Transportation planners and Traffic Engineers to align Traffic, Transit and New Mobility Services

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"In 1980, McKinsey & Company was commissioned by AT&T (whose Bell Labs had invented cellular telephony) to forecast cell phone penetration in the U.S. by 2000.

The consultant’s prediction, 900,000 subscribers, was less than 1% of the actual figure, 109 Million.

Based on this legendary mistake, AT&T decided there was not much future to these toys.

A decade later, to rejoin the cellular market, AT&T had to acquire McCaw Cellular for $12.6 Billion.

By 2011, the number of subscribers worldwide had surpassed 5 Billion and cellular communication had become an unprecedented technological revolution."
Forecasting the future of transport
It’s become tricky

Traditionally….. We project forward based on historical trends. And then only a handful of futures

Traditionally….. We freeze…

- Trip Rates – our propensity to travel
- Value of Time (usually a disbenefit, but could this become a positive with AVs?)
- Car Availability levels (declining amongst younger people?)

But are we witnessing new Megatrends with MaaS?

- Increased adoption in alternate modes (a change in consumer mindset)
- Reduced private car ownership?
- Increase in choices, e.g. E-Mobility
- Increased inclusivity (propensity to travel)
By providing insight in the **possible** vs. the **probable**
The MPO as key player in a multimodal integrated future

The data hub for multi-modal mobility

- Transportation Network Data
- Movement data of people and goods
- Data standards

The Scenario Manager for the region

- New business models, roles and responsibilities
- Impact of New Technology

Providing insights in the “possible” and “probable”

- Performance metrics, visualization of the impact
- Investments, costs and revenues
- Policy guidance to the public and politicians
With a **digital replica** of Urban Mobility

- Levers can be pulled
- Use the ‘now’ to try and understand the ‘future’
The Oslo Study
in conjunction with
for
Ruter

COWI

THE OSLO STUDY - HOW AUTONOMOUS CARS MAY CHANGE TRANSPORT IN CITIES

PTV GROUP

the mind of movement
What is shared mobility?

- Ride sharing system
- Potential passenger sends a trip request
- Dispatcher assigns vehicles to passengers
- If an occupied vehicle is close to the new passenger, it can pick her up
- System is described by
  - fleet size
  - pick-up / drop-off points
  - vehicle size
  - min. guaranteed performance
  - ...

Oslo’s PT provider: Ruter

Replacing private cars & PT with Shared Mobility

<table>
<thead>
<tr>
<th></th>
<th>Car Share</th>
<th>Ride Share</th>
<th>Ride Share</th>
<th>Δ VMT</th>
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<tbody>
<tr>
<td>1A</td>
<td>[Diagram]</td>
<td>[Diagram]</td>
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<td>+26%</td>
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<tr>
<td>1B</td>
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<td>2A</td>
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<td>+97%</td>
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<td>2B</td>
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<td>+31%</td>
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<tr>
<td>3A</td>
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<td>+67%</td>
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<td>3B</td>
<td>[Diagram]</td>
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<td>[Diagram]</td>
<td>+27%</td>
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</tbody>
</table>
Study Area

Covers Oslo & Akershus

AM peak 06:00-10:00 simulated.

The busiest Scenario includes existing car drivers, their passengers and public transport riders on tram and bus.

Simulating 600,000 individual trip makers moving to shared mobility.

- 540,000 trip requests
- 56,000 vehicles
- 37,000,000 journey legs
Simulating the solution
Ride pooling as a mobility concept of the future!

The shared mobility algorithm addresses three core conditions:

- Minimise unserved trip requests
- Minimise the fleet size required
- Minimise the objective function

Simulating Shared Mobility

The objective function

- Passenger focus
  - Travel demand served
  - Waiting times
  - Detours
  - Travel distances
  - Travel times
  - Fare

- City focus
  - Congestion relief / impacts
  - Environmental factors (emissions)
  - Safety
  - Urban realm possibilities / challenges

- Operational focus
  - Required vehicle fleet
  - Occupancy
  - Duration of the trip
  - Operating hours
  - Operating performance
  - Revenue

Sustainable decisions
Simulating Mobility as a Service

The shared mobility algorithm addresses three core conditions:

- Minimize unserved trip requests
- Minimize the fleet size required
- Minimize the objective function (cost)

<table>
<thead>
<tr>
<th>TABLE 5-2 MaaS Simulations by scenario</th>
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<tbody>
<tr>
<td></td>
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<tr>
<td>---</td>
</tr>
<tr>
<td>CAR</td>
</tr>
<tr>
<td>PT (BUS &amp; TRAM)</td>
</tr>
<tr>
<td>FLEET SIZE</td>
</tr>
<tr>
<td>WAIT TIME</td>
</tr>
<tr>
<td>DETOUR</td>
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<tr>
<td>TOTAL</td>
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</table>

62 combinations calculated
## Best and worst case

Fleet size reduction does not correlate to reduced vehicle miles travelled.

<table>
<thead>
<tr>
<th></th>
<th>BASE</th>
<th>1A</th>
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<th>2A</th>
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<th>3A</th>
<th>3B</th>
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</thead>
<tbody>
<tr>
<td><strong>PRIVATE CARS 2020</strong></td>
<td>FROM PRIVATE CAR TO CAR SHARING</td>
<td>FROM PRIVATE CAR TO SHARED TAXI</td>
<td>FROM PRIVATE CAR, BUS AND TRAM TO CAR SHARING</td>
<td>FROM PRIVATE CAR, BUS AND TRAM TO SHARED TAXI</td>
<td>FROM BUS AND TRAM TO TAXIBUS</td>
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<tr>
<td>PERSON TRIPS</td>
<td>401,000</td>
<td>401,000</td>
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<td>611,000</td>
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<td>FLEET SIZE</td>
<td>352,000</td>
<td>33,000</td>
<td>26,000</td>
<td>55,000</td>
<td>40,000</td>
<td>49,000</td>
<td>42,000</td>
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<td>FLEET SIZE COMPARSED TO BASE (PCT. OF BASE)</td>
<td>-</td>
<td>9%</td>
<td>7%</td>
<td>16%</td>
<td>11%</td>
<td>14%</td>
<td>12%</td>
</tr>
<tr>
<td>VEHICLE KM (MILLION)</td>
<td>4.4</td>
<td>5.5</td>
<td>3.7</td>
<td>8.6</td>
<td>5.7</td>
<td>7.3</td>
<td>5.5</td>
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<tr>
<td>PCT. CHANGES IN VEHICLE KM COMPARSED TO BASE</td>
<td>-</td>
<td>+26%</td>
<td>-14%</td>
<td>+97%</td>
<td>+31%</td>
<td>+67%</td>
<td>+27%</td>
</tr>
</tbody>
</table>

**Fleet size reduction - 91%**

**Vehicle VMT reduction -14%**

**Vehicle VMT increase +97%**
Empty vehicles

Caused by vehicle re-positioning.

Has the effect of adding to congestion levels.

Reduces the benefits of ride pooling.

Car sharing increases empty miles by 50% compared to ride-pooling

<table>
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<td></td>
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<tr>
<td>VEHICLE KILOMETERS – IN SERVICE (MILLION)</td>
<td>4.4</td>
<td>4.0</td>
<td>3.1</td>
<td>6.1</td>
<td>4.6</td>
<td>5.5</td>
<td>4.7</td>
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<tr>
<td>VEHICLE KILOMETERS – EMPTY VEHICLE (MILLION)</td>
<td>0</td>
<td>1.5</td>
<td>0.6</td>
<td>2.4</td>
<td>1.1</td>
<td>1.7</td>
<td>0.9</td>
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<tr>
<td>VEHICLE KM (MILLION)</td>
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<td>3.7</td>
<td>8.6</td>
<td>5.7</td>
<td>7.3</td>
<td>5.5</td>
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<tr>
<td>VEHICLE KILOMETERS SHARE – IN SERVICE</td>
<td>100%</td>
<td>73%</td>
<td>83%</td>
<td>72%</td>
<td>81%</td>
<td>76%</td>
<td>84%</td>
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<tr>
<td>VEHICLE KILOMETERS SHARE – EMPTY VEHICLE</td>
<td>0%</td>
<td>27%</td>
<td>17%</td>
<td>28%</td>
<td>19%</td>
<td>24%</td>
<td>16%</td>
</tr>
</tbody>
</table>

28% of VMT are “empty” vehicles
### Fleet utilisation

Mean occupancy “in service” includes empty vehicle status

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<thead>
<tr>
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<td>FROM BUS AND TRAM TO TAXIBUS</td>
<td>FROM PRIVATE CAR TO SHARED TAXI</td>
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<tr>
<td><strong>MEAN OCCUPANCY - IN SERVICE</strong></td>
<td>1.14</td>
<td>0.79</td>
<td>1.62</td>
<td>0.80</td>
<td>1.62</td>
<td>1.10</td>
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<tr>
<td><strong>MEAN OCCUPANCY - IN OPERATION</strong></td>
<td>1.14</td>
<td>1.14</td>
<td>1.86</td>
<td>1.14</td>
<td>1.89</td>
<td>1.40</td>
<td>1.89</td>
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<td><strong>MEAN OPERATION DISTANCE [KM]</strong></td>
<td>12</td>
<td>166</td>
<td>144</td>
<td>153</td>
<td>143</td>
<td>148</td>
<td>133</td>
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<tr>
<td><strong>MEAN OPERATION TIME [H]</strong></td>
<td>0.2</td>
<td>3.2</td>
<td>3.0</td>
<td>2.9</td>
<td>3.0</td>
<td>2.9</td>
<td>2.8</td>
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</table>

Vehicle operation distance increase from 12 kilometers to ~150 kilometres (in 4 hours)

Vehicle operation time increase from 12 minutes to ~3 hours (in a 4-hour period)
Demonstrating actionable **Outcomes and Results**

**BASE CASE – EXISTING V/C**
Demonstrating actionable Outcomes and Results

SCENARIO 2a – Worst Case V/C
Demonstrating actionable **Outcomes and Results**

**SCENARIO 1b – TRAFFIC FLOW REDUCTION**
Demonstrating actionable **Outcomes and Results**

**SCENARIO 1b – Average wait time**
Demonstrating actionable **Outcomes and Results**

**SCENARIO 1a – Average wait time**
Passengers Level of Service

Without ride sharing, Car users’ travel time extends by ~6 minutes

With ride sharing, Car users’ travel time extends by ~8 minutes

Public transport passengers in bus/tram save 10-11 minutes

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<tr>
<td><strong>FROM PRIVATE CAR TO CAR SHARING</strong></td>
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<tr>
<td><strong>FROM PRIVATE CAR TO SHARED TAXI</strong></td>
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<tr>
<td><strong>FROM PRIVATE CAR, BUS AND TRAM TO CAR SHARING</strong></td>
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<tr>
<td><strong>FROM PRIVATE CAR TO SHARED TAXI</strong></td>
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<tr>
<td><strong>FROM CAR AND BUS TO TAXI</strong></td>
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<tr>
<td><strong>FROM TRAM TO TAXI</strong></td>
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<td></td>
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<tr>
<td><strong>AVERAGE TRIP DISTANCE [KM]</strong></td>
<td>11.7</td>
<td>11.4</td>
<td>12.6</td>
<td>11.4</td>
<td>12.6</td>
<td>11.9</td>
<td>12.7</td>
<td>12.9</td>
<td>13.3</td>
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<tr>
<td><strong>AVERAGE TRIP TIME - TOTAL</strong></td>
<td>12.3</td>
<td>18.3</td>
<td>20.5</td>
<td>18.3</td>
<td>20.7</td>
<td>19.2</td>
<td>20.7</td>
<td>21.0</td>
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<td><strong>AVERAGE WAITTIME [MIN]</strong></td>
<td>0.0</td>
<td>4.1</td>
<td>2.9</td>
<td>4.0</td>
<td>2.8</td>
<td>3.6</td>
<td>2.8</td>
<td>2.8</td>
<td>5.7</td>
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<td><strong>AVERAGE TRIP DURATION [MIN]</strong></td>
<td>12.3</td>
<td>14.1</td>
<td>17.7</td>
<td>14.3</td>
<td>17.9</td>
<td>15.6</td>
<td>17.9</td>
<td>18.0</td>
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<td><strong>AVERAGE DETOUR TIME (RIDE) [MIN]</strong></td>
<td>-</td>
<td>2.0</td>
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<td>2.0</td>
<td>5.6</td>
<td>3.3</td>
<td>5.6</td>
<td>5.7</td>
<td>-</td>
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</table>
Sensitivity analysis

Level of service

- Detour factor and waiting time

Larger reduction in VMT and fleet size can be achieved, but...

...it costs at the service level.

10 or 20 minutes of accepted waiting time makes no difference.
Sensitivity analysis

Level of service

- Served passengers

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<td>From private car to shared taxi</td>
<td>From private car to shared taxi</td>
<td>From private car to shared taxi</td>
<td></td>
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<tr>
<td>Person trips</td>
<td>401,000</td>
<td>401,000</td>
<td>401,000</td>
</tr>
<tr>
<td>Share served passengers</td>
<td>100%</td>
<td>98%</td>
<td>94%</td>
</tr>
<tr>
<td>Fleet size</td>
<td>26,000</td>
<td>22,000</td>
<td>20,000</td>
</tr>
<tr>
<td>Fleet size proportion of basis</td>
<td>7%</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Vehicle km (million)</td>
<td>3.7</td>
<td>3.7</td>
<td>3.5</td>
</tr>
<tr>
<td>Vehicle km change compared to basis</td>
<td>-14%</td>
<td>-16%</td>
<td>-20%</td>
</tr>
</tbody>
</table>

Fleet size can be reduced considerably
Take-aways & where next

Policy Insights
- Availability of technology
- Consumer preference
- Business Models
- Public investment plans

What’s next for Ruter?
- Feeder Services
- Expanding transport hub catchment areas?
- Prioritize corridors?
- Equitability?
- ON STREET PILOT
Conclusions
Aligning Traffic, Transit and New Mobility Services

Multi Modal/ Multi Agency
Focus on increased co-ordination
Transit, traffic, goods

Data Hub
Network data
Movement data

Scenario Manager
Data sharing & optimizing the optimized

Decision Support
Insights to public, politicians, and DOT’s
Cost, revenue, travel time, access, equitability
Thank you!

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(202) 805 4706

More detailed report at: link