BALTIC GEOSPATIAL INFORMATION TECHNOLOGY CONFERENCE

Routing and Optimization Complexities in Home Care: An Oslo Case

Elīza Ozola, Project Manager at Mappost

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Context: About Mappost

Mappost

- Mappost, a cloud-based SaaS product, uses powerful algorithms to solve **high complexity route and resource optimization problems** containing multitude of changing real-life constrains in various industries
- Provides companies with complete **process control and transparency**, significant cost reductions, reduced CO_2 emissions, ability to react to rapidly changing business process environment
- A team of 15 industry experts with competencies in business process analysis, system analysis, IT development and testing, mathematics, statistics, mapping, geography, GIS

THE PROBLEM

Vehicles	Objects	Obj./route	Possible dispatch scenarios
1	5	5	120
1	10	10	3 628 800
1	25	25	$\approx 1.55 \times 10^{25}$
5	50	10	$\approx 1.52 \times 10^{65}$
10	250	25	$\approx 3.23 \times 10^{493}$
15	4500	300	$\approx 3.41 \times 10^{14487} \rightarrow \infty$

*for reference: stars in the Universe $\approx 10^{23}$

+ Mappost plans routes based on vehicle profiles and load limitations, service time windows, road categories and their mutual priorities, driving speed profiles, regional and legislative restrictions & many other essential factors

What is Home Care Optimization?

- Planning daily visits to people who receive care at home
- The goal to reduce time spent on transport and planning → more face-to-face time with citizens
- Why it matters now: aging population, staff shortages, rising demand

What is Home Care Optimization?

Current Scale in Oslo

80 TEAMS
OF 10-15 EMPLOYEES

1000 EMPLOYEES VISITING
CITIZENS EVERY DAY

4 MILLION VISITS
(2023)

Current Scale in Oslo

- 15 districts
- 800-1000 visits daily per district
- Day, evening & night shifts
- All optimization requests sent in around the same time for each shift

#1: Three Simultaneous Travel Profiles

- Walking, cycling or driving employees within one team’s shift
- Need to pick a routing profile for each employee instead of usual "pick one mode for the optimization request"
- Each profile needs its own routing network, its own speed model, its own constraints

+ added parking times, dependent on the transport mode of employee

CAR | 04:33 | 2.3km

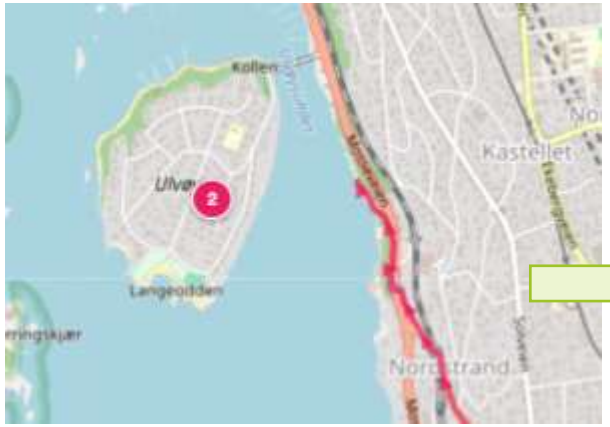
+ longer parking time = ~07:33

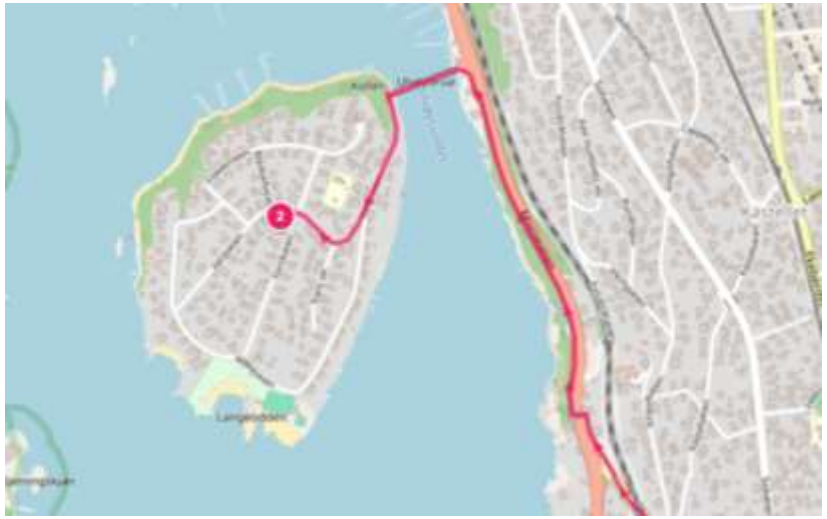
BIKE | 04:49 | 1.1km

FOOT | 10:52 | 0.9km

#2: The Road Network

- In Oslo we also work with NVDB (Norway's national road database, and its Elveg extract)
  - …you only see the gaps once you start routing on it
- OSM quality can be uneven, especially for the pedestrian and bike network, but we can fix it fast instead of waiting for updates which might not include the fix
- Within last few years, major central tunnel closed, central one-way streets changed directions, allowed turns and car access in centre gets more and more restricted, etc. → **fast are changes important!**





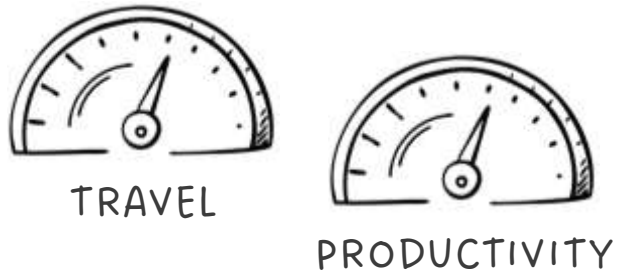
#2: The Road Network

Some people who live in the islands at summertime do also get home care visits

→ Public ferry roads already in bike and foot network 😎

#3: Speed and Productivity

- Road conditions may change drastically in winter



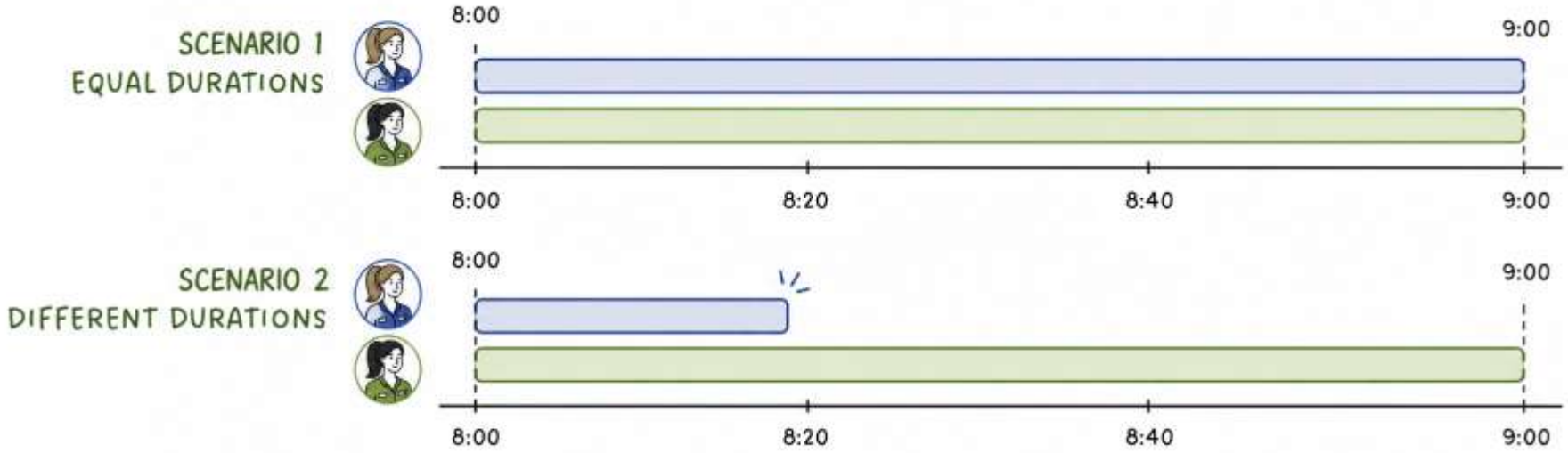
- Employees are not interchangeable units of capacity: age, fitness, injuries, new on the job, etc.
- In other applications we just limit work time or max visits per day

In HCO, we model it with two **per-employee** coefficients:

1. **Speed coefficient** for travel speed
2. **Productivity coefficient** for visit durations

#4: Double Visits

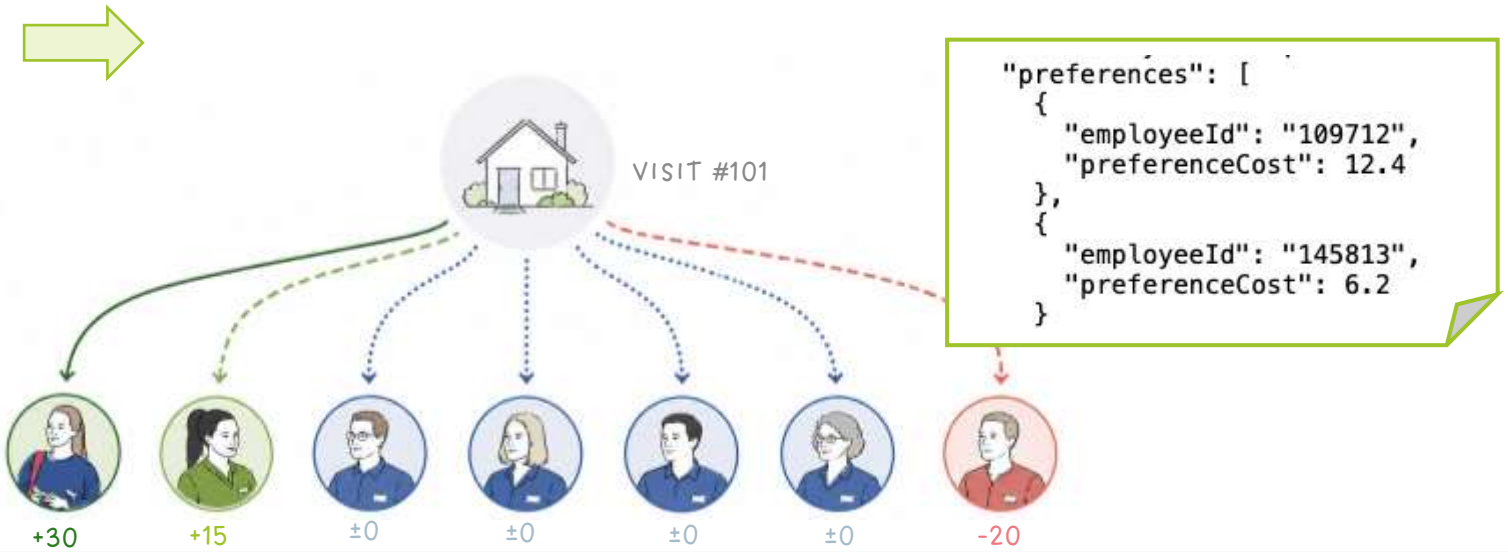
- Some visits require two employees being present at the visit at the same time (lifting a patient, complex care, etc.)
- They must arrive within a tight window of each other – if one arrives early, they wait
- Each individual visit still has unique skill requirements (e.g. a double visit of nurse + assistant)
- Coupling two otherwise independent routes, multiple times per shift!



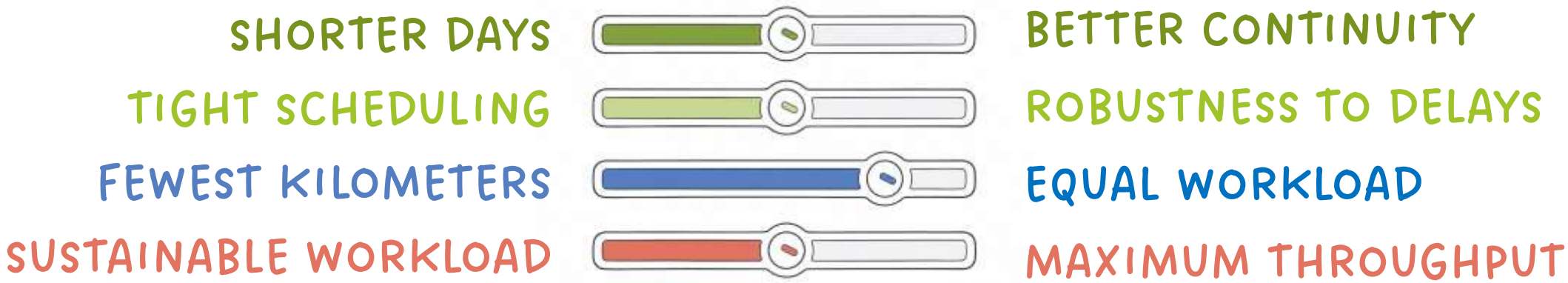
#5: Continuity of Care

- Service receivers prefer familiar faces
- A caregiver who visits a patient often enough knows the person and can notice when their health changes + build stronger social bonds
- Each citizen has a **primary contact** and a **secondary contact** – it is preferrable that the visits are asigned to them
- The BOB rule on top: the primary contact should take at least **every 7th main visit**, so they have enough regular touch points to actually assess the citizen over time

- Each visit carries an additional **preference score** benefit when assigned to a preferred employee
- A negative value allows to also penalize specific employees from taking the visit
- The preference cost (benefit) is configurable for each relationship and weighted against other costs



Trade-Offs In Optimization



- City's priorities decide where the solution should land between all trade-offs
- The dials are configurable per request
- Possibility to re-weight priorities every optimization run, and even set different priorities for different districts when local conditions call for it

Why The Details Matter

- The patient never sees the planning system and the employee only sees their daily tasks
- When an employee says "this schedule isn't working," it's likely there is a parameter at the wrong point – not enough weight on continuity, a heavy visit cap that's too generous…
- Weights can be re-tuned without losing optimization – solution lands where it fits the people doing the work
- Every detail scales over 4 million visits a year

Photo: Kobets Freund / Oslo kommune

What's Next

- Relatively new project
- Further use-case-specific developments, e.g. digital visits with *any* location
- New applications in similar environments ☝

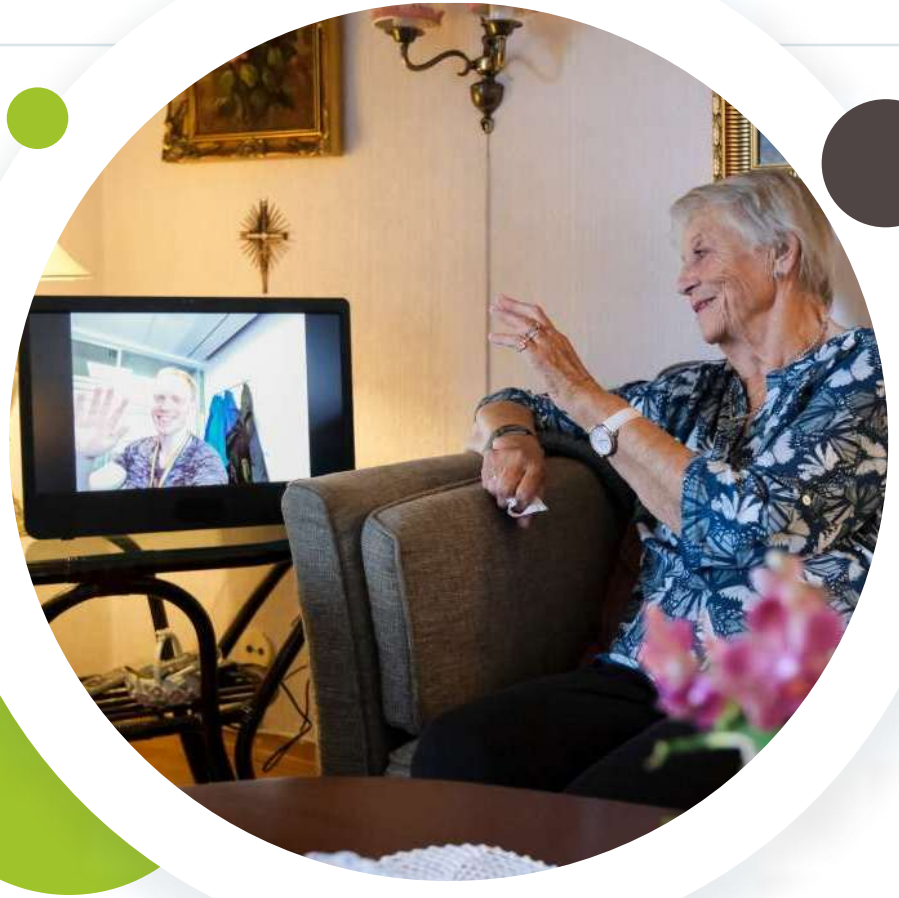


Photo: Kobets Freund / Oslo kommune

Thank you for your attention!
Questions?