Using Travel Card Data to Improve Public Transport Services

October 3, 2018

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Facts about Movia,
Public Transport Authority

Inhabitants
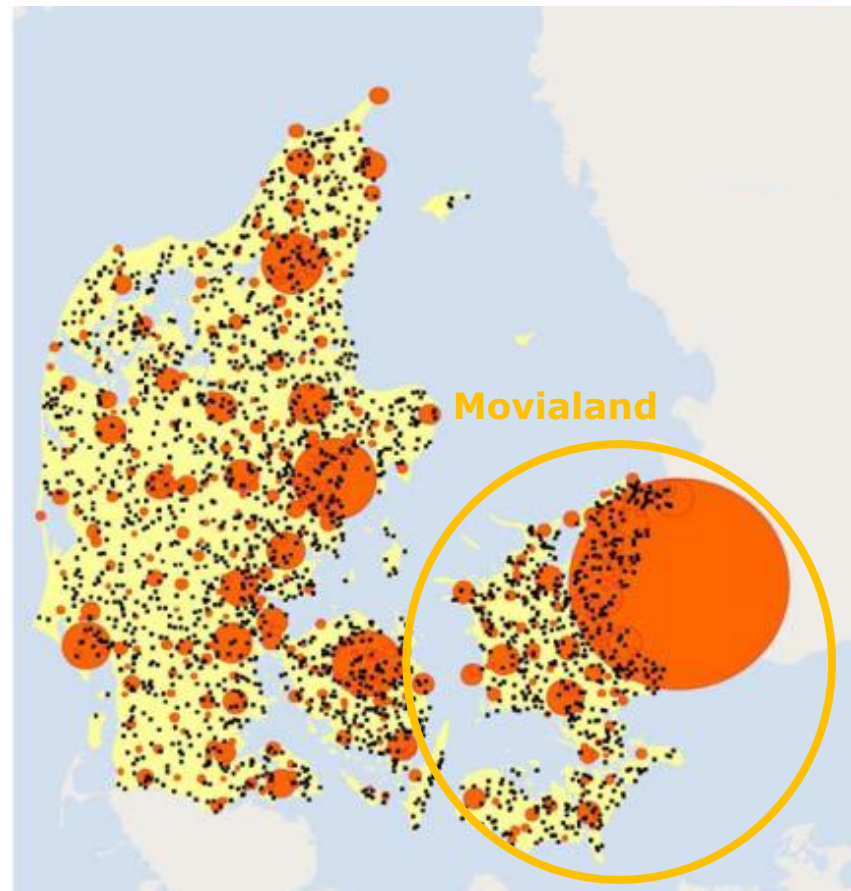- 5,8 m in Denmark
- 2,6 m in the area of Movia
- 1,9 m in Greater Copenhagen

Public administration
- 2 regions - 45 local municipalities
- App. 23 contractors

Key figures
- App. 215.000.000 passengers/year
- App. 450 bus lines – 1.300 buses
- 10 local railway lines + 3 harbour bus lines
- Demand responsive transport
- Metro and national rail run by other companies

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Bus passenger counts – what's the problem to be solved?

- Recording boarders/alighters per stop per trip on a given bus route
- Video-based automatic counting systems in 10 % of buses on most lines/30 % of local trains
- Manual counts by driver on a number of smaller lines

- Pros
  - Well known method for many years
  - Fairly high data quality

- Cons
  - No info regarding travel patterns
  - Static data - passenger figures only as averages (average weekday/month)
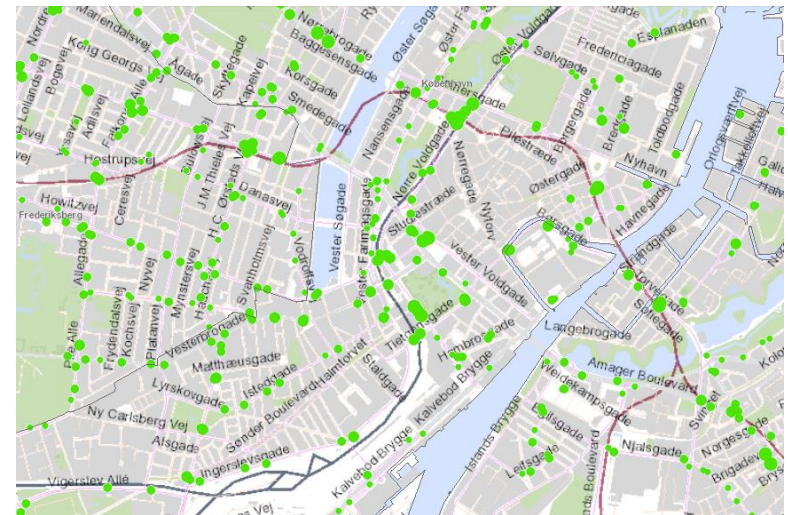
Travel card data – large potential for better knowledge, but…

- National system, in use in most areas since 2011
- Multiple check-ins and final check-out for each journey

First check-in ▸ Check-in ▸ Check-in ▸ Check-out

- Pros
  - Extensive travel pattern information
  - Large amounts of data
  - Detailed information on a daily basis

- Cons
  - Sample around 35 % of journeys but uneven distribution (time and geography)
  - Missing data for certain user groups (students, most commuters, pensioners…)
  - Lack of credibility among users

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Our solution: Combining the two incomplete data sources

- Passenger counts – number of boarders/alighters per stop

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- Travel card – detailed information regarding travel patterns, but uneven distribution among user groups

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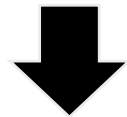
- Combined matrix showing all travel patterns on an "average weekday" in a given month
  - Relations between 14.000x14.000 stops/stations
  - Data for each of the 24 hours of the day
  - Produced once every month
  - Focusing on use for tactical/strategical purposes

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Using passenger counts to adjust travel patterns

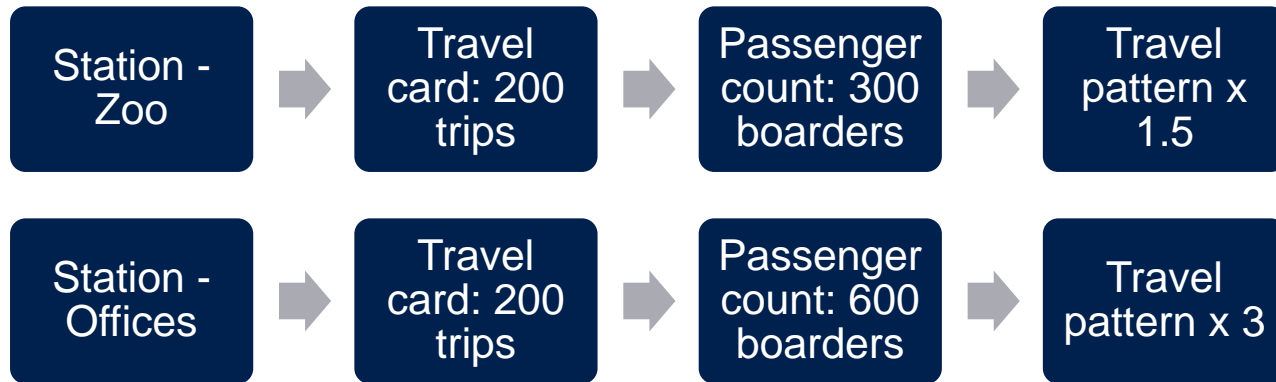| Station - Zoo | → | Travel card: 200 trips | → | Passenger count: 300 boarders | → | Travel pattern x 1.5 |

| Station - Offices | → | Travel card: 200 trips | → | Passenger count: 600 boarders | → | Travel pattern x 3 |

- Calculating and adjusting all relevant travel patterns between 14,000 stops and stations in the Movia area
- Using advanced matrix estimation methods (MPME) and transport modelling tools (passenger assignment model)
- Flexible method – can handle several different data sources
- Input data (timetables) from Travel planner (GTFS)

- Based on ArcGIS Enterprise + Transit Analyst + SQL Server

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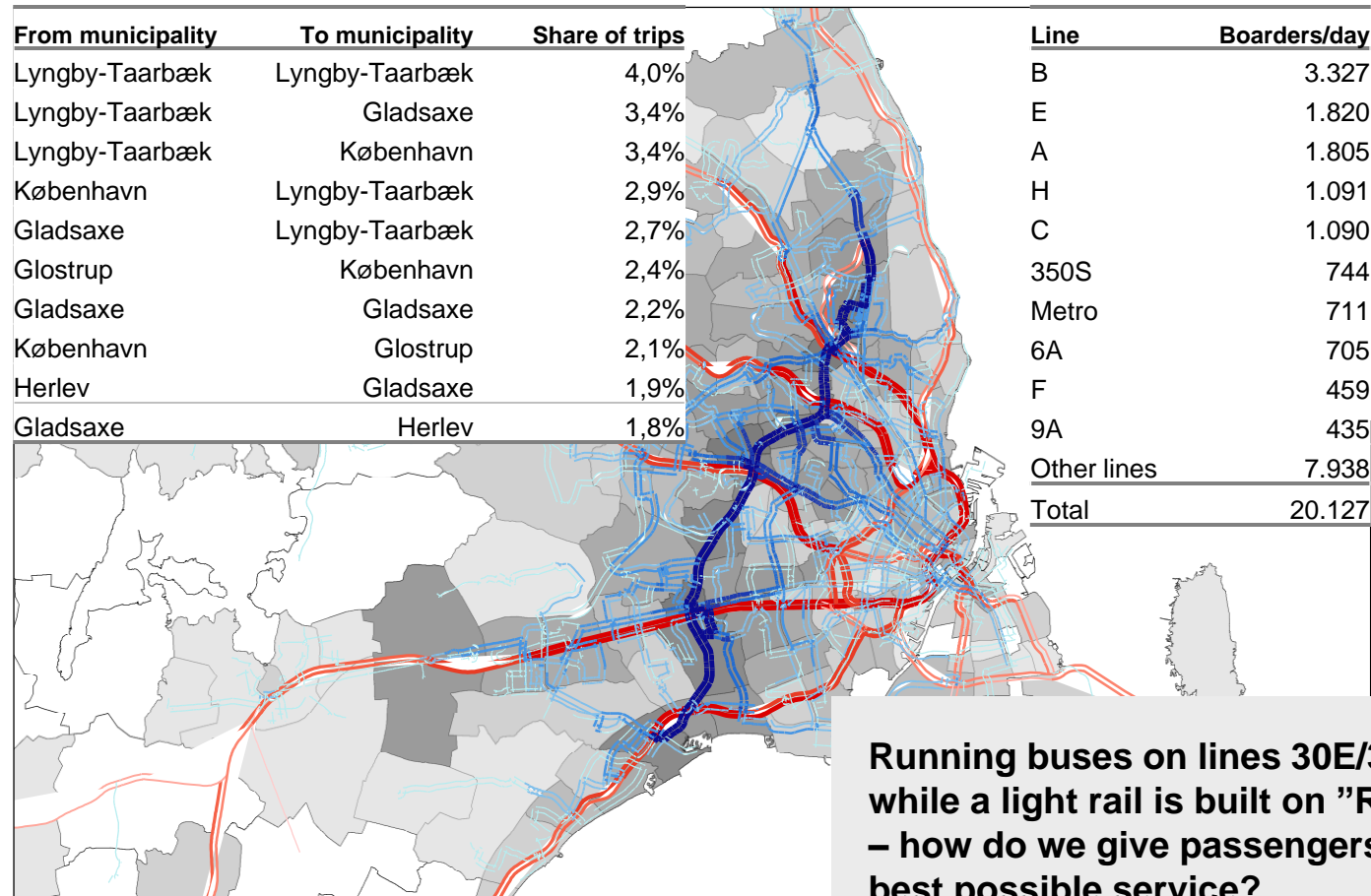# What are the benefits from better in-sight into customers' travel patterns?

Change of focus – optimizing revenue instead of minimizing costs

Better quality in our decision support towards our owners (municipalities and regions)

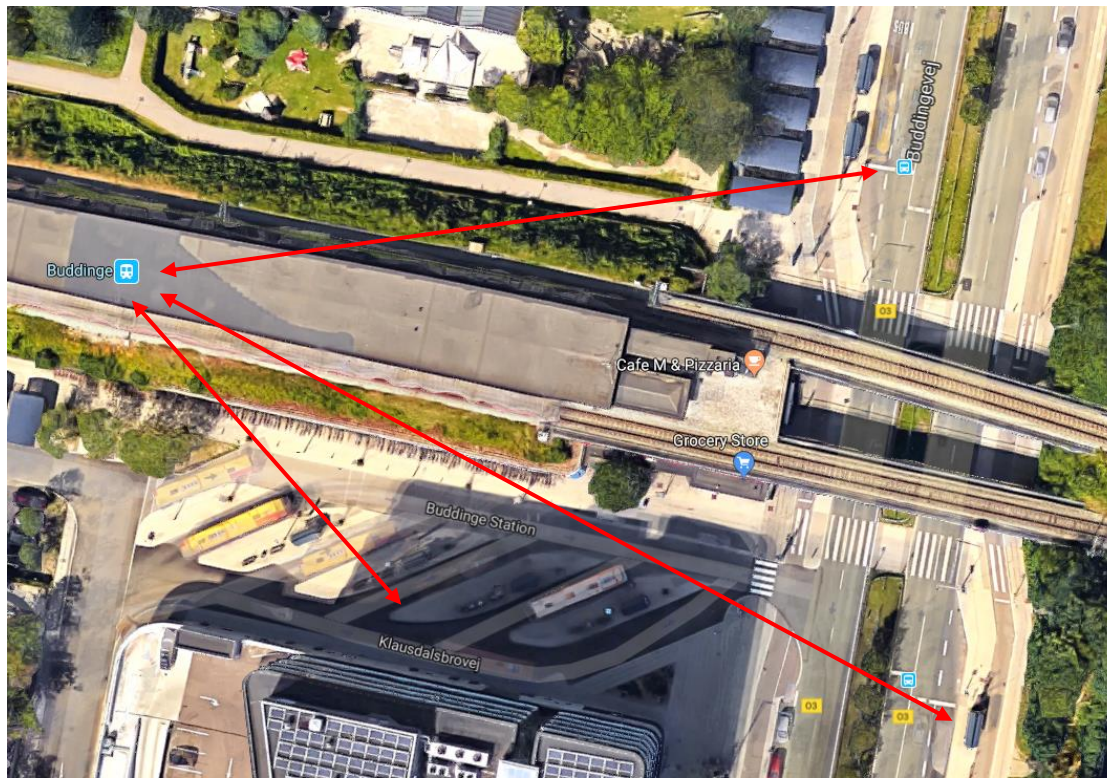More qualified assessment of new lines and timetables

Potential for better information to passengers

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How do passengers combine different lines and modes?

From municipality	To municipality	Share of trips
Lyngby-Taarbæk	Lyngby-Taarbæk	4,0%
Lyngby-Taarbæk	Gladsaxe	3,4%
Lyngby-Taarbæk	København	3,4%
København	Lyngby-Taarbæk	2,9%
Gladsaxe	Lyngby-Taarbæk	2,7%
Glostrup	København	2,4%
Gladsaxe	Gladsaxe	2,2%
København	Glostrup	2,1%
Herlev	Gladsaxe	1,9%
Gladsaxe	Herlev	1,8%

Line	Boarders/day
B	3.327
E	1.820
A	1.805
H	1.091
C	1.090
350S	744
Metro	711
6A	705
F	459
9A	435
Other lines	7.938
Total	20.127

Running buses on lines 30E/300S while a light rail is built on "Ring 3" – how do we give passengers the best possible service?

Exploring differences in travel patterns across the day

Morning peak (7-9 AM)

Afternoon peak (3-5 PM)

Understanding and improving changes at terminals

Usually difficult to obtain necessary information

Design con-siderations: Where to place stops

Timetable: Prioritizing meets

Services: Ticketing and information

Change patterns between bus and S-train at Buddinge Station

Sum of TrafLoad	ToLineName	ToLineEndStop				
	B	B	B	H	H	Total
FromLineName	Farum St.	Høje Taastrup St.	København H	Farum St.	Frederikssund St.	
68	6	38	1	0	11	56
200S	117	166	5	38	45	371
250S	73	32	1	10	9	125
300S	173	276	3	16	56	524
30E	90	102		16	10	218
6A	107	75	1	11	14	209
Total	566	689	12	91	145	1503
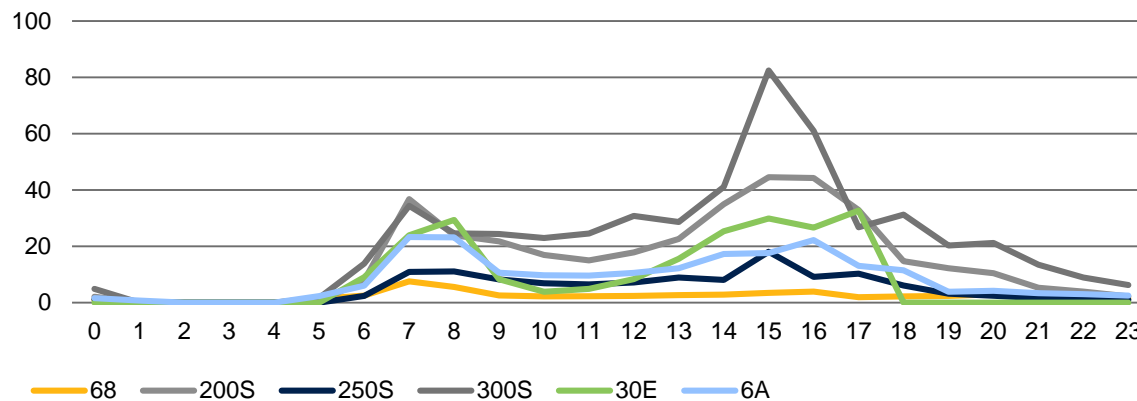
Changes in combination with number of passengers starting/ending at the station

68   200S   250S   300S   30E   6A

Overview of no. of travellers from/to different geographical zones

FromZoneID	ToZoneID	Val		TimeInteID
49440	10762	110,27		22
8600642	4148	102,48		15
50460	6026	93,24		7
8600642	4148	82,32		7
8600642	4148	80,18		16
6015	6584	71,70		16
8600642	4148	69,52		17
8600642	4148	60,18		8
6015	6584	54,26		15
490	6584	46,79		7
10762	49440	45,00		22
1368	6026	36,82		8
6018	6584	32,06		14
8600642	4148	31,41		19
600001	1367	31,35		7
10041	8150	29,02		14
10762	49440	28,21		19
8600642	4148	28,00		18
50460	1368	27,12		15
6018	6584	26,84		15

Trips beginning or ending at
- **municipality x**
- **zone y**
- **bus stop z**

Rejser med start i Faxe kommune

Antal rejsende pr hverdag - Faxe
1 - 25
26 - 50
51 - 100
101 - 500
501 - 1000
1001 - 5000
>5000

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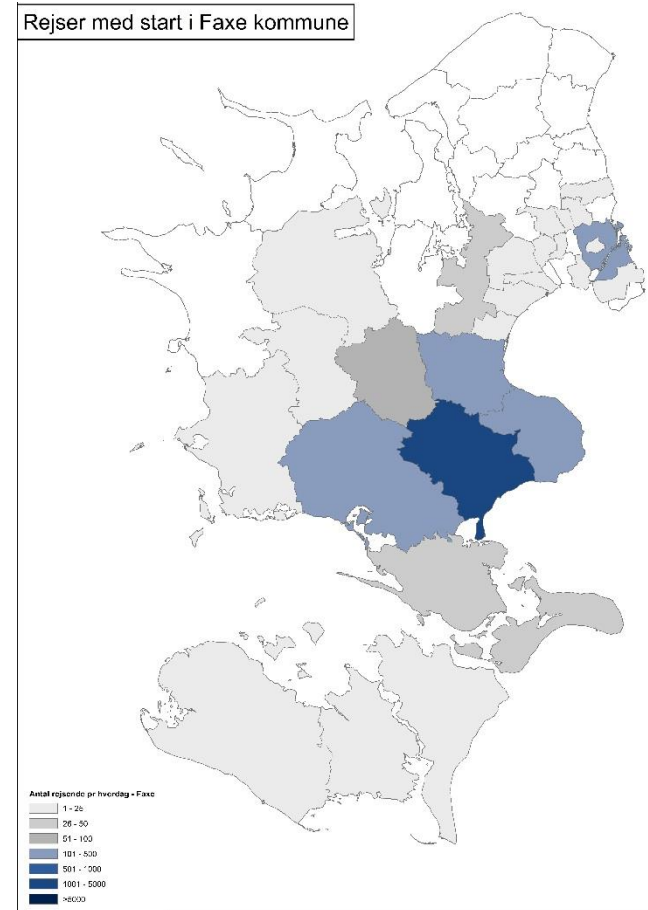
Assessment of service changes

- Approx. 100 trips Ishøj - Herlev
- Total travel time + 4,5 min. (15%)
- Driven distance + 3%
- Number of changes + 16%
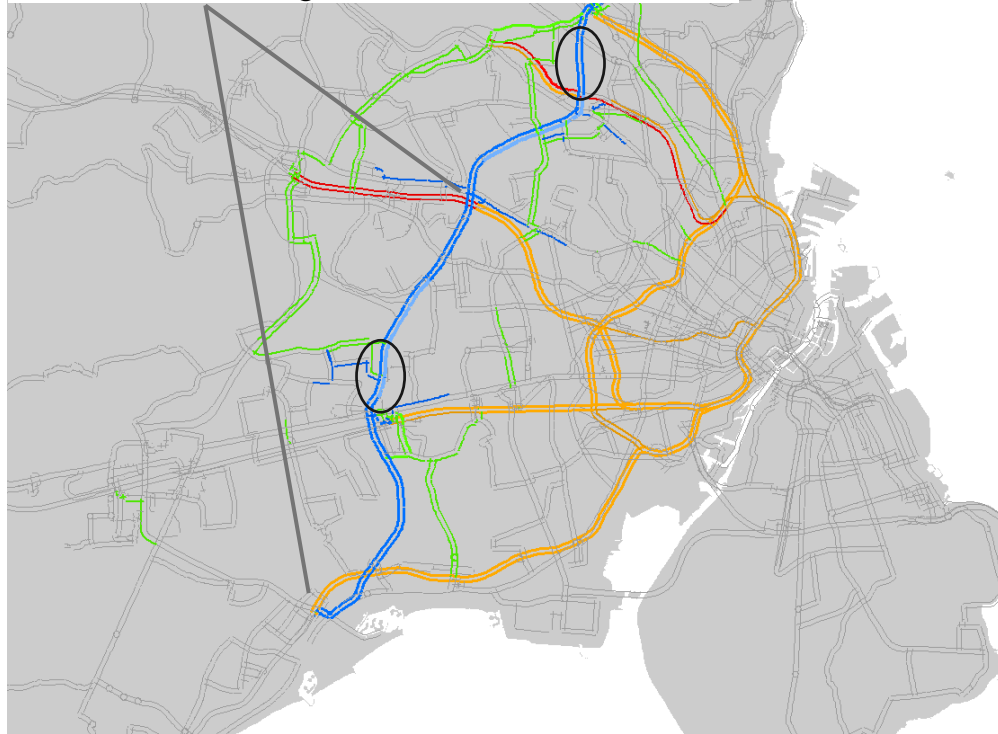
A tool for fast comparison between different timetables or changed routes – helping to find the best solutions

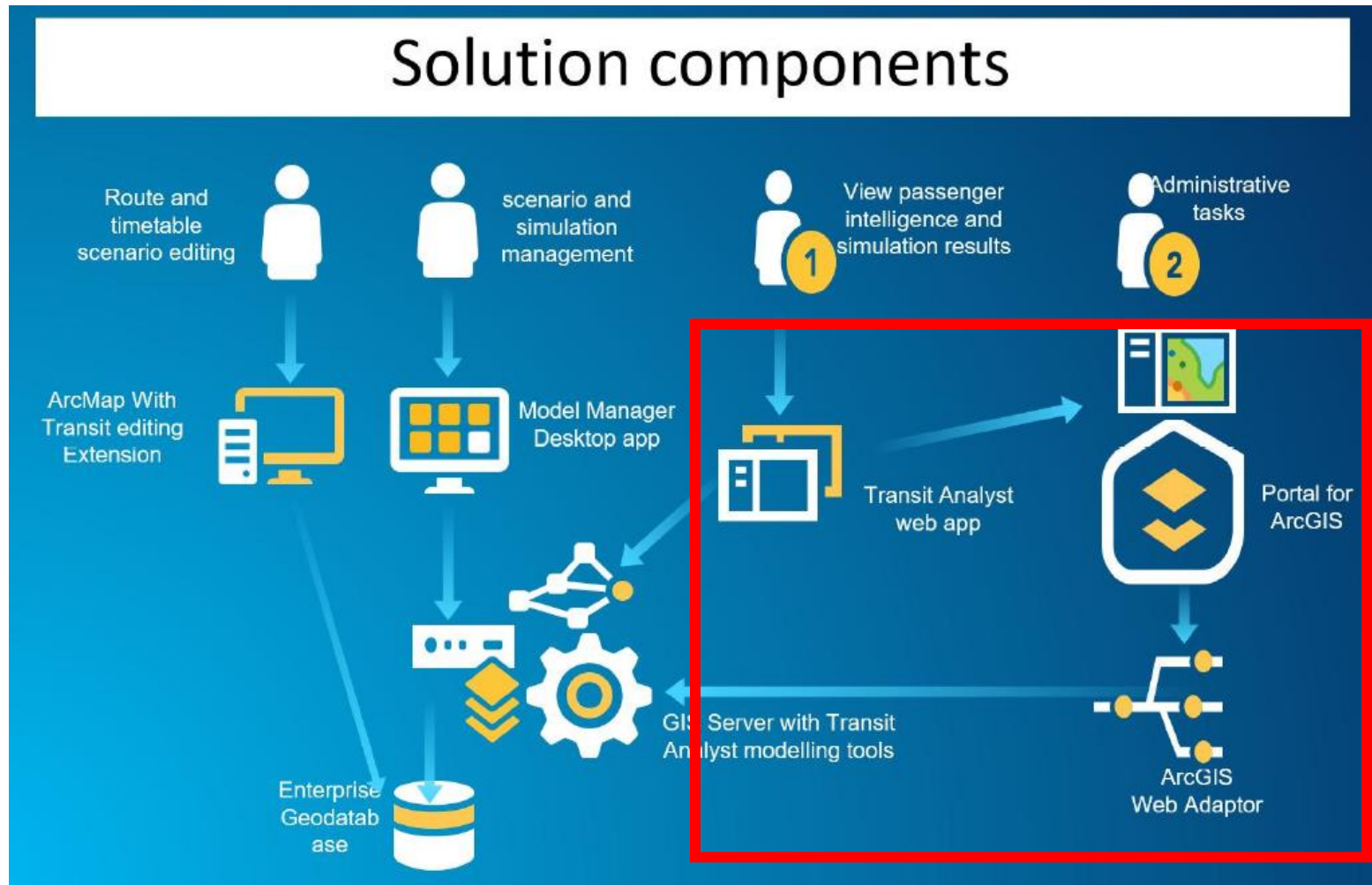Example: Road works on "Ring 3" leads to longer drive times (2 x +5 min.)

Calculation of changed route choice for current passengers

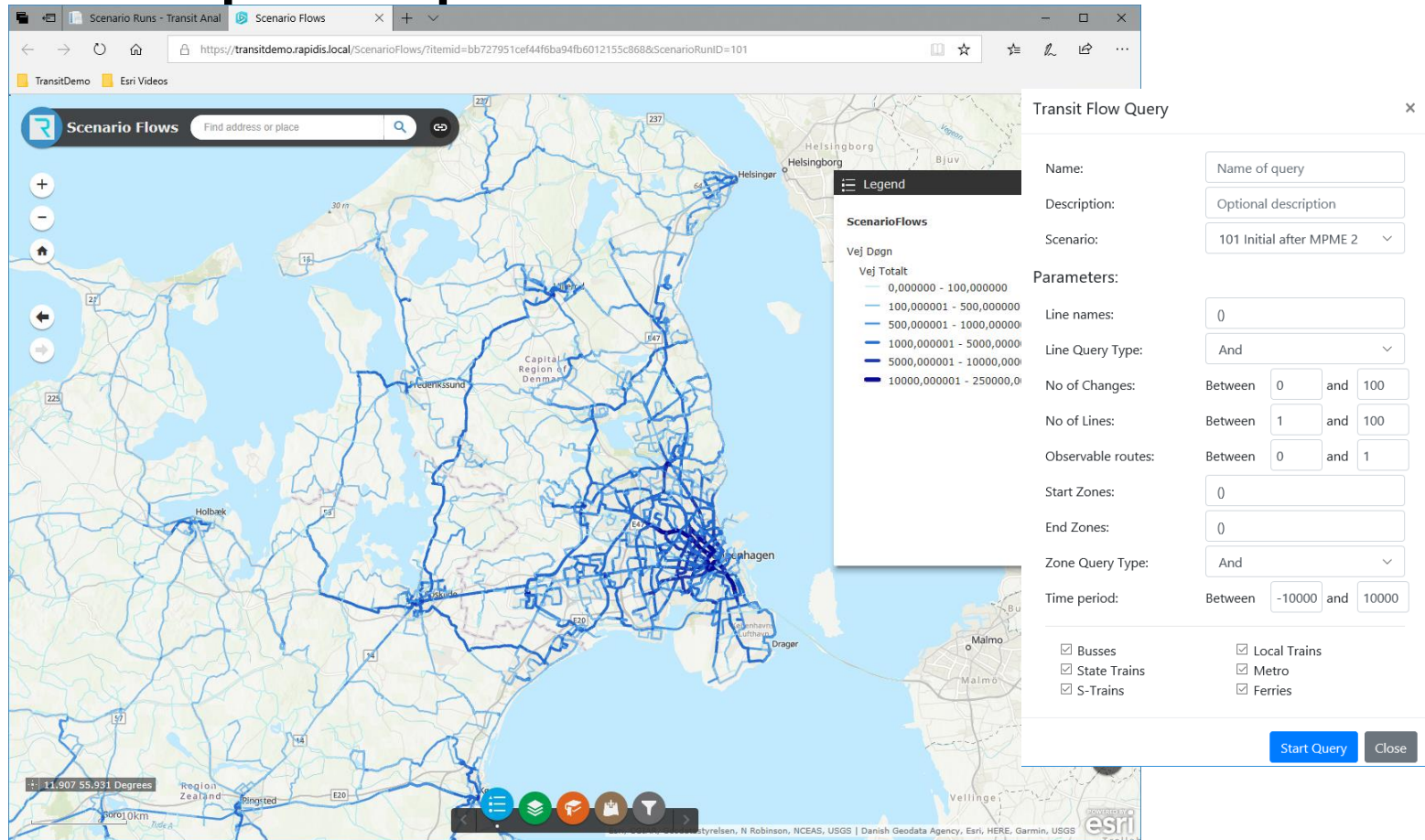Basic data updated every month

Key figures for changes in:
- Driving time
- Walking- and waiting time
- Driven distance
- Number of changes

Solution developed by Rapidis in collaboration with Movia

Web interface using ArcGIS Enterprise portal

Web interface – differences and filters

Short term development plan

October 2018
- Test phase ends and monthly data production begins
- ArcMap-based analysis tools made available for approx. 10 users in Movia
- Assessment tool made available for a small group of experts

End 2018
- WebGIS-portal introduced in Movia
- Supplementary data regarding metro- and train trips to be included in model
- Improved map design

1st half of 2019
- WebGIS-portal made available for municipalities, regions etc.
- Further development of analysis and presentation tools
- New tool to estimate how a new Metro Cityring in Copenhagen affects travel patterns
- Detailed calculation of the market share of public transport

Future development

2019-20

- Develop methods to get faster results for operational purposes
- Detailed analysis of travel patterns in connection with large events
- Closer link to planning and timetabling systems
- Combinations with other data sources (reliability, travel time, survey data, …)
- And more analysis tools

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