Digital Transformation of Last-Mile Delivery

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Each day a subset of customers require deliveries

- The deliveries must be grouped into routes and sequenced in delivery order
- The results must satisfy delivery constraints, be efficient and make customers happy
Number of Possible Delivery Routes

• Suppose there are **200 customers** that must be visited with **10 trucks**.

• There are \((200 \text{ to the } 10^{th} \text{ power})/10!\) or about **55 trillion possible groupings** of the customers into the **10 routes**.

• There are **20!** or about **2,433 trillion possible sequences** for a group with **20 customers**.

• It is **impossible** to generate delivery routes that are **provably optimum**.

• Good route optimizers combine **efficient computer processing** with **optimization concepts** to evaluate very large numbers of good groupings and sequences and select the best possible in the time available.

• The only way to **evaluate** a route optimizer is to **try it**!
Delivery Environments are continually changing

• Increasing urban deliveries
• Changing traffic patterns
• Decreased parking availability
• Restrictions on road usage by trucks
• Increasing customer expectations
• Decreased time available for planning
• Increasing cost of labor
• Increasing stop time to drive time ratio
• Increasing delivery cost to value ratio
• Multiple customers serviced from the same stop
• Increasing customer-first strategies
What is wrong with current delivery management?

- Assumes an unrealistically static environment
- Inaccurate and missing data
- Poor time estimates for routes
- Extensive manual effort on daily route plans
- Ad hoc planning processes
- Inefficient or unachievable delivery plans
- “Islands” of technology
- Delivery monitoring doesn’t improve delivery planning
- No digital process improvement
A Better Approach - Adaptive Delivery Management

1. Master Planning Tools
2. Automatically optimize daily delivery plans
3. Use mobile devices to monitor status & capture delivery data
4. Use data hub to organize and store delivery data
5. Apply data science to improve data & identify problems

Business Intelligence
ETAs & Alerts
Analytics
Visualizations
Master Planning Tools

Use data hub to organize and store delivery data
Apply data science to improve data & identify problems
Optimize and adapt master delivery plan when required
Use mobile devices to monitor status & capture delivery data
Automatically optimize daily delivery plans
Delivery Dynamics Integrated Platform

- Dispatch
- Monitoring and Exception Handling
- Delivery Mobile Assistant
- Sales Mobile Assistant
- Analytics and Business Intelligence
- Data Science
- Automated Geocodes
- Automated Route Optimization
- Master Route Planner
Design Issues – traditional sales

• Determine delivery day assignments
  • Drivers are typically on salary
  • Trucks are owned or leased
  • Costs are mostly fixed
  • Minimize delivery cost by balancing work over days

• Determine sales rep assignments
  • Delivery frequency is usually based on sales volume
  • For “traditional sales” a sales rep takes orders that are delivered X days later
  • Minimize sales rep cost by balancing work over days

• Determine route strategy
  • Driver familiarity decreases drive time and service time
  • Customers like having the same driver and salesperson each visit
  • Returns and revisits
  • Dynamic or master routes
What data is required?

- Customer data
  - Geocodes
  - Delivery stop times
  - Delivery windows
  - Delivery restrictions

- Drive data
  - Drive times
  - Drive distances

- Order data
  - SKUs
  - Quantities
  - Size

- Product data
  - Weight
    - Volume

- Truck data
  - Size
  - Cost

- Driver data
  - Availability
  - Cost

- Stop data
  - Parking
  - Multiple delivery points
Stop time data

- Typical approach is to use a general estimating function \( \text{time} = (\text{fixed time}) + (\# \text{ line items})*(\text{variable time}) \)
- Often very large errors in predicted delivery times
- Better approach is to use a different estimating distribution for each customer
Drive time data

• Data required
  • Drive distance matrix
  • Drive time matrix

• Sources
  • Google
  • Bing
  • Open streets

• Problems
  • Bad geocodes
  • Bad network assignment
  • Drive time variability

• Solution
  • Revise based on GPS trails
“Automated” Route Optimization

- Dynamic routes
- Master routes

True cloud routing and scheduling solution that leverage parallel computing architecture and advanced optimization algorithms.

Flexible constraints and objectives
Automated Daily Route Generation

Efficient and compact routes
Mobile Platform

• Capture GPS trails
• Capture reasons for returns
• Capture reasons for no sales
• Provide digital information to help driver and salespeople improve effectiveness
• Provide managers with “smart” real-time visibility
• Provide alerts to drivers, salespeople, managers and customers
Customer #401615

MINI SUPER EL CANGREJO

PREVIOUS  SKIPPED CUSTOMER  NEXT

ACTIONS

Add a note or comment

INFORMATION

Driving directions
Address: CALLE F EL CANGREJO PANAMA

Delivery time window
Not specified. Tap here to input a delivery time window.

Make phone call
The customer’s phone number is not

Specify reason

Out of route
Unable to find customer
I would not make it on time
Maximum route time exceeded
Supervisor decision
Truck too big
Other

Make phone call
The customer’s phone number is not available.
MODIFY ORDER
16634 EXH 6 BATERIAS AA

Modify quantity
Delivering 0 out of 4 ordered

Specify reason for modification
Provided reason: Product not on truck

Add a note or comment

DONE

Modify Order

Specify reason

Not ordered
Insufficient money
No longer wanted
Damaged
Incorrect quantity invoiced
Incorrect price invoiced
Product not on truck
Wrong product on truck
Expired or about to expire
Other

Order #3509412

<table>
<thead>
<tr>
<th>QTY</th>
<th>PRODUCT</th>
<th>DESCRIPTION</th>
<th>UNIT PRICE</th>
<th>TAX</th>
<th>SUBTOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>PG-82838</td>
<td>CHARMIN ESSENTIAL 1 MEGA ROLL 451CT</td>
<td>$0.00</td>
<td>7%</td>
<td>$0.00</td>
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<tr>
<td>0</td>
<td>16634 EXH 6 BATERIAS AA</td>
<td>UNIT PRICE: $4.27</td>
<td>TAX: 7%</td>
<td>SUBTOTAL</td>
<td>$0.00</td>
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<td>2</td>
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<td>UNIT PRICE: $4.27</td>
<td>TAX: 7%</td>
<td>SUBTOTAL</td>
<td>$0.00</td>
</tr>
<tr>
<td>1</td>
<td>88-812590</td>
<td>ENFAGROW 3 PREM 1700G / 6UN</td>
<td>UNIT PRICE: $35.92</td>
<td>TAX: 0%</td>
<td>SUBTOTAL</td>
</tr>
</tbody>
</table>

Non-taxable subtotal: 35.92
Taxable subtotal (7%): 30.90
Tax (7%): 2.16

Total: $68.98*
What is the role of real-time visibility?

Execution at a glance

<table>
<thead>
<tr>
<th>Last Contact</th>
<th>Status</th>
<th>Visited</th>
<th>Distance to DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:17 AM</td>
<td>Left MINI SUPER MULTICENTRO VERANILLO at 11:15 AM</td>
<td>9 / 21 (42%)</td>
<td>2.8 km</td>
</tr>
<tr>
<td>11:16 AM</td>
<td>Arrived at MINI SUPER ESTRELLA DORADA at 11:03 AM</td>
<td>15 / 25 (60%)</td>
<td>17.0 km</td>
</tr>
<tr>
<td>11:08 AM</td>
<td>Arrived at MINI SUPER LA GLORIA at 11:06 AM</td>
<td>10 / 21 (48%)</td>
<td>49.8 km</td>
</tr>
<tr>
<td>10:56 AM</td>
<td>No deliveries yet</td>
<td>0 / 1 (0%)</td>
<td>8.4 km</td>
</tr>
<tr>
<td>10:58 AM</td>
<td>Arrived at MINI SUPER CRISTALINA at 10:58 AM</td>
<td>10 / 20 (50%)</td>
<td>47.8 km</td>
</tr>
<tr>
<td>11:16 AM</td>
<td>Arrived at MG LA NUEVA ESPERANZA at 11:17 AM</td>
<td>9 / 18 (50%)</td>
<td>21.2 km</td>
</tr>
</tbody>
</table>

Detailed map view

Delivery Dynamics
Automated data improvement

- Geocodes
- Stop times
- Drive times
What is the role of business analytics?

- Business decisions
- Business insights
- Identify where to improve delivery
- Identify how to improve delivery
Why Delivery Dynamics?

**KEY FEATURES**

- Tools for developing master plans that digitally maintain the key characteristics of the delivery system and guide daily route optimization.
- Automated optimization of daily route plans.
- Mobile applications to collect delivery data and provide real-time status.
- Business intelligence regarding routes, deliveries, drivers, customer and products.
- Data science for cleaning data, improving planning estimates and identify problems.
- Integrated technology designed to support a continual improvement process.

**BENEFITS**

- Better utilization of drivers and sales reps.
- More driver/customer familiarity.
- Improved planner productivity.
- More efficient and reliable delivery plans.
- Systematic planning process.
- Fewer planners to maintain and train.
- Provides data for master delivery plan improvements.
- Enables supervisors to mitigate delivery problems.
- Provides customer visibility to delivery status.
- Analytical measurements of driver performance and customer profitability.
- Identification of problem accounts and products.
- Better data and planning estimates.
- Guidance for improving delivery plans.
- A single point of support for delivery technology.
- Technology components designed to work together.
- Seamless movement of data reduces risks.
Questions?