Site Visit Report

ITS Center the University of Tokyo
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Within the course of our field trip to Japan, on the afternoon of Friday, July 7th, 2017, we visited the ITS center of the University of Tokyo. The visit officially started by a relatively short introduction by Professor Yoshihiro SUDA, the director of the ITS center at a lecture room of Institue of Industrial Sciences (IIS). Then afterward we visited Chiba experiment station which was just attached to Institute of Industrial Sciences. This report intends to summarize the lecture presented by professor Suda and the subsequent tour of Chiba Experiment station. To explanations of this report are referenced to the slides presented by professor Suda, the leaflets of the ITS center, and our field observation during the visit.

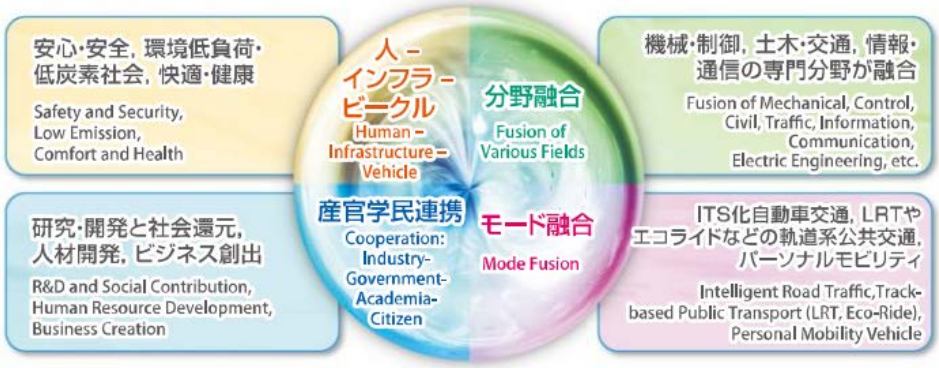
Introduction:

Advanced mobility research center (ITS center) of the institute of industrial science, the University of Tokyo is established in April 2009 for the promotion of research and development of ITS-related subjects. The research center incorporates 16 professors from mechanical, electrical and civil engineering departments and 20 members from government and industry sector. This research center aims to promote research in the following fields.

1. Advanced transport system based on Automated Driving
2. Design of social mobility using Big Data
3. Integrated mobility design including road and railway public transportation

The research center contributes to education by holding special course for practitioners, ITS seminars and graduate lectures in the university of Tokyo. The courses aim to develop human resources for ITS, to deploy ITS applications further in society, and to create next generation of ITS systems using cutting edge technologies from all related fields.

The researches of the ITS research center are colloborative activites among transport engineers, vehice engineers and information communication technology experts



Professor Yoshihiro SUDA, the director of the advanced mobility research center (ITS center) and the head of Chiba experiment station, introduced the aims, activities, and infrastructures of his respective organization which are briefly described in the following.

1 Research Activities of ITS center

1.1 Automated Driving, Energy ITS project

Development of automated Truck Platoon System

- Fully automated truck platoon: 3 heavy automated trucks and 1 light automated truck at 80 km/h with 4 m headway
- Development of human machine interface for drivers on the followers
- Result leads to demonstration project in Japan

1.2 Societal Implementation of Automated Driving

Echo system for autonomous driving

To realize the technology and in response to increasing interest in automated driving, it is necessary to consider social acceptability. ITS research center aims to establish the comprehensive ecosystem related to automated driving.

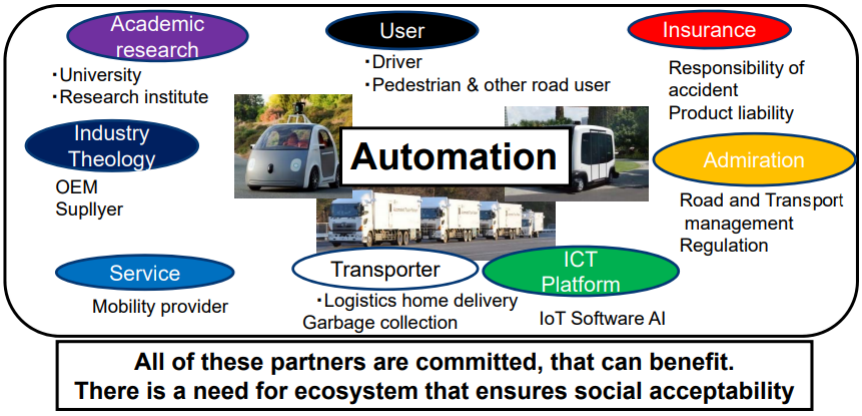


Figure 1, Echo system for autonomous driving

Mobility as a service and social change

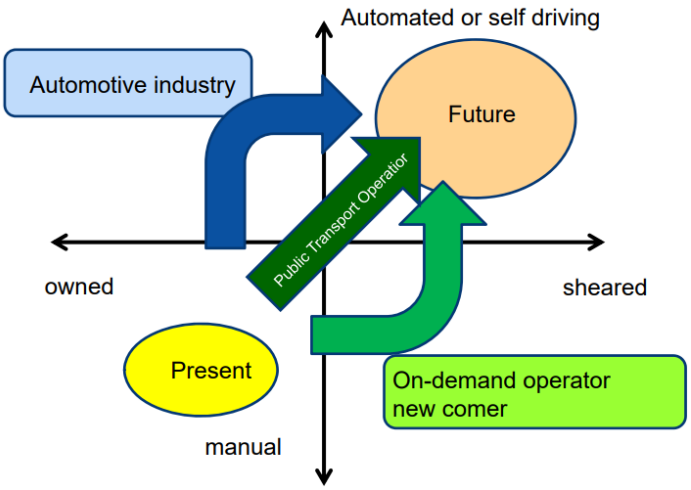


Figure 2, mobility as service and social change

Model for next generation environmental city

- Encourage modal mix and sustainable transport including feasibility study of next generation transport mode
- Next generation environmental city (reducing co2 emission and energy consumption)

1.3 Energy Mobility Management; Disaster Recovery

Next-generation Energies for Tohoku Recovery Project

- Research and development of a mobility integrated energy management system (EMS) as support for the earthquake disaster reconstruction of Tohoku region
- Research and development of human behavior model and three-dimensional environmental measurement
- Demonstration of the project in Ishinomaki area, Tohoku in near future

1.4 Automated Driving; SIP[1]-adus[2]

Advanced Rapid Transit (ART)

As a safe and convenient public transport, the concept of ART[3] and the required technologies have been proposed. The proposal will be used for R&D planning of the strategic innovation promotion (SIP) program, to introduce ART to Tokyo Olympic games in 2020.

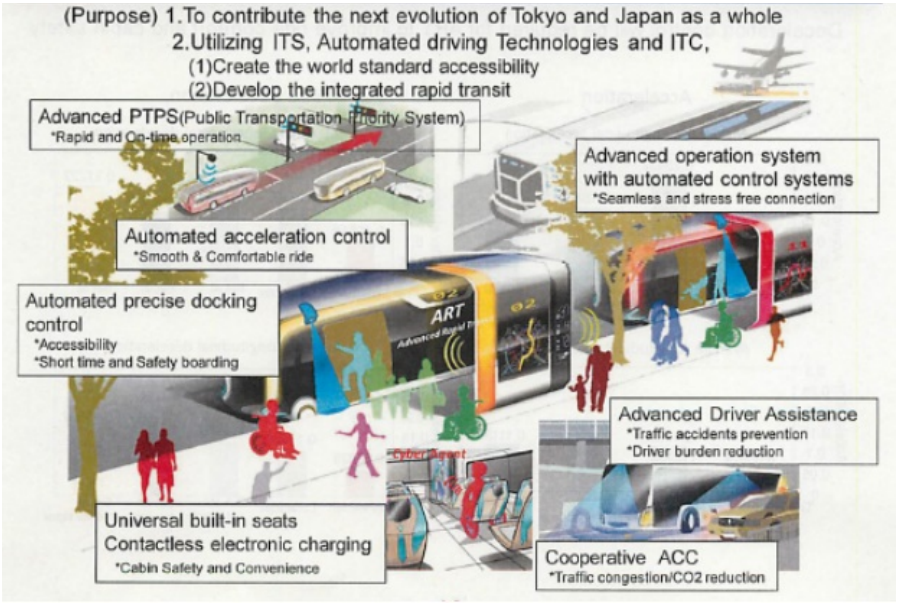


Figure 3, future of transportation for Japan

[1] Cross-Ministerial Strategic Innovation Promotion Program
[2] Innovation of Automated Driving for Universal Services
[3] Autonomous Rail Rapid Transit (ART)

1.5 Hiroshima Advanced Safety Vehicle (ASV) project

ASV project using v2v[4] communications

- FOT of innovative ASV in Hiroshima-v2v by communication between tramcars and cars
- Realization of the proposed services for safe driving by V2V communication between private vehicles and public transport vehicles in Hiroshima

1.6 Kashiwa ITS FOT Model City

Kashiwa city is one of the ITS model cities designed by the Japanese government, where the ITS center is leading research and development on ITS, especially with some field studies, concerning public transport use, advanced mobility, etc. In this project, a social feedback system was developed to make local citizens aware of CO2 emissions and to promote their eco-friendly travel behavior. This was done through estimating regional traffic situation using ICT and presenting the forecasts through a user-friendly and understandable web interface. The project was meant to Build the stepping stone for future social implementation.

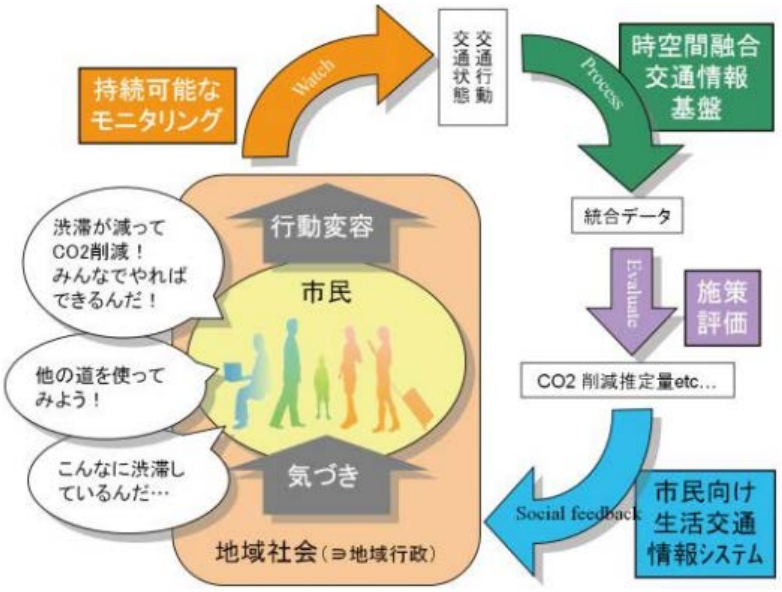


Figure 4, Sustainable feedback system of regional transport information for promoting modal shift for regional citizens

2 Social Contribution Activities and Global Collaboration

2.1 Social contribution activities (ITS seminar series)

- To promote ITS, series of workshops are organized based on the needs of local areas as well as central administration.
- In this seminars other than academia, lecturers from industry and government are invited and free, frank and active discussion is made.

[4] Vehicle to Vehicle

2.2 Global Collaboration

- Besides domestic collaboration, ITS center is actively engaged in international partnerships.
- ITS center hosts an international symposium every year
- exchanges faculty members and students, share information and facilities with other universities and institutes around the world.

3 Sustainable transportation

- Low emission and energy saving
- Safety and security
- Comfort and healthy
- Anti-disaster and emergency
- Social changes and aging society
- Connected and automated driving for 2020 Tokyo Olympic and Paralympic

3.1 Keywords for sustainable transport development

- ITS for road traffic and advanced automobile
  - Improvement of energy efficiency of automobiles
  - Intelligent management of traffic, energy flow
  - Autonomous driving and self-driving
- Advance guideway system
  - Modal shift from automobile to public transport system
  - LRT [5]and new concept system “Echo-ride” in urban area
  - Energy efficiency High-speed rail and Megalev
- Personal Mobility
  - Promote to small EV and human power
  - Promote from automobile to public transit
  - Robotic two-wheel vehicle for stability and safety

[5] Light Rail Transit

4 Field experiments at Chiba Experiment Station, IIS, the University of Tokyo (ITS P&R experiment fields)

From April 2017 a new test facility is opened and put into operation just beside Institute of industrial sciences at Kashiwa campus of University of Tokyo. This facility is called Chiba Experiment Station or ITS P&R experiment field. The test station incorporates several tests facilities which are briefly mentioned in following.

Figure 5, the layout of ITS P&R experiment field

4.1 Proving Ground and Experimental Traffic Lights

The proving ground has an asphalt pavement and can accommodate different types of experiments related to automobiles, motorcycles, aircraft and others. We can conduct various experimental research in the field of mechanical engineering, traffic engineering, ergonomics and acoustical engineering. There is an experimental intersection with traffic lights installed to reproduce an actual road environment such as city road and rail road crossing. This allows us to conduct experiments that are difficult to perform in the actual traffic environment. Intelligent Transport Systems (ITS) research is initiated with the collaboration among industry, academia, and government, to promote new safe driving assistance system, automated driving, and V2X related development.

Figure 6, proving ground and experimental traffic lights

4.2 Driving simulator for large vehicle

- To promote the application of automated driving in public transport and logistics systems the ITS center have developed a driving a simulator specialized for large vehicles such as bus and heavy-duty truck. The simulator is used to carry out experiments involving dangerous situations and requirements of controlling experimental conditions. The driving simulator has a 6 degrees of freedom motion system and a visual system to respond a view of large vehicles. Using the driving simulator, Tokyo University experts are conducting studies on HMI (Human Machine Interface) and evaluation of social acceptance for the realization of automated driving in bus and truck systems for the next generation of traffic systems.
    - 360-degree screen
    - Car navigation system
    - Turn table for yow motion
    - x-y table for adjustment of yow center
    - developed by collaboration with industries internationally

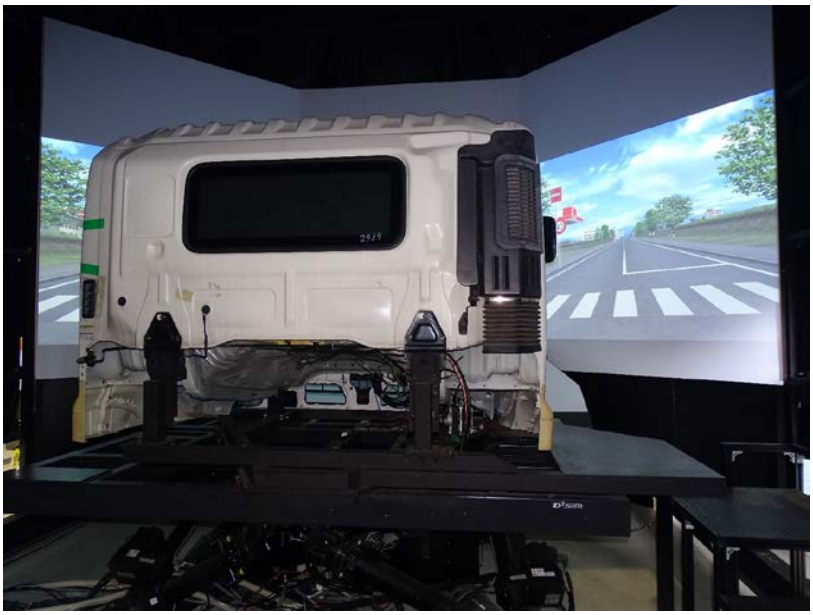


Figure 7, large vehicle driving simulator

4.3 Chiba test track 2.0 and scaled model vehicle running test track

Test track facilities are used to study motion and vibration control of railway vehicles. Using a full-scale test track (about 333m in length), actual bogies and vehicle can travel on straight line, a transition curve, a steady curve (R 33.3 m), railroad crossing and switching. Wheel/rail contact patches are measured and abnormal vehicle states originating in bogies of track are detected. Moreover, using a 1/10 scale running platform with R 3.3 m steady curve a scale model bogie can be operated and investigated. Research is being carried out on the effects of changing track or vehicle conditions and on a novel bogie running system and wheel rail tribology including wet environment.

Figure 8, 1/10 scaled test track

Figure 9, full scale LRT test tracks

Chiba test track can be used for the following experiments:

- Rail/wheel contact tests
- Integrated studies with ITS road automobiles
- Validation study with scaled model test and computer simulations
- Development of new types of bogies (trucks), steering bogies, and independently rotating wheelsets
- Safety study for derailment
- Education and training

4.4 Experimental Vehicles for Test Track

Various test vehicles and bogies (trucks) are used for research and education at the test platforms of Chiba Test Track 2.0. There is a real subway car and a bogie (truck) of a commuter train car, which were operated in actual conditions, as well as a vehicle mockup and a scale model car. These vehicles are used for research on friction control, contact problem tribology in wheel/rail contact, research, and development of new types of steering truck, tests on safety against derailment, study on space comfort, etc.

Figure 10, the test subway car

Figure 11, the mock-up vehicle used for seat alignment experiments

4.5 Autonomous bus experiments

Japan has recently purchased two self-driving buses from the French company of Navya. The buses are designed to operate on fixed routes for shuttle services. These buses will remain under test and experiment of ITS center researcher at Chiba ITS P&R experiment field for a while. The vision is to cover the first and last mile gap to Tokyo subway stations by autonomous buses before 2020 Tokyo Olympic games.

Figure 12, Navya autonomous buses at the ITS center lab