Using Data Analytics to Drive Decision Making and Improve Resiliency in Last Mile Distribution

Track 16 / Abstract 136
November 15, 2023
Panel Agenda

Introductions – 5 minutes

Presentations – 10-12 minutes each

Q&A and Discussion – 15-20 minutes
Introduction

PANEL:
Using Data Analytics to Drive Decision Making and Improve Resiliency in Last Mile Distribution

Moderator: Kevin Pilz
Senior Supply Chain Advisor, USAID
kpilz@usaid.gov

PANELISTS

Increasing the visibility on the value of using data analytics to support last mile approaches
James Flood, Frontline Research Group/Project Last Mile, jamesfl@frontlineafrica.com

Using an open-source dynamic routing tool for sustainable, flexible, and cost-effective last mile distribution in Zambia
Bruce Kamuti, Zambia Medicines and Medical Supplies Agency (ZAMMSA), Bruce.Kamuti@zammsa.co.zm

Using data for last mile distribution for hard-to-reach communities in DRC
Mariam Zameer, VillageReach, Mariam.Zameer@villagereach.org

openrouteservice (ORS) – Open-Source routing & optimization
Julian Psotta, Heidelberg Institute for Geoinformation Technology (HeiGIT), julian.psotta@heigit.org
Increasing the visibility on the value of using data analytics and insights to guide decision making for last mile distribution.

JAMES FLOOD, PROJECT LAST MILE
GLOBAL HEALTH SUPPLY CHAIN SUMMIT 2023
Project Last Mile works closely with ministries of health and partners to apply the Coca-Cola System’s best practices in logistics, supply chain, and strategic marketing to improve access to, availability and uptake of life-saving medicines and health services down to the last mile in Africa.
Quick exercise: Think about THREE different outlets / shops where Coca-Cola is sold in your hometown.

One large sized, one medium sized, one small sized

Examples: supermarket, a convenience store, a bar or restaurant, an informal spaza shop or the local market

How do the following differ across these three outlets?

1st End user / shopper (Consumer)

• Firstly, who are the typical consumers shopping for Coke at these outlets?
• What typical consumer behaviour happens here? Month-end shopping? Convenience shopping? Refreshment while on-the-go? Or simply enjoying a leisurely beverage with friends?
• What are their favorite brands / pack sizes, how much do they typically spend, how often do they do this?

2nd Outlets / shop (Customer) and what they offer the end consumer.

• CC has many brands and pack sizes... Are all the brands and packs available at these 3 outlets?
• Is pricing the same across all these outlets?
• How about the quantities available?
• How about marketing materials / promotions and the targeted messaging?

3rd Service or delivery needs at these outlets (customers)

• How does distribution take place? How often? What day of the week? How accessible is it?
• Who services them? Where are they serviced from? What type of vehicles used?
• What storage capacity and cash flow constraints? Payment (cash / credit)?
• How do they order and receive deliveries?

THE ANSWER 🎓 IT’S HIGHLY LIKELY THAT ALL 3 OUTLETS ARE DIFFERENT.... DO YOU AGREE????
This is a differentiated service model/approach, successfully used by the Coca-Cola Company right across the world.

This model/approach is designed around:

- Putting the consumer at the center
- And then understanding what type of product, messaging, and placement is required to meet those consumer needs.
- All with the objective of making the right products, available to consumers at the right place, in the right quantities, at the right price, and with the right positioning and targeting messaging.
So, what does this mean?

In summary, there are **three elements** to this differentiated service model:

**Understanding the consumer behaviour**
Understand where and when key consumer behaviour is taking place.
Understanding the consumer needs.

**Strategic segmentation and channel design**
Grouping all outlets into channels based on where / when these consumer behaviours take place, and how these outlets typically sell to the end consumer.

**Route to market model design**
Fit for purpose distribution & service model to meet the needs across these strategic channel or groups… and ultimately the end consumer.

This a consumer centric, evidence-based approach, where **data analytics and insights** play a key role in guiding decision making across each of these key elements.
Once you understand the service needs for your different channel groupings, you are better positioned to match the right distribution model.

These service needs may include:

- The number of channel groups
- The number of outlets per channel group
- Coverage in proximity to target population
- Visit frequency requirements
- Ordering requirements
- Typical order sizes and product makeup
- Preferred delivery day / time
- Optimal vehicle size / carrying capacity, and accessibility
- The activities that need to take place during the visit - this may vary depending on the channel and size

This is where data analysis and insights come in. Tactical & operational guidance.
PRACTICAL EXAMPLE FROM A PILOT STUDY IN BOANE DISTRICT, MOZAMBIQUE, WORKING WITH THE NATIONAL AIDS COUNCIL (CNCS) IN 2022 - 2023
PLM implemented this consumer centric, evidence based approach in Boane to improve accessibility, availability and uptake of government condoms, in non-traditional access points, outside of the Public Health Services Supply Chain.

**CREATING DEMAND**
**STRATEGIC MARKETING**
National Condom Strategy Pillar 2

- Focus on consumer research
- A strong brand / call to action, with a compelling visual identity system,
- Developed segmented messaging approach for focus channel groups

**FULFILLING DEMAND**
**ROUTE-TO-MARKET**
Condom Strategy Pillar 3

- Landscape analysis study and data collection – where, when, who, and how…
- Designing a segmented, channel strategy with DC team
- Development of RTM strategy, including a delivery model and operations plan

**EDUCATIONAL MESSAGING**

**AT WORK MESSAGING**

**AT LEISURE MESSAGING**

Example of a important insights on leisure channel, how shaped our model
The team then designed and implemented a fit-for-purpose RTM model to execute PLM’s consumer centric, evidence based, segmented channel strategy.

Working closely with provincial and district level representatives from the CNCS, PLM implemented a *hybrid model* with x 2 distribution models for LMD:

- **TruckSell model (3PL)**
- **Call & collect (COBs)**

### Diagram

**BOANE PILOT (2022/23)**

**PROVINCIAL LEVEL**
- CPCS storage
- 3P L

**DISTRICT LEVEL**
- New BOANE Warehouse
- 3P L

**PRIMARY/ COMMUNITY LEVEL**
- TruckSell distribution model
- Order, delivery, marketing & data collection
- Distribute to +160 access points over 4 days per month.
- 8 delivery routes, using 2 x delivery teams

**Other CBO activity**

**Other key features and focus areas:**

- TruckSell order / delivery approach
- Inventory management system at district WH
- Delivery tracking tool for data collection & manage 3PL

CBO – Community based organisation. 3PL – third party logistics provider
Phase 1 results – Improved access, availability and uptake in non-traditional access points, outside of the public health supply chain

- **Over a period of 6 months**, the project distributed **1,200,000 condoms**

- **977,000 condoms** were distributed by a third-party logistics (3PL) partner. **223,000 condoms** were distributed by CDCS/CBOs

- **2-3 condoms per person**, per for the target population of 90,000 individuals month, aged 15-40 years (previously <1).

- **43% increase** in the number of active access points

- **243% increase in the number of condoms** made available to the population in Boane.

- Demand was increased, ensuring the population absorbed the additional condoms supplied.

- Despite this large increase in the availability of condoms, offtake was high at 75% averaged across access points.

Ultimately, making the right products, available to consumers, at the right place, in the right quantities, with the right positioning and targeting messaging.
Like the private sector, **data analytics and insights key** for LMD planning and operations in public health supply chain.

There is a lot of value in a **consumer centric, evidence-based decision making** in last mile distribution. Bottom up approach. Start with the consumer / patient.

Implementing the **right distribution model** can improve efficiency, effectiveness, and ultimately impact, if executed correctly.

**Question:** In your supply chain, how do the patients’ needs, and service needs vary across the different facility classifications?

In hospitals, health facilities, pharmacies, rural health posts or other alternative access points. Are the patient and service needs all the same?

What data analysis can be done to better understand these when designing your LMD strategy / model?
To learn more about some of the distribution models applied by The Coca-Cola Company across Africa, and how these can be adapted, please reach out to the Project Last Mile team.

### COMPLEXITY

<table>
<thead>
<tr>
<th>Model</th>
<th>Environment</th>
<th>Model</th>
<th>Environment</th>
<th>Model</th>
<th>Environment</th>
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</thead>
</table>
| **MOTOR-BIKE/MANUAL DISTRIBUTION CENTRE** | • Inventory held locally in *small to medium storage area* (shipping containers, informal market outlets)  
• Manual pushcarts used for delivery  
• High delivery frequency (2.00-6.00x weekly)  
• High daily route visits (30-60 outlets per day)  
• Product sold and delivered at the same time during the outlet visit  
• High density outlet areas (informal outdoor markets, taxi ranks, city centre)  
• Small outlets with limited range of items sold and limited storage  
• Outlets inaccessible for truck delivery  
• Short travel distances between outlets (<25m) | **TRUCKSELL** | • Inventory held locally in *small to medium storage area* (shipping containers, informal market outlets)  
• Small trucks (<2.5T) used for delivery  
• High delivery frequency (1.00-3.00x weekly)  
• Medium daily route visits (15-30 outlets per day)  
• Product sold and delivered at the same time during the outlet visit  
• Small to medium VPO (General Trade and On-Premise outlets)  
• Limited range of items sold  
• Outlets accessible for truck delivery  
• Short stem distance from storage (<5km)  
• Limited range of SKUs delivered (<10) | **PRESELL** | • Inventory held remotely in *medium to large storage area* (warehouse, central distribution centre)  
• Large trucks (>2.5T) used for delivery  
• Low delivery frequency (0.25-1.00x weekly)  
• Low daily route visits (10-20 outlets per day)  
• Product sold and delivered at the same time during the outlet visit  
• Product sold by salesman then delivered next day  
• High VPO (supermarkets, wholesale)  
• Large outlets with wide range of items sold and sufficient storage  
• Outlets accessible for truck delivery  
• Long stem distance from storage (>5km)  
• Wide range of SKUs delivered (>10) |
Project Last Mile

Find out more at projectlastmile.com
Using data for last mile distribution for hard-to-reach communities in DRC

Mariam Zameer
What does the last “mile” look like in DRC?
Often, the last mile looks like this:
The Last Mile Delivery Challenge in DRC

Challenge: Recurrent stock out of vaccines and other health products at facilities

1. Inefficient supply chain design
2. Limited leadership & management capacity among supply chain actors
3. Limited data & supply chain management capacity among health workers
4. Poor data visibility and product traceability
5. Limited and inefficient transport
6. No inventory management to monitor stock regularly
Results from implementing NGCA in Equateur Province

- **Improved product availability:**
  - Health facilities with full vaccine availability increased from 17 percent to 85 percent

- **Overall cost reduction:**
  - Total supply chain costs decreased by 34 percent

- **Increased immunization coverage:**
  - Average monthly consumption of vaccine doses increased 22 percent
Designing Next Generation of Supply Chain: Overview

Traditional multi-level supply chain

- Population-based allocation system
- SDPs fetch from zone, zones fetch from province
- Monthly to zones
- Siloed supply chains for vertical programs

Optimized supply chain

- Consumption-based Inventory Control System
- Delivery from province to SDPs
- Every 2 months to SDPs
- Resource sharing for distribution

Province

Health Zone/District

Hausse

Kanzele, aire de santé

Health Facility

113 km

75 km

2-3 Days

6 hours

2-3 Days
**Designing Next Generation of Supply Chain: Components**

<table>
<thead>
<tr>
<th>Products to People</th>
<th>Supply Chain Redesign</th>
<th>Route Design</th>
<th>Supply chain capacity</th>
<th>Inventory management</th>
<th>Responsive Supply Chain</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rapid assessment</strong></td>
<td>Use <strong>data triangulation</strong> to create a vulnerability and prioritization score, using data from coverage, surveillance, vaccine supply and logistics, cold chain equipment functionality, provider capabilities etc. across different health zones to prioritize zones for targeting.</td>
<td><strong>Use historical data to co-design the supply chain with provincial stakeholders. The model implements direct delivery, skipping health zones, informed allocations, and delivery every 2 months.</strong></td>
<td><strong>Design for shortest route and lowest cost, for direct delivery to health facilities.</strong> Routes defined based on distance, functional cold chain capacity, road network, road conditions, transport available, and safety.</td>
<td><strong>Build supply chain leadership at central, provincial and zonal levels defining roles and responsibilities, and communication processes.</strong> Supply chain management capacity on supportive supervision and focusing on ways to improve the use of data for decision-making.</td>
<td><strong>Leverage distributions to provide supportive supervision and to collect regular stock data from health facilities. Data is analyzed to inform future deliveries.</strong></td>
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**Note:** The table above outlines the key components of designing the next generation of supply chain, focusing on rapid assessment, supply chain redesign, route design, supply chain capacity, inventory management, and responsive supply chain. Each component is described with a brief overview of the activities involved.
Building leadership and management capacity in supply chains:

- **Leadership:** strategies and mobilizing resources to succeed in constantly changing system
- **Management:** managing day-to-day tasks necessary for supply chain to run effectively

**HOW?**

- Position public health supply chain as a core component of a ministry’s business model.
- Build knowledge of different supply chain approaches and models
- Enable leaders to create, convene, and broaden the capacity of stakeholder groups to positively impact supply chain operations.
- Supportive supervision
- 5-day training, accompanied by solving a challenge for capstone and WhatsApp group to problem solve together
Designing Next Generation of Supply Chain: Components

**Rapid assessment**
Use data triangulation to create a vulnerability and prioritization score, using data from coverage, surveillance, vaccine supply and logistics, cold chain equipment functionality, provider capabilities etc. across different health zones to prioritize zones for targeting.

**Supply Chain Redesign**
Using historical data to co-design the supply chain with provincial stakeholders. The model implements direct delivery, skipping health zones, informed allocations, and delivery every 2 months.

**Route Design**
Design for shortest route and lowest cost, for direct delivery to health facilities.
Routes defined based on distance, functional cold chain capacity, road network, road conditions, transport available, and safety.

**Supply chain capacity**
Build supply chain leadership at central, provincial and zonal levels defining roles and responsibilities, and communication processes.
Supply chain management capacity on supportive supervision and focusing on ways to improve the use of data for decision-making.

**Inventory management**
Leverage distributions to provide supportive supervision and to collect regular stock data from health facilities. Data is analyzed to inform future deliveries.

**Responsive Supply Chain**
Using data triangulation and other methods, to ensure that supplies are adequate and reaching the most under-reached communities.

**Products to People**

1. Rapid assessment
2. Supply Chain Redesign
3. Route Design
4. Supply chain capacity
5. Inventory management
6. Responsive Supply Chain
Leverage distributions to provide supportive supervision and to collect regular stock data from health facilities. Data is analyzed to inform future deliveries.

**WHY?**
- The current logistics management information system (SIGL) does not have data on consumption, and number of days of stockouts. DVD-MT and SMT do not have updated data.
- Paper tools are almost non-existent, and stock is almost never monitored or managed on a daily basis, leading to frequent stock-outs.
- Some health facilities are overstocked and some understocked

**HOW?**
- Analysis of monthly inventories before each distribution at province and health zone.
  - Compare the inventory data for vaccines and other health products to calculate stock needed
- At each delivery, collect as average monthly consumption, vaccine wastage rates, expiry, number of days of stockouts and months of stock available after the delivery
- Create a stock information circuit on a regular basis: Zonal office analyses consumption data weekly and highlights fluctuations
- Supervision at health facilities, builds supply chain management and inventory management capacity
- Triangulate the number of kids vaccinated, and number of vaccine doses used per month or weekly.
Designing Next Generation of Supply Chain: Components

**PRODUCTS TO PEOPLE**

1. **Rapid assessment**
   - Use **data triangulation** to create a vulnerability and prioritization score, using data from coverage, surveillance, vaccine supply and logistics, cold chain equipment functionality, provider capabilities etc. across different health zones to prioritize zones for targeting.

2. **Supply Chain Redesign**
   - Using historical data to co-design the supply chain with provincial stakeholders. The model implements direct delivery, skipping health zones, informed allocations, and delivery every 2 months.
   - Districts sign a commitment in presence of provincial governor.

3. **Route Design**
   - Design for shortest route and lowest cost, for direct delivery to health facilities.
   - Routes defined based on distance, functional cold chain capacity, road network, road conditions, transport available, and safety.
   - Data collected during delivery is analyzed to inform future deliveries.

4. **Supply chain capacity**
   - Build supply chain leadership at central, provincial and zonal levels defining roles and responsibilities, and communication processes.
   - Supply chain management capacity on supportive supervision and focusing on ways to improve the use of data for decision-making.

5. **Inventory management**
   - Leverage distributions to provide supportive supervision and to collect regular stock data from health facilities.
   - Data is analyzed to inform future deliveries.

6. **Responsive Supply Chain**
   - Using **data triangulation** and other methods, to ensure that supplies are adequate and reaching the most under-reached communities.
Next Generation of Supply Chain: Component Deep Dive

PRODUCTS TO PEOPLE

WHY?
Delivery to the last mile is only effective if it is meeting the needs of people – both the “visible” demand (what we can see in the data) and the “invisible” demand, i.e. children who do not interact with the health system and we need to uncover with more complex data triangulation.

Responsive supply chain is a “learning supply chain” – constantly validating the needs of the population and is getting products to ALL people. This creates an efficient and agile supply chain, allowing for adjustment to serve more people.

HOW?
During health facility visits, triangulate data from health facility register and vaccination cards.
- Assess whether the expected children have been vaccinated by triangulating the target, children who have been vaccinated and then calculated then % of coverage for each antigen
- For those not vaccinated, create a map and plan with health facility nurse and CHWs. Plan includes strategies for vaccinating the child and target date for vaccinating.
Nouvelle Génération des Chaînes d’Approvisionnement (NGCA): Success Factors for a Holistic Approach

- Pooling Resources
- Integrated Distribution, At Any Opportunity
- Triangulation of Data Early & Often
- Going the Extra Mile
Using an open-source dynamic routing tool for sustainable, flexible, and cost-effective last mile distribution in Zambia

Bruce Kamuti, Assistant Manager Outbound Logistics, Zambia Medicines and Medical Supplies Agency (ZAMMSA)
Background: Why is a Dynamic Routing Tool Needed?

As the number of destination facilities grows, the number of possible facility sequences grows exponentially.

If 4 health facilities are scheduled for deliveries, they can be sequenced 24 different ways for a delivery route. But if 22 facilities are scheduled for deliveries, the number of possible sequences grows to $1,124,000,727,777,607,680,000$ — that’s over 1.1 sextillion!

A dynamic routing tool, such as the Dispatch Optimizer Tool, can quickly conduct these complex mathematical calculations that are beyond human capability. This can allow transportation planners the flexibility to reconstruct routes weekly as volumes and conditions change.
What Problems Does the Dispatch Optimizer Solve?

Reduce cost and time of deliveries while maintaining service standards by dynamically optimizing delivery routes.
**Why Dynamic Route Optimization?**

**Static Route Planning vs. Dynamic Route Optimization**

- Using set routes planned with or without the use of route optimization software
- Even if routes are mathematically optimized, they are done so for one static scenario and reused under changing circumstances
- This makes it difficult to manage changing volumes, late orders, changing circumstances

This is what most countries do today, but there is now the ability to do better.

- Software like the Dispatch Optimizer can allow rapid dynamic adjustments based on changing circumstances and uncertainty
- Can adjust to variability in orders (e.g., different commodity types, quantities, seasonal patterns)
- Can adjust to changes in vehicle and driver availability
- Can optimize late orders separately to find the most efficient dispatch plans while not delaying the on-time orders
- Can adjust as a rainy season impacts accessibility (e.g., split truck routes onto smaller 4x4 SUVs, remove inaccessible facilities)

Open-source software and improving data and IT landscapes have opened options that used to be accessible primarily to corporations able to purchase costly software licenses.
Experience Using DOT in Zambia and Beyond
A Successful Roll-out in Zambia

• Engagement with local stakeholders
  ZAMMSA collaborated with USAID’s GHSC-PSM project and their 3PLs in Lusaka to coordinate efforts for the application and business processes.

• User-focused design tailored to public health supply chains
  App developers spent time embedded in ZAMMSA central medical warehouse and 2 hubs, observing operations and collecting requirements for an operational route optimization application.

• Ongoing and expanding operational use
  ZAMMSA staff use the tool weekly, with all regional hubs and about 1,955 last-mile health facilities in Zambia currently receiving deliveries planned using this tool; working on expansion to every hub in-country.

DOT being run in ZAMMSA Lusaka warehouse on October 1, 2021
First optimized dispatch leaving Mansa hub on June 3, 2022
Transforming Transportation and Warehouse Planning

**BEFORE**

- Transportation planning was done manually, using guess work based on prior experience
- Sometimes delivered to the same facility on multiple routes for different commodities
- Warehouse sometimes staged orders and the truck was too small or unnecessarily large
- Consistently increasing commodity categories and volumes in Zambia was making reliance on prior experience risky

**AFTER**

- Data-driven decision making that is flexible to changing circumstances
- Reduced instances of multiple dispatches to the same facility
- Volumetrics and optimized vehicles ensure the best vehicles are planned for each load
- Transportation planners are well prepared to respond to changing or increasing order volumes, even during health crises

**Other benefits:** Reduced costs and carbon emissions; increased customer satisfaction and employee/3PL coordination
The footprint and features continue to grow, as other countries actively seek to learn from Zambia’s example and adopt the tool.

Early 2020
A proof of concept was developed by USAID GHSC-PSM in Excel and tested in Haiti.

October 2021
The Dispatch Optimizer was launched in Zambia’s central medical warehouse in Lusaka.

June 2022
Based on the initial success, the tool was adapted and rolled out in Luanshya and Mansa, Zambia.

July 2022
The app was tested in Kenya, including developing new features to address country-specific needs.

2023 and Beyond
Zambia is expanding to 2 new hubs this year and 3 by end of 2024. New features are improving use.

Mali is also testing use of the app.
Technical Solution Details
How to Use the Dispatch Optimizer Tool

The process to generate optimized routes with the Dispatch Optimization Tool

1. User uploads order template; facility details are pre-loaded in the application.
2. User reviews the customers for the order on a map and excludes any as needed.
3. User reviews the available fleet and customer vehicle restrictions and modifies, as needed.
4. User selects parameters for the model and clicks a button to run the optimization.
5. Optimization outputs the ideal routes and vehicle assignments and displays them on the website as maps and KPIs.
6. User downloads an Excel file, which includes stop-by-stop route plans for drivers and loading plans for warehouse managers.
The Dispatch Optimizer Application

Route maps, details and KPIs can be viewed on the interactive website or downloaded in Excel for manual modifications, additional analysis, or sharing plans with warehouse staff and suppliers.
Collaborating with and Contributing to Open-Source Technology

- Tool built on top of open-source tools, as shown in the graphic – including OpenRouteService from co-panelist organization HeiGIT
- Deployed on Azure cloud and users access it like any website
- Source code is available for download on GitHub (link below)
- Tool can be adapted for other types of health commodity distribution or service delivery, such as for community health workers conducting home visits

Want to Learn More?

Visit the QR Code on the Screen to:

READ more about the Dispatch Optimizer Tool

WATCH a video about the Dispatch Optimizer Tool

EXPLORE the Dispatch Optimizer Tool's source code

EMAIL for more details

OUR VALUES

Integrity
Respect
Efficiency
Reliability
Innovation

Transparency
Accountability
Teamwork
Client Centeredness
Environmentally Friendly
Thank You!
Introduction

openrouteservice (ORS) – Open-Source routing & optimization

Julian Psotta
Heidelberg Institute for Geoinformation Technology (HeiGIT) at the University of Heidelberg (Germany)
What is openrouteservice?

openrouteservice is...

- ... built on OpenStreetMap data
- ... open source
- ... free for everyone to use (*)

(*) based on terms of service
OpenStreetMap

- Since 2004
- ~70 GB of data (2023)
- 9 billion nodes
- ~980 million ways
- Free open-data
- Customizable
- Regularly updated
- World-wide coverage

Often better quality and completeness compared to authoritative data!
OSM Comparison - Kenya and Germany

**Mapping Saturation Kenya**
The saturation of the last 3 years is 86.88%. Saturation is in progress (30% < Saturation ≤ 97%).

**Mapping Saturation Germany**
The saturation of the last 3 years is 100.0%. High saturation has been reached (97% < Saturation ≤ 100%).
OSM - Road Quality in Kenya

Mapping Saturation Kenya
The saturation of the last 3 years is 86.88%. Saturation is in progress (30% < Saturation ≤ 97%).

Currentness Kenya
In the area of interest, 37% of the 391405 features were edited (created or modified) for the last time in the period between 22 Oct 2019 and 22 Oct 2020. Some features are up-to-date, and some features are out-of-date.

Last Edit to a Feature
- 37.0% younger than 4 years
- 62.8% between 4 years and 8 years
- 0.2% older than 8 years
Openroute service is a stack of routing related services.
### Endpoint - Matrix

- Simple **coordinate to coordinate**
  time/distance

- Up to **2,500 Combinations** in one GO

- Backbone of the VRP optimizer

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#### API response:

**Response data in a table**

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[DOWNLOAD]
Optimization - Overview

Preference-based optimization:
- Fastest vs Shortest vs Recommended routes
- Avoid Highways, toll ways and ferries
- Avoid borders
- Avoid specific countries
- For routing and reachability
- Dynamic avoidable storage

Algorithm-based optimization:
- Optimize time and distance
- Scenario oriented and software driven
- Uses the matrix endpoint
Optimization - Turkey Earthquake

Preference-based optimization

Select a disaster region

- Slovenia
  Last update: 2023-11-10 15:47:29 UTC

- Earthquake in Anatolia region
  Last update: 2023-11-10 15:47:29 UTC

- Africa
  Last update: 2023-11-10 15:14:20 UTC

- Central and South America
  Last update: 2023-11-10 15:10:19 UTC

- SE Asia and Oceania Islands
  Last update: 2023-11-10 15:07:16 UTC
Route Optimization with ORS – VRP

Travelling Salesman Problem (TSP)

- capacity = C+VRP
- time window = VRP+TW
- multiple depot = MD+VRP
- pickup and delivery = PD+VRP
- multiple depot heterogeneous = MD+H+VRP+TW

Lower Image: https://www.researchgate.net/figure/The-Capacitated-Vehicle-Routing-Problem-CVRP_fig1_319754352
Outlook - What’s to come

- AI detected road surface detection
  - 95,000 Mapillary images
  - Combined logic paved & unpaved
  - Matched to OSM
  - Global scale
- Enhanced travel time estimations
- Public transit optimization
- Vehicle optimization with avoid areas
- Increased free request quotas for our public API
  - +10,000 global routing requests
  - Higher requests per minute
  - More vehicles in optimization
- Public transit oriented multimodal routing
- ArcGIS Desktop and Cloud integrations
How to use openrouteservice - Plans

Plans

- **Standard** – for everyone

- **Collaborative** – academia, non-profit and humanitarian organisations

- [openrouteservice.org/plans](http://openrouteservice.org/plans)
In numbers:

- +80,000 registered users
- 10+ Years of experience
- ~1.2 million requests / day
- Requests from 192 countries
How to use openrouteservice?

Access through our...

- Home: openrouteservice.org
- Maps: maps.openrouteservice.org
- API Documentation: openrouteservice.org/dev/#/api-docs
- Open-Source Code: github.com/GIScience/openrouteservice
- Disaster-Portal: disaster-portal.heigit.org

OSM Quality Analyses:
- Home: ohsome.org
- Quality Analyst: dashboard.ohsome.org

Contact:
- Smart Mobility Group @ HeiGIT: Julian.Psotta@heigit.org
Q&A and Discussion