



Parallel Session 3A – Station Design 2

# Railway Transfer Station Design and Performance



**UIC next station**  
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# Railway Transfer Station Design and Performance

## Content

1. Aim
2. Typology of railway (transfer) stations
3. Appraisal of station accessibility
4. Estimation of station attractiveness and passenger volume
5. Assessment of railway station performance
6. Conclusions

# Railway Transfer Station Design and Performance

## Aim

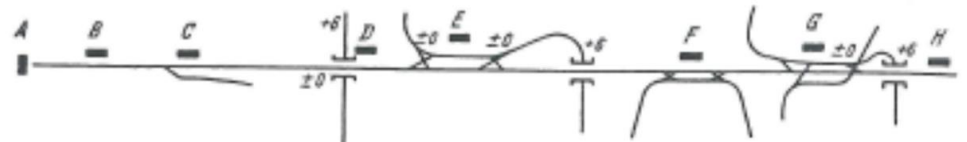
Design of railway stations varies a lot as of other buildings depending on its transport & traffic function, urban accommodation and architecture.

The objective of this presentation is introducing

- Parameters for principal design of railway stations, tracks and platforms
- Performance assessment methods for station transport accessibility, attractiveness, capacity and connectivity

# Classification of railway stations

- I. Network function
  - Network function
    - Terminal station
    - Intermediate station
    - (No) Line transfer connection
      - At-grade
        - Merging/Diverging
        - Tangent
      - Grade-separated
- II. Route and line network
- III. Track number and usage
- IV. Platform arrangement
  1. Horizontal
  2. Vertical
  3. Single line
  4. Two lines



Source: Weigelt (1999)

# Classification of railway stations

## II. Route and line network

- Dedicated routes and lines
  - High-speed
  - Metro
- Mixed operation
  - Passenger lines
    - ❖ High-speed
    - ❖ Intercity/Regional (Express)
    - ❖ Rail Rapid Transit
    - ❖ Suburban
  - Freight lines

## III. Track number and usage

- **Single track**
- **Multiple tracks**
  - 2 tracks
  - 4 tracks
  - $\geq 6$  tracks
- **Track usage**
  - Train Operation
  - Shunting
  - Stabling
- **Traffic direction**
  - Monodirectional
  - Bi-directional

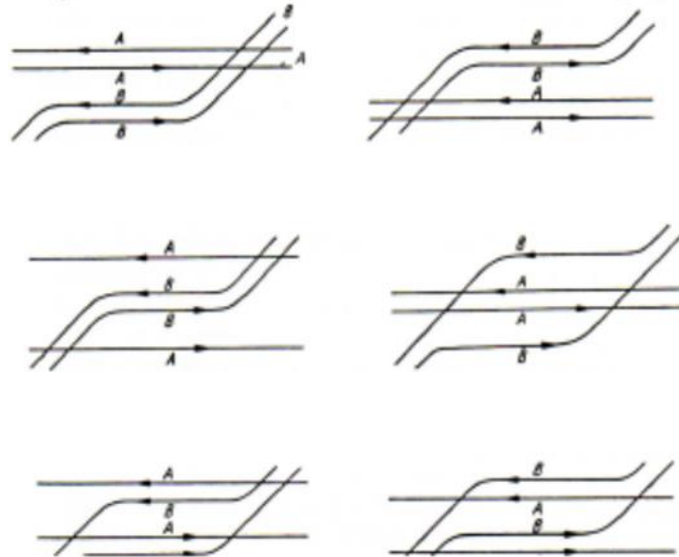
# Classification of railway stations

## IV. Platform arrangement

□ by lines

□ by direction

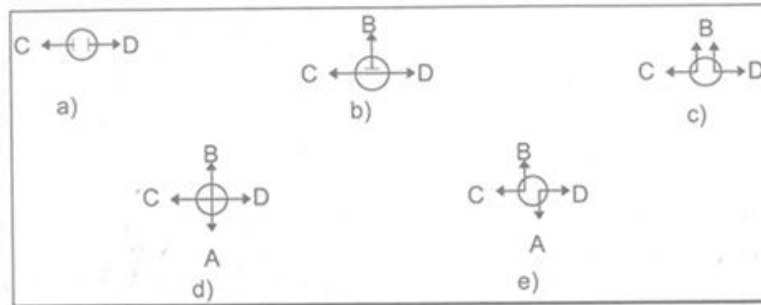
### Lateral and/or Center



Source: Vuchic (1981), Weigelt (1999)

# Classification of interchange stations

1. Transport modes interconnected
2. Levels of route alignment (At-grade, Elevated, Underground)
3. Kind of line connection and timetable synchronization



- a) Connection of ending lines
- b) Connection of ending and continuing lines
- c) Connection of splitting and merging lines
- d) Connection of crossing lines
- e) Connection of touching lines

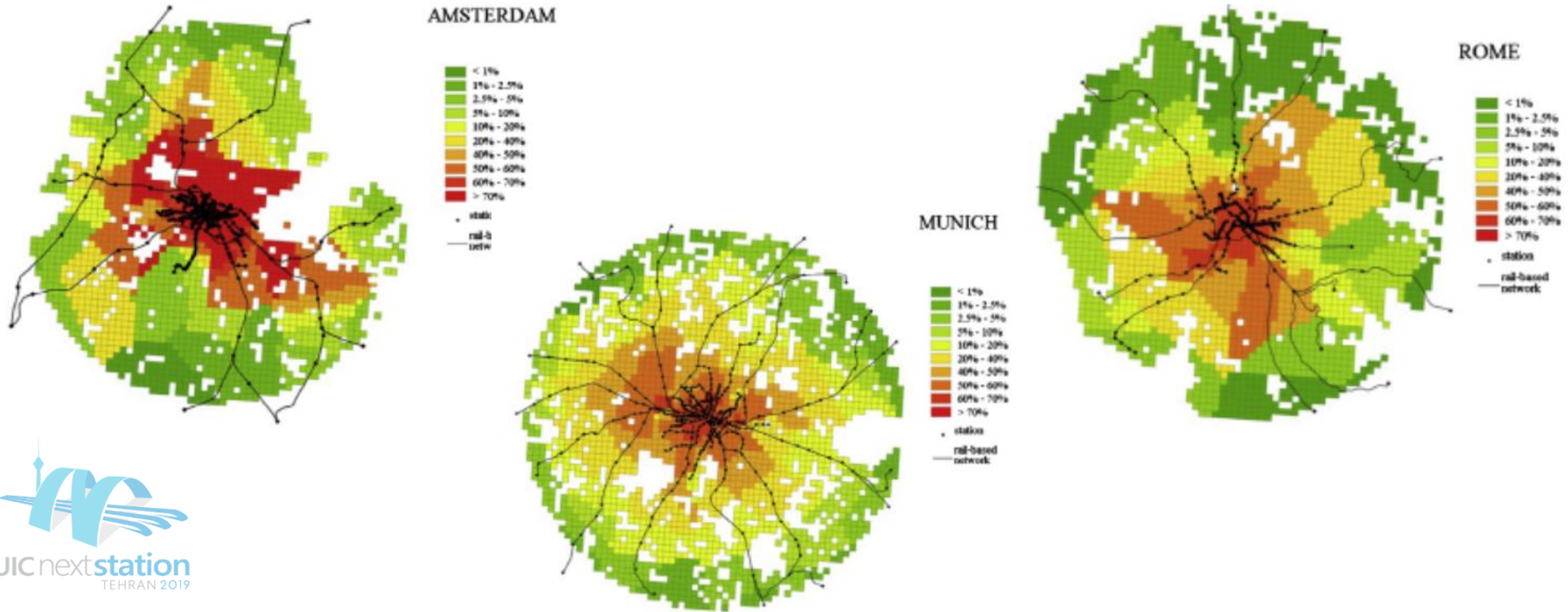
Source: Kruse, 1995

4. Transfer mode (Cross-platform, Grade-separated crossing)
5. Escalator and/or elevator availability
6. Synchronization of arrival and departure times
7. Real-time monitoring of delays and transfer connections

# Station Accessibility of population and jobs

- Accessibility index within urban rail network commuting time  $\leq 30$  min

Source: Papa & Bertolini (2015)





# Station Attractiveness and passenger volume

- Station attractiveness measure by regression analysis based on questionnaire survey w.r.t.

- vicinity of station and attractiveness of commuting destination station

- presence of facilities within station

abundance of ticket vendors, little waiting time at ticket sales counters, station cleanliness, restroom cleanliness, wide platforms, platform screen doors, security,

- railway service

easy-to-understand departure guidance, many trains departures, express or faster trains are available, many originating trains (on a one-to-five scale)

- presence of facilities around station

Source: Ozaki et al. (2017)

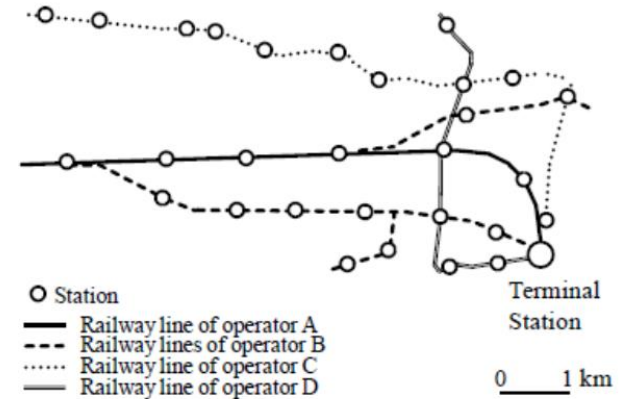


Fig. 1 Railway map of a part of Tokyo metropolitan area

## Region A

Average number of passengers per day in the station =  
 $2786 * \text{attractiveness}$

$+ 0.536 * \text{residential population around the station}$

$+ 1.778 * \text{number of transit passengers}$

$+ 3502 * \text{number of bus stops around the station}$

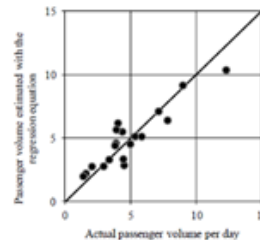


Fig. 4 Relationship between actual and estimated passenger volume in Region A

# Station Performance Assessment

## A. Track capacity

1. Graphical methods (Time-distance diagram, station track occupation diagram)
2. Analytical methods (Queuing, Mathematical Programming)
3. Simulation of (scheduled) train operations

## B. Network connectivity

- Variables
- Benchmark indicators
- Case Rotterdam CS



# Station Connectivity

- Benchmark indicators

- ❖ Number & kind of connected PT modes  $M_i^k$   
(Air, HSR, Rail, Metro, Tram, Bus, Ferry)
- ❖ Number & kind of connected railway stations  $S_i^k$   
(International, national, regional, urban, suburban)
- ❖ Number & kind of connected (railway) lines  $L_i^k$   
(High-speed, Intercity, Regional, Local, Freight)
- ❖ Number & kind of line frequencies/hour  $F_i^k$
- ❖ Volume of passengers boarding & alighting/day  $P_i^k$
- ❖ Travel time to destination  $T_i^k$



## Case Rotterdam CS

6

>100

18

20

93 000

# Railway Transfer Station Design and Performance

- Conclusions

Railway stations are characterised by great variety of architectural design, scope and functions.

Railway stations are classified by their network function, route and line network, track number and usage, and platform arrangement.

Transport & traffic performance of railway stations can be measured by capacity, accessibility, attractiveness, and connectivity.

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