# Stochasticity in line planning and timetabling

**Presentation**

**Author(s):**
Klasovitá, Viera; Corman, Francesco

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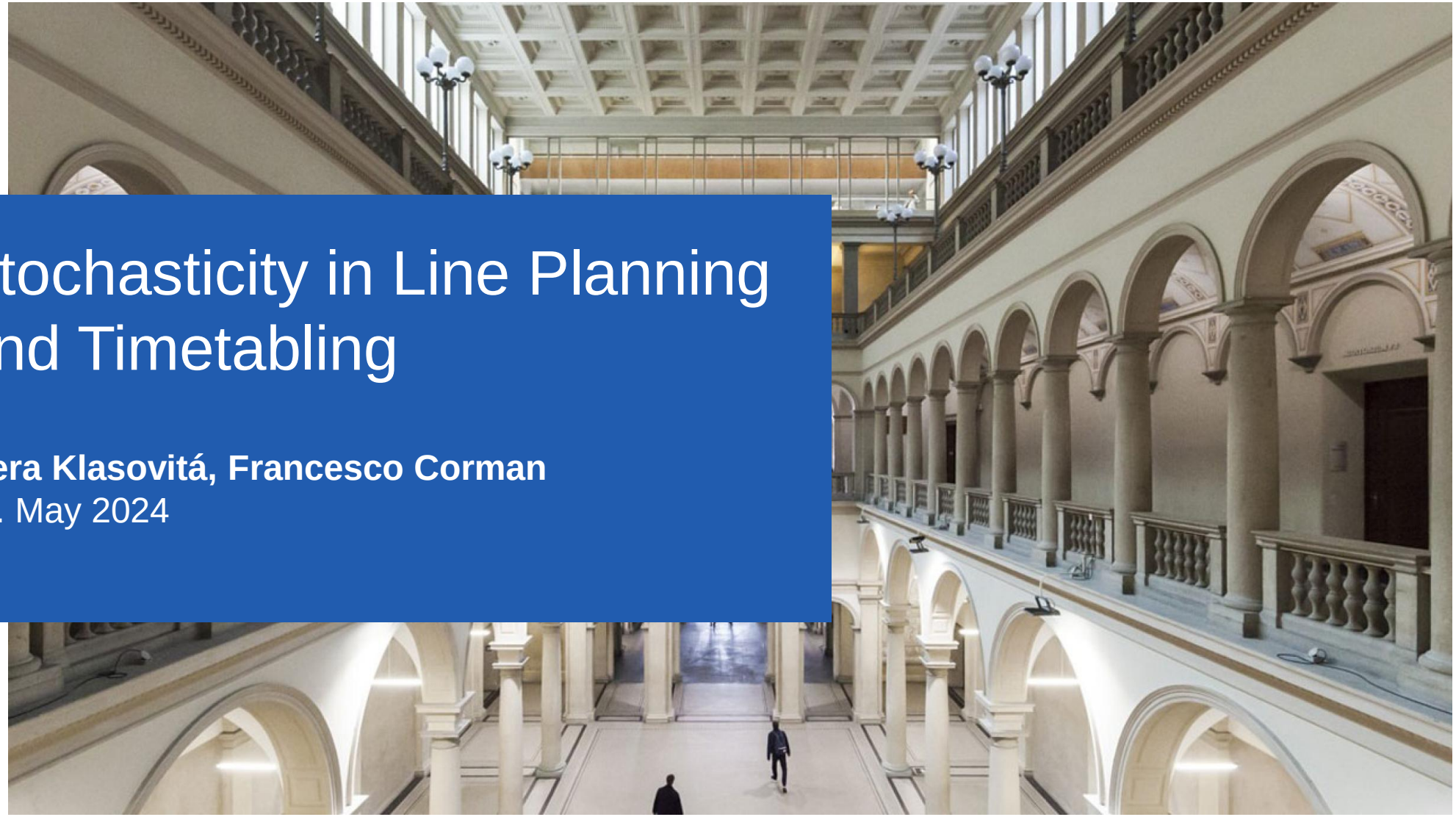
IVT Institut für Verkehrsplanung und Transportsysteme
Institute for Transport Planning and Systems



# Stochasticity in Line Planning and Timetabling

**Viera Klasovitá, Francesco Corman**

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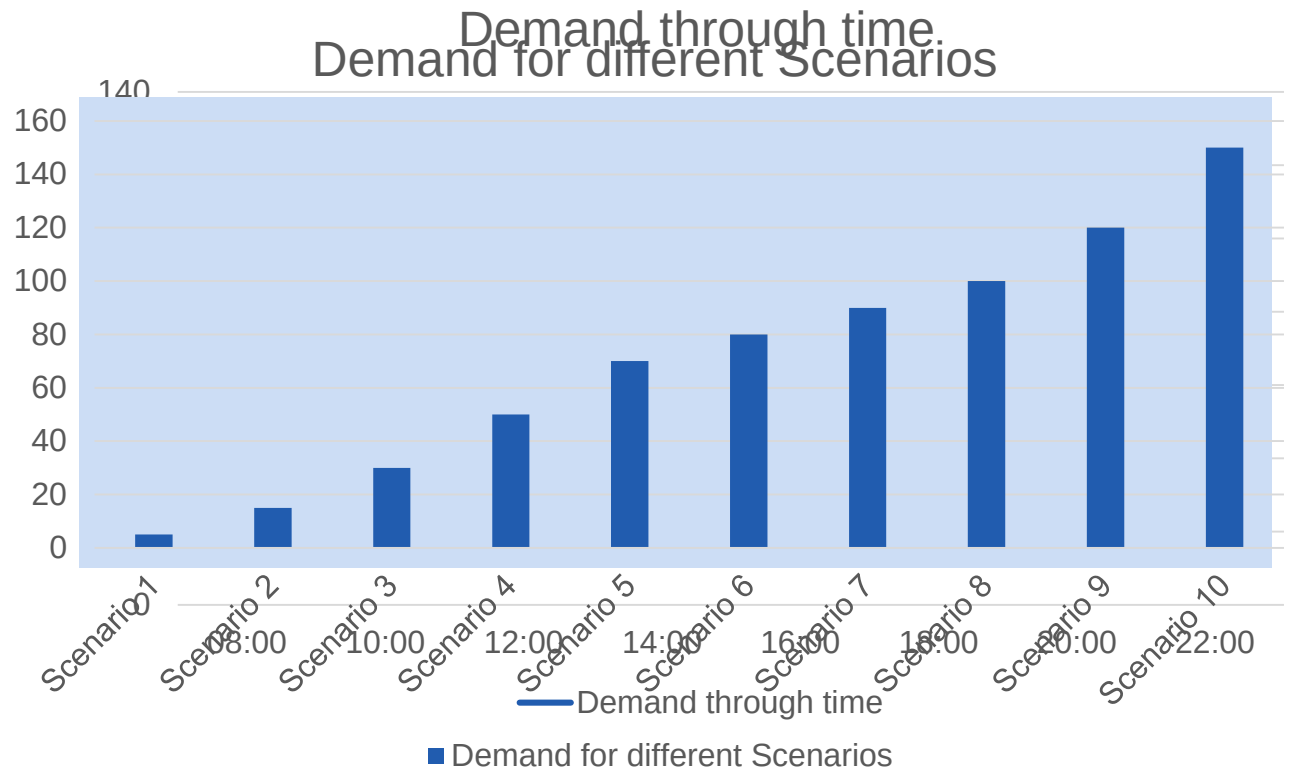
# Motivation

- Line Planning and Timetabling belong to the first steps in public transport design

- Parameters (e.g. demand and travel time) are
  - not known in advance
  - changing

# Approaches to Modelling

- Variable Input
- Robustness
- Stochastic Programming



# Overview of Planning Steps

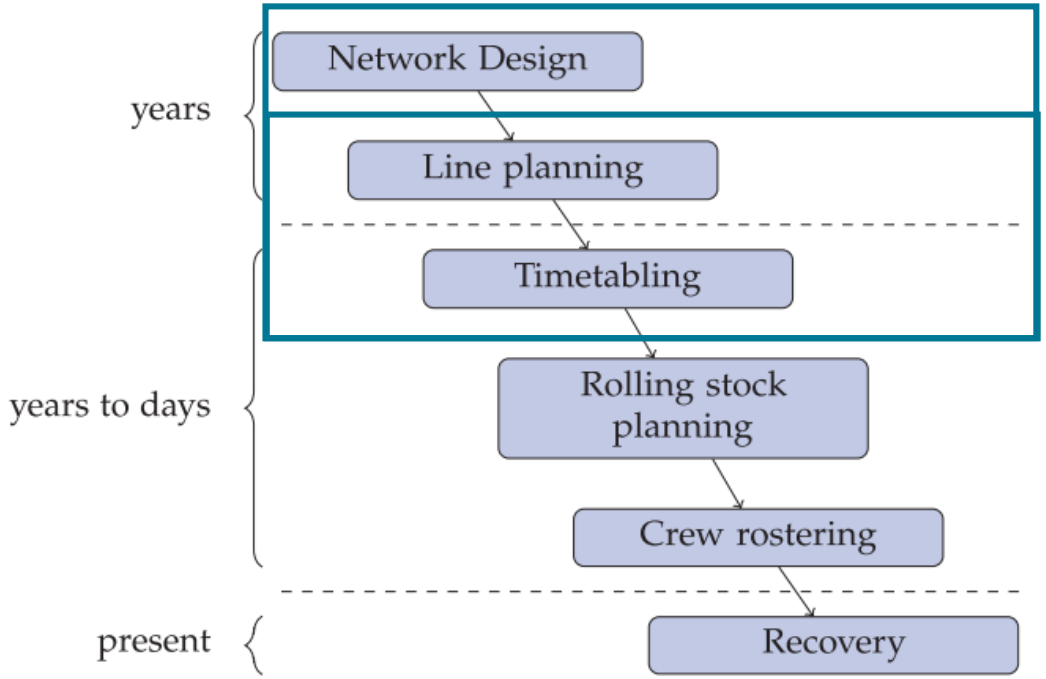
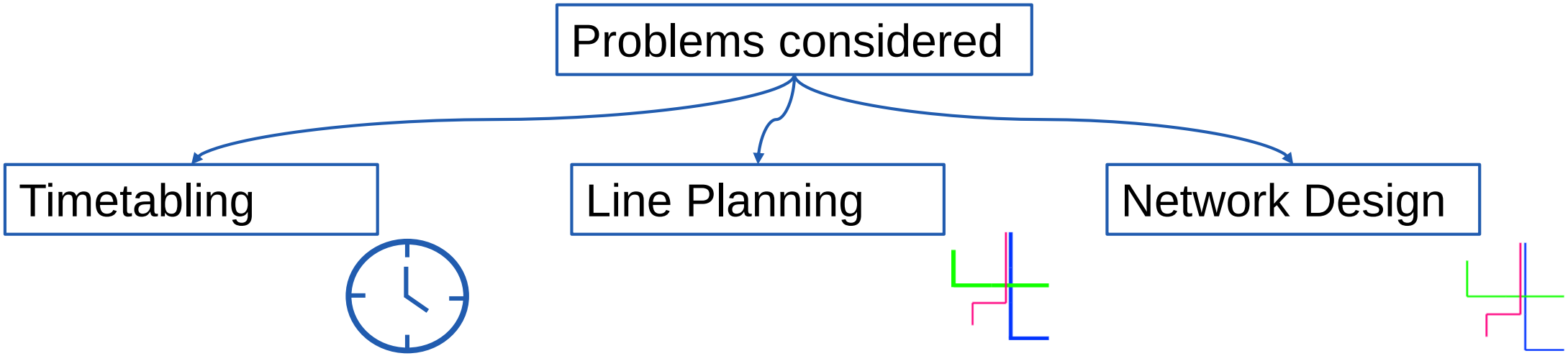


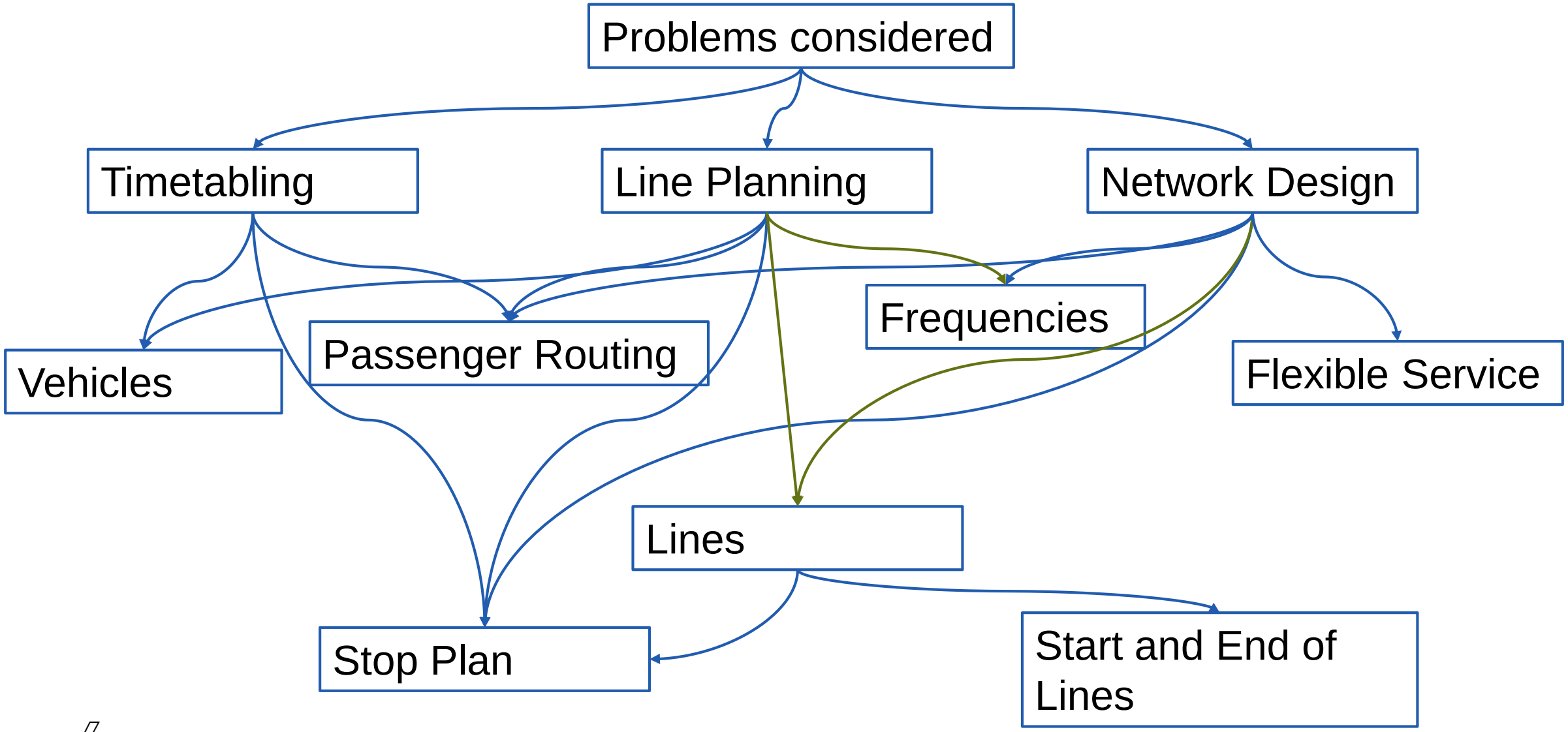

**Fig. 1.** Overview of the possible steps of rail planning, indicating their relative time horizons.

Lusby, Richard M., Jesper Larsen, and Simon Bull. "A survey on robustness in railway planning." European Journal of Operational Research 266, no. 1 (2018): 1-15.

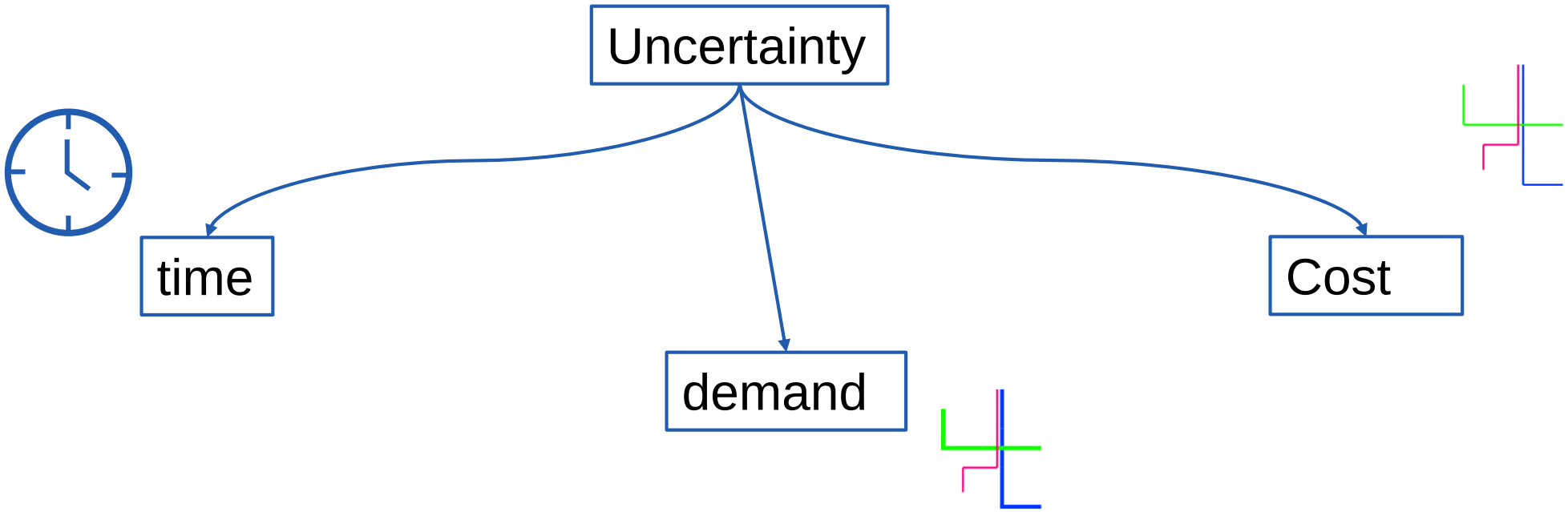
# Problems considered



# Problems considered



# Uncertain Parameters



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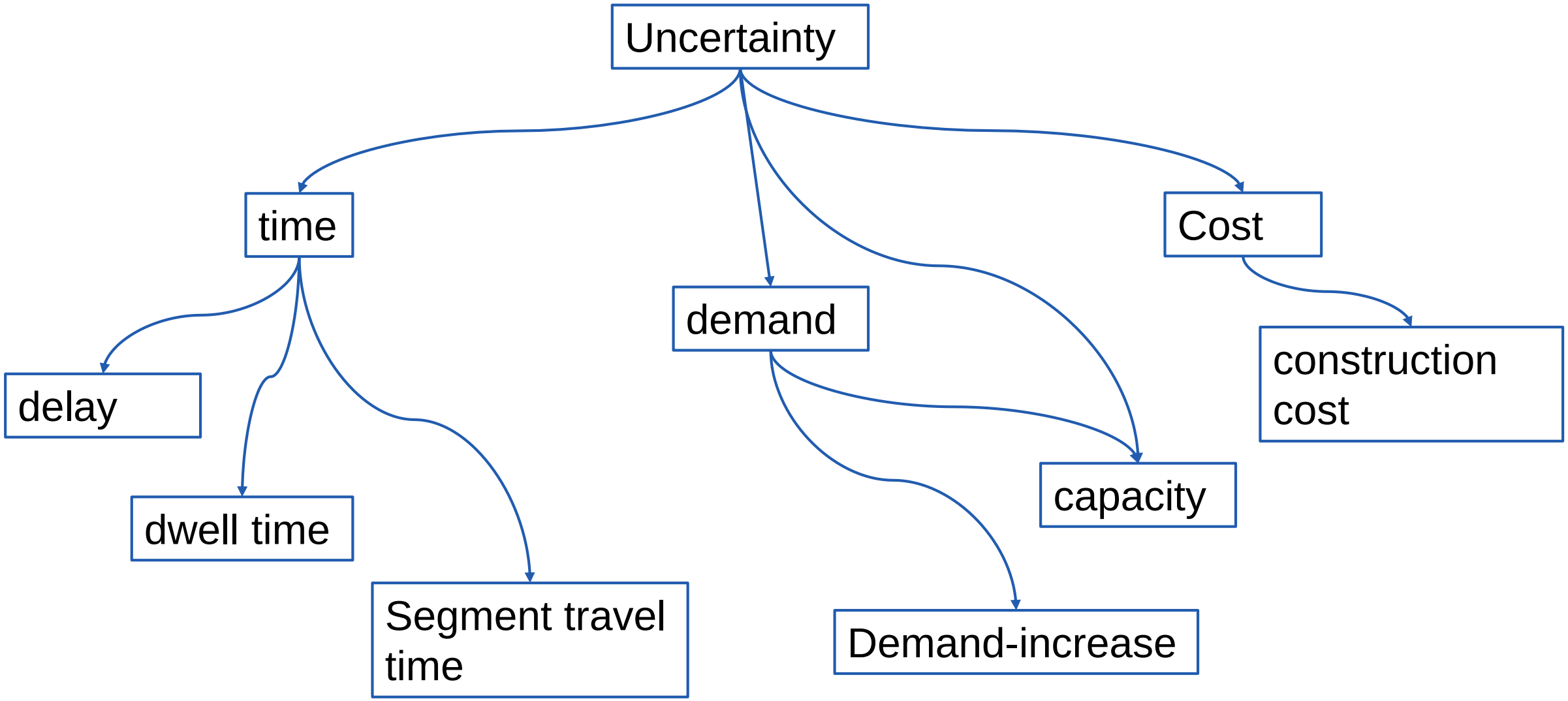
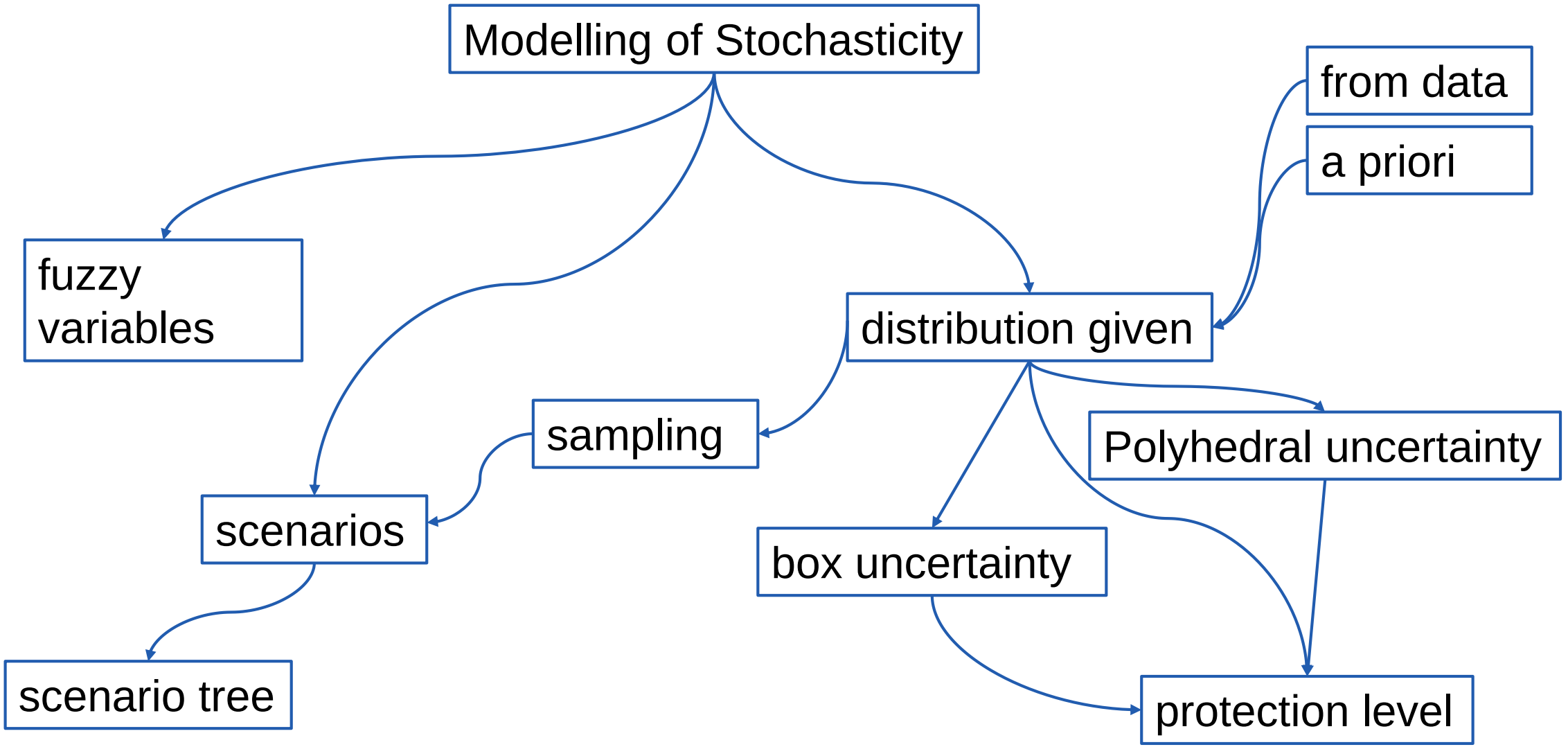


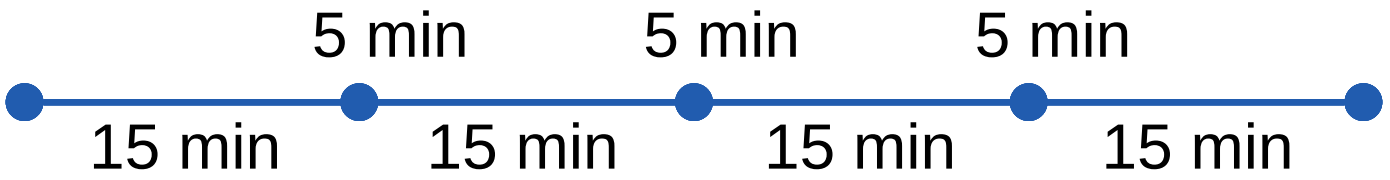
# Modelling of Stochasticity



# Approaches for Solving Network Design, Line Planning and Timetabling

- Using Solvers
- Heuristics
- Algorithms

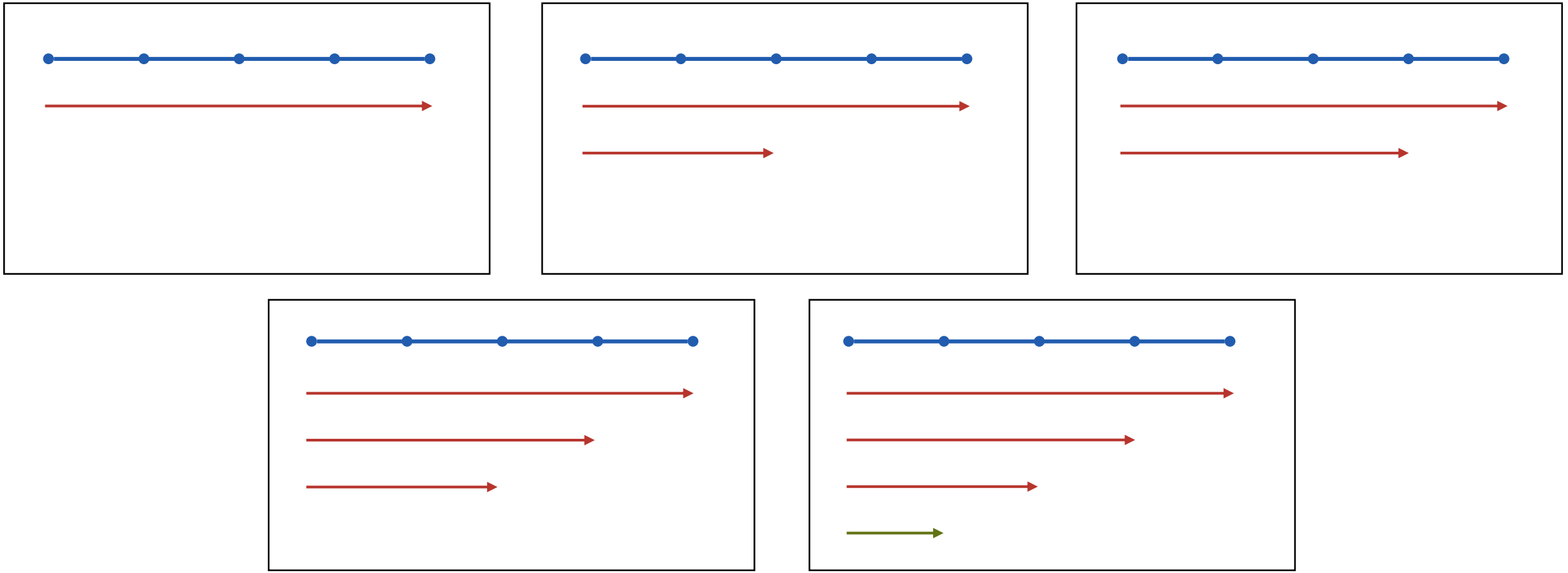
# Toy Example



# Toy Example

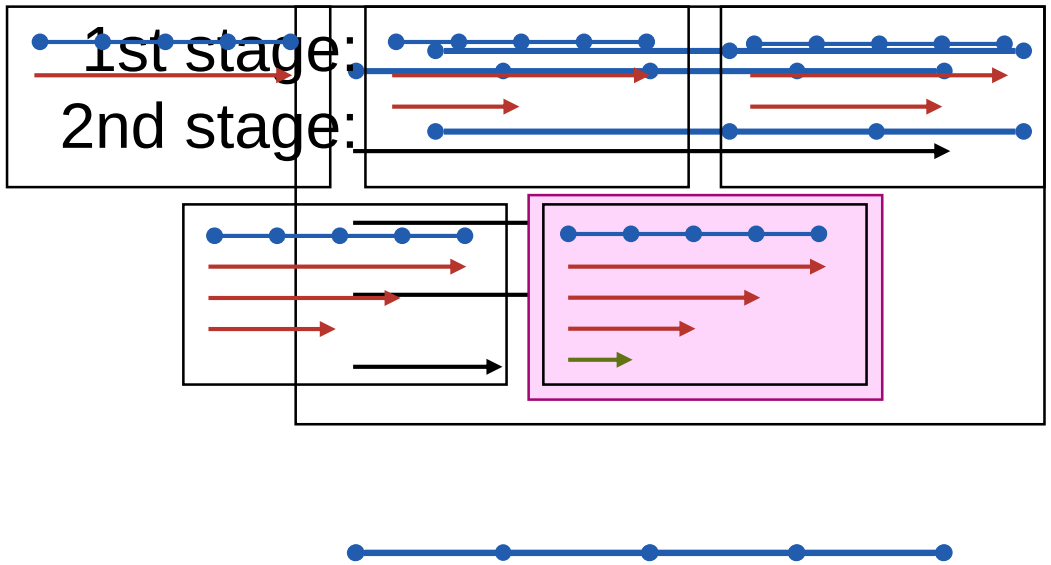
100 passengers

10 passengers

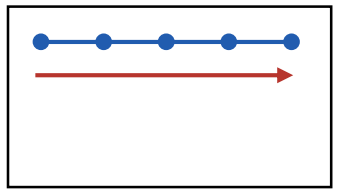
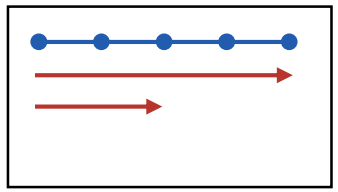
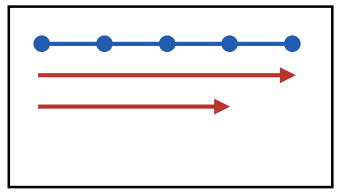
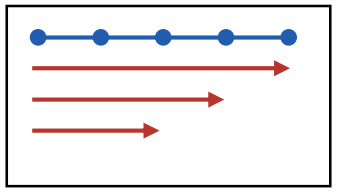
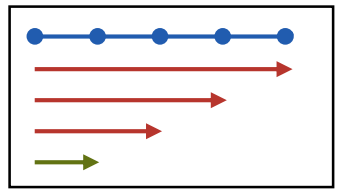


# Toy Example

- Deterministic Approach
  - Average Demand
- Robust Approach
- Stochastic Approach
  - 2-stage model:
    - adding stops (dwell time +5min)



# Toy Example

| Total travel time [min] |  |  |  |  |  |
|---|---|---|---|---|---|
| Deterministic  | 7’500 | 11’000 | 13’000 | 16’500 | 16’650 |
| Robust  | 7’000 | 10’000 | 12’000 | 15’000 | |
| Stochastic  | 6’500  | 9’500  | 12’500  | 15’500  | 18’650  |
| Ideal | 6’000  | 9’500  | 11’000  | 15’000  | 16’650  |

# Conclusion

- Different Approaches: Variable Input, Robustness, Stochastic Programming
- Interconected Problems, esp Network Design and Line Planning
- Overview of different uncertainties
- Limited use of data
- Common test cases could be useful
  - Also real-life test cases

# Questions?