Behaviour of rail passengers in railway stations

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Introduction

In all railway design processes related to passengers, they must be in the focus of all investigations!

The author is focused for more than 16 years on rail passengers by analysing passenger’s

• Behavior

• Needs and expectations

........... along the whole mobility chain!

In more than 15 projects the behavior and the needs of passengers during their stay in the rail station have been analyzed in many different phases.
Methodology

Over all projects the methodology can be summarized as following:

- **Surveys:**
  - In total about 5000 passengers were asked about their problems, needs, expectations and behaviour in railway stations.
  - In total about 10,000 passengers were asked about their problems, needs, and expectations in case of boarding a train.

- **Video analyses:**
  - About 7000 persons have been filmed in different situations in stations (e.g. on escalators, in lifts, on stairs etc.).
  - About 20,000 passengers have been filmed when boarding or alighting trains and have been analysed.
  - About 2,000 passengers have been filmed to analyse their waiting position at the platform.

- **Automatic passenger counting:** Automatic passenger counting of about 4 million boarding situations in Vienna metro system have been analysed.
Passengers in train stations

Passengers stay and move in stations.

Process:

- Entering a station
- Stay in the station
- Move in the station
- Walk to the platform
- Wait on the platform
- Board the train
Stay at the station

*Passengers have to stay more or less long on the station*

- Before train departure
- Changing trains, transfer time

*Waiting time …*

- has an influence on comfort → modal split
- is felt subjectively!
- has to be reduced (subjectively)!
Stopp over time in the station

Approximately 20% of (long distance travelling) passengers stay more than 30 min. at rail stations (esp. holiday maker)
Stations are mutating more and more into shopping and entertainment centres

*We do have to care about the basic needs of passengers*

shopping and entertaining possibilities

⇔ conflict with luggage

⇔ its hardly possible to use attractions

→ easy short term luggage deposing is necessary
Waiting passengers – potential shoppers
If the waiting time is longer than 30min:
→ ~ 25% prefer shopping
→ ~ 30% prefer going to a bar or restaurant
Impairments because of luggage

About 40% of all passengers who prefer shopping or going to a bar or restaurant feel impaired because of their luggage.

Would you feel impaired because of your today's luggage when following the planned activities?
80% wish to have an easy handling luggage storing possibility at the station for shopping etc. without luggage.
luggage storing - needs

Luggage storing in the stations is necessary

• Passengers have the wish of storing luggage, also short term
• Short term locking must be offered for free (long term 2 € to 4 €)
• Handling time not longer than 1 min
• Storing must be as easy as possible
• No lifting of the luggage!
• Size of lockers, extra sized luggage!

Benifit for railway and station operators

• more shopper → more benefit for the station operator
• More satisfied customers
In average 66% of passengers (without luggage) choose an escalator and only 2.5% choose lifts!
Downstairs only 52% use an escalator, upstairs 85%!
Behaviour on stairs

- Downstairs about 50% walk in the middle, upstairs between 50% and 70% walk on the right
- Velocity:
  - 1.2 m/s (young), 1.1 m/s (40-60 years), 0.9 m/s (elderly)
  - Crowding, capacity limit: 0.9 m/s
- Approx. capacity: 1.52 pers./m (stair width)
Escalator capacity / time need

The movement of 20 persons need between 15 sec and 40 sec
There is no time difference if people are just standing or standing on the right and walking on the left

![Graph showing time requirement vs number of people for different scenarios.](image-url)
In 50% of all cases the occupancy rate is just 30% (by people).

- Only in 10% the occupancy rate is higher than 50%, in all cases the maximum is 70%
- In 50% of all cases up to 80% of the area in the lift is occupied.
Passenger exchange time has a strong influence on the dwell time. In long distance travel the boarding time is raising with higher potential, in urban transport it is close (but not exactly) to a linear distribution.

The higher the number of boarding passenger, the longer the dwell time.
The boarding time is strongly influenced by the vehicle interiors! Main influences are caused by:

- Entrance situation
- Aisle with
- Seat arrangement
- Baggage stowage

In railways vehicles the difference between very **good** and very **bad** designed vehicles are approx. 1:3

**Dwell time and passenger behaviour** can be exactly calculated by using **TrainOptimizer** → more info see outside in **poster session**
Usually **not all doors are used equally**, some doors are strongly crowded.

The **over linear time need** at crowded doors enlarges the dwell time even more.

The passenger distribution depends on different behaviour.

Most **impact comes from the station design** – passengers who are used to the system exactly know where they have to expect the closest exit. Usually the use the door for boarding where they have the shortest way to the next exit at their departure station.

Some examples are following.
Passenger distribution – example 1

One secondary exit (N); one main exit (H)
Passenger distribution – example 2

Two main exits (approx. in the quarter points)

Deboarding passengers

- around the corner
- direct way
- direct way

Passengers in percent

Door number
Passenger distribution – example 3

Two medium frequented exits at the and same platform changes
Passenger distribution – example 4

One wider main exit in the middle of the platform
Installations (example wall)
Comparison of different platform types

Deboarding passengers in percent for the most frequented door for each platform type

- Two middle exits and same-platform change of train possibility
- Three main exits and one middle exit
- One centrally arranged main exit
- Two main exits and one middle exit
- Two main exits
- One main exit and two middle exits
- One main exit and one side exit
- One main exit and two side exits
- Just one main exit at one side

Theoretical average load 5.56%
Passenger flow depending on access

H = main access,  M = medium frequented access
Waiting areas - seats

Older people stay closer to the platform access, younger people also use benches away.

![Bar chart showing seating preferences by age groups.]

- Seating area 5m from main entrance:
  - 20-40 years: 58.9%
  - 41-60 years: 29.4%
  - 61-80 years: 11.7%

- Seating area 60m from main entrance:
  - 20-40 years: 40.0%
  - 41-60 years: 35.0%
  - 61-80 years: 25.0%
Passengers with heavy luggage avoid walking on the platform. Some of them are also tourists which do not exactly know the system – that’s why they are waiting close to the access.
Passenger exchange time has a strong influence on the dwell time.

In long distance travel the boarding time is raising with higher potential, in urban transport it is close (but not exactly) to a linear distribution.

The higher the number of boarding passenger, the longer the dwell time.
exchange time – significant door

- **25 Persons**: 17-22 seconds
- **10 Persons**: 7-9 seconds
- **average e.g. 7 Persons**: 5-6 seconds

Delta!

- **ideal**
- **Best case**
- **Worst case**
Conclusion

Stay in the station: Passenger want to make use of facilities – easy handling short term baggage storage is required – also benefit for station operator → more passengers will spent more money

Dimensioning of lifts, escalators and stairs: Actual behaviour must be the basis for designing

- **Lifts:** Maximum achievable occupancy rate is 50%
- **Escalators:** Example 80cm wide steps: max. 4500 to 5000 persons per hour
- **Stair:** Maximum achievable capacity is 1.5 Persons per meter stair width
- **Platform access:**
  - more than one access is meaningful
  - Not only at the end of the platform, better additionally in the quarter or third points
  - Along the line not exactly always at the same places
Conclusion – vehicle design

For efficient railway system also influences caused by vehicle design must be taken in consideration.
• Good design leads to:
• Higher occupancy rate
• Much shorter dwell time
• Less energy consumption
• More efficiency

→ See outside in poster session
Thank you for your interest

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