Patterns of Motorization Development and the Next Generation Urban Mobility Systems

1. “3-Stage Development Cycle” Hypothesis (Prof. P. Jones)
2. Patterns of Motorization Development
3. ‘Auto Sapience’ and the Next Generation Urban Mobility Systems
1-1 “3-Stage Development Cycle” Hypothesis : Prof. P. Jones on the evolution of urban transport polices

- Useful platform and Japanese cities:
  Stage1 $S_1$ : ‘Vehicle’ focus $-$ 1960’s～
  Stage2 $S_2$ : ‘Personal movement’ focus $-$ Middle of 1990’s～
  Stage3 $S_3$ : ‘Activity/Quality of life’ focus $-$ 2010’s～(?)

- Relation with ‘Transport Culture’
  - Reflected in the motorization patterns, problems/issues identified and policy responses in each countries/cities
  - Turning points and the key issues:
    $S_0 \Rightarrow S_1$: Traffic problems (congestion, accident, air pollution)
    $S_1 \Rightarrow S_2$: Environment, sprawl, the mobility poor, sustainability; TDM and MM, 1997 COP3 Kyoto Convention
    $S_2 \Rightarrow S_3$: Global climate, depopulation and ageing, quality-of-life, health; 2013 Basic Act of Transport Policy
Fig. 1 Different Paths of Motorization development

Reference: M₁, M₂—Changes of vehicle ownership of city 1 and 2 (vehicles / 1,000 persons)
SL₁, SL₂—‘Saturation’ levels of vehicle ownership
D₁—Difference of the saturation level
D₂—Share of different types of vehicles
D₃—Difference of the motorization timing and speed type
1-2 P. J. Hypothesis and Transport Culture

D1 Vehicle ownership: saturation level (per person or per household)
   - Difference of the saturation level (vehicles /1,000 persons)
     E.g. USA(800) > Europe, Japan(600) . Tokyo(300)
   - Underlining factors: income, population density, road and public transport provision, life style, women’s role, etc.

D2 Social meaning and use of the vehicle
   - Vehicle type: car + pick up truck(USA), motorcycle (Asia)
   - Function: transport or social status, recreation or work/business
   - Roles of alternative modes (NMT, public transport)

D3 Contents and timing/speed of motorization:
   - Policy stance on motorization management
   - Industrial dev. policy (truck over car)
   - Restraint of ownership and use based on urban/ social/ environmental policy (e.g. Singapore, Beijing)
Major Causes of Policy Shift
—Factors in Transport demand, supply and the market—

1. Changes in demand side
   —Demography: Population, ageing, suburbanization
   —Socioeconomic development: Income growth
   —Culture and the value: Westernization, sharing economy, peak-car

2. Changes in transport supply side
   —Technological innovation: Performance, Cost, materials, energy
   —New mobility system: Virtual transport, ride-share(Uber), automated car(AV)
   —Environmental / resource constraint: environmental capacities

3. Changes in institutional framework of the market
   —Decision-making context: Political changes (leader)
   —Regulation, standards, framework for new problems and technology

Note. Policy shift is accelerated when the time is ripe w.r.t. various factors above.
Factors behind the policy shifts: New issues or key problems identified
- Severe traffic problem (e.g. NOx/PM air pollution, climate change)
- Shift of political, social, economic situation

Paradigm shifts of the approach:
- Ad hoc, piecemeal approach ⇒ Strategic approach
- Demand-following approach ⇒ Integrated package approach

Needs of new approaches
- New problems and issues: Climate change, natural disasters, security and technological innovations
- Increase of uncertainly in the socioeconomic context: the need of new approach - Consensus building on visions and goals, then act / implement together

★ Predict and Provide ⇒ Predict and Prevent ⇒ Decide and Act together
## 2 Patterns of Motorization Development

### Table 1 City Type by Major Transport Modes (around 2000)

<table>
<thead>
<tr>
<th>City type</th>
<th>Cities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car City C1 (S1-max, and S2, S3&lt;15%)</td>
<td>Ho Chi Minh City*, Cape Town*, Kuala Lumpur*, Athens, Bologna, Brussels, Chicago, Manchester, Melbourne, Stuttgart</td>
</tr>
<tr>
<td>Public Transport (Transit) City C2 (S2-max, and S1, S3&lt;20%)</td>
<td>Dakar*, Manila*, Hong Kong, Warsaw, Tokyo</td>
</tr>
<tr>
<td>NMT (walk/bicycle) City C3 (S3-max, and S1, S2&lt;20%)</td>
<td>Mumbai*, Shanghai*, Johannesburg*, Amsterdam, Bilbao, Valencia, Osaka</td>
</tr>
</tbody>
</table>
  - Public transport-base C42 (S2-max, and S1 and S3≥20%) | Bogota*, Prague*, Budapest, Moscow, Prague |
  - NMT (walk, bicycle)-base C43 (S3-max, and S1 and S2≥20%) | Harare*, Beijing*, Jakarta*, Sao Paulo, Osaka |

Note 1. S1, S2, S3—Modal share(%) of car, public transport and walk/bicycle.

2 Patterns of Motorization Development

Table 2 Main Public Transport Modes in Major Cities

<table>
<thead>
<tr>
<th></th>
<th>Paratransit</th>
<th>Bus</th>
<th>Mixed modes</th>
<th>Railways</th>
<th>Notes Motorization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>—</td>
<td>Utsunomiya☆</td>
<td>Toyama, Nagoya</td>
<td>Tokyo</td>
<td>Matured(600) (ageing, depopulation)</td>
</tr>
<tr>
<td>U.S.A.</td>
<td>—</td>
<td>Los Angeles☆</td>
<td>Portland, Boston,</td>
<td>New York</td>
<td>Matured(800) (congestion: peak car?, car/cycle sharing)</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>San Francisco</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europe</td>
<td>—</td>
<td>Bristol,</td>
<td>Munich, Zurich,</td>
<td>London, Paris</td>
<td>Matured(~600) (peak car? cycle revival)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cambridge</td>
<td>Copenhagen</td>
<td></td>
<td></td>
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<tr>
<td>Others</td>
<td>Hanoi*, Manila</td>
<td>Jakarta*,</td>
<td>Bangkok, Chengdu*,</td>
<td>Beijing*, Shanghai*</td>
<td>Rapid increase (economic dev. /urbanization)</td>
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<tr>
<td></td>
<td></td>
<td>Curitiba, Bogota</td>
<td>Medellin*</td>
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</table>

Note1. NMT(walking and bicycle) is vital in many cities as an indispensable transport mode. Besides car, motor cycle, SUV, small truck are used as a private mode.  
2. ☆: Cities where development of modern public transport systems (BRT, LRT, subway etc.) are actively proceeded.  
3. Paratransit includes various NMT modes (rickshaw and horse carriages). Also, Motorized modes include two-, three-wheel vehicle, small 4 wheel cars and light trucks.  
4. Numbers in the parentheses in Notes is the total vehicles ownership level i.e. vehicles per 1,000 persons.
2-1 Patterns of Motorization Development: Japan and Asia

- Modernization and development of urban public transport means
  - Man / animal powered (NMT) ⇒ Bicycle • paratransit ⇒ Bus • tram • rails
  - Exploring more convenient, affordable, safe and speedy transport means

- Co-existence of various transport means in Asian cities
  - Besides formal modes, various informal or intermediate public transport modes (NMT plus MT) operate in the limited street space

- Different patterns of motorization (vehicle type, motorization speed and the saturation level)
  - Motorcycle or paratransit based motorization
2-3 Patterns of Motorization Development

Goal: Sustainable city with the next generation mobility systems
(Shared EV/FCV, Automated EV/AV or Auto Sapiens)

Fig.2 Developments of Urban Transport System based on main public transport modes (Image)
3 ‘Auto Sapiens’ and the Next Generation Urban Mobility Systems
— ICT technological innovation and automated vehicles

- Evolution of ‘Auto Sapience’, connected and autonomous EV/AV
  — Depends on the socioeconomic context of each city. The possibility of ‘leap frog’ propagation of the new technology.
  — Adaptation of semi-automated technologies is expected soon.
    Need some decades for fully automated system.

- The next generation mobility system will be a multi-mode mobility system (AV mixed with conventional vehicles; walking as the basic mode): More choices of travel modes for all. Business models of the mobility services face major revolution with ICT.

- Goals — Healthy and Sustainable City: Accessibility and various travel options for all with sustainability subject to security and resilience, and avoiding the mobility divide
Table 2  The Next Generation Urban Transport System with AV or AS  
- An Image -

<table>
<thead>
<tr>
<th>General</th>
<th>Implications on Activity Modes and Transport Services</th>
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<tbody>
<tr>
<td>Transport modes</td>
<td>Level3: Automatic driving system with manual intervention at emergency.</td>
</tr>
<tr>
<td>Transport services</td>
<td>- Level4: Driver and the passengers can do business / study / rest / enjoy coffee and other activities during the travel. On demand, door to door service by shared AV</td>
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<tr>
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<td>- Automated parking with e- recharge and maintenance at remote garage. (Road/parking diet)</td>
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<td>- Automated mobility service of persons and goods available for all at all time.</td>
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<td>- Personal travel basically provided by shared AS in urban areas. No need of professional drivers in general. Conventional public mobility services or taxi-type services are also provided for non-AV and passengers with special mobility needs.</td>
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<td>- The boundary of public and private mobility service becomes ambiguous with shared AV.</td>
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<td>- Personal ownership of AV and other vehicles is limited for the specific users</td>
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<td>- Personalized vehicle serves as a private room, storage of personal items and a shelter, alternative supply source of electricity and information at emergency</td>
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<td>☆ Possible social dispute/confusion in the transitional period. E.g. TNC and Uber vs taxi.</td>
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