A conceptual proposal for an expert system to analyse smart policy options for urban CEP transports

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Agenda

- Motivation
- Study scope
- CEP demand
- CEP supply
- Summary and outlook

Motivation

- The market of courier, express and parcel (CEP) services has been growing fast and is the biggest segment in urban freight

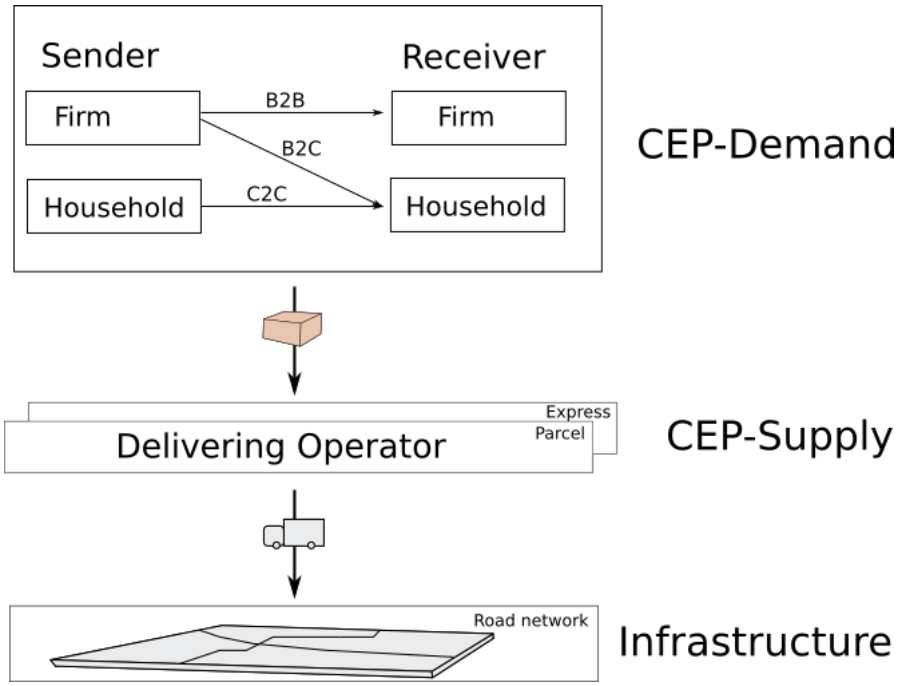
- Not only good but also comes with negative impacts

- Transport policy measures such as
  - Vehicle type dependent toll in environmental zone from 8am - 4pm
  - Support for micro depots and parcel stations
  - …

- Multi-Agent Transport Simulation

→ Focus on the derivation of CEP demand and supply patterns

Study scope – How do CEP transports emerge?



- Fundamental (trade-)relation between sender and receiver → Shipment
- Physical object transported with delivery operator → Vehicle Movement

Study scope – Market scope

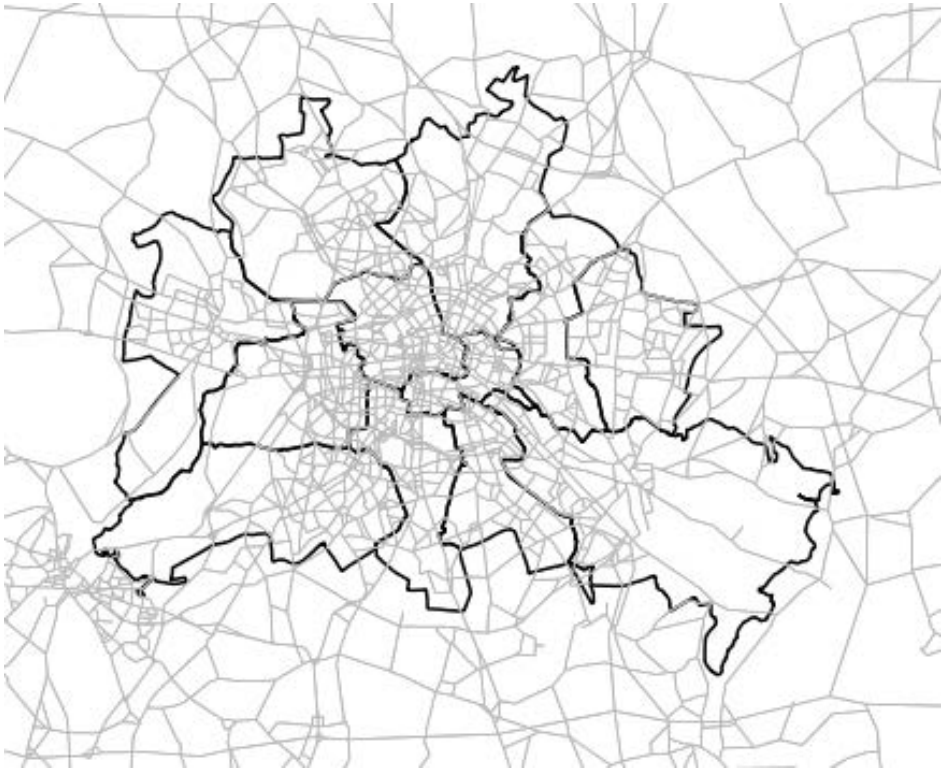
- **Courier** – fast transport directly from the sender to the receiver usually within the same day
- **Express** – items are usually delivered overnight. Short lead times and high service level.
- **Parcel** – high degree of standardization, no fixed delivery date and weight restriction

→**Parcel** segment is by far the biggest one with 82% of all shipments[1]

→Focus on **Express** and **Parcel** services, i.e. parcels that are shipped via dedicated distribution networks

1,2: Esser and Kurte (2014)

Study scope – Geographical scope



- Berlin, the biggest city in Germany with 3.3 million inhabitants
- Dense road network
- Focus on last mile deliveries
- Synthetic population of households and firms

CEP demand

- Demand of Households (B2C & C2C)
- Demand of Firms (B2B)

CEP demand – Households' eCommerce order behaviour

- Survey of 40,000 households (January – December 2013)
- Mail order and online shopping
- Survey features:
    - **Ordered products** and **shopping intensity** by age, sex, region of orderer and household size
    - **Back rates** by product type
    - **Relation type**, i.e. B2C or C2C

→Parcel demand per household

Survey source: GIM, 2013

CEP demand – Delivery options

- Parcels are not only delivered to household's home address
- Several options:
    - Home address (currently still >90%)
    - Parcel station
    - Work place
    - Relay point such as convenience store
    - Central pickup points
- Distribution will be part of our scenario definition

→Household's demand with corresponding delivery option

CEP demand – Receiver firms' order behaviour

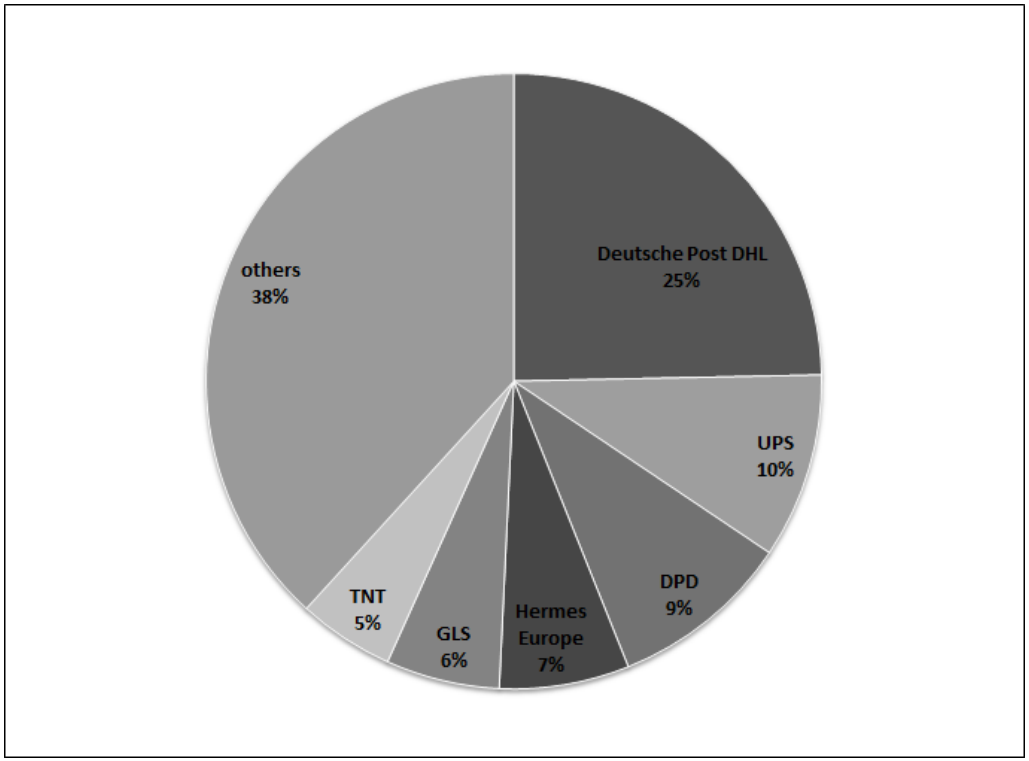
- Firm database in Berlin: firm size, location and industry
- No data available yet, thus we are currently design our own survey
- Necessary data: shopping intensity by product type

→ CEP demand of firms

CEP demand – Linking demand to supply

- Each shipment is transported by a transport service provider
- Need to link the shipment to a service provider
- Simple choice model, e.g. according to the market share of transport service providers

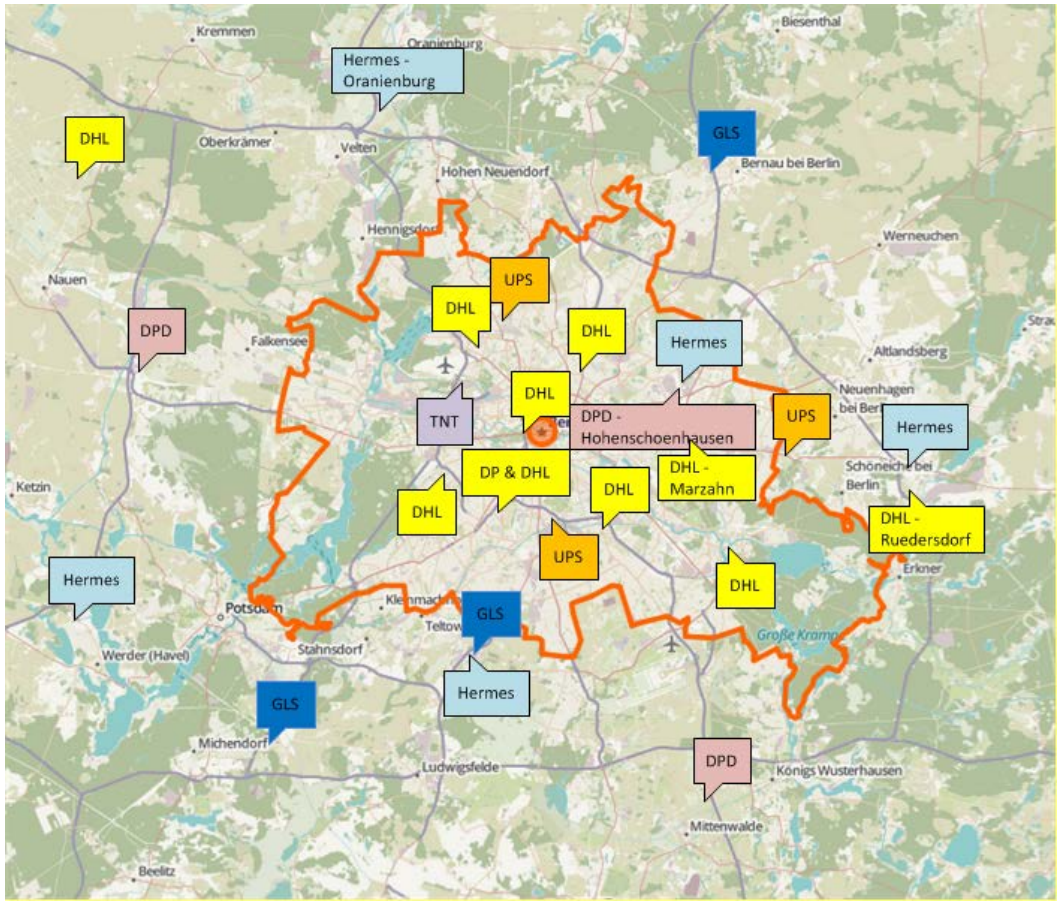
CEP supply – Market share of service providers



Source: C. Kille and M. Schwemmer, 2012

- Figure shows the TOP6 service providers in terms of revenues
- DHL is by far the biggest one

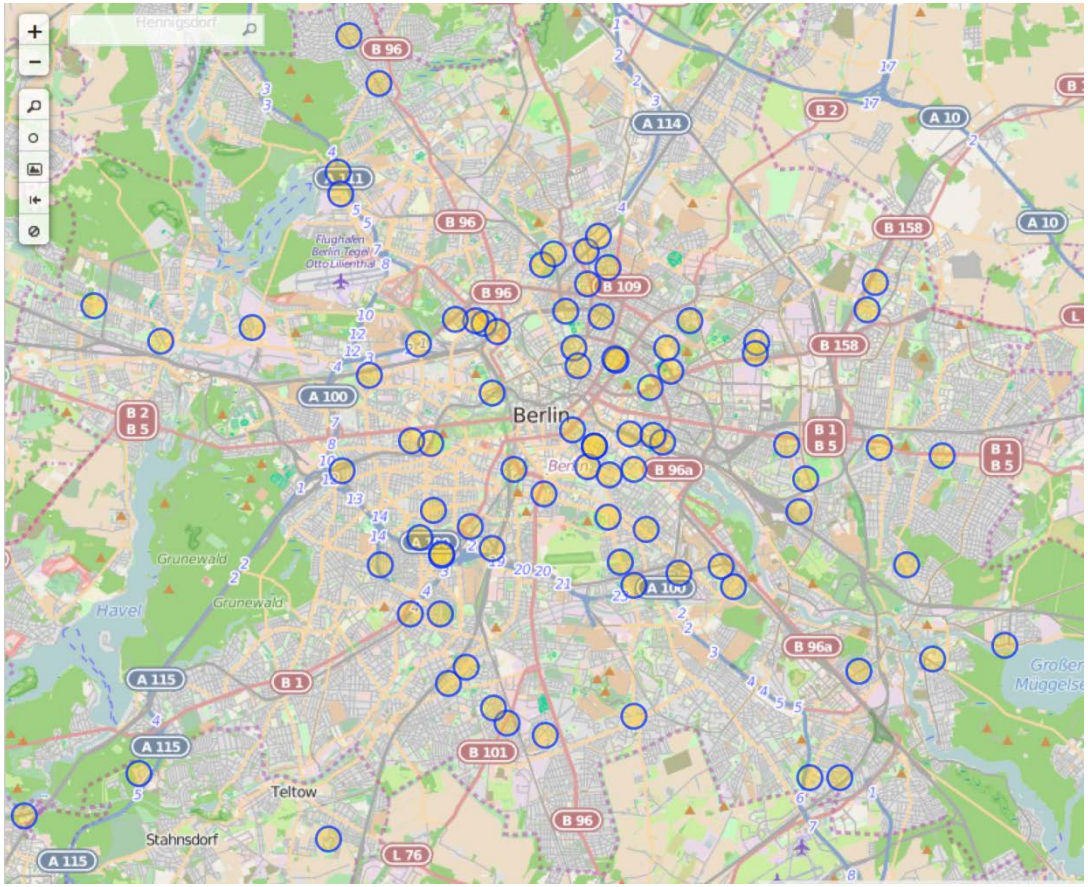
CEP supply – Distribution centres



- Egress and access points for shipments
- Distribution centers of TOP6 operators (25 in total)
- Differ significantly in size, number of employees and throughput (the biggest 16,000 parcels per hour)

Source: Paketda, 2015

CEP supply – Other delivery infrastructure



Source: OpenStreetMap, 10.05.2015

- Each service provider operates its own inner city distribution network
- Parcel stations
- Post offices
- Relay points such as small convenience stores, gas stations etc.

- Example shows parcel stations of DHL according to OSM

CEP supply – Vehicles

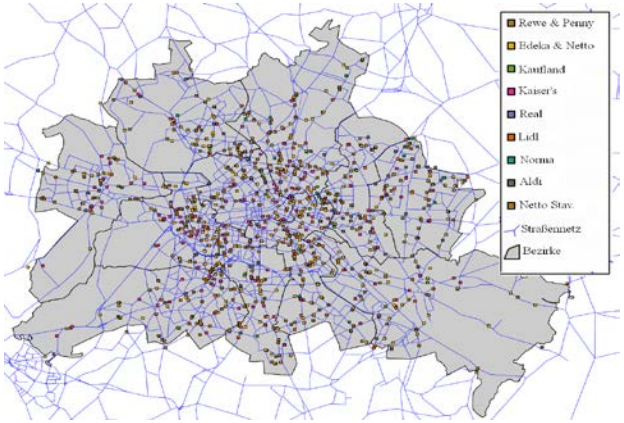
- Usually 3 types of vehicles are employed 3.5t, 7.5t and 12t
- Full cost accounting to derive fixed and variable costs
- Taking into account purchase price, price of wheels, maintenance and insurance costs, driver wages, interest rates etc.

Table: fixed and variable costs in EURO

vehicle type	adm. weight	fixed costs	costs per km	costs per hour
light	3.5t	76	0.28	28
medium	7.5t	79	0.37	28
heavy	12t	84	0.47	28

Motivation – Multi-Agent Transport Simulation

- CEP demand
- CEP supply
- policy scenarios
- network



transport sim

jsprit

matsim

agent based vehicle routing (heuristic optimization)

* network-based
* time and policy dependent costs
* heterogeneous fleet
* multiple depots
* time windows
* arbitrary business constraints

Learn more: https://jsprit.github.io

multi agent transport sim

* concurrent sim of passenger and freight agents

Learn more: http://www.matsim.org

Summary and outlook

- Study the effects of various policy measure
  - Support of micro depots for employing freight bicycles on the very last mile
  - Support of parcel stations accessible for all CEP service providers
  - Introduction of dedicated parking space
  - Introduction of vehicle type and time of day dependent charges in inner city areas
- Study future developments
  - Further growth in CEP demand
  - Different adoptions of delivery options
  - Radical change of fleet composition due to electric vehicles

Summary and outlook

Thank you for your attention!

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References

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