City Logistics Development on the base of Modelling and Simulation

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### Scales of Spatial Organization for Transportation

<table>
<thead>
<tr>
<th>Scale</th>
<th>Nodes</th>
<th>Links</th>
<th>Relations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>Employment and commercial activities</td>
<td>Roads and transit systems</td>
<td>Commuting and distribution</td>
</tr>
<tr>
<td>Regional</td>
<td>Cities</td>
<td>Corridors (rail lines, highways, canals)</td>
<td>Urban system</td>
</tr>
<tr>
<td>Global</td>
<td>Gateways (airports and ports)</td>
<td>Air and maritime lanes</td>
<td>Investment, trade and production</td>
</tr>
</tbody>
</table>
Transportation and Urban Form

Transportation

Infrastructures

Modes

Users

Spatial imprint

Urban Form
Model Scenarios

Real World

Encoding
- Representation model (space and data)

Management
- Spatial – Thematic - Temporal

Analysis
- Query – Operations - Modeling

Reporting
- Visualization and Cartography

User

Layers
- Land Use
- Flows
- Transportation Network

Project part-financed by the European Union
Traffic Intensity on Main Road Network (vehicles/day)

Baltic sea

Riga gulf

Lithuania

Belorus

Russia

Estonia

Ludza

Daugavpils

Rezekne

Preili

Belorus

Lithuania

Baltic sea
The main working movements in Riga

- There is star topology
Decision Process

Decision makers go through a fairly systematic process.

General steps
- Define problem
- Collect base data
- Develop goals/objectives
- Model scenarios
- Evaluate outcomes

Intelligence phase
- Define the “Process or Problem”

Modelling phase
- Develop Alternative Courses of Action

Choice phase
- Select The “Best” One
- Review It

Implementation phase
- Act on it
Model Levels

- High-detail description
  - mikroskopisch
- Medium detail
  - mesoskopisch
- Low detail
  - makroskopisch
Tasks:
1) The analysis of an available transport infrastructure and, as consequence, revealing of "narrow" places; 
2) Offers on Development and Improvement of the Organization of Transport Movement of a Traffic Intersection

Simulation Modelling

Data Collection
Model construction
Validation of Model
Planning and Carrying out of Experiments

The Analysis of Results

The Task for the Project
Which aim of data collection for city logistics?

- Knowledge of the flows for traffic management in the town (*short term local decision marking*)
- Decision marking for urban planning (*middle term urban planning policy*)
- Concerns for environment and sustainability (*long term policy and laws: decisions at European, national, regional scale for application at the local level*)
The sources of data in the modelling of transport tasks

- Interview with passengers
- Outer observation (mean number of passengers, frequency, direction and etc.)
- Traffic statistics obtained with the help of objective control systems on the basis of modern transport telematics aids
The investigation within the frame of the international project “Riga Light Rail Transit Feasibility Study” with participation of the representative of group SYSTRA and Transport & Telecommunication Institute

October 2002

Aims

• To elaborate plan of public urban transport development
• To investigate and elaborate priority tram routes
• To elaborate system of public urban transport
It was defined 71 investigation points according to 2 perimeters.
There were defined 124 zones in Riga.

There are defined origin and destination zones for each movement.

The zoning system on the basis of the analysis of inter-regional movements.
Observations: common results
(10.2002)

Volume of main movements
**Observations: common results (10.2002)**

- The biggest traffic volume moving to the right side
- This volume without private transport

Flow using the bridges crossing Daugava
Case study

1. Application of Simulation Modelling at the stage of Transport Node Planning (by the example of a Coach Station in Pardaugava)

2. Simulation Model for Complex Transport Node in Pardaugava
Case 1: Application of Simulation Modelling at the stage of Transport Node Planning (by the example of Coach Station in Pardaugava)
About the Riga International Coach Station

• RIGA INTERNATIONAL COACH TERMINAL (RICT) was designed from 1960 to 1962 and was built and put to use in 1964.
• Nowadays RICT provides services both to regional (local) long distance and international routes.
• In 2006: 565 domestic runs and 63 international runs were serviced per day.
• RICT cooperates with 53 carriers and 8 travel agencies.
• RICT annually provides services to 5-6 million passengers.
The Future Plans of Riga Coach Station Evaluation

- The Ministry of Transport of the Republic of Latvia has forecasted that in the next years the transport flow thought the RICT will increase by at least 5% a year.

This requires:

- A comprehensive reconstruction of the RICT in order to improve the operational reliability and to increase the capacity of the Coach Terminal in servicing buses and passengers.
- Construction of an alternative terminal
The Project

The object of simulation:

- The new coach station on the Vienibas Gatve 6
- The territorial location of the land plot is close to the railway station „Torņakalns“, next to a newly developing administrative and cultural centre of the city.

The main goal of using modelling at the stage of the transport node planning is the analysis of future decisions and their influence on common situation around.

The Project Participants

- JSC “Rīgas Starptautiskā Autoosta”
- JSC “Transporta un Sakaru Institūts”
The view of realized model (2D)
The view of realized model (3D)
The modelling results

• The buses queue fixation (evening loading):
  – The maximum queue length – 11 buses
  – The maximum time of staying in queue – 5 min
The modelling results

• The distribution diagram of average and maximum queue length by time
The conclusions (case study 1)

- The constructed simulation model validated the design of new coach station in the scope of maximizing the potential throughput of the station
  - The intermediate results of simulation have been taking into account for new station plan realization

- The simulation has shown:
  - The new station is able to operate the existing bus station loading in general
  - But, it operates at the braking point of its potential
  - It has been established that the scheme of buses exits from the bus station territory suggested for today leads to a queue formation

- The future work:
  - The realization of different scenarios of bus station plan optimization and analyzing of new schedules scenarios influencing
Case 2: Simulation Model for Complex Transport Node in Pardaugava
Traffic flow intensity (8:15 – 9:15)
Krustojums Nr.11.1 (Balasta dambis-Daugavgrīvas iela-A.Grīna bulv.-Rāņķa dambis)

Krustojums Nr.11.2 (Balasta dambis-Daugavgrīvas iela-A.Grīna bulv.-Rāņķa dambis)

Krustojums Nr.11.3 (Balasta dambis-Daugavgrīvas iela-A.Grīna bulv.-Rāņķa dambis)

Krustojums Nr.11.4 (Balasta dambis-Daugavgrīvas iela-A.Grīna bulv.-Rāņķa dambis)
Krustojums Nr.5.2 (Uzvaras bulv.-Slokas iela-Rapka dambis)
The Distribution of a Congestion Level of Crossroads according to the ICU Standard

Standard ICU establishes A as the lowest level of congestion (55%) H - the highest (109%). A level of congestion of the majority of crossroads is in norm (A, B, C) and crossroads 3 and 6 concern to group, which is the last satisfactory (D).
The most problematic node
### The Information about Transport Network Loading

<table>
<thead>
<tr>
<th>The information about transport network loading</th>
<th>Evening peak hours</th>
<th>Morning peak hours</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2005</td>
<td>2010</td>
</tr>
<tr>
<td>Number of vehicles in the network, all vehicle types</td>
<td>266</td>
<td>621</td>
</tr>
<tr>
<td>Number of vehicles that have left the network, all vehicle types</td>
<td>4435</td>
<td>4585</td>
</tr>
<tr>
<td>Average speed [km/h], all vehicle types</td>
<td>17.186</td>
<td>8.609</td>
</tr>
<tr>
<td>Average delay time per vehicle [sec], all vehicle types</td>
<td>83.786</td>
<td>213.347</td>
</tr>
<tr>
<td>Average stopped delay per vehicle [sec], all vehicle types</td>
<td>48.116</td>
<td>137.017</td>
</tr>
<tr>
<td>Average number of stops per vehicles, all vehicle types</td>
<td>1.976</td>
<td>4.004</td>
</tr>
</tbody>
</table>
The Forecast of Crossroad "Slokas - Uzvaras Bulvaris" Queue Length (5)

The crossroad "Slokas - Uzvaras bulvaris" intersection queue length characteristics (evening peak hours)

- Average queue length
- Maximum queue length
- Upper bound of conf. lim. (95%)
The Forecast of Crossroad "Slokas - Uzvaras Bulvaris" Queue Length (5)

The crossroad intersection "Slokas - Uzvaras bulvaris" queue length characteristics
(morning peak hours)

- Average queue length
- Maximum queue length
- Upper bound of confidence limit (95%)
Results

- The investigated crossroads are now at the normal level of congestion according to ICU standard, but the situation will change opposite if the rate of motorization level is held on the same level (as last 5 years).
- This investigation did not take into account the possible increasing of the traffic volume on the reason of new administrative centre construction.
Conclusions

- Cities have developed over many years and both their transport and their social systems are complex.
- Problems of city cannot be solved by simply increasing transport supply; demand management is both desirable and necessary.
- Complexities of city structure, an integrated systems approach to travel demand management on the base of modelling and simulation provides the best opportunity for the development of equitable, efficient and sustainable urban transport systems.