Traffic Management:
State of the art, current trends and future perspectives

Ben Immers - TrafficQuest
Outline presentation

- Why traffic management?
- How does it work?
- Solutions - Measures
- State of the Art
- Current Trends
- Future Perspectives
- Research Agenda
- Analogies for TM
Why Traffic Management?

• Reducing delays;
• Improving throughput
• Improving travel time reliability
• Improving traffic safety
• Improving sustainability of transport system

• But..... Sometimes other solutions (other than TM) may be preferred!
3 level approach

- Traffic management
- Mobility management
- Infrastructure and activity management
Benefits

Many types of intelligent traffic systems offer a superior benefit-to-cost ratio than the physical expansion of roads

Comparison of returns for different road investments
Average benefit-to-cost ratios

<table>
<thead>
<tr>
<th>Type of Investment</th>
<th>Lower Range</th>
<th>Upper Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Traditional&quot; road capacity</td>
<td>2.7</td>
<td></td>
</tr>
<tr>
<td>Electronic freight management system</td>
<td>2.8</td>
<td>3.6</td>
</tr>
<tr>
<td>Dynamic curve warning</td>
<td>4.2</td>
<td>6.6</td>
</tr>
<tr>
<td>Commercial vehicle information systems and networks</td>
<td>2.9</td>
<td>7.5</td>
</tr>
<tr>
<td>Maintenance decision support system</td>
<td>1.3</td>
<td>8.7</td>
</tr>
<tr>
<td>Intelligent traffic management</td>
<td></td>
<td>14.0</td>
</tr>
<tr>
<td>National real-time traffic information system</td>
<td></td>
<td>25.0</td>
</tr>
<tr>
<td>Road weather management technologies</td>
<td>2.8</td>
<td>37.0</td>
</tr>
<tr>
<td>Service patrols (traffic incident management)</td>
<td>4.7</td>
<td>38.0</td>
</tr>
<tr>
<td>Integrated corridor management</td>
<td>9.7</td>
<td>39.0</td>
</tr>
<tr>
<td>Optimized traffic signals</td>
<td>17.0</td>
<td>62.0</td>
</tr>
</tbody>
</table>

What can go wrong?

Underlying processes that cause congestion

• Capacity drop (14% – 30% reduction of capacity)
• Moving shockwaves
• Sub-optimal route choice
• Spillback
How does TM work?

Basic types of intervention (solutions)

- Increase throughput
- Distribute traffic in an effective way across the network
- Regulate the inflow of traffic
- Prevent spillbacks
- Control the speed
- Enforcement
- Prioritise specific user groups
<table>
<thead>
<tr>
<th>MAIN SOLUTIONS</th>
<th>RAMP METER</th>
<th>TRAVELER INFORMATION</th>
<th>PEAK HOUR SHOULDER LANES</th>
<th>DYNAMIC SEPARATION OF THROUGH AND LOCAL TRAFFIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>INCORRECT THROUGHPUT</td>
<td>Effective capacity increase by postponing queue formation</td>
<td>-</td>
<td>Increase capacity by opening an extra lane during peak periods (shoulder and/or re-striping)</td>
<td>Increase in capacity by decreasing weaving movements</td>
</tr>
<tr>
<td>EFFECTIVELY DISTRIBUTE TRAFFIC</td>
<td>Reduce cut-through traffic (rat running)</td>
<td>Inform drivers about routes with residual capacity</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>REGULATE INFLOW</td>
<td>Regulate entering traffic to main roadway</td>
<td>Inform drivers which on-ramp to use if options are available</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PREVENT SPILLBACKS</td>
<td>Prevent queue spillback on the main roadway to an upstream exit</td>
<td>Inform drivers to choose exit if options are available</td>
<td>Prevent spillback by buffering traffic</td>
<td>Prevent spillback by channeling exiting traffic to dedicated lanes</td>
</tr>
</tbody>
</table>
State of the Art

• Long history (London 1868 - Eindhoven 1968)

• Wide range of measures
  – Roadside
  – In-car

• Traffic data
  – Public - National Data Warehouse
  – Private - GPS, probe, etc.

• Stakeholders (public – private)
  – Societal interests
  – Individual or commercial interests

• Cooperation and coordination (network-wide)
Current trends

- Societal trends e.g. individualization, societal relevance, aging, generation Y, virtual society/mobility, flexibility of demand
- Organizational trends (PPP, DBFMO-contracts, DITCM), internationalization e.g. EC ITS-action plan, ITS Directive
- Economic trends e.g. economic crisis
- Technical developments e.g. traffic information systems, driver assistance systems, cooperative systems, incident and event management - penetration rate, standardization
Interrelationships
Possible effects

• Shifts in traffic demand (time and space)

• Changes in mobility objectives
  – More focus on sustainability

• Increasing effectiveness of traffic management (more advanced measures)

• But: Road user is also better informed - less easy to influence
  → Reconciliation individual and social (governmental) interests

• And: Better cooperation – public-private partnerships

→ Opportunities for effective deployment of traffic management will increase
Perspectives for the Future

• Primary task: demand-supply alignment
  – Regular situations
  – **Non-recurrent and unexpected situations**
• Ability to respond to rapidly changing situations; rapidly deployable measures
• Pro-active approach
• High degree of instrumentation to guide traffic
• Well established coordination

→ TM needs to be flexible, coordinated, cooperative, and pro-active
→ Requires close cooperation between
  – Road authorities
  – Private sector partners
  – Research/education institutes
Optimal network performance thanks to collaboration between stakeholders
Transition towards Pro-active TM

Traffic Management

Informing

Monitoring

Controlling

Predicting

Knowledge (understanding) traffic
There is still work to do!

Topics that need to be addressed:

• Flexibility in supply and demand
• Road pricing
• More cooperation and coordination: network-wide Traffic Management
• Pro-active traffic management
• Optimization for multiple policy goals
• Integrated approach
• Organization (Public – Private)
• Training and education
• Basic facilities (architecture, monitoring)
• Evaluation
Dynamic Road Pricing

Road pricing is HOT

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Future Research Agenda

Focus on:

Strategic – policy oriented research
Operational – problem oriented research
Knowledge development
Knowledge application
Selection of TQ research topics

- DITCM (cooperation and evaluation)
- Modelling human behaviour in traffic models
- PPA (Field trial Amsterdam)
- Analogies (controlling versus self organisation (informing))
Analogies

• What is happening elsewhere in the world – scanning tours

• How are flows managed in other systems - Analogies
  – Swarms of birds
  – Distribution logistics
  – Communication networks
  – Electronic payment systems
  – Water management
  – Electricity networks
  – The brain
Questions asked

• Self-organization versus dedicated (hierarchical) control?

• To what extent are we dealing with a stratified (layered) system?

• How are robustness and reliability of the system ensured?
Preliminary results

Many similarities, but also clear differences, such as:

• Much more control in some systems
• Close attention to the robustness of the system (redundancy)
• Clear agreements between stakeholders
• Various forms of self-organization (with mutual alignment between a limited number of neighboring entities)

Next steps:

• Make a design a traffic management system based on the management and control principles deployed in the analogous systems
• What does that mean for the traffic system? Will or could it work? Are the goals still achievable? Is it acceptable for the traveler? etc.
Interesting concepts

• Highly controlled: Slot management

• Complete self-organisation (information driven)

• Hybrid forms

→ new ideas for future traffic management
Thank you for your attention
Contact

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