

OR @ DPDHL

CHALLENGES SOLUTIONS IN DEPLOYING OR PROJECTS

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Data Analytics Center of Excellence

**Deutsche Post DHL
Group**



“Definition of Operations Research”

Operations Research is giving complex decisions that are...

Better

Lower costs, lower emissions, higher productivity, higher profit ...



Faster

Complex manual operations taking minutes instead of hours or even days



Applicable

Decisions designed with end-user in mind



Strategy 2025 focuses on significant digitalization opportunity for DPDHL Group



About myself

- DPDHL Group (2017 – current)
- Amazon – OR Scientist (2017)
- Deloitte Analytics – Business Analytics Lead (2014-2017)
- Solvoyo – Sr. OR Developer (2013-2014)

Education:

- Bilkent University Industrial Engineering (B.S. 2008)



Corporate brands - One company with two strong pillars

Deutsche Post DHL
Group

Deutsche Post 

The Post for Germany



The logistics company for the world

A global company with a unique portfolio

Germany's No. 1 mail and parcel provider



Global E-Commerce enabler



Deutsche Post DHL
Group

No. 1 in international express delivery



Leader in the forwarding business



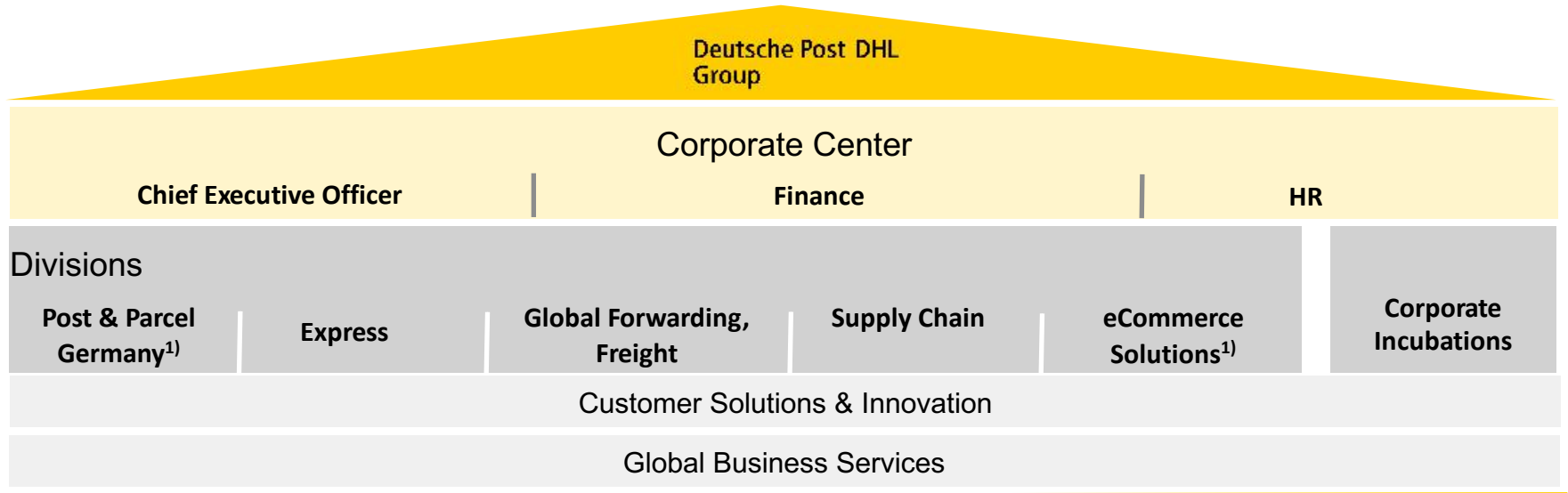
No. 1 in contract logistics



Efficient Organization

The Group is organized into five operating divisions. The Corporate Center (group management functions), Corporate Innovations (innovative products) and the Global Business Services are reported in the segment Corporate Functions.

Organizational structure



Source: Corporate Responsibility Report 2018 1) Effective January 1, 2019 the Post - eCommerce - Parcel division portfolio was reorganized into two separate divisions: The Post & Parcel Germany division handles business in Germany, our international business is the responsibility of the newly created eCommerce Solutions division.

Key facts 2018 - Overview of Deutsche Post DHL Group

- ▶ About 550,000 employees in more than 220 countries and territories (of which 59.3% outside of Germany)

- ▶ Group revenues: EUR 61.5bn
Group EBIT: EUR 3.2bn
Market capitalization¹⁾: EUR 29.4bn

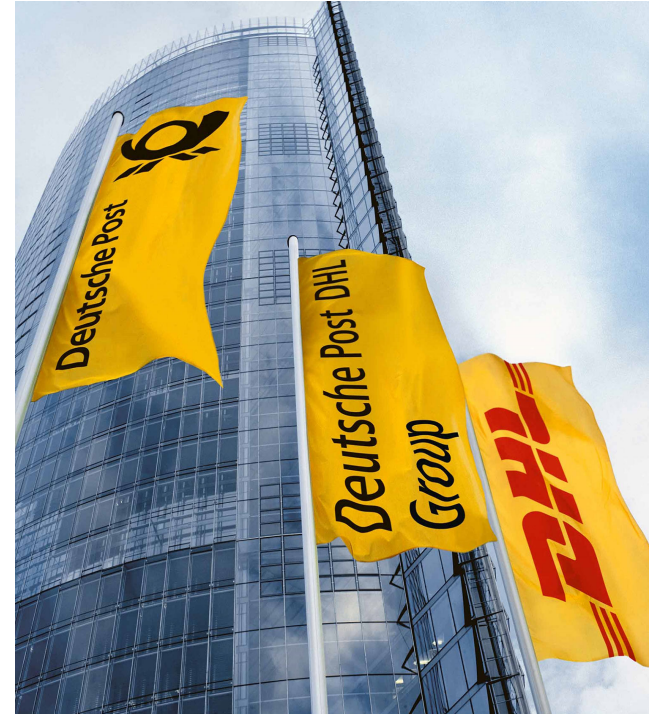
- ▶ ~57m letters per workday in Germany
~ 5m parcels per workday in Germany
Around 27,000 sales outlets in Germany

- ▶ ~ 995,000 international express shipments per day (Time Definite International)
+7.4% versus 2017

- ▶ 3.8m tons of air freight; 3.2m TEU²⁾ of ocean freight. No. 2 European road freight

- ▶ 13.2m square meters³⁾ of warehouse space in contract logistics

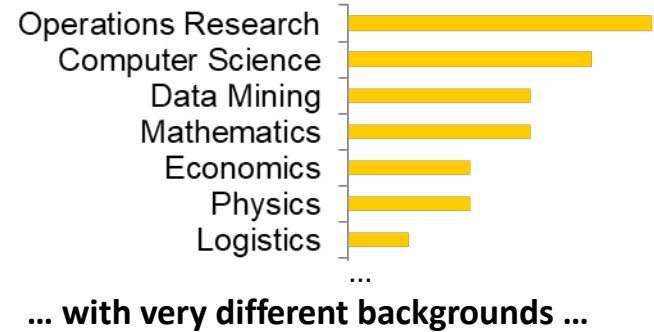
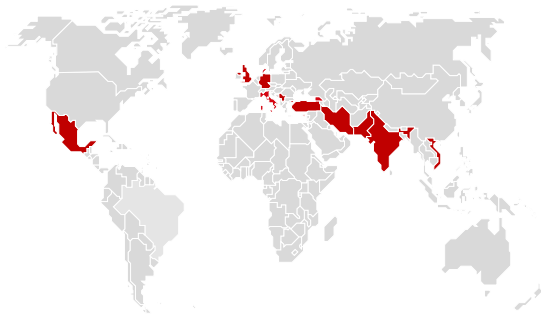
Source: Annual Report 2018; 1) As of 12/31/2018; 2) TEU = Twenty-foot equivalent unit; 3) Owned or leased sites



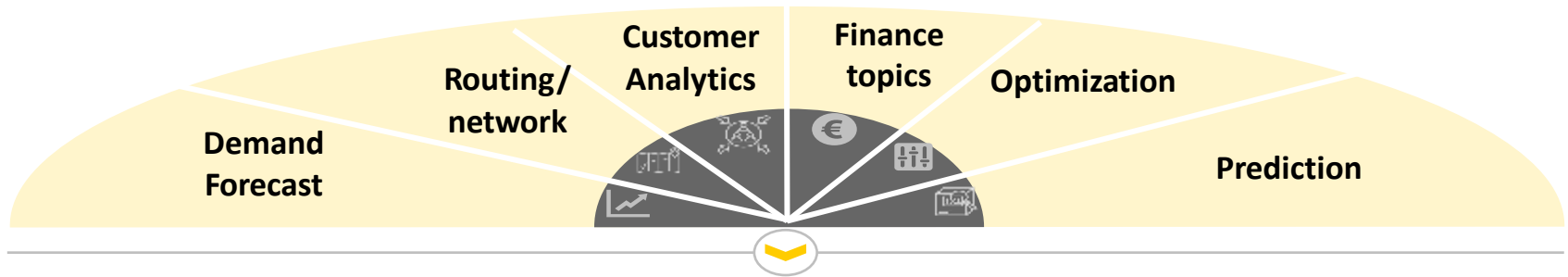
Data Analytics Center of Excellence



~40 Data Scientists...



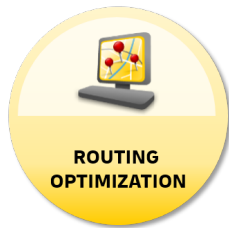
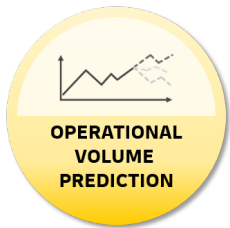
Our Projects & Solutions



Investment of choice

Provider of choice

Employer of Choice



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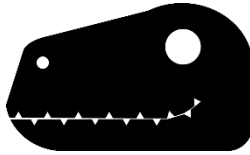
3 Core Operations Research Projects in our Data Analytics CoE



GO: Gangfolge Optimierung

Route Planning for Mailmen

Design of the **daily sequence** within the postmen delivery districts.



RaptOR: Route Optimizer for Transportation

Pickup and Delivery Optimization

Operational optimization of the daily **pick-up and deliveries**, applicable to Freight and LLP businesses



ZoRo: Courier Oriented Routing Optimization

Last Mile Optimization for Parcel

Operational optimization of the daily routes for **parcel deliveries**, especially in urban areas.



RAPTOR

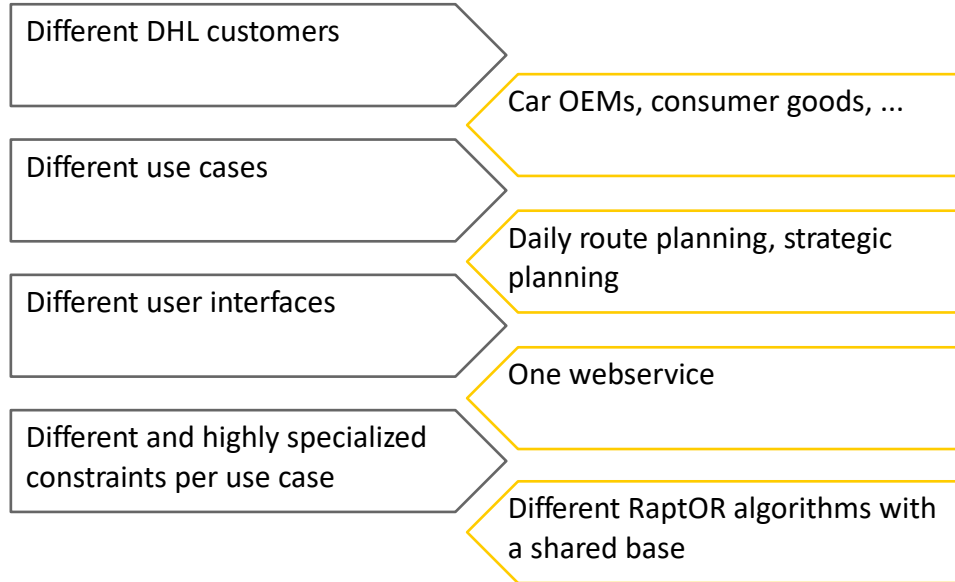
OPERATIONAL ROUTING FOR
PICK-UP AND DELIVERY





Routing Algorithm for Planning Transportation: RaptOR

RaptOR is a specialized routing tool for different customers from DHL Freight





RaptOR for an automotive company

Problem definition

- Deliver ~1000 shipments daily from supplier to plant locations
- High variation in order size and weight

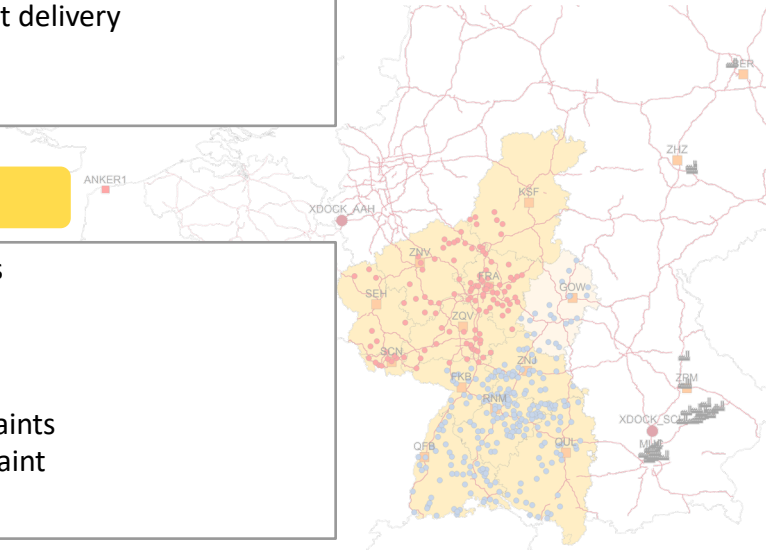


Handling Options

- Direct supplier to plant delivery
- Delivery via crossdock
- Delivery via terminal

Constraints

- Driving/working times
- Time windows
- Load capacity
- Robust schedules
- Last-in-first-out constraints
- Stacking height constraint
- ...



RaptOR Algorithm: How it works



1

Create initial solution - For *tour_type* in [DIR, ABH, OT]:

Bundle shipments that share the same pickup (and delivery)

Try to fit bundle into existing *tour_type* tours

If not feasible, construct new *tour_type* tour with bundle

2

LNS - For several iterations:

Destroy tours and reassign orders

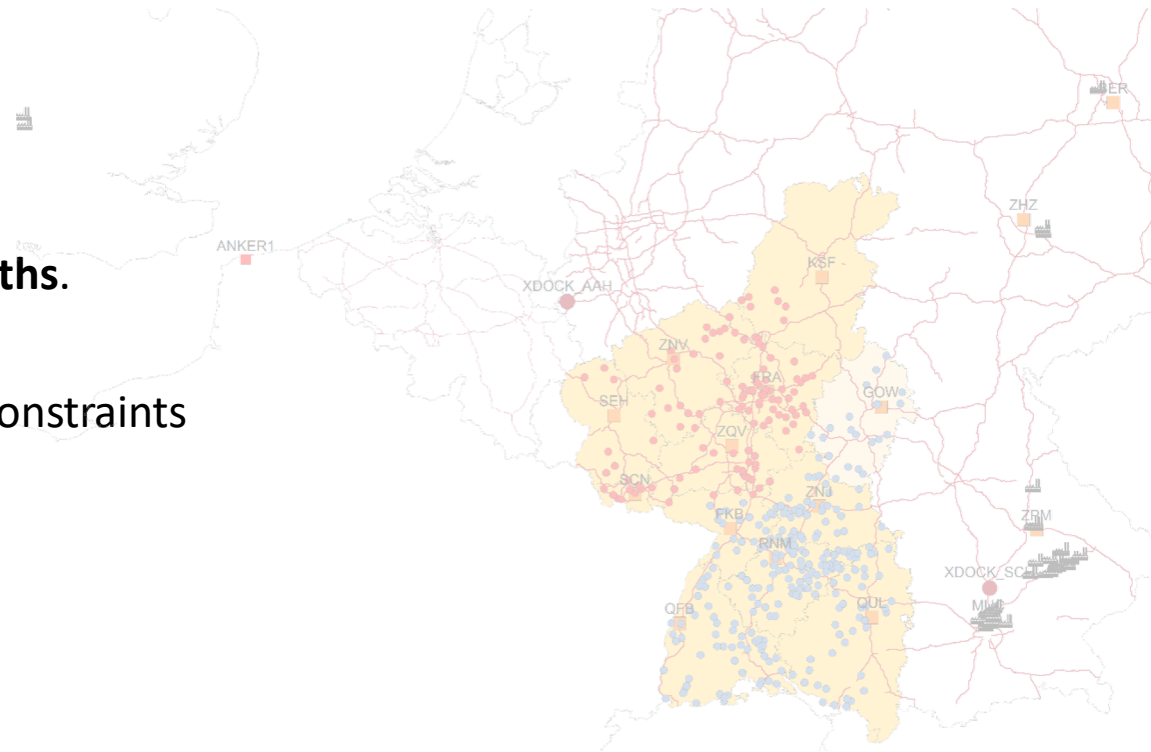
Do several local moves (swapping, merging, splitting, clustering...) on tours

3

Return best solution found.

RaptOR: Summary

- Idea to production in only **3 months**.
- Close feedback loop enabled **fast adaptation** to business-specific constraints
- Significant **time & cost savings**

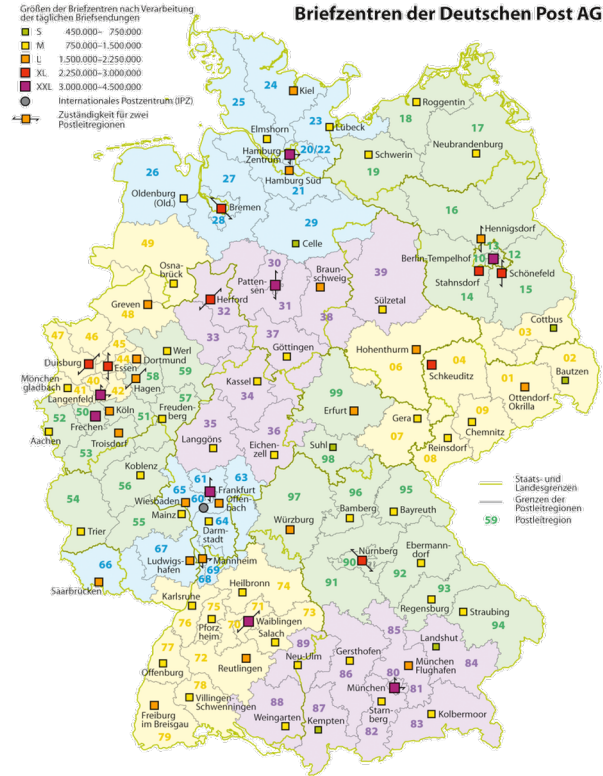


GANGFOLGE OPTIMIERUNG

ROUTE DESIGN FOR POST



GO – Post Delivery in Germany



Germany is divided into
Niederlassungen



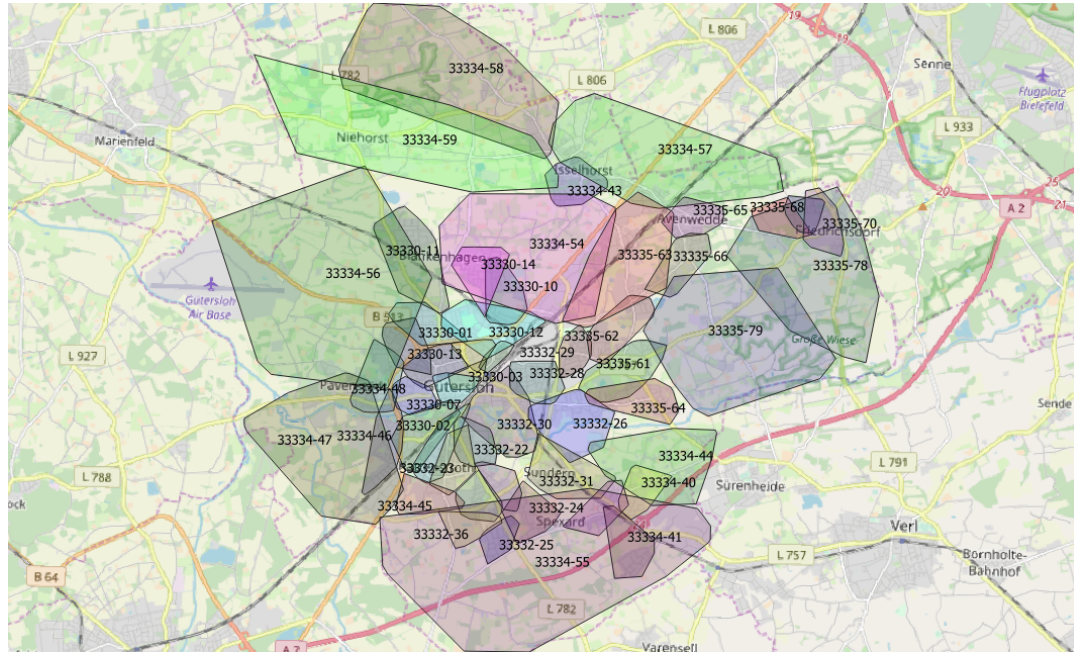
Every **Niederlassung** is divided into
Zustellstützpunkte (delivery base)



Every **delivery base** is divided into
Zustellbezirke (districts)

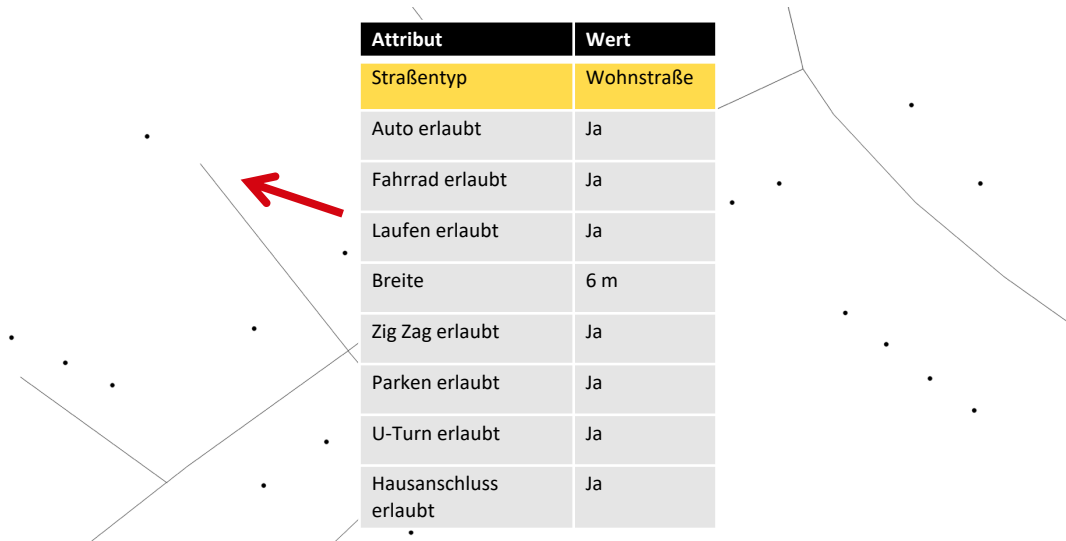
A **Zustellbezirk** is the area served by a postman.

GO – Post Delivery in Germany



GO – Network Creation

We use the Open Street Map Data combined with Post Data to create a **network** consisting of nodes and edges with attributes.

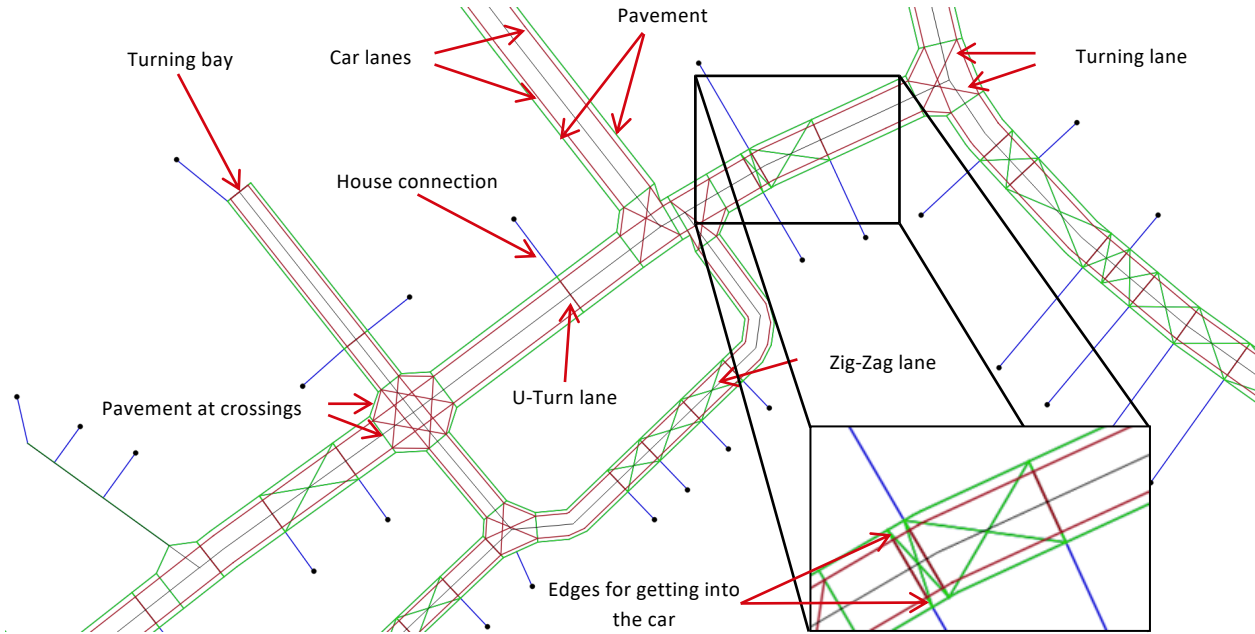


The diagram illustrates a network of nodes and edges. A red arrow points from a table to a specific edge in the network. The table lists attributes and their values for a specific edge.

Attribut	Wert
Straßentyp	Wohnstraße
Auto erlaubt	Ja
Fahrrad erlaubt	Ja
Laufen erlaubt	Ja
Breite	6 m
Zig Zag erlaubt	Ja
Parken erlaubt	Ja
U-Turn erlaubt	Ja
Hausanschluss erlaubt	Ja

GO – Network Creation

We transform the base network into a **detailed network**.



GO – Park and Loop

Park and Loop Structure

Consists of **changing between means of transportations** (driving-walking, bicycling-walking, ...) on the route

Evaluation

Given a fixed Gangfolge, find the optimal Park and Loop structure under the constraints of street attributes, stop times, maximal loop size, ...

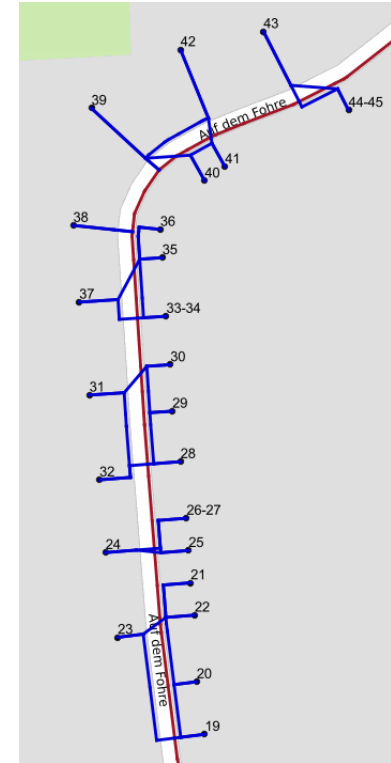
Optimization

Find an optimal Gangfolge with respective Park and Loop structure.



Solution Approach

We apply local search techniques and a series of different improvement algorithms.



GO – Unexpected Issues

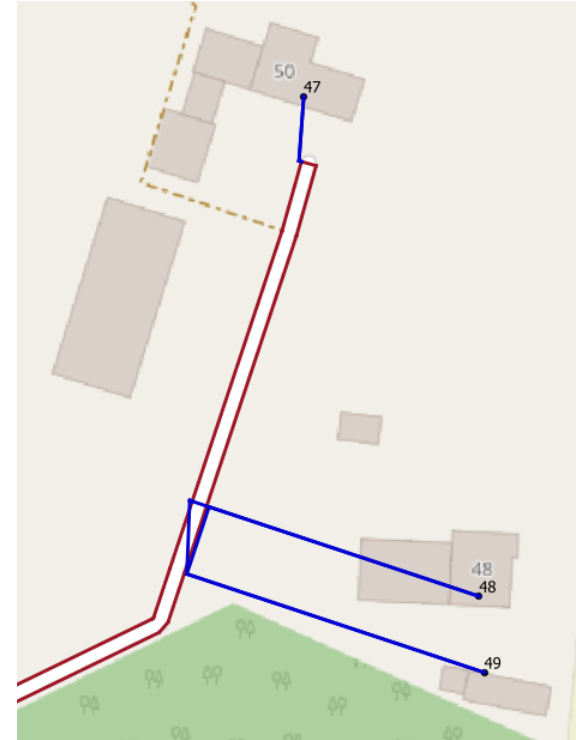
Postman/ Customer/ Map specific restrictions

- Preferred delivery sides
- Oversized loops
- Street specific restrictions
- Missing/ falsely located addresses/ streets



Solution Approach

We allow the user to modify (falsely depicted) data and to manually adjust the Gangfolge.



GO – How it looks like

DEMO MODUS -- Gangfolgeoptimierung - Bad Pyrmont - Optimiert

Verfüge Gangfolge

ZBez: 31812-01

Nr.	Straße	H.Nr.	Bemerkung
1	Hauptstr.	2	
2	Hauptstr.	4	
3	Hauptstr.	8	
4	Hauptstr.	3	
5	Hauptstr.	9	
6	Hauptstr.	10	
7	Hauptstr.	12	
8	Hauptstr.	11	
9	Hauptstr.	11a	
10	Hauptstr.	13	
11	Hauptstr.	16	
12	Hauptstr.	18	
13	Hauptstr.	20	
14	Hauptstr.	22	
15	Hauptstr.	24	
16	Hauptstr.	17	
17	Hauptstr.	17a	
18	Hauptstr.	17b	
19	Alte Str.	2	
20	Hauptstr.	15	
21	Hauptstr.	15	
22	Hauptstr.	19	
23	Hauptstr.	21	
24	Hauptstr.	23	
25	Hauptstr.	28	
26	Im Mittleren ...	1	
27	Im Mittleren ...	5	
28	Im Mittleren ...	5	
29	Im Mittleren ...	2	

Rückwärts Vorwärts
Springe zu

Markierungen beibehalten Letzte Wegstrecke hervorheben

GO: Summary

- Detailed understanding and manipulation of the data to the **smallest possible level**
- A **user-friendly** tool that *your decision is* the base, but can be modified significantly
- Most routing problems in real life are not **pure-TSP**

DEMO MODUS - Gangfolgeoptimierung - Bad Pyrmont - Optimiert

Digitale Begehungsplan Kurz: Optimiert

Schrotweg	2	3	4	5	7	6	6A	9	8	10
	11									
Wacholderweg	2	4	6B	6A	6	8	7	5A	5	1A
	3	10	12	14	16	11	9			
Eichenbrink	2 ²¹	2 ⁴²	2 ⁶³	2 ⁸⁴	3 ⁰⁵	3 ²⁶	3 ⁴⁷	3 ⁶⁸		
Winterbergstr.	1 ⁹									
Zum Rah	2 ¹⁰	4 ¹¹	6 ¹²	8 ¹³	10 ¹⁴	12 ¹⁵	14 ¹⁶	16 ¹⁷	18 ¹⁸	20 ¹⁹
Vor der Grenze	2 ²⁰	2 ⁵²¹	2 ⁷²²							
Zum Rah	1 ²³	3 ²⁴								
Winterbergstr.	17	15A	13 ²⁵	11 ²⁶	9 ²⁷	7 ²⁸				
Großer Kamp	1	3	2	5	5	4	7	7A	6	6A
	9	8	10	13	15					
Vor der Grenze	17									
Großer Kamp	14									
Vor der Grenze	2	10	13	11	9	7	1	3	6	5
	8									
Großer Kamp	11	11A								
Winterbergstr.	11	9	7B	7A	4					
Am Bürgergarten	4	6	3	5	1					
Winterbergstr.	6	8	2	7	5A	5	3			
Pyrmontstr.	13	13	10	10	12	12A	14	16	18	20
	22	25	23	21	19	15	15	15	24	
Henlingsburgstr.	18	20	20B	9	7	14	16	16A	12	10
	10	3	3	8	8	6	1	4	2	2A
Pyrmontstr.	7A	7	5	9	11	11A	3	1	4	4A
Ebersbergstr.	14	4								
Am Elbusch	17	16	14	12	10	9	11	13A	13	8
	6	7	5	2	3	1				
Eikermanns Torweg	3	6	5	7	4	2A				
Meintetalstr.	12	10	7							
Unterdorfstr.	2	2	1	1A	3	6	10			

Zustellblatt: 13812-08

Weg	Eingang	Full	Fahrzeit	Kfz	Stoppes
	14778m	0m	0m	25048m	169
	-544m	0m	0m	-1554m	-9

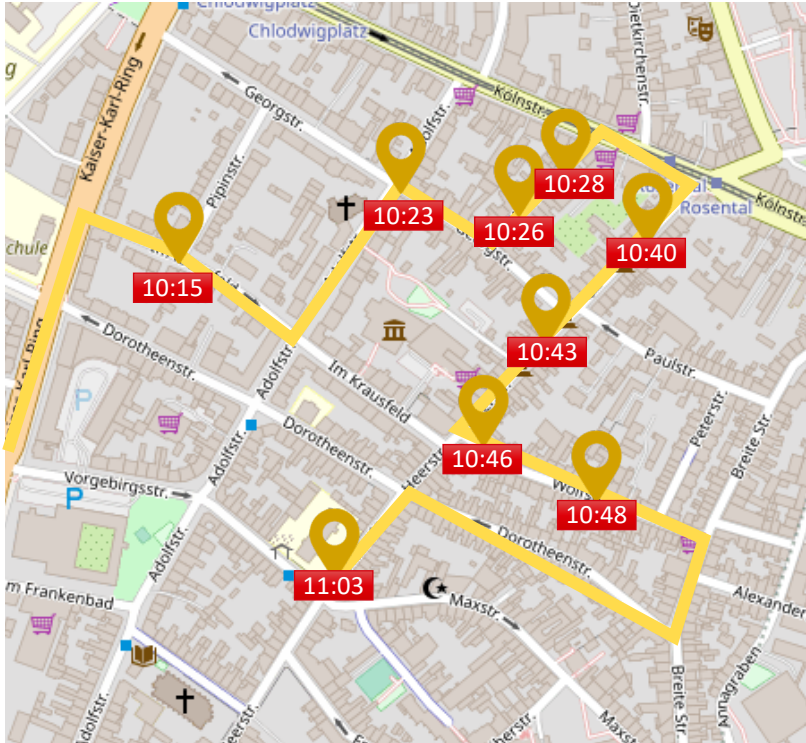
Auf Karte ausblenden
Sortiere nach Auswahl
Sortiere nach Meist/ Wenigst
Umdrehen
Optimieren
Rückgängig machen

ZORO

COURIER ORIENTED PARCEL DELIVERY ROUTING
(TREX: TOUR ROUTING WITH EXPERIENCE)



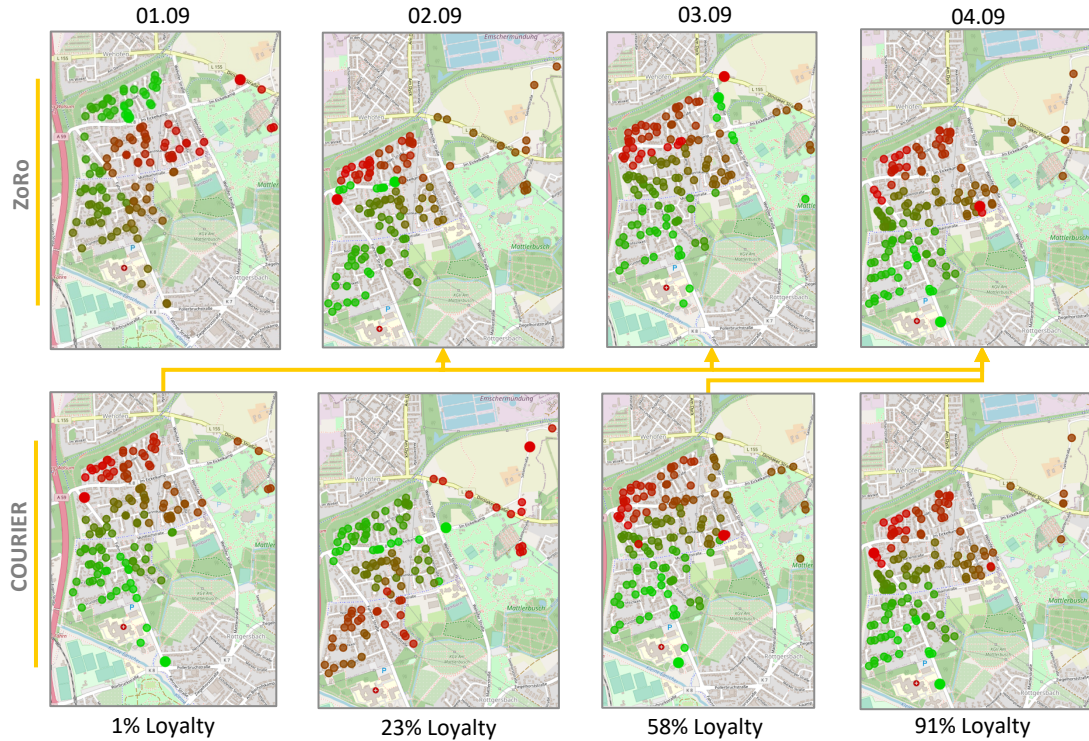
ZoRo Deep Dive: Last Mile Routing for Parcel Germany



- ZoRo automatically learns from past courier behavior to create the **most favorable tour** for the courier
- Pilots showed **significant increase** in tour loyalty
- ZoRo will be **scaled up** for the **peak season** to enable **more** and **accurate** time-window predictions



How ZoRo learns from the courier?



Final words in ~~challenges~~ solutions to OR/DS projects deployment



- **Be close to the real** operations – no constraint is *silly* to be ignored
- Focus on **value generated**, not the complexity of your algorithm
- Love **the problem** not **your solution**

THANK YOU!



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