What algorithms can (not) do in last-mile optimization

Congres

e-commerce logistiek

January 15, Arnhem

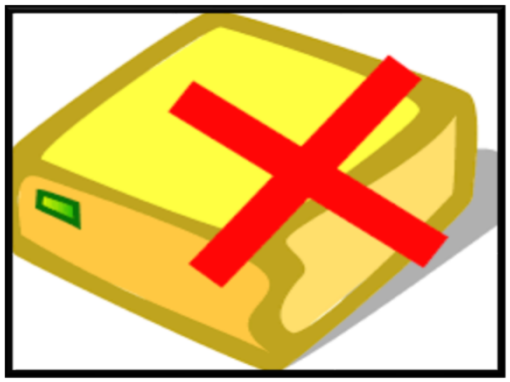
E-global project,

Bolor Jargalsaikhan

Challenges of last mile delivery for e-commerce

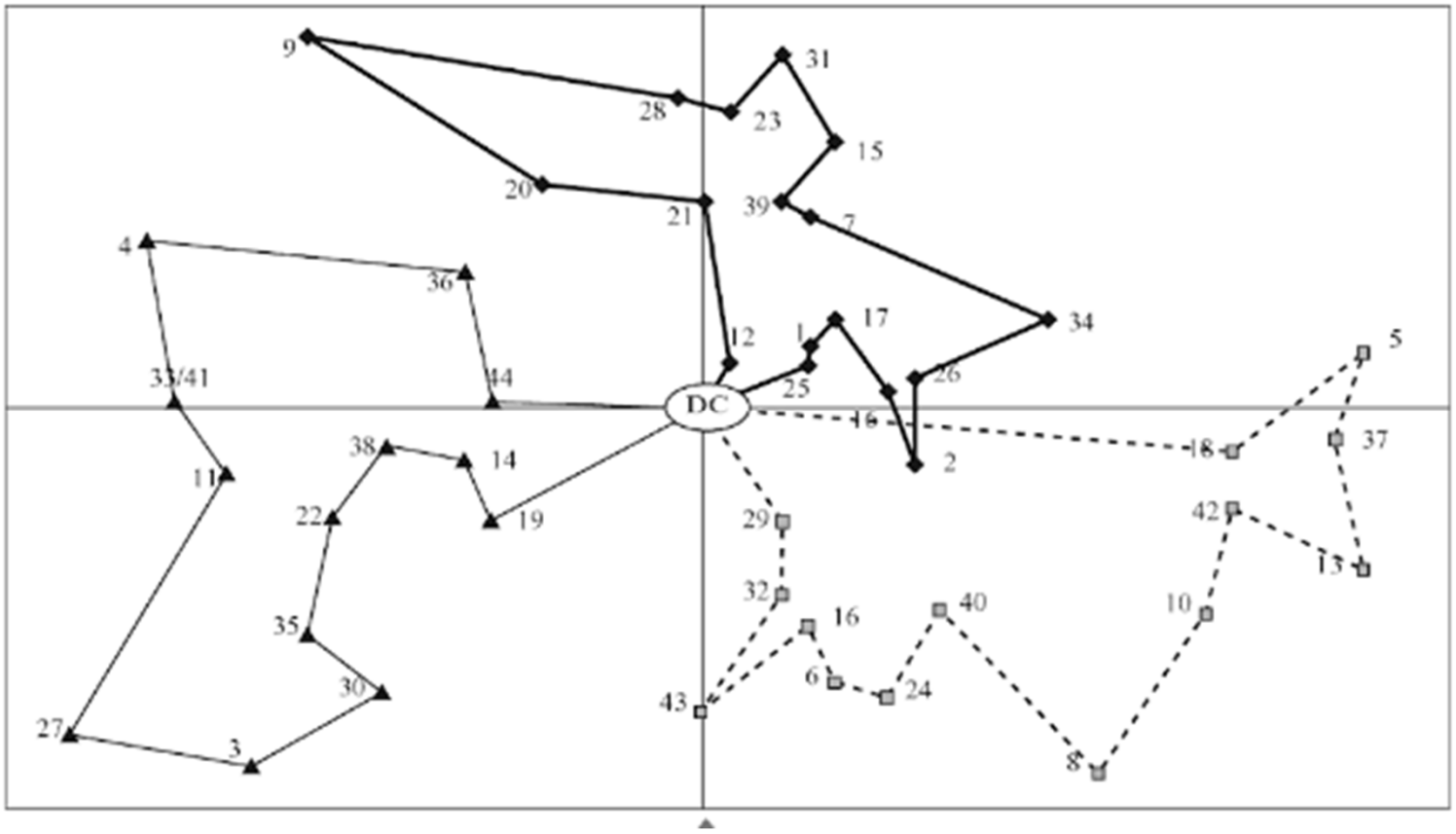
E-commerce growth

Fast delivery

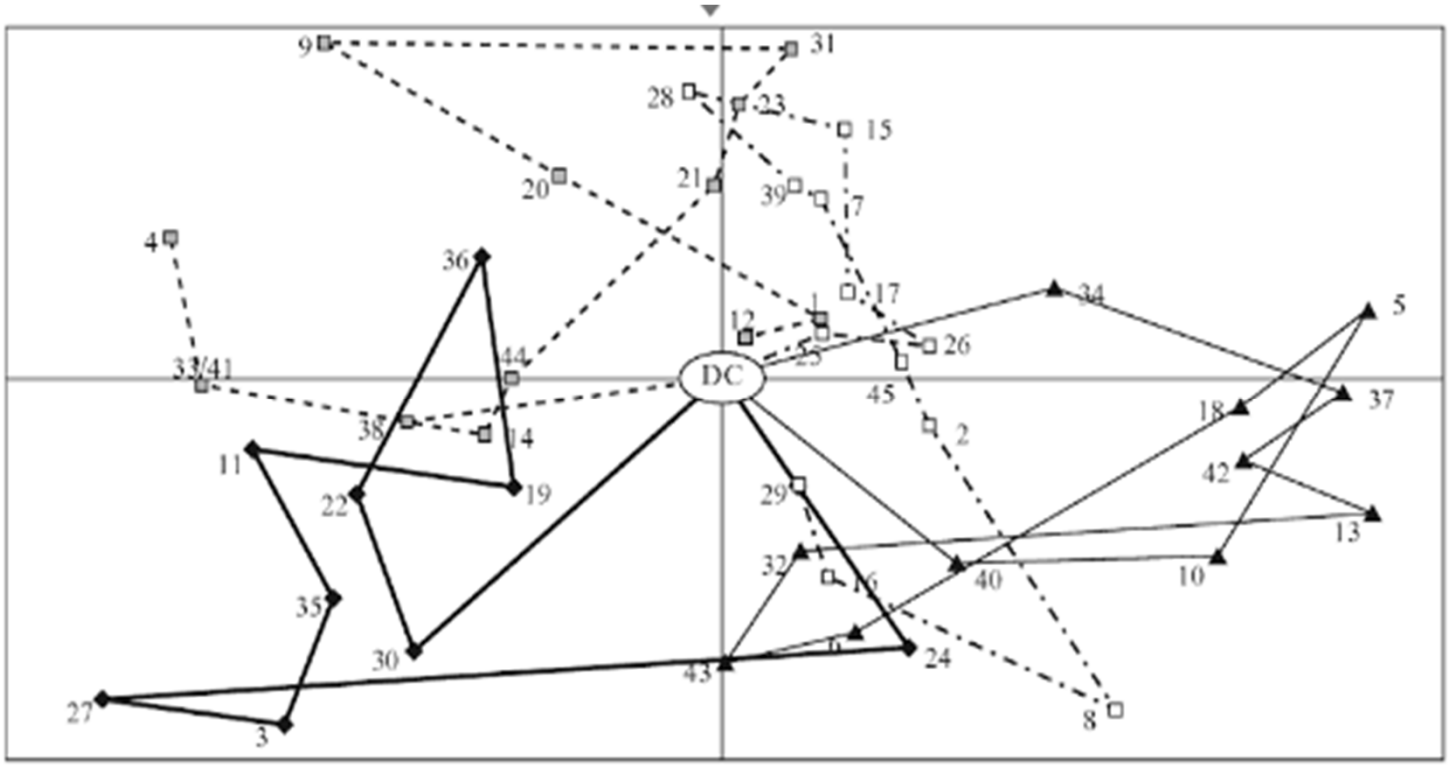


Failed delivery

Last mile is costly (13%-75%)



Last mile is costly (13%-75%)



Bover et. al. (2005)

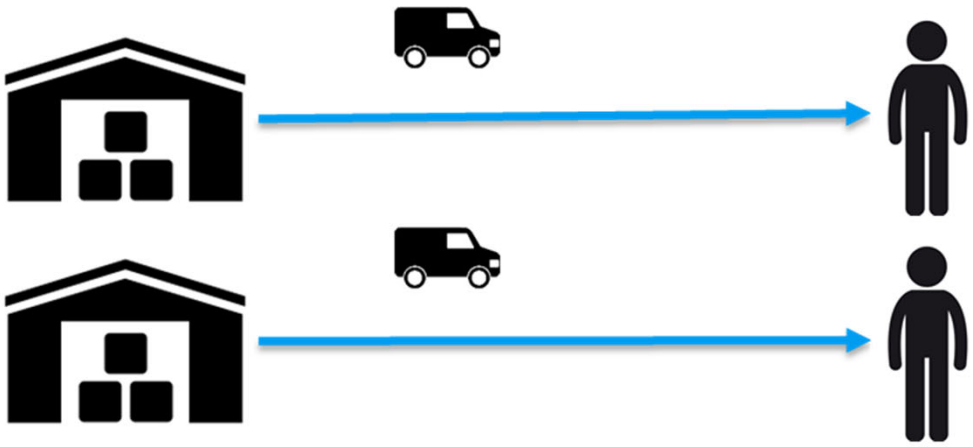
Sustainable city distribution

Pollution

Traffic Congestion

Rethinking the last mile

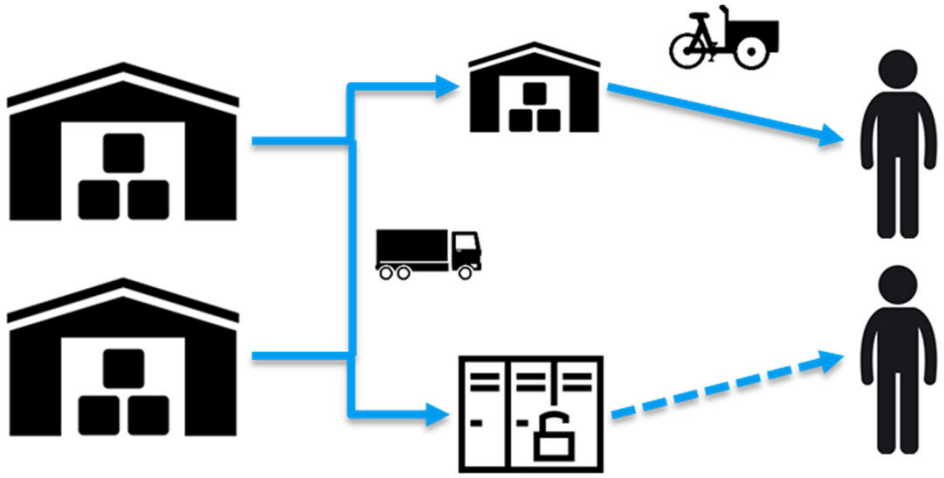
Current situation



Consumers demand

- Fast delivery lead time
- Delivery time windows
- Reduction of CO2 emiision footprint

Towards sustainable city distribution: city logistics hubs, lockers and freight bicycles



1. Reduces the amount of trucks in the cities
2. Increases the potential usage of environmentally friendly vehicles, e.g., freight bicycle
3. Lockers are available 24/7

binnenstadservice nederland

Routing

Suppose a salesperson wishes to visit a number of cities. Find the shortest route that visits each city exactly once, while the salesperson ends where (s)he started.

Complexity of routing

Number of cities	Number of routes
5	12
10	181.440
20	60.822.550.204.416.000

Algorithms

- Optimal method
  - Find the best solution
  - good search routine will skip the maximum number of potential solutions.
  - Skipping so that the best solution will not be skipped.
  - Long calculation times
- Heuristics
  - taking the search time into account.
  - quickly finding a good solution.

What is possible?

- More than 15 years ago scientist solved a routing problem with 15,112 cities.
  - But that took 22 years of computer time
  - Only one vehicle
  - Only one depot
- Since then
  - better algorithms
  - faster computers
  - Parallel computing

What is possible?

- For most practical problems it is impossible to find a good solution.
- We often settle for acceptable.
- Or don’t even know how good the answer is.
- How long may calculations take?

What algorithms can do

- Two-echelon vehicle routing problems with covering locations where utilization of lockers can be investigated (D. Enthoven et. al., 2019)
- Profitable arc routing problem where utilization of freight bicycles can be investigated (B.Jargalsaikhan et. al., working paper)

Next step in the last mile optimization

- In the literature, benchmarks involve hundreds of nodes
- But "real" data may involve thousands of nodes
- These benchmark instances with thousands of nodes need to become available for the research community
- New heuristic tailored to thousands of nodes