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Sustainable last mile solutions – Superior route design

Dr. Clemens Beckmann | CEO Greenplan GmbH
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Increasing complexity of E-Commerce logistics…

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Sustainable and successful urban logistics has to be customer centric, economical, and ecological…

URBAN CONSUMER

Shop anywhere and anytime & good value for money

- Convenience: Seamless experience, adaption to individual schedule
- Transparency: “Where is my parcel?”
- Time savings
- Best price
- Environmentally responsible: “Green”, bio, vegan, etc.

LOGISTICS BUSINESS

Increase market share

- Meeting customers’ needs: Individualized offers & sales
- Development of new verticals, e.g. food delivery
- Contributing to corporate goals: Acting environmentally responsible
- Reducing costs

CITY AUTHORITIES

Preserve quality of life

- Reducing noise and air pollution
- Reducing traffic congestion
- Protect brick-and-mortar stores (local commerce)

...requires new solutions

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LAST-MILE DELIVERY

FOCUS

FLEXIBLE DELIVERY SOLUTIONS – TO GUARANTEE ...

- Convenience
- Less air pollution
- Less traffic congestion

Focus today

Tour Planning

Preferred Location

Parcel Station

Preferred Time

Smart Locks

Delivery Robot

Postal Retail Outlet

Electric Vehicles

Greenplan is a SaaS for tour planning

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Greenplan is a **powerful algorithm for planning tours & stop sequences** to move goods and people in an efficient and clean way

Greenplan optimizes routes of **last-mile delivery, road-freight operations (LTL/PTL)** and **field services task planning**

Greenplan leverages full optimization potential by **focusing on complete planning scope**, optimizing larger instances instead of sub-instances with reduced complexity

Greenplan solves **use-case specific problems** efficiently, without compromising on details

Greenplan's disruptive innovation approach – creating a paradigm shift…

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1 No partitioning / geo-fencing

- Change traditional model/approach
- Achieving more balanced tours by complete avoidance of geo-fences (e.g. based on postal code areas)
- Achieving codified ubiquity of delivery address information, i.e. enable knowledge transfer from individuals to organization

2 Planning in space and time

- Solving complexity of physical distance and given time constraints (e.g. time windows)
- Planning physical delivery tour stops with most accurate predicted delivery time

3 Can both targets be realized with realistic computation time?

Greenplan – Superior. Efficient. Sustainable.

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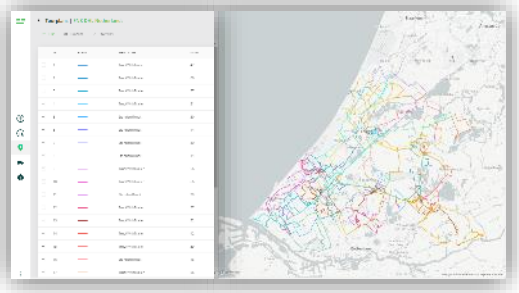
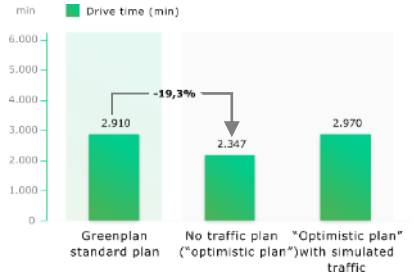
USP #1: Fully dynamic routes

- Instead of geo-fence based static routes
- Better balancing of volumes
- Tour structure depends on actual shipments of the day, not averages
- Optimization target can be adjusted for a fixed fleet size, i.e. equal workload planning



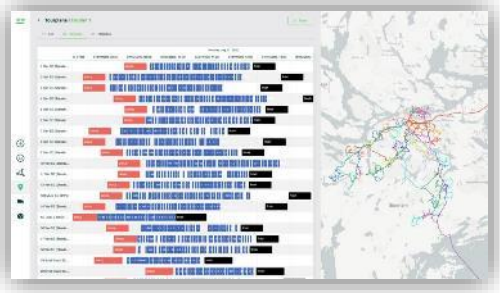
USP #2: Speed profiles

- Travel times on same road vary significantly during the day, algorithm considers this fact to identify optimal tours
- Relevant data granularity ensured by using street-specific flow velocities
- Optimal route planning and stop sequence depend on day of week and time of day



USP #3: Optimal start times

- Exploits flexibility of various potential starting times and determines optimal time based on delivery time windows, travel times and work time constraints
- Automates calculation and thus, eliminates manual work effort
- Plans more efficient tours driving "the best way"



Values provided

- Less delivery tours
- 10-30% cost savings
- High acceptance by drivers
- Reduced carbon emissions

Importance of considering time-of-day dependent flow velocities...

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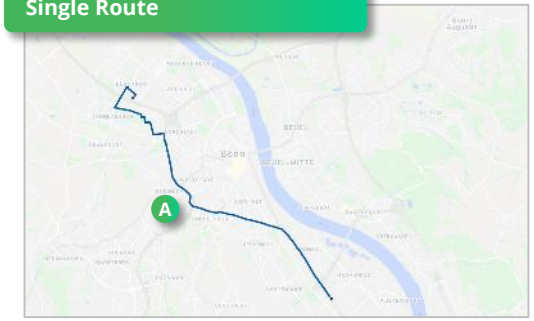
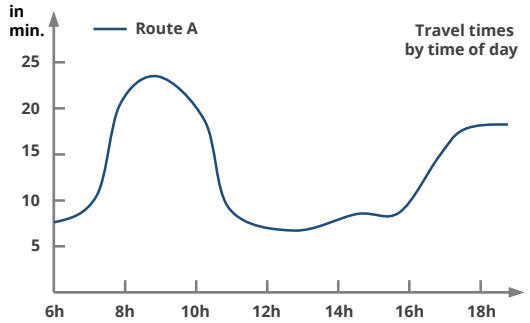
Why is it creating complexity?

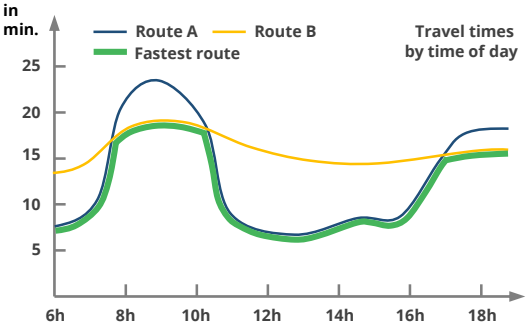
- For each point-to-point pair different routes are possible
- Greenplan considers travel times depending on day of week and time of day for each of those routes
- Different routes are combined to obtain optimal route choice based on time of day
- Greenplan is inherently considering all these combined routes in every single optimization step – an optimization that standard tools cannot provide [1)]
- Algorithm is powered by high-performance custom library for piecewise linear functions (time-distance matrix)

Single Route





Time-dependent alternatives



1) Either not providing feature or only sequential, i.e. planning shortest tours and adding traffic delays afterwards

Avoiding every unnecessary driven kilometer means less CO2…

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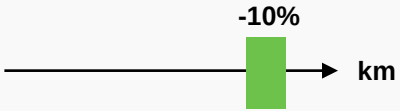
Typical fleet of 100 vans emits 500 tons of CO_2 per year

- A van emits 0,2 CO_2/km and drives approximately 25.000 km per year
- A fleet of 100 vans drives 2,5 M km/year

Greenplan minimizes total driven kilometers by 10%

- Greenplan optimizes routes of last-mile delivery and road-freight operations



50 Tons of CO_2 per year can be saved, an equivalent of planting 1.500 trees

- One tree absorbs e.g. 33,3 kg CO_2 per year

A gradual approach: static to dynamic tour planning...

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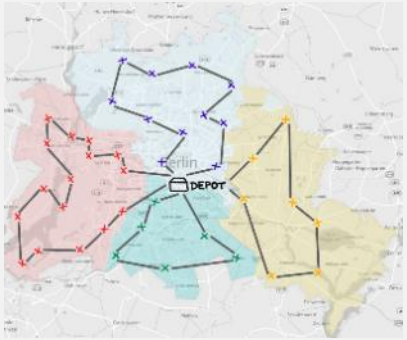
Step 1

Fixed districts
(optimized stop sequence)

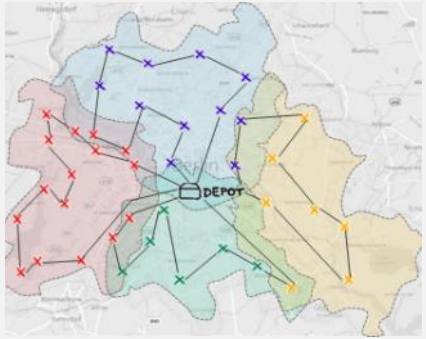


Fixed & non-overlapping districts for each driver, stop sequences are optimized within these static districts

Tours stay the same, drivers stays in known district, changes for dispatcher and customers are limited

Step n-1

Overlapping districts
(semi-dynamic tours)

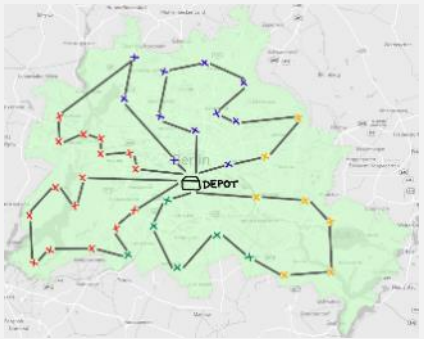


Enlarged and overlapping districts, some tour stops can be part of more than one district

Gained flexibility, volume-balancing, better time mgmt., drivers still operate in focused and known districts

Step n

No districts
(fully dynamic tours)



No districts, tour structure and no. of tours may vary from day to day

Driving time, driving distance, no. of tours and costs are fully optimized in regards to customer requirements, high robustness in case of e.g. driver sickness

Increased Flexibility, Efficiency, Robustness

Customer groups

Courier & Parcel

One of the most demanding industries, parcel & courier services are at the heart of the economy. Greenplan supports to lower operating costs and delight customers with on-time delivery times

Road Freight

Greenplan supports supply chain operators to optimize their challenging just-in-time transport, specifically when it comes to complex LTL networks.

Field Services

More flexibility is always needed – Greenplan enables planning for service, repair or expert support. Optimized tour planning saves time and resources and increases satisfaction of customers

Grocery & Home Delivery

Greenplan supports retail companies and home delivery providers with optimal routing and stop-order solutions – especially in dense city/ urban areas

E-Retail and Marketplaces

Greenplan enables large online marketplaces and their logistics subsidiaries with better routing solutions for their own delivery and LTL fleets

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Use Case – Field Services

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Company Profile

Industry	Property & Facility Management
Services	Maintenance and repair of real estate & related equipment
Scope	400+ service technicians 26,000+ locations 250,000+ orders annually 80+ dispatchers planning

Initial situation

- No automated & systematic route planning
- High manual effort leads to large dispatcher workforce
- Inefficient worktime usage caused by long travel times
- Only less than 3 orders fulfilled per day and technician
- Unnecessary outsourcing of orders causes higher costs
- High operating costs due to longer travel distances
- Aggressive growth plans, i.e. >30% increase in locations

Benefits provided by Greenplan

- Effective service time raised to >80% of total work time
- Service orders increased from 3 to 5 per day and technician
- Lower costs and CO2 emissions through less distance travelled
- Reduced penalty fees as less orders are fulfilled delayed
- Automated dispatch planning is freeing up resources

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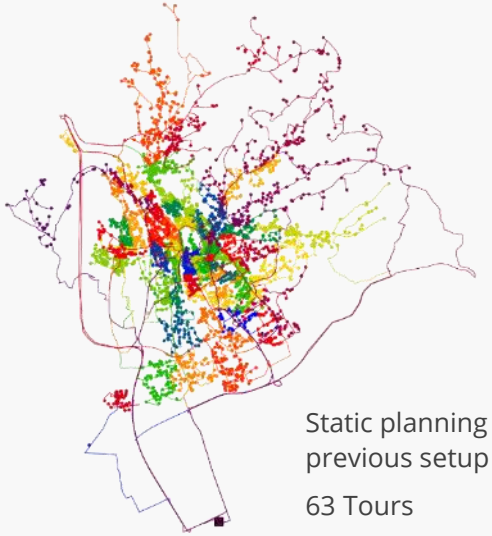
Use Case – Postal

Domestic postal operations in EU country

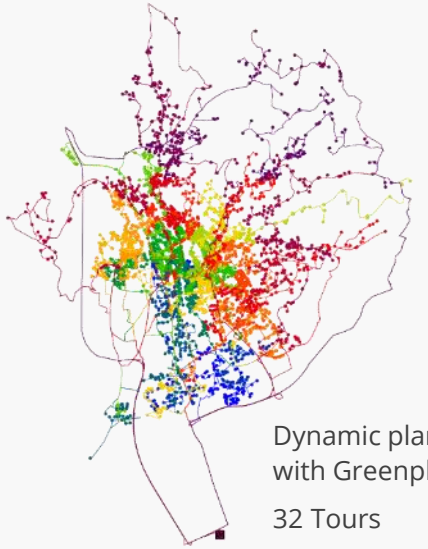
- Tour planning in city area for one full week, comparing dynamic vs. previous statically planned tours
- Dynamic tour planning reduces number of tours significantly
- Total driving time is reduced by more than 30%
- Dynamic tours have much better balanced working time, independent of stop times
- Handling time for deliveries dominates total work time, cannot be reduced by tour planning

Comparison Previous Setup vs. Greenplan



Static planning in previous setup

63 Tours



Dynamic planning with Greenplan:

32 Tours

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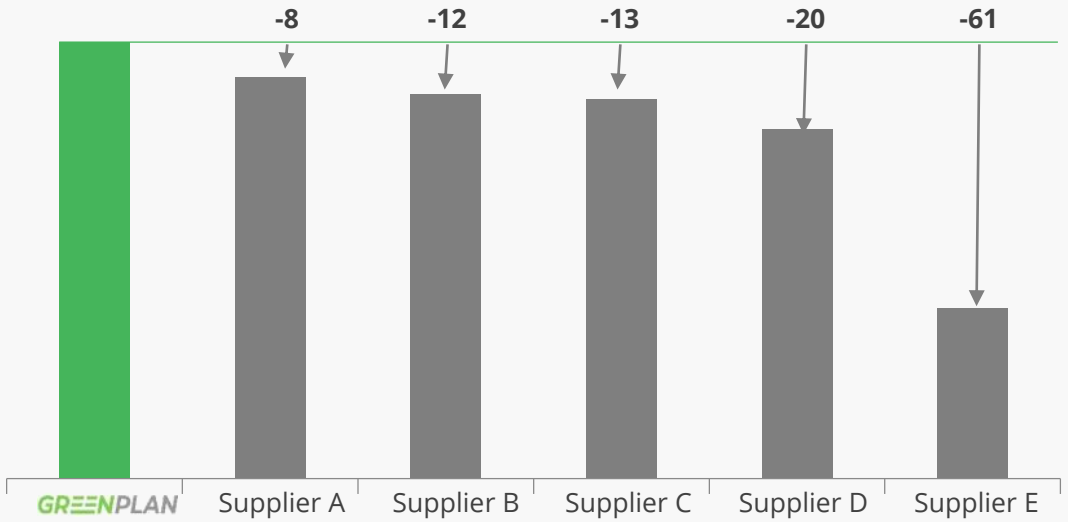
Use Case – Road Freight

Road Freight LTL benchmark

- Official tender conducted by one of the largest Road Freight providers
- Focusing on long-haul LTL road freight
- Comparing total cost of all tours planned (pickup & delivery)
- Greenplan has beaten several market-leading providers of route planning systems

Cost Optimization Result (%)*



*) Operative PuD (pickup & delivery) planning, optimization of total cost of all tours, depicting gap to best result (Greenplan)

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