessed the effectiveness of change through scenarios
    • Evaluates emissions, estimated costs, turn times, volumes, hours of operations, and effects on competitiveness
  • Benefits include more informed decision-making, increased predictability, and improved financial outcomes
PROJECT BACKGROUND

• TranSystems Corporation
  • Provided technical background required to utilize GPS, a renewable data source, to build a user-friendly analysis tool
    • Provides performance metrics
    • Allows visualization through ESRI ArcMAP
  • Built a regional drayage model
    • Combined GPS data, discrete event simulation, and data processing
    • Unique because the data is renewable on a monthly or more frequent basis allowing for continual and up-to-date scenario planning and monitoring
DRAYAGE MODEL
DRAYAGE MODEL

- Our GIS team focuses on processing and analyzing GPS data to report on truck movement

- Import process:
  1) Run GPS Data Processor
     - Set date parameters for data
  2) Launch ArcMAP
     - Open custom toolbox
     - Import GPS points
     - Connect points based on truck ID to create lines
     - Create trips that start and end in geofences
     - Calculate inputs for other Drayage Model components
• Process results in more than 200,000 monthly trips (20 million segments total, 15GB file geodatabase)
Each trip line includes:

- Truck ID
- Point Received On (Date/Time)
- X & Y Coordinates
- Origin Geofence
- Destination Geofence
- Trip ID
- Bearing

- Trip Type
- Traffic Analysis Zone
- Hour
- Truck Age
- Emission Bin
- Meters From Previous GPS Point
Once importing is complete, our GIS team uses several tools to analyze the trips:

- Seven tools total
- Three tools produce monthly reports
- Four tools are run upon request

Tools were built in two ways:
- ModelBuilder for model tools
- Python Programming Language for script tools
1. Isolate Truck Movement tool
   • Produces total trips for an individual truck
ANALYSIS TOOLS
ANALYSIS TOOLS

2. Isolate From-To Trips tool
   • Produces total trips for a specific origin/destination geofence combination
3. Isolate Individual Trip tool
   • Produces a specific trip by a single truck
4. Origin Destination Matrix Table tool

- Reports total number of trucks entering and leaving each geofence
5. Bridge Crossings Map tool

- Produces total number of trucks crossing each bridge for three specific time periods
ANALYSIS TOOLS
6. Hourly Truck Volumes by Direction tool
   • Shows total number of trucks intersecting a user-defined line, broken down by hour and direction
ANALYSIS TOOLS

7. Origin Destination Traffic Volume Maps tool
   • Shows routes taken to and from each of the geofences
   • Produces 50 maps total when run
IN-DEPTH EXAMPLE

• Now a behind-the-scenes look at the Origin Destination Traffic Volume Maps tool
• Good example of logic we use in doing these different kinds of analysis
• 5-step automated process for each geofence when user runs the tool
IN-DEPTH EXAMPLE

- Query trip lines
- Count trucks against road
- Calculate volume
- Change road colour and labels
- Export PDF map
IN-DEPTH EXAMPLE

- Query trip lines
- Count trucks against road
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IN-DEPTH EXAMPLE

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• Large volume of data was a challenge
  • Initial pilot used MS Access
    • Due to increasing number of trucks using GPS, we quickly realized data was too large
    • Converted to SQL Server for data processing
  • Once entire fleet was equipped with GPS, ArcMAP had difficulty processing all the monthly GPS points
    • ArcMAP is 32-bit software
    • Converted all GPS import tools from Modelbuilder to Python
    • Ran successfully in 64-bit Background Geoprocessing environment
  • Long processing times also a trade-off
CONCLUSION

• Next steps:
  • Regional transportation planning
    • Make compatible with Translink Traffic Analysis Zones
  • Environmental considerations
    • Calculate emissions based on truck age, speed, and distance
    • Use calculations to create maps of total volumes
  • Real-time GPS feed for terminals
    • Monitor traffic on-site
      • Track how long a truck is on the terminal
      • Help terminals avoid paying wait time fees
QUESTIONS?

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