# FY2013
# Feasibility Studies on Joint Crediting Mechanism Projects towards Environmentally Sustainable Cities in Asia

## Feasibility Study of Dissemination of Japanese Standard Digital Tachographs and Unification of Regional Standards for Traffic Pollution Countermeasures in ASEAN Metropolises – for Indonesia and Thailand

Report

English Version

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DENSO CORPORATION

# Summary

1. Various institutions and business environment of the host countries/cities

1-1. Indonesia

In Jakarta, the capital of Indonesia, where public transportation systems, such as subways and monorails, are not well developed, traffic congestion occurs chronically, causing problems in the movement of people and the distribution of goods. Measures to prevent traffic accidents, reduce exhaust gases containing nitrogen oxides (NOX) and particulate matters (pm) as well as CO2 emissions are increasingly important issues from the perspective of sustainable development of Indonesia.

The governmental organization responsible for the road and traffic policies above is the Ministry of Transportation (MOT). The Research and Development Agency of the MOT makes proposals to each department and the Department of Land Transportation (DLT) develops draft laws and implements, superintends, and supervises the policies. In terms of various related institutions and policies, for traffic safety, regulations concerning road traffic have been strengthened since 2004 in response to the initiatives of the World Health Organization (WHO) to reduce traffic accidents. As for global warming prevention policies, the Indonesian Government announced a CO2 reduction target of 26% in 2009. As measures to reduce CO2 in the transportation sector, traffic congestion mitigation and eco-driving are considerably appealing as effective measures.

With deeper cooperation with the government (specifically the MOT) and through utilization of technologies and knowhow of the private sector, this project aims to contribute to taking measures to deal with these various issues, such as traffic congestion, traffic safety, and CO2 emissions in the transportation sector.

1-2. Thailand

In Bangkok, the capital of Thailand, where the number of automobiles is rapidly increasing, alternative transportation networks, such as subways and the Bangkok Sky Train (BTS), are being developed to mitigate air pollution and traffic congestion caused by automobiles. However, with the number of automobiles consistently increasing and the population continuously flowing into and concentrating in the urban areas, the issues of traffic congestion, traffic accidents, and air pollution continue to exist.

The governmental organization responsible for the measures for the traffic issues above and the traffic policies is the Ministry of Transport (MOT). In the MOT, the Office of Transport and Traffic Policy and Planning (OTP) submits draft policies and the Department of Land Transport (DLT) executes laws and regulations concerning land transportation.

In terms of various related institutions and policies, for the purpose of enhancing the safety of freight vehicles, such as buses and trucks, the "installation of a GPS tracking system" has been obligated in a phased manner starting in 2013.

In this project, similarly to the approach to the Indonesian Government mentioned above, a direct contact was made to Deputy Permanent Secretary of the MOT to start an approach to the Thai Government in order to conduct a study of the possibility of introducing smart tachographs, including the demonstration experiment for government-owned buses.

## 2. Study project

### 2-1. Background and aim of the project

Along with the economic growth of the two host countries, the number of trucks and buses has increased rapidly and the traffic issue is increasingly serious, for which measures are being taken. It is considered significant to combine the unification of regional standards based on Japanese technologies and the institutions and traffic policies of Japan together as a single package through government-private sector collaboration to promote the export and introduction of Japanese smart tachographs to the host countries.

The project will conduct pilot experiments for transportation and bus companies in two cities, Jakarta (Indonesia) and Bangkok (Thailand), and also clarify the possibility of introducing Japanese legal systems and technologies to the host countries, the main persons to contact, and the status of the host countries' needs, such as capacity development. The project aims to study and develop the approach with the unification of regional standards workable in the ASEAN countries and the traffic policies of various countries combined together as a single package, the industry-government-academia collaboration, and the project scheme.

### 2-2. Technical characteristics of smart tachographs and the related institutions

#### 1) Technical characteristics of smart tachographs

In addition to meeting the requirements for a digital tachograph, a smart tachograph has functions to meet various needs for operation efficiency, safety and fuel economy, and transportation quality improvement.

A digital tachograph offers a feature capable of providing various functions suitably and on a timely basis, particularly including the function whereby the audio and monitor system of in-vehicle equipment provides guidance for operation improvement activities and the function whereby the operation manager can give instructions and guidance to drivers based on the operation data analysis results.


2) Institutions related to smart tachographs (Trends in Japan and the world)

In Europe, the installation of a tachograph on any truck with a maximum load of 3.5 tons or more is obligated to record the operating hours. In Asia, tachographs were introduced to publicly owned buses in Hong Kong and Singapore and a fuel cost reduction effect of 4.5 to 7% was achieved. In some other countries such as Australia, there is a trend to obligate the installation of a tachograph instead of a GPS tracking system.

## 3. Investigation method

### 3-1. Tasks of investigations and description of implementation thereof

In Southeast Asia, traffic infrastructures are, unlike in Japan, in a developing state, and there are specific traffic situations, such as the occurrence of chronic traffic jams and epidemics of traffic accidents. Furthermore, in transportation business using trucks, buses, etc, the following matters are late in being put into practice: safe driving control by means of tachographs; and safe driving education of drivers by operations managers. Studies will be made of the following matters: the issues of whether smart tachographs will be accepted by transportation entrepreneurs in Southeast Asia under such circumstances, and of whether smart tachographs are effective in safety and in fuel consumption saving; the issue of how much CO2 reduction effect will be achieved; and the feasibility of commercialization.

- Investigation on receptivity of smart tachographs
- Pilot experiments involving trucks and buses
- Evaluation of effects in reducing fuel consumption and in decreasing CO2 emissions
- Workshop type discussions
- Study of MRV method and monitoring setup
- Study of large-scale deployment and commercialization

### 3-2. Implementation setup

Investigations were carried out as follows in Indonesia and Thailand: Pilot experiments were conducted; furthermore, workshops for deepening industrial-government-academic research discussions were set up; cooperation was made with the Head Office of Denso Corporation (in Japan) and this corporation’s local subsidiaries (Denso Indonesia and Denso Thailand).

| | Indonesia | Thailand |
|---|---|---|
| Implementation entity | Head Office of Denso Corporation, Denso Indonesia | Head Office of Denso Corporation, Denso Thailand |
| Pilot experiment participant | Blue Bird, DAMRI, HARIJAYA | V-SERVE, Padoongrich |
| Workshop participant (Observer *) | MOT (Land Transportation Bureau, Research & Development Bureau), Bandung Institute of Technology, ITS Indonesia, DAMRI, HARIJAYA, JICA Indonesia*, Japanese Embassy* | MOT, NECTEC, IT Thailand, Chulalongkorn University, V-SERVE, Padoongrich, BMTA (public bus corporation), Intercity Bus (public bus corporation), Japanese Embassy* |
| Investigation supporter (Outsourcee) | Pricewaterhousecoopers Sustainability<br>PwC Indonesia | Pricewaterhousecoopers Sustainability<br>PwC Thailand |

4. Investigation results

4-1. Investigation on receptivity of smart tachographs, and investigation results.

1) Investigation of realities of traffic safety policy regarding trucks and buses, and needs for tachographs

The current systems, policies, and needs that are addressed by the pertinent governments were grasped, and confirmations were made as to whether the relevant countries are receptive of the technology and effects, which smart tachographs have, regarding operations management (pertaining to time, distance, and speed), safe driving, and eco-friendly driving.

| | Indonesia | Thailand |
|---|---|---|
| Traffic safety policy | ● Regulations regarding driving time and break time (2009)<br>● Approval of installation of digital tachometers and GPS (2012) | ● Start of obligation to equip dangerous goods transportation vehicles with GPS tracking systems (2013) |
| Policy needs | ● By utilizing the results of this investigation, the government is verifying the effects in reducing accidents and in decreasing CO2. | ● Strong interest in the comparison of effectiveness between GPS tracking systems and smart tachographs |

2) Interview type investigation of realities of operations management, and needs for smart tachographs

Interview investigations were conducted at Japanese and local physical distortion companies and GPS system companies in Jakarta and Bangkok. The GPS and smart tachograph introduction status, the realities of operations management, and the relevant needs are as follows.

| | Indonesia | Thailand |
|---|---|---|
| Operations management setup* | ● Operations managers have already been stationed. | ● Operations managers have already been stationed. |
| Realities of operations management work | ● Daily driving guidance is provided in such a way as to fumble for an appropriate way. An effective method is being groped for. | ● Daily driving guidance is provided in such a way as to fumble for an appropriate way. An effective method is being groped for.<br>● Advanced enterprises recognize the importance of guidance, |
| Needs | ● Specific tactics for having drivers perform safe driving are desired to be known. | ● Japanese good practice for improving driving safety and road manners is desired to be learned. |

*: In Japan, there are legal obligations to station operations managers. However, in the above-mentioned two countries, there is neither such legal obligation nor relevant administrative guidance.

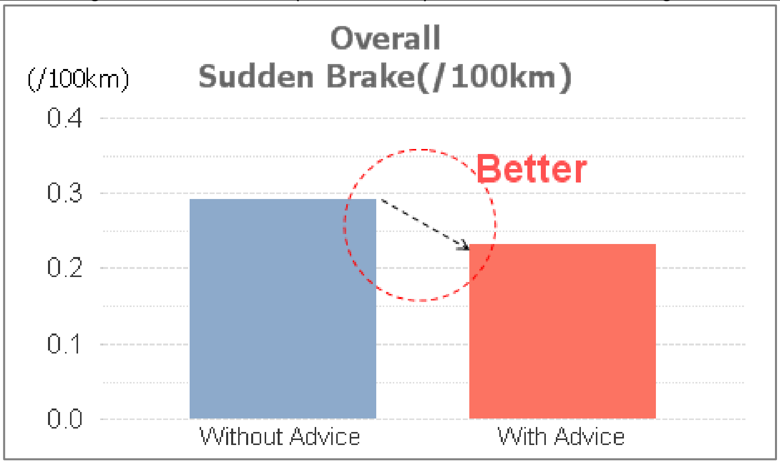
4-2. Pilot experiment and research results for trucks and buses

1) Safety effect results

(1) Count of dangerous drive

As a result of research on dangerous drive, we found about 20% reduction of the count of dangerous drive (per 100 km), of overall average of 13 vehicles, in a period with advice as compared to a period without advice.

Fig. Count of Dangerous Drive (/100 km), Overall Average of All Vehicles




(2) Near-miss scenes

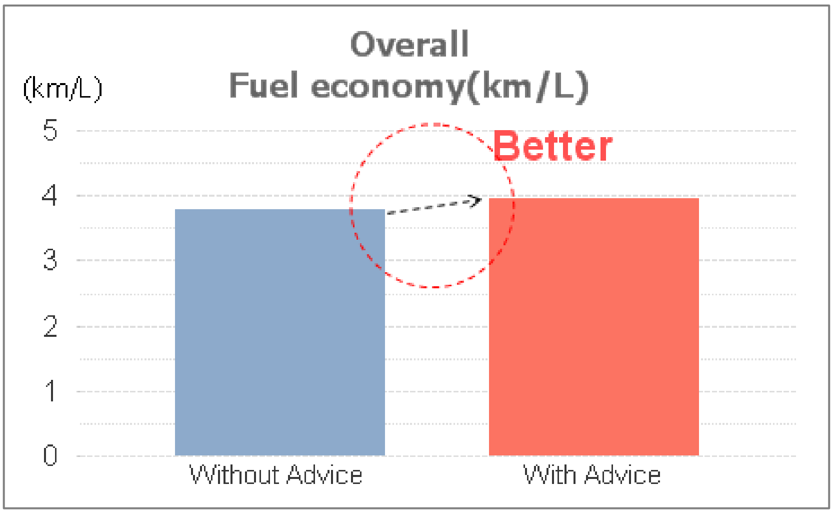
Selected from various images taken at dangerous drive scenes, we analyzed in details some images which actually led to a near-miss. As a result of the analysis, we found out many of them were caused due to an insufficient distance to the front car on a straight road, and that more than a half of the near-misses(17 out of 32 cases) could have been prevented by following a sudden brake warning advice while driving.

2) Research result of fuel saving effect

(1) Fuel economy (km/L)

As a result of investigation on fuel saving drive data, we found out the average fuel economy (km/L) of the 13 vehicles in a period with advice (advice function is activated) improved 4.4% from a period without advice (advice function is not activated).

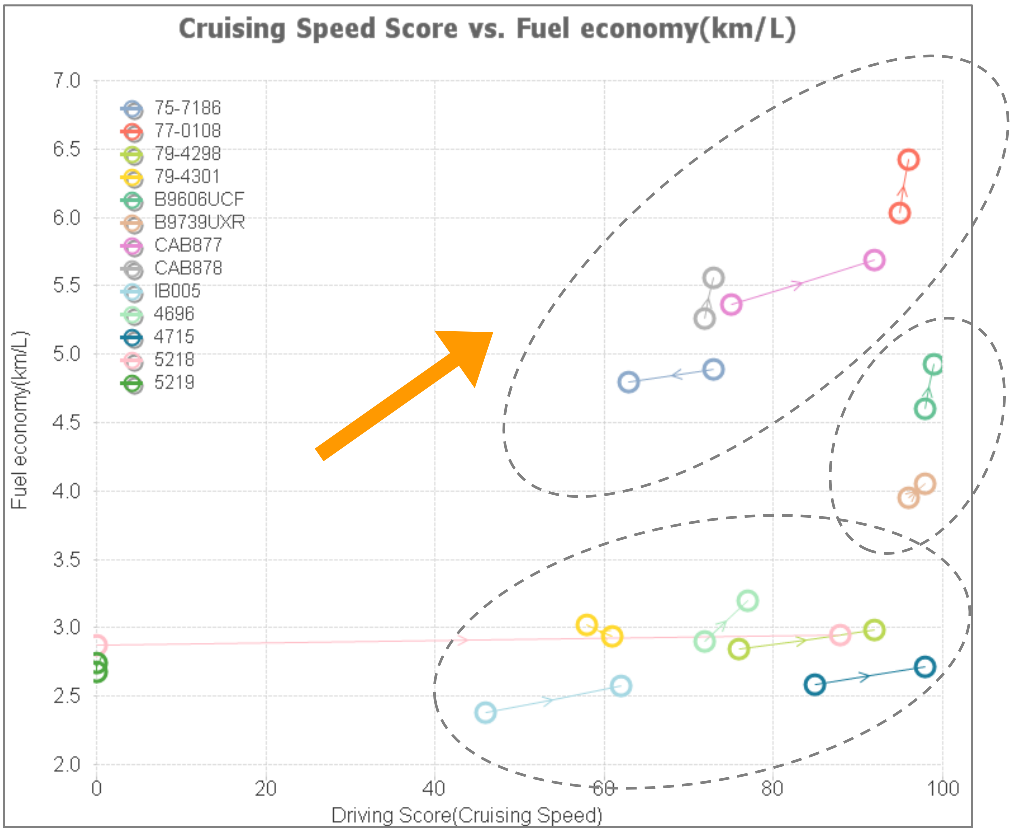
Fig. Fuel Economy (km/L), Average



(2) Relationships between fuel saving score vs. fuel economy on smart tachograph

Graph of fuel saving score and fuel economy (km/L), a function of smart tachograph, is shown in the figure below. Fuel saving speed data and fuel saving engine rotation data, which especially influence fuel economy, are used here. From the figure, we can see the fuel economy improved when the respective scores increased, and found out that fuel economy can be improved by driving in a way to increase the fuel saving score on the smart tachograph.

Figure: Fuel Saving Score (Cruising Speed) vs. Fuel Economy (km/L)




4-3. CO2 Emission Reduction Effect and Co-Benefit

| | | Indonesia | Thailand |
|---|---|---|---|
| CO2 reduction effect | Feasibility Study (This time) | Total 9 vehicles experimented<br>Pilot test period 20 to 81 days<br>Calculated on annual basis 21.4 tons of CO2 (Estimate) | Total 4 vehicles experimented<br>Pilot test period 77 to 99 days<br>Calculated on annual basis 3.0 tons CO2 (estimate) |
| | Large scale campaign | In case 60,000 vehicles are installed over three years,<br>where fuel efficiency is | In case 45,000 vehicles are installed, where fuel efficiency is 5% and 15%, 140,800 to 314,400 tons |

| | | | |
|---|---|---|---|
| | | 5% and 15%<br>161,300 to 483,800 tons of CO2 | of CO2 |
| Co-benefit | Feasibility study (This time) | ● Safe driving and improvement of driver's mind<br>● Improvement of work environment | ● Safe driving and improvement of driver's mind<br>● Improvement of work environment<br>● Building operation control system (1 company) |
| | Large scale campaign | ● Same as above<br>● Building operation control system<br>● Reduction of economic loss due to traffic congestions<br>● Reduction of accidents caused by commercial vehicles | |

4-5. Total project cost and cost benefit

In this research, our technical staff, using the equipment of the existing system center in Japan, visited the subject countries, installed, provided advices/instructions for the installation and operation, and conducted data collection/analysis, etc. When the project is expanded to a large scale, we can expect cost can be reduced by using the system equipment and specialist technical staffs available locally.

## 5. Study for commercialization

As a result of business feasibility study, we would like to develop a large scale commercialization in the respective countries one after another from the next fiscal year on. The following are the future business images to promote and establish our smart tachograph system, on-board equipment technology and our know-how of software support we have built up in Japan, and tasks to be carried out.

5-1. Image and prospect of commercialization in Indonesia, and tasks for a large scale commercialization

1) Image of commercialization (Future image)

Digital tachograph operation control system in accordance with the Japanese standard is legislated and mandatory, and the digital tachograph is widely used as JCM credit equipment. Its use is expanding in a favorable environment for the introduction aided by schemes such as leasing under government subsidies.

2) Tasks needed for commercialization

1. Establishment of on-board equipment standard for smart tachograh and

operation control standard, as well as legislation including its mandatory introduction are needed.

2. If the initial investment is too large for local companies, it will be a barrier for introduction and promotion. Financial schemes (such as leasing method) which allow local companies to introduce more easily will be needed.

5-2. Image and prospect of commercialization in Thailand, and tasks for a large scale commercialization

1) Image of commercialization (Future image)

Safe driving mode, $CO_2$ reduction function and operation control system of smart tachograph are added to the present GPS legislation standard, and finantial schemes such as leasing including government subsidy which enable easy introduction are established, and promotion progresses.

2) Tasks needed for commercialization

1. Establishment of on-board equipment standard for smart tachograh and operation control standard, as well as legislation including its mandatory introduction are needed.
2. If the initial investment is too large for local companies, it will be a barrier for introduction and promotion. Financial schemes (such as leasing method) which allow local companies to introduce more easily will be needed.

Contents

* A smart tachograph is a next-generation operation control system based on a Japanese standard digital tachograph, which is adapted or upgraded for the use in local countries.

This study was conducted with DENSO CORPORATION working as a main organizer, and various studies, pilot experiments, and workshops were conducted in Indonesia and Thailand with the cooperation of PT. DENSO SALES INDONESIA, DENSO SALES (THAILAND) CO., LTD., DENSO INTERNATIONAL ASIA CO., LTD., PricewaterhouseCoopers Sustainability Co., Ltd., PwC Indonesia, and PwC Thailand.

# 1. Various institutions and business environment of the host countries/cities

## 1-1. Socio-economic status of the host countries/cities

### 1) Indonesia

| | |
|---|---|
| Area | 1.89 million $km^2$ |
| Population (2010) | 238 million |
| Capital | Jakarta |
| Language | Indonesian |
| Religions | Islam 88.1%, Christianity 9.3%, Hinduism 1.8%, Buddhism 0.6%, Confucianism 0.1%, others 0.1% |
| Currency | Rupiah US$1 = 11,365 rupiah (October 18, 2013) |
| GDP (nominal) | US$879.4 billion |
| GDP per capita (nominal) | US$3,562 |
| Real economic growth rate | 6.2% |

Source: Ministry of Foreign Affairs of Japan, JETRO*: Figures in 2012 are used unless otherwise specified.

### 2) Thailand

| | |
|---|---|
| Area | 0.51 million $km^2$ |
| Population (2010) | 59 million |
| Capital | Bangkok |
| Language | Thai |
| Religions | Buddhism 94%, Islam 5% |
| Currency | Baht US$1 = 31.08 baht (Average in 2012) |
| GDP (nominal) | US$365.0 billion |
| GDP per capita (nominal) | US$5,382 |
| Real economic growth rate | 6.5% |
| Inflation rate | 3.0% |

Source: Ministry of Foreign Affairs of Japan, JETRO*: Figures in 2012 are used unless otherwise specified.

## 1-2. Status of energy consumption and greenhouse gas emissions of the host countries/cities

### 1) Indonesia

In Jakarta, the capital of Indonesia, where public transportation systems, such as subways and monorails, are not well developed, traffic congestion occurs chronically, causing problems in the movement of people and the distribution of goods. Measures to prevent traffic accidents, reduce exhaust gases containing nitrogen oxides (NOX) and particulate matters (pm) as well as CO2 emissions are increasingly important issues from the perspective of sustainable development of Indonesia.

2) Thailand

In Bangkok, the capital of Thailand, where the number of automobiles is rapidly increasing, alternative transportation networks, such as subways and the Bangkok Sky Train (BTS), are being developed to mitigate air pollution and traffic congestion caused by automobiles. However, with the number of automobiles consistently increasing and the population continuously flowing into and concentrating in the urban areas, the issues of traffic congestion, traffic accidents, and air pollution continue to exist.

1-3. Environmental load condition, etc. related to the project

1) Indonesia

The number of automobiles, including buses and trucks, are rapidly increasing. According to “World Motor Vehicle Statistics” issued by Japan Automobile Manufacturers Association, Inc. and the research by the Ministry of Land, Infrastructure, Transport and Tourism of Japan, the number of automobiles owned in 2010 reached 18.9 million in Indonesia.

Traffic accidents are a serious problem and according the transportation statistics by the Indonesia police, the number of traffic accidents increased to 117,949 in 2012, almost doubled from 59,164 in 2008. According to the WHO research results, fatalities from traffic accidents per thousand of the population are 17.7 (2010).

As for energy consumption, the energy demanded in the transportation sector goes on increasing with the increase in the use of automobiles and increased to 25.8 million tons in 2008 from 5.9 million tons in 1980.

2) Thailand

With a rapid progress of motorization, the number of automobiles owned in 2010 reached 10.7 million in Thailand according to “World Motor Vehicle Statistics” issued by Japan Automobile Manufacturers Association, Inc. and the research by the Ministry of Land, Infrastructure, Transport and Tourism of Japan.

Traffic accidents are a serious problem and according the WHO research results, fatalities from traffic accidents per thousand of the population are 38.1, the third worst in the world (2010).

When an interview was conducted with the Ministry of Transport of Thailand in October 2013, a comment was made that the safety measures were recognized as a key issue to address.

The Ministry of Transport of Thailand also reported in Transport Statistics in 2009 that land transportation accounted for about 90% of the energy consumed in the transportation sector.

### 1-4. Status of the development of infrastructure/facilities, etc. related to the project

1) Indonesia

A rapid increase in demand due to overconcentration to the metropolitan area causes the increase in accidents and traffic congestion, posing a serious problem. The total road length in Indonesia was 472,000 km as of 2009 and the express highway length in Indonesia is planned to be 1,710 km in 2014.

2) Thailand

The total length of motor highways in Thailand is 67,000 km. The maintenance and management of roads in Thailand is very important because automobiles play a significant role in domestic distribution of goods. The government spends a large amount of its budget every year for the expenses of road maintenance and safety measures.

### 1-5. Governmental organizations and their roles related to the project

1) Indonesia

The governmental organization responsible for the road and traffic policies is the Ministry of Transportation (MOT). The Research and Development Agency of the MOT makes proposals to each department and the Department of Land Transportation (DLT) develops draft laws and implements, superintends, and supervises the policies.

2) Thailand

The governmental organization responsible for the measures for the traffic issues above and the traffic policies is the Ministry of Transport (MOT). In the MOT, the Office of Transport and Traffic Policy and Planning (OTP) submits draft policies and the Department of Land Transport (DLT) executes laws and regulations concerning land transportation.

1-6. Status of various institutions related to the project

1) Indonesia

In terms of various related institutions and policies, for traffic safety, regulations concerning road traffic have been strengthened since 2004 in response to the initiatives of the World Health Organization (WHO) to reduce traffic accidents. As for global warming prevention policies, the Indonesian Government announced a CO2 reduction target of 26% in 2009. As effective measures to reduce CO2 in the transportation sector, traffic congestion mitigation and eco-driving are considerably appealing. In the ITS World Congress in October 2013, Dr. Elly, the Director General (then Deputy Director General) of the Research and Development Agency of the Ministry of Transportation of Indonesia announced that Indonesia would study the regulations to obligate the installation of a digital tachograph in official cars and was studying the development of laws and regulations through the verification study of the effect by utilizing the FS of this project, where Japanese standard tachographs are used, in order to improve safety (reduce accidents) and environment (reduce CO2).

With deeper cooperation with the government (specifically the MOT) and through utilization of technologies and knowhow of the private sector, this project aims to contribute to taking measures to deal with these various issues, such as traffic congestion, traffic safety, and CO2 emissions in the transportation sector.

2) Thailand

In terms of various related institutions and policies, for the purpose of enhancing the safety of freight vehicles, such as buses and trucks, the "installation of a GPS tracking system" has been obligated for trucks transporting hazardous materials in a phased manner starting in 2013. In addition, the government-owned bus company is now promoting the experiment to introduce GPS tracking systems in cooperation with the National Electronics and Computer Technology Center (NECTEC) of Thailand.

In this project, similarly to the approach to the Indonesian Government mentioned before, a direct contact was made to Deputy Permanent Secretary of the MOT to start an approach to the Thai Government in order to conduct a study of the possibility of introducing smart tachographs, including the demonstration experiment for government-owned buses.

## 2. Study project

### 2-1. Aims of the project

**Purpose of the study No. 1**

Set up a workshop consisting of stakeholders, such as a business entity, governmental organization (MOT) and research institute, in two countries/cities to conduct pilot experiments for transportation and bus companies, study an MRV methodology to evaluate the $CO_2$ reduction effect, and verify the applicability of the technology to local business entities and traffic issues.

**Purpose of the study No. 2**

Study the possibility of introducing Japanese Road Trucking Vehicle Act, emission regulations, technical guidelines, and subsidy scheme for the development of the legal system to disseminate Japanese standard digital tachographs in the two countries utilizing the ITS. Also study the possibility of utilizing the data obtained by digital tachographs for the traffic control system project for global warming and traffic congestion prevention measures.

**Purpose of the study No. 3**

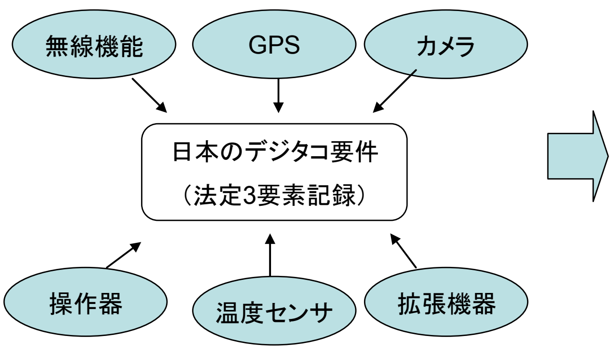
In order to create ripple effects simultaneously and multiply as well as in large quantity and multiple aspects in two countries/cities, study and develop the approach with the unification of regional standards workable in the ASEAN countries and the traffic policies of various countries combined together as a single package, the industry-government-academia collaboration, and the project scheme.

### 2-2. Applicable technologies, institutions, etc.

1) Comparison of the technologies and institutions of tachographs between Japan and foreign countries

Market needs for Japanese tachopgraphs are considered as shown in the following figure:

Figure 2-2-1 Response of Japanese tachographs to market needs




| 市場ニーズ | | 付加機能 |
|---|---|---|
| 業務効率化 | 車両位置のリアルタイム把握 | 車両位置送信と事務所画面での位置表示 |
| | 運行実績帳票出力の自動化 | 車載機の実績入力と記録機能<br>事務所PCでの帳票出力 |
| | 緊急時連絡 | 事務所ー車両間のメッセージ送受信 |
| 安全・省燃費 | 安全運転管理 | 安全・運転アドバイス機能<br>ドライブレコーダ |
| | 省燃費運転管理 | |
| 輸送品質向上 | 庫内温度管理 | 庫内温度の記録と温度異常時の警報機能 |

The comparison of the standards for tachographs between Japan and foreign countries is shown in the following tables:

Table 2-2-2 Comparison of the standards for tachographs between Japan and foreign countries (1/2)

| | | 日本 | 欧州 | 中国 |
|---|---|---|---|---|
| 対象車両 | | 最大積載量　5t以上、または、総重量　8t以上の貨物事業車両 | 最大積載容量　3.5t以上の貨物車両　他 | 総重量12t以上の貨物車両　他 |
| 基準名／番号 | | ディジタル式運行記録計の型式指定基準 | **On recording equipment in road transport**<br>3821/85EEC | 自動車運行記録装置<br>GB/T 19056 |
| 車載機要件 | 運転手識別 | 規定なし | ICカード（運転者情報） | ICカード（運転手ID） |
| | 入力<br>表2-2-1 日本と海外のデジタコ基準の比較（1／2） | ・速度信号 | ・速度信号<br>・スイッチ入力：<br>運転手活動データ<br>（運転中、作業中、休憩等）<br>業務開始・終了時の場所 | ・速度信号<br>・衛星測位アンテナ信号<br>・スイッチ入力　（装置の操作用）<br>・通信入力（USB、RS232C） |
| | 記録データ | ・時刻、速度、距離（法定三要素） | ・時刻、速度、距離<br>・運転手活動データ<br>・速度超過等 | ・運転手情報、車両情報<br>・時刻、速度、距離<br>・衛星測位情報<br>・停車時速度データ<br>（0.2秒間隔、20秒間、10回） |
| | 記録期間 | 車載機内部に　上記記録データを0.5秒毎に24時間、および、1分毎に52週分記録する。 | 車載機内部に　上記記録データを365日分、詳細速度は24時間 | 1分間隔で360時間 |
| | データ出力 | [利用者向け]<br>利用者向けソフトへと伝達可能な情報伝達媒体に記録データを出力する。（媒体の規定なし　メモリカード、移動体通信等）<br>[行政向け]<br>行政向けの記録データ出力端子<br>通信速度1Mbps以上の一般に使用されるもの　（USB2.0等） | ・ICカードへの出力：<br>使用車両と使用開始・終了時刻とその時点の距離値（最大84件）<br>運転手活動データ（最大28日分）<br>業務開始終了の場所（最大42件）<br>等<br>・出力端子：<br>記録データの出力 | ・通信出力（USB、RS232C）：<br>記録データの出力 |

Table 2-2-2 Comparison of the standards for tachographs between Japan and foreign countries (2/2)

| | | 日本 | 欧州 | 中国 |
|---|---|---|---|---|
| 車載機要件（つづき） | 表示 | データ記録状態表示（LED等） | ディスプレイ表示<br>・現在の運転手活動<br>・警告（連続運転時）<br>・連続運転時間、休憩時間　等 | ディスプレイ表示<br>・時計、速度、または、運転手ID<br>・警告（連続運転、速度超過等）<br>・[操作時]<br>最近15分間の速度データ<br>最近2日間の連続運転データ等<br>故障表示（LED等） |
| | 印刷 | 規定なし | ・運転手、車両の情報<br>・運転手の活動データ<br>・運転時間、休憩時間、走行距離<br>・速度超過　等 | ・運転手情報、車両情報<br>・停車15分前からの速度データ<br>・連続運転情報 |
| 利用者ソフトウェア要件 | | データの保存：車両運行データおよび保存年月日、運転手名、運行記録計の識別ID　等<br>規定の行記録図表の表示、印刷 | 規定なし | 規定なし |
| 車載装置市販品の概観 | |  |  |  |
| 特徴 | | ・車載機の要件は他の2カ国に比べシンプルであり、記録項目は少なく、ディスプレイ、ICカードの要件はない。<br>・3カ国の内、唯一利用者ソフトについての規定がある。 | ・車載機の要件は他の2カ国に比べ細かく規定されている。<br>・ICカードは運転手情報のほか、運行データも保存され、路上取締り時にも使用される。 | ・欧州の基準を簡易したタイプであり、ICカードへの記録機能はない。<br>・3カ国の内、唯一衛星測位機能の規定がある。（2012年より） |

2) Technical characteristics, advantages and disadvantages, and cost of a smart tachograph

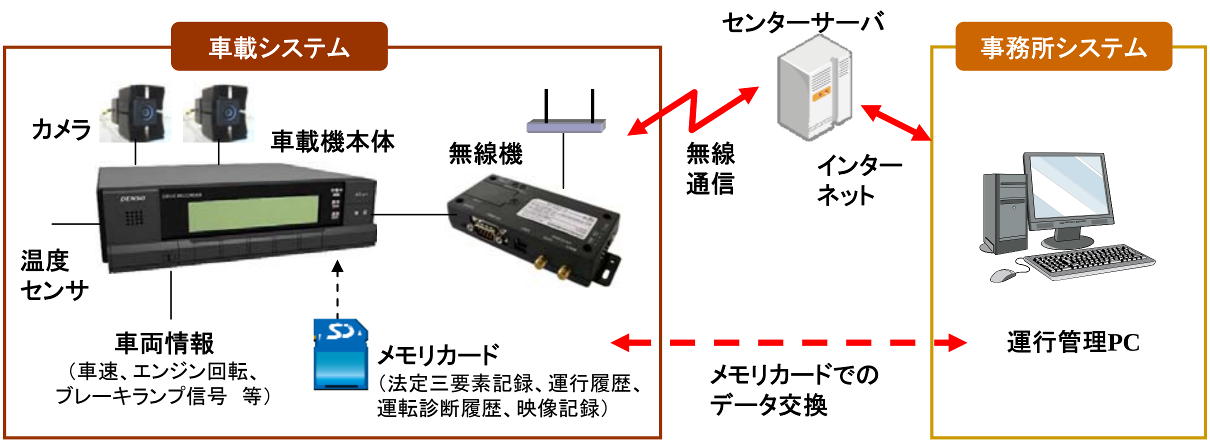
Shown below are the system configuration and characteristics of the smart tachograph[1] used in the pilot experiment in this study.

(i) System configuration

The system configuration is shown in Figure 2-2-3.

The system is configured with the in-vehicle and office systems, and the in-vehicle system is configured with the in-vehicle main unit, radio, cameras and memory card. The in-vehicle unit acquires the information on the vehicle, such as vehicle speed, engine rotation, and brake light signal, and cameras are installed for shooting the forward view and inside of the vehicle. The three statutory factors for a digital tachograph, namely the operation history, driving diagnostic history, and camera images, analyzed based on such sensing information are recorded in the memory card. The information in the memory card is analyzed by the fleet management PC in the office system and displayed on the screen for the manager. The information transmitted to the center server through wireless communication is provided to the manager on the web screen.

Figure 2-2-3 System configuration of the smart tachograph




(ii) Functions

Major functions are shown on Table 2-2-4. In addition to meeting the requirements for a digital tachograph, a smart tachograph has functions to meet various needs for operation efficiency, safety and fuel economy, and transportation quality improvement. It is particularly characterized in providing driving guidance and the outline is shown in the following paragraph (iii).

[1] In this FS, a Japanese standard digital tachograph to find the local requirements is called a smart tachograph.

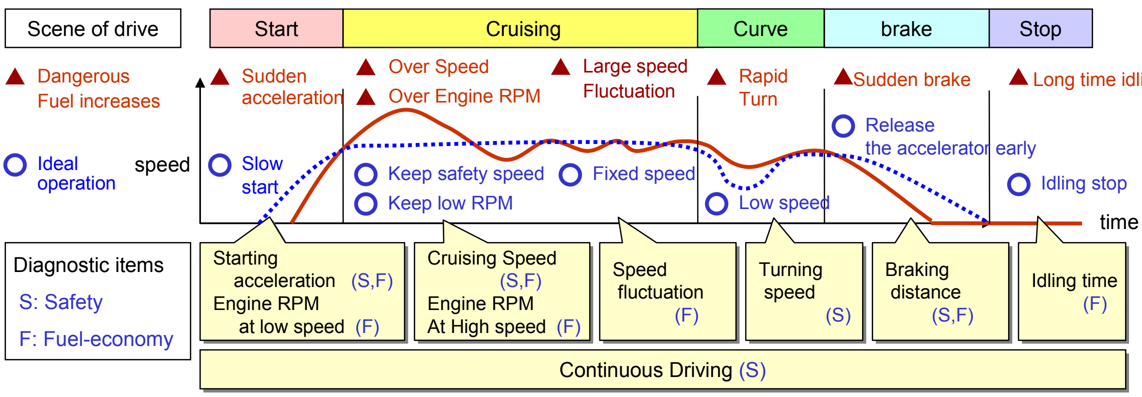
Table 2-2-4 List of smart tachograph functions

| Classification | Function | Details |
|---|---|---|
| Legal matter | Digital tachograph | Record and display three statutory factors. |
| Operation efficiency improvement | Displaying/printing the daily operation log | Output the operation result on the specified sheet through the analysis using the fleet management PC based on the position tracking record, speed record, and operation record (inputted using the operating switch). |
| | Displaying the driving history | Display the driving history of the vehicle for each driving. |
| | Position tracking | Display the vehicle position on a real-time basis through wireless communication. |
| | Vehicle operation monitoring | Provide the vehicle status and the crew operation condition through wireless communication.<br>Examples of status: Departure, return, loading, unloading, taking a break, etc. |
| | Message transmission | Transmit messages to the crew through wireless communication. (Display on the in-vehicle main unit) |
| Safety/fuel economy | Guidance on driving | Provide guidance in the vehicle in accordance with the safe and fuel-saving driving diagnosis results, and display the diagnosis results and their changes using the fleet management PC based on the results to provide guidance, evaluation rank, etc. |
| | Drive recorder | Detect a dangerous vehicle behavior, and record the images of the forward view and inside of the vehicle depending on the level of danger and replay the images using the PC. |
| | Emergency message | Detect a dangerous vehicle behavior and notify the manager depending on the level of danger. Also add the image at that time (when 3G communication is used). |
| Transportation quality | Temperature control inside the freezer | Detect and record the temperature inside the freezer and the door opening/closing information and display the temperature history on the fleet management PC. Notify the manager when the temperature is abnormal.<br>(Not used in the pilot experiment) |

(iii) Characteristics

A smart tachograph classifies driving scenes based on the change in speed and provides diagnosis based on the level of the safe and fuel-saving driving evaluation result for each driving scene. (See Figure 2-2-5.)

Figure 2-2-5 Characteristics of driving diagnosis




The figure shows types of driving scenes and evaluation items for each diving scene. In accordance with the results of this evaluation, guidance is provided using the display and audio of the in-vehicle unit. The details of this guidance are shown in Figure 2-2-6. The evaluation results are also recorded on the SD card and read by the fleet management PC to display driving guidance screen. (See Figure 2-2-7.)

On the driving guidance screen, the results for each evaluation item and the total score are displayed and comprehensive guidance is indicated. The image during dangerous driving can be also displayed together with the map where the dangerous driving occurred.

Figure 2-2-6 Characteristics of in-vehicle driving guidance

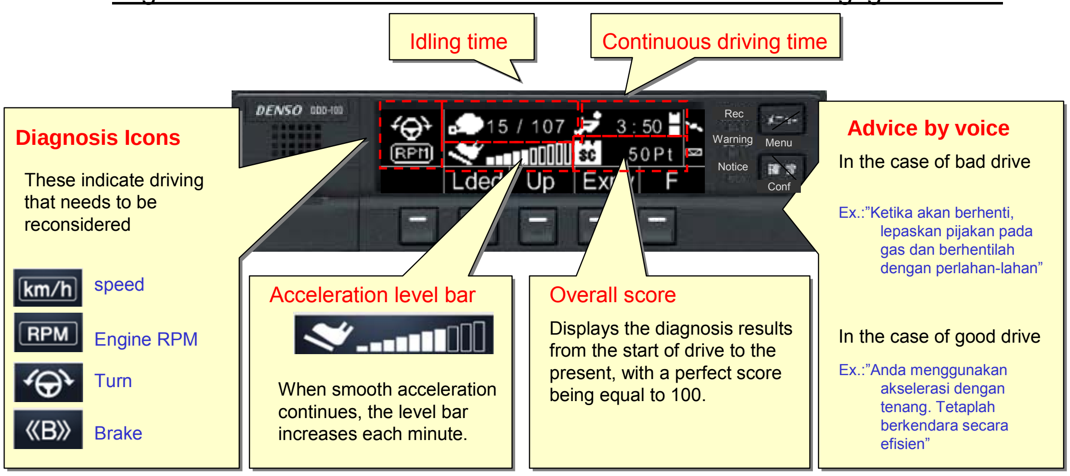




Figure 2-2-7 Driving

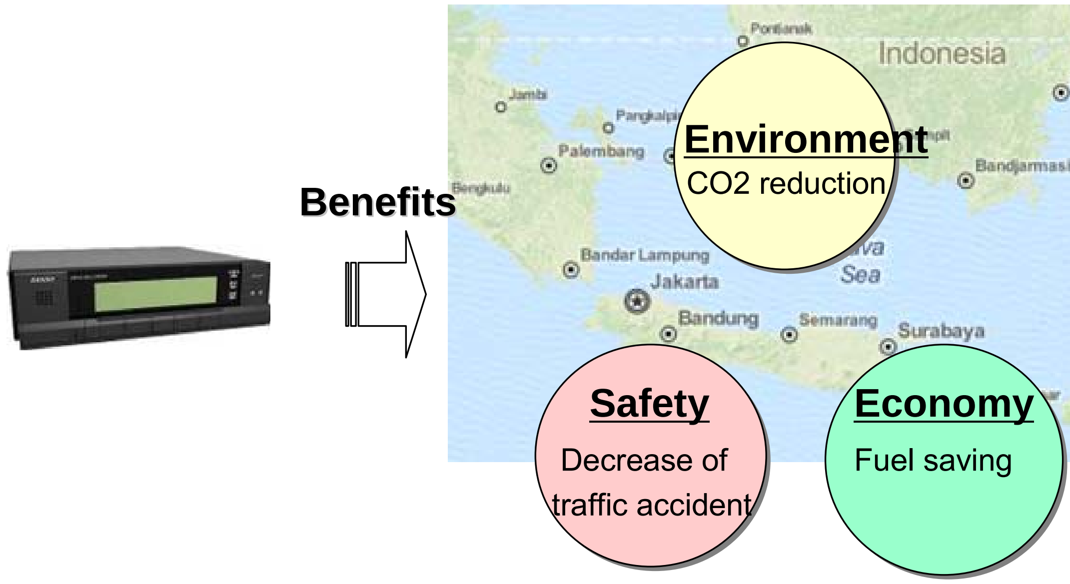
guidance screen in the office

## 3. Investigation method

### 3-1. Investigation tasks

Investigations and experiments will be conducted regarding the following matters: the issues of whether smart tachographs will be accepted by transportation entrepreneurs in Southeast Asia under such circumstances, and of whether smart tachographs are effective in safety and in fuel consumption saving; and the issue of how much CO2 reduction effect will be achieved.

Figure 3-1 Scheme regarding smart tachographs




### 3-2. Implementation setup

Investigations were carried out as follows in Indonesia and Thailand: Pilot experiments were conducted; furthermore, workshops for deepening industrial-government-academic research discussions were set up; cooperation was made with the Head Office of Denso Corporation (in Japan) and this corporation's local subsidiaries (Denso Indonesia and Denso Thailand).

| | Indonesia | Thailand |
|---|---|---|
| Implementation entity | Head Office of Denso Corporation, Denso Indonesia | Head Office of Denso Corporation, Denso Thailand |
| Pilot experiment participant | Blue Bird, DAMRI, HARIJAYA | V-SERVE, Padoongrich |
| Workshop participant | MOT (Land Transportation Bureau, Research & | MOT, NECTEC, IT Thailand, Chulalongkorn University, |

| | | |
|---|---|---|
| (Observer *) | Development Bureau), Bandung Institute of Technology, ITS Indonesia, DAMRI, HARIJAYA, ROSALIA INDAH (public bus corporation), JICA Indonesia*, Japanese Embassy* | V-SERVE, Padoongrich, BMTA (public bus corporation), Intercity Bus (public bus corporation), Japanese Embassy* |
| Investigation supporter (Outsourcee) | Pricewaterhousecoopers Sustainability PwC Indonesia | Pricewaterhousecoopers Sustainability PwC Thailand |

3-3. Description of investigations

The description of the main points of the investigation conducted, and the methods of investigations, are as follows:

- Investigation on receptivity of smart tachographs
- Pilot experiments involving trucks and buses
- Evaluation of effects in reducing fuel consumption and in decreasing CO2 emissions
- Workshop type discussions
- Study of MRV method and monitoring setup
- Study of large-scale deployment and commercialization

1) Investigation on receptivity of smart tachographs

Matters such as document investigation and hearings from local governments will be carried out, with the result that the current systems, policies, and needs that are addressed by the Indonesian government and the Thai government will be grasped

Furthermore, investigations based on interviews with physical distribution companies and bus companies will be conducted with the aim of grasping receptivity from the viewpoint on the part of smart tachograph users. Not only will the interest in, and the needs for, the introduction of tachographs and GPS systems be grasped, but also the following matters will be investigated and considered: realities of the use of smart tachographs and GPS systems in physical distribution companies, bus companies, etc. that have already introduced these devices; and room for a switch to the introduction of smart tachographs.

2) Workshop type discussions

The aim of workshops is to exchange opinions with as many stakeholders as possible and to grasp on-site realities.

In each of the relevant counties, a "Workshop" was organized in which inspection tours of pilot projects, studies of MRV methodologies, and studies of the feasibility of the introduction of our country's systems and technologies will be made by the conference method together with stakeholders of countries concerned, government agencies such as MOT, universities and research institutes that conduct researches on digital tachometers and related setups, automobile-related industrial organizations, entrepreneurs providing cooperation in pilot projects, and other related institutions and organizations.

| Indonesia | |
|---|---|
| First session November 2013 | First session November 2013 |
| Second session February 17, 2014 | Second session February 17, 2014 |
|  |  |

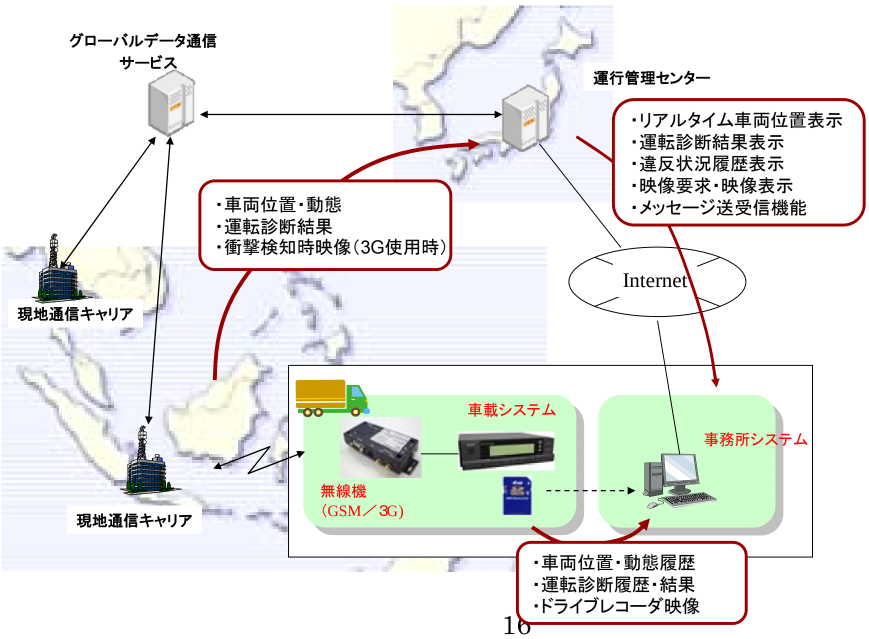
| Thailand | |
|---|---|
| First session<br>October 25, 2013 | First session<br>October 25, 2013 |
| Individual report form<br>Early in February 2014 | Individual report form<br>Early in February 2014 |
|  |  |

3-4. Description of pilot experiment

1) Structure of experiment system

An on-vehicle system was mounted on a vehicle of a user cooperating in the experiment. An office system was installed in the administration office of the user cooperating in the experiment. Furthermore, an operations management center was established in a data center in Japan. Information from the on-vehicle system will be transmitted to the operations management center. The transmitted data will be processed into web screens, and will be browsed on on-site PCs via the Internet.

Figure 3-3-1 Structure of Experiment system

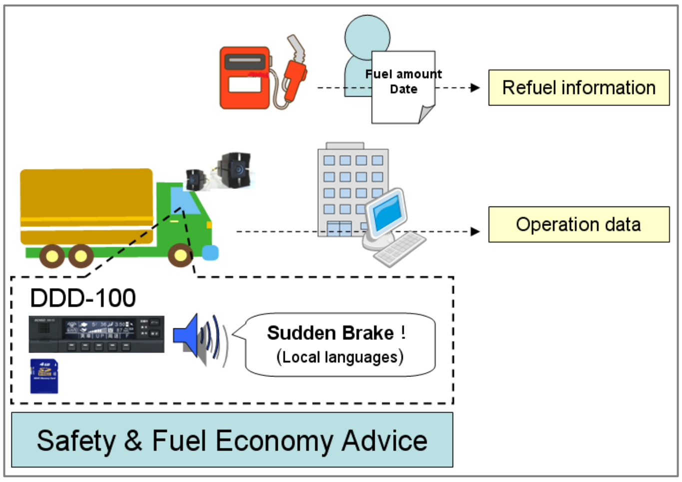


2) Description of experiment data

A tachograph will be installed in an experiment vehicle, and travel data will be obtained. In this respect, this system is not provided with a function to directly measure the amount of fuel supplied. Therefore, the driver will be asked to fill in fueling sheets, resulting in the acquisition of fueling information (Figure 3-3-2).

The travel data to be obtained are shown in Table 3-3-3-1. The fueling information is shown in Table 3-3-3-2.

Figure 3-3-2 Method of obtaining relevant data




As shown in item (iii), the safety and fuel consumption saving advice function in tachographs in Figure 3-3-1 is such that advice (voice warning and LED indication) on safety and fuel consumption, is given with regard to driver's driving operation, and the said operation is scored, with the result that improvement in driving is prompted.

This experiment system will be introduced into bus and truck entrepreneurs, during a period of 1.5 months after the start of an experiment, data will be collected without the advice function activated (the said period being hereinafter referred to as "Period without Advice"). During a period of 1.5 months thereafter, the advice function will be activated (the said period being hereinafter referred to as "Period with Advice"). Data during a Period without Advice will be compared with data during a Period with Advice.

Table 3-3-3-1 Travel data

| No. | Data name |
|---|---|
| 1 | Time |
| 2 | Position |
| 3 | Vehicle speed |
| 4 | Road grade |
| 5 | Longitudinal acceleration |
| 6 | Lateral acceleration |
| 7 | Engine speed |

Table 3-3-3-2 Fueling information

| No. | Data name |
|---|---|
| 1 | Date |
| 2 | Travel distance |
| 3 | Amount of fuel supplied |

3) Subjects of experiment, and period thereof

A total of 13 vehicles (13 drivers) belonging to a total of five bus/truck entrepreneurs in Indonesia and Thailand are the subjects of this experiment. The experiment period is about 3 months (Table 3-3-4-1). At the present point in time, the elapsed time is 0.5 month within a Period with Advice. Data recovered during the 0.5 month within a Period with Advice will be compared with data within a period without Advice.

Table 3-3-4-1 List of bus/truck entrepreneurs

| Country | Company | Type | Number of vehicles | Period without Advice | Period with Advice |
|---|---|---|---|---|---|
| Thailand | V-SERVE | Truck | 4 | 1.5 months | 1.5 months |
| Indonesia | HARIJAYA | Truck | 2 | 1.5 months | 1.5 months |
| Indonesia | BLUEBIRD | Bus | 2 | 1.5 months | 1.5 months |
| Indonesia | DAMRI(Jakarta) | Bus | 4 | 1.5 months | 1.5 months |
| Indonesia | ROSALIA Indah | Bus | 1 | 1.5 months | 1.5 months |

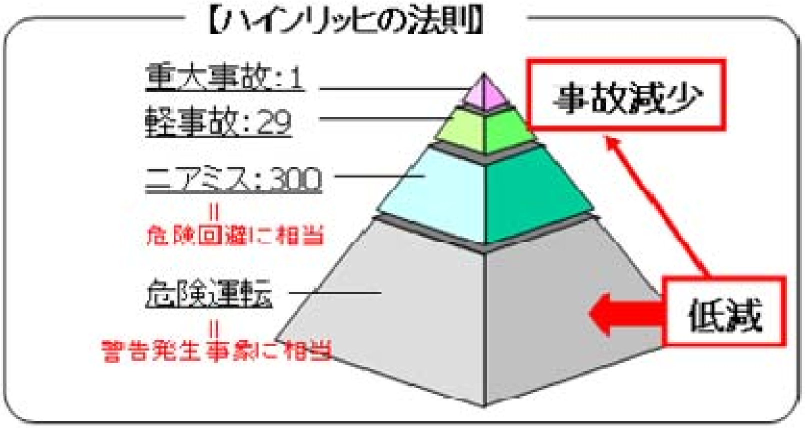
* Each vehicle is driven by a predetermined driver.

4) Method of verifying safety effects

It is difficult to confirm reductions in accidents by means of an experiment conducted for about three hours. Therefore, safety effects will be verified by comparing the number of times of instances of dangerous driving during a period without Advice with the number of times of instances of dangerous driving during a period with Advice, on the basis of Heinrich’s law (Figure 3-3-4-1).

Here, as for instances of dangerous driving, the numbers of times of occurrence of rapid deceleration will be counted. Furthermore, images recorded on that occasion will be used to analyze individual causal factors, resulting in the verification of the effectiveness of advice in smart tachographs.

Figure 3-3-4-1 Heinrich's law




5) Method of verifying safety effects

In order to accurately grasp the amount of fuel consumed, it is necessary that a device for measuring the amount of fuel consumed be installed in each vehicle. This time, however, for reasons of the experiment system, the amount of fuel consumed will be grasped by using fueling information generated in such a way that drivers enter data obtained by the full tank method. The fuel consumption saving effects will be verified by comparing fuel consumption in a Period without Advice with fuel consumption in a Period with Advice.

Here, there is a possibility that human errors (in writing or fueling work) will occur in fueling information based on the full tank method. Therefore, fuel consumption (in km/L) was calculated from fueling information. In the case of an amount that deviated by a value not less than a threshold value, confirmation was made with the pertinent driver, and the said amount was corrected or eliminated.

Furthermore, it is necessary that travel roads (with grades, and in urban areas or suburban areas) and travel conditions (including vehicle speed and engine speed) in travel data be the same as far as possible. Therefore, routes and data distributions were confirmed from travel data, and those that greatly differed, were eliminated (Figure 3-3-5-1) (Figure 3-3-5-2).

Figure 3-3-5-1　Confirmation of travel routes

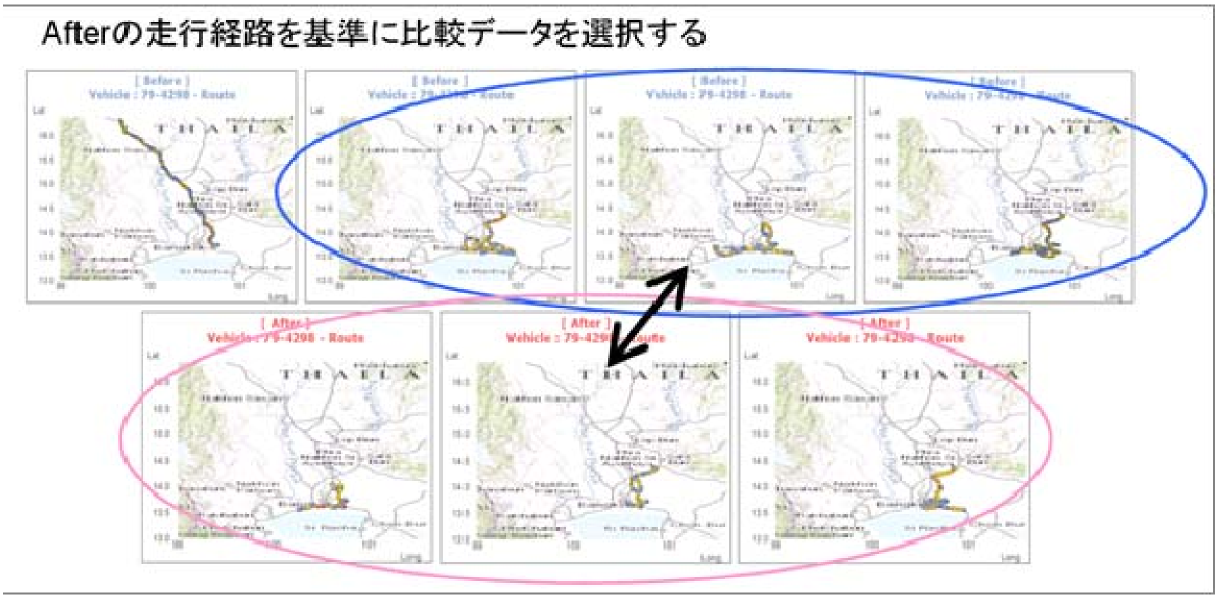
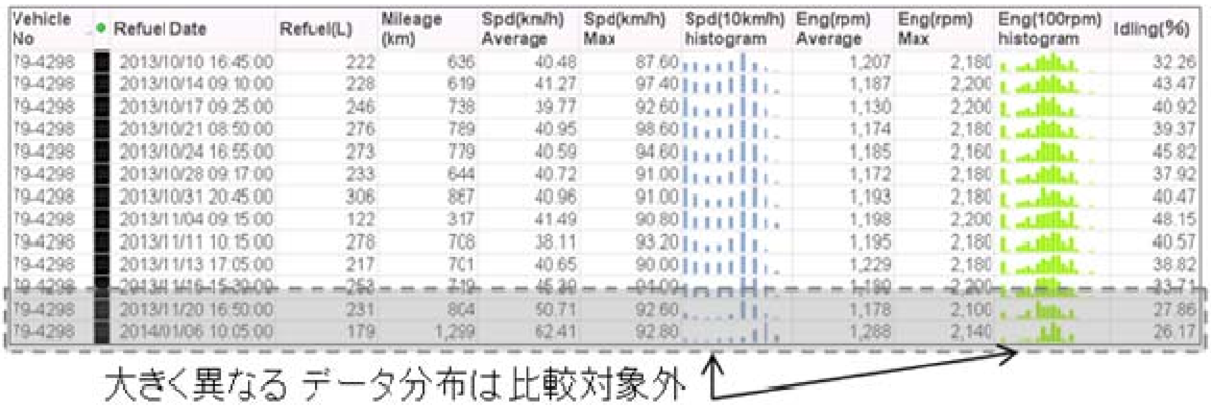



Figure 3-3-5-2　Confirmation of travel conditions




| Vehicle No | Refuel Date | Refuel(L) | Mileage (km) | Spd(km/h) Average | Spd(km/h) Max | Spd(10km/h) histogram | Eng(rpm) Average | Eng(rpm) Max | Eng(100rpm) histogram | Idling(%) |
|---|---|---|---|---|---|---|---|---|---|---|
| 79-4298 | 2013/10/10 16:45:00 | 222 | 636 | 40.48 | 87.60 | | 1,207 | 2,180 | | 32.26 |
| 79-4298 | 2013/10/14 09:10:00 | 228 | 619 | 41.27 | 97.40 | | 1,187 | 2,200 | | 43.47 |
| 79-4298 | 2013/10/17 09:25:00 | 246 | 738 | 39.77 | 92.60 | | 1,130 | 2,200 | | 40.92 |
| 79-4298 | 2013/10/21 08:50:00 | 276 | 789 | 40.95 | 98.60 | | 1,174 | 2,180 | | 39.37 |
| 79-4298 | 2013/10/24 16:55:00 | 273 | 779 | 40.59 | 94.60 | | 1,185 | 2,160 | | 45.82 |
| 79-4298 | 2013/10/28 09:17:00 | 233 | 644 | 40.72 | 91.00 | | 1,172 | 2,180 | | 37.92 |
| 79-4298 | 2013/10/31 20:45:00 | 306 | 867 | 40.96 | 91.00 | | 1,193 | 2,180 | | 40.47 |
| 79-4298 | 2013/11/04 09:15:00 | 122 | 317 | 41.49 | 90.80 | | 1,198 | 2,200 | | 48.15 |
| 79-4298 | 2013/11/11 10:15:00 | 278 | 708 | 38.11 | 93.20 | | 1,195 | 2,180 | | 40.57 |
| 79-4298 | 2013/11/13 17:05:00 | 217 | 701 | 40.65 | 90.00 | | 1,229 | 2,180 | | 38.82 |
| 79-4298 | 2013/11/16 15:30:00 | 253 | 719 | 45.30 | 91.00 | | 1,180 | 2,200 | | 33.71 |
| 79-4298 | 2013/11/20 16:50:00 | 231 | 804 | 50.71 | 92.60 | | 1,178 | 2,100 | | 27.86 |
| 79-4298 | 2014/01/06 10:05:00 | 179 | 1,299 | 62.41 | 92.80 | | 1,288 | 2,140 | | 26.17 |

# 4. Investigation results

## 4-1. Investigation on receptivity to smart tachographs, and investigation results

### 1) Investigation of realities of traffic safety policy regarding trucks and buses, and needs for tachographs

The current systems, policies, and needs that are addressed by the pertinent governments were grasped, and confirmations were made as to whether the relevant countries are receptive of the technology and effects, which smart tachographs have, regarding operations management (pertaining to time, distance, and speed), safe driving, and eco-friendly driving.

| | Indonesia | Thailand |
|---|---|---|
| Traffic safety policy | ● Regulations regarding driving time and break time (2009)<br>● Approval of installation of digital tachometers and GPS (2012) | ● Start of obligation to equip dangerous goods transportation vehicles with GPS tracking systems (2013) |
| Policy needs | ● By utilizing the results of this investigation, the government is verifying the effects in reducing accidents and in decreasing CO2. | ● Strong interest in the comparison of effectiveness between GPS tracking systems and smart tachographs |

① Indonesia

After National Road Safety Week was held a total of four times from 2007 to 2010, the “DECADE OF ACTION for ROAD Safety 2011” and the “National Plan” were announced by the Vice President in 2011. The national plan consists of the following five pillars:

① Safe Management
② Safer Road
③ Safer Vehicle
④ Safer Road Users
⑤ Post Crash Response

In this plan, where data in 2010 are taken as baselines, the targets are such that the death index, which is proportional to the number of automobiles as of 2010, is to be reduced from 3.93 to 0.79, and that the number of traffic accident deaths is to be decreased from 31,234 to 6,247. Traffic safety policy items which belong to the five-pillar plan and are related to this project are the rules regarding driving time and break time in Article 22 of the Road Traffic Law in 2009 and the installation of digital tachographs and GPS equipment as specified by Government Ordinance No. 55 in 2012.

Article 90 of the Road Traffic Law in 2009 specifies that the driving time per day of a truck or bus driver shall be eight hours at the most, or 10 hours at the most up to twice per week, or 12 hours at the most under specific conditions, provided that one hour out of the said 12 hours shall be break time. Furthermore, it is specified that a 30-minute break shall be taken per each four-hour continuous driving.

In Article 92, which pertains to automobiles, of PP (PERATURAN PEMERINTAH) No. 55 in 2012 specifies that trucks shall be capable of being equipped with vehicle management equipment for grasping positions and movements during vehicle travel, such as tachographs or GPSs,

Meanwhile, as for CO2 reduction, President Yudhoyono gave speeches at the G20 Summit in September 2009 and at COP 15 in 2009 to the effect that by 2020, CO2 would be reduced to 26% compared to 2005, in which no measures were taken to decrease CO2, and that it would be possible to increase the extent of reduction to 41%, resulting in further reduction of CO2, provided that intentional support would be obtained. The first above-mentioned percentage constitutes the CO2 reduction target of the Indonesian government. The breakdowns of 26% are decided by individual sectors.

● Needs for smart tachographs in Indonesia

In the Worldwide Meeting of ITS held in October 2013, the Director General of the Resource and Development Agency of the MOT, who doubles as the Director General in Charge of Environmental Affairs, said, "I would like to make a study of regulations for making it obligatory to equip official vehicles with smart tachographs. Effectiveness verification is being performed utilizing FSs which pertain to this project and in which digital tachographs based on Japanese standards are used. Such being the case, it can be said that there are sufficient needs for smart tachographs.

② Thailand

In Thailand, since January 2013, it has been made obligatory, by the Land Transportation Act B. E. 2522, to equip dangerous goods transportation trucks and trailers with GPS tracking systems. According to Article 10 of the Land Transportation Act B. E. 2555, this obligation will be enforced in stages, depending on license acquisition timings, over a period of two years ranging from January 2013 to January 2015. The Land Transport Bureau of the Thai Ministry of Transport explains that the installation of GPS tracking systems is made obligatory for the purpose of taking traffic safety measures in land transportation. Furthermore, any transportation entrepreneur who, after the obligation periods in Articles 71 and 148 of the Land Transportation Act B. E. 2552, uses a vehicle which is not yet equipped with a GPS tracking system, will be punished with a fine of 50,000 baht or less.

The installation obligation starts in January 2013. In 2014 and onwards, the range of subjects of application of the obligation will be extended. In a hearing conducted from a major GPS tracking system provider in Thailand in December 2013, a comment was obtained that GPS tracking systems were already introduced into about 50% of the vehicles that are subjects of application of the obligation, on the condition that this statement is based on the limited information that the said provider has.

| Obligation start time | Subject of application |
|---|---|
| January 2013 | Vehicle with a newly obtained license |
| January 2014 | Vehicle with a license obtained in or before January 2013 |
| January 2015 | Vehicle that has a license obtained in or before January 2013, and that is equipped with a GPS tracking system, which does not yet comply with the conditions in the promulgated act. |

As for technical requirements for GPS tracking systems, the following five points are specified in Article 4 of the Land Transportation Act B. E. 2555:

1. Speed shall be recorded at intervals of one minute.
2. Recorded speed shall be transmitted to the network at least once every five minutes.
3. The record shall be stored by the GPS tracking system provider for six months
4. Warnings (transmission of alarms) shall be issued for operations with the GPS tracking system not in operation.

5 Warnings (transmission of alarms) shall be issued for unconfirmed operations and for operations in which licenses are used in error.

Certification is performed by the automotive technology sector in the Land Transport Bureau. About 25 models have been certified. Certified models are disclosed on the website of the Land Transport Bureau (http://apps.dlt.go.th/esb/approve.html ). If certification is once received, it is not necessary to renew it.

Figure: Certified equipment

● Needs for smart tachographs in Thailand

In Thailand, introduction of GPS systems into dangerous goods transportation vehicles has just started. Also, a project is underway in which GPS systems are introduced into the buses of Transport Corporation. The Administrative Vice Deputy Minister of Transport shows a high interest in the effects to be caused by the introduction of smart tachographs. Stabilization of the political situation in Thailand is waited for. The experiment results are intended to be reported directly to the said vice deputy minister after the said political situation stabilizes.

2) Interview type investigation of realities of operations management, and needs for smart tachographs

Interview investigations were conducted at Japanese and local physical distortion companies and GPS system companies in Jakarta and Bangkok.

| | Indonesia | Thailand |
|---|---|---|
| Operations management setup* | ● Operations managers have already been stationed. | ● Operations managers have already been stationed. |
| Realities of operations management work | ● Daily driving guidance is provided in such a way as to fumble for an appropriate way. An effective method is being | ● Daily driving guidance is provided in such a way as to fumble for an appropriate way. An effective method is being |

| | | |
|---|---|---|
| | groped for. | groped for.<br>● Advanced enterprises recognize the importance of guidance, |
| Needs | ● Specific tactics for having drivers perform safe driving are desired to be known. | ● Japanese good practice for improving driving safety and road manners is desired to be learned. |

*: In Japan, there are legal obligations to station operations managers. However, in the above-mentioned two countries, there is neither such legal obligation nor relevant administrative guidance.

In Indonesia and Thailand, an operations manager who performs operations management work or part of this work was stationed in any of the companies where interviews were conducted. Preparation of driving duty allocation tables, which is one of the main work items of operations management (preparation of driving duty allocation tables, implementation of face-to-face roll-calling, provision of guidance), was carried out in any of the enterprises. However, as for the management of working hours and driving hours pertaining to driving duty allocation tables and work duty plans, the following was the case with some of the enterprises where GPS tracking systems have already been introduced: Although records based on GPS were used, the greater part was managed on the basis of hours-declaring daily reports. As regards roll-calling, in some enterprises, it was observed that before drivers got on duty, operations managers made physical checks and alcohol checks, and made judgments on the feasibility or infeasibility of operations. However, in greater part of the enterprises, operations managers (or persons equivalent to them) and drivers briefly confirmed the contents of work for the pertinent day, with greetings exchanged as an additional purpose. As for guidance, most of the enterprises periodically conducted training for employees, thereby calling attention to safe driving. As regards the contents of training, the following instances were mentioned, among others: Safe driving programs are independently prepared based on the contents of daily driving instruction; or training by outside organizations are received; and opportunities for sharing information among drivers are provided.

The following opinions were offered by Indonesian and Thai companies where interviews were conducted. “We would like to correctly grasp the realities of drivers’ driving, thereby having them perform safe driving. We would like to know specific means of achieving that.” “We have the recognition that daily instruction on a daily basis is important in order to have safe driving performed.” “Having safe driving performed on a thoroughgoing basis is line with the vision of our company. We would like to learn the best practice in Japan." Furthermore, remarks were uttered to the effect that improvement in drivers' manners is required in terms of sales activities. Such remarks were made particularly by persons centering on cargo owners of local major enterprises and global enterprises.

● Needs for smart tachographs in both countries

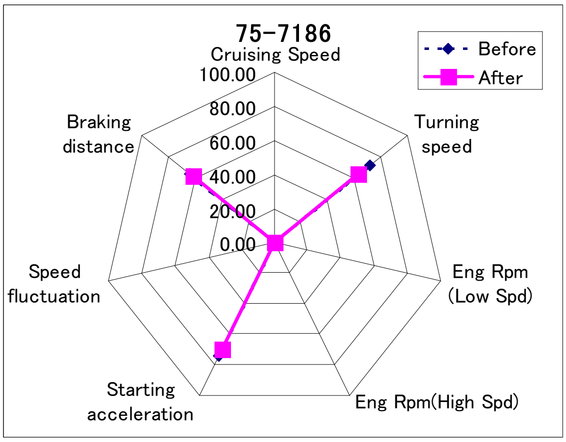
From the results of interviews, it was possible to understand the following: The fact that roll-calling and instruction that are included in operations management work in Japan is important for safe driving, is comprehended; interviewed entities are interested in specific measures. Under the present circumstances, roll-calling and instruction are performed in such a way to grope for appropriate practice. Therefore, it is considered that there are needs for a method in which systematic work for achieving effects is understood, introduced, and continuously carried out, and for a method whereby motivations for safe driving and echo-friendly driving are provided to both drivers and operations managers, and are maintained. Meanwhile, in actually introducing smart tachographs, voices were raised to the effect that there are concerns about the bearing of costs of introducing equipment.

4-2. Pilot experiment for trucks/buses and research results

1) Verification results of safety/fuel efficiency by using smart tachograph

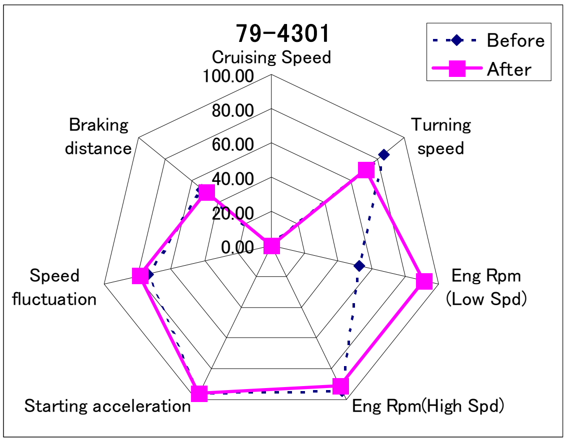
Regarding the scores of the respective experiments as described before in 3-4, results of 13 vehicles in a period without advice (advice function is not activated) and in a period with advice (advice function is activated) are provided below. From the figure below, improvement of respective drivers' mind on safe/fuel saving drive can be recognized.

## Thai V-SERVE　4 Vehicles (TRUCK)



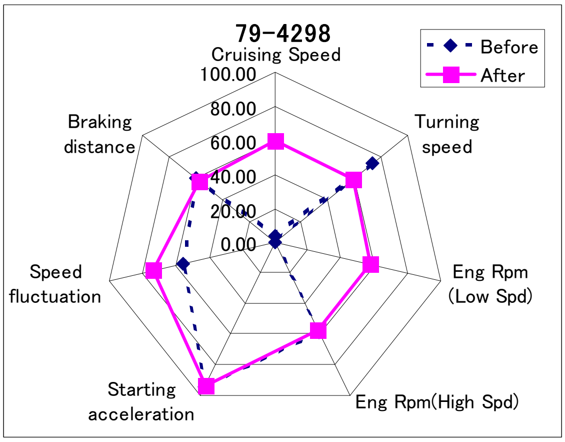

Dangerous drive (Count):0.39 → 0.28

Fuel economy (km/L) : 4.9 → 4.8



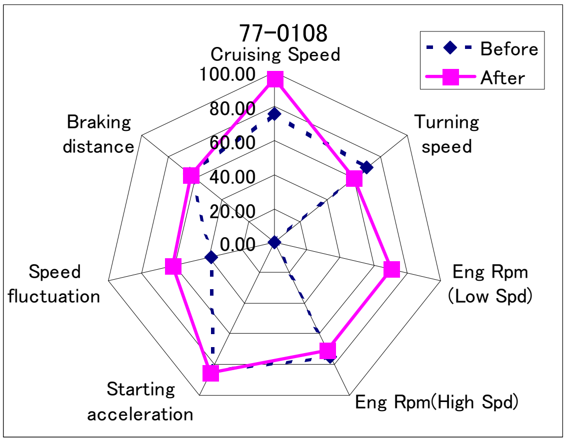

Dangerous drive (Count):1.18 → 0.99

Fuel economy (km/L) : 2.9 → 3.0




Dangerous drive (Count):0.49 → 0.36

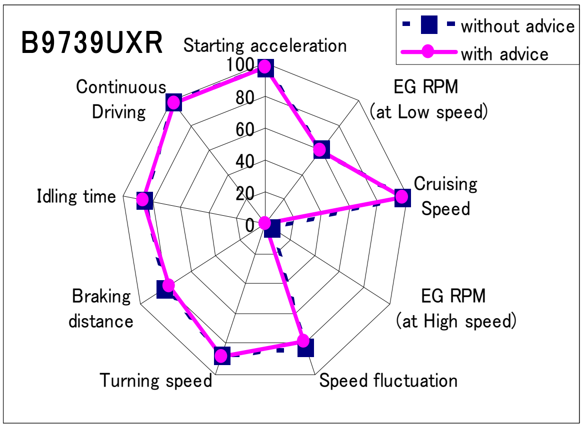
Fuel economy (km/L) : 2.8 → 3.0




Dangerous drive (Count):0.24 → 0.29

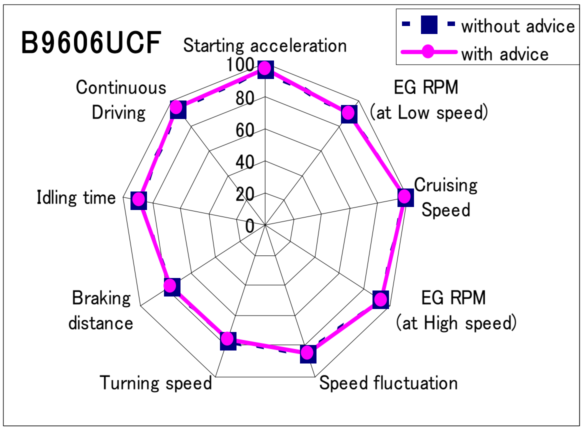
Fuel economy (km/L) : 6.0 → 6.4

## Indonesia HARIJAYA　2 Vehicles (TRUCK)




Dangerous drive (Count):0.33 → 0.34

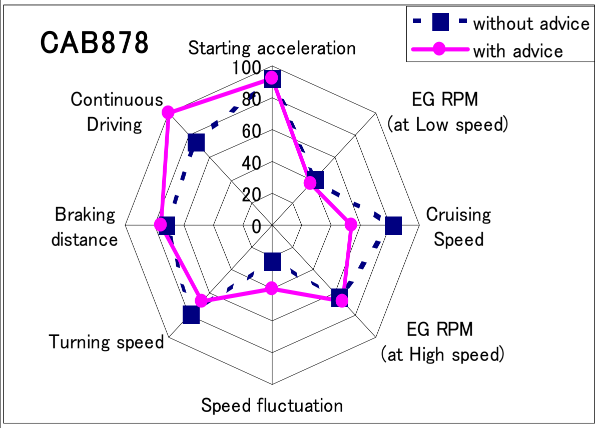
Fuel economy (km/L) : 3.9 → 4.0




Dangerous drive (Count):0.16 → 0.11

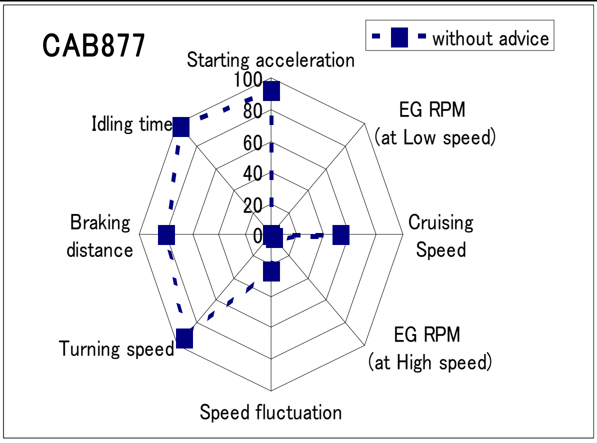
Fuel economy(km/L) : 4.6 → 4.9

## Indonesia BLUEBIRD　2 Vehicles(BUS)




Dangerous drive (Count):0.29 → 0.15

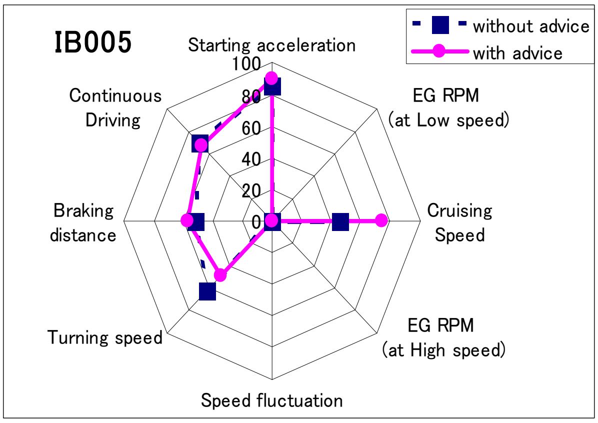
Fuel economy(km/L) : 5.3 → 5.7




Dangerous drive (Count):0.04 → 0.00

Fuel economy(km/L) : 5.4 → 5.7

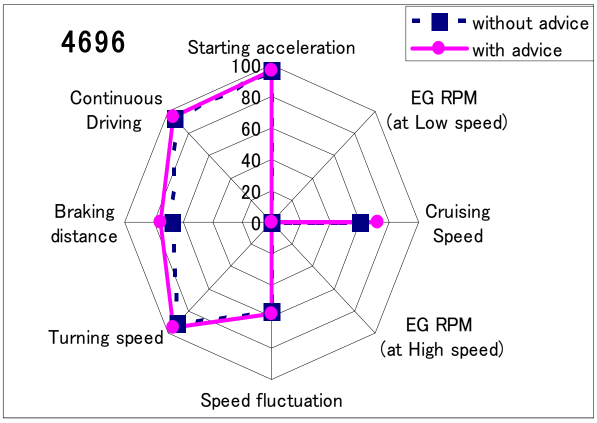
## Indonesia ROSALIA Indah (BUS)




Dangerous drive (Count):0.18 → 0.23

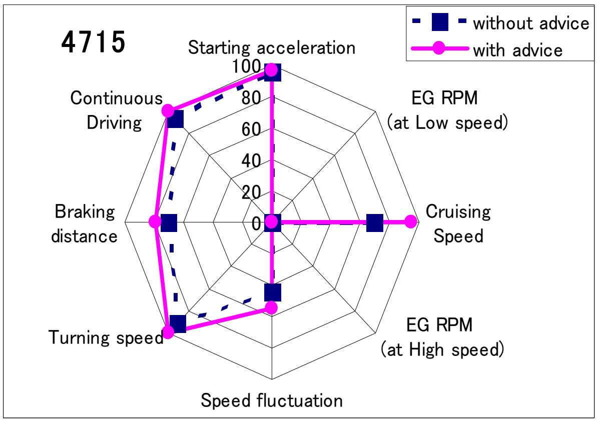
Fuel economy(km/L) : 2.4 → 2.6

Indonesia DAMRI(Jakarta)　4 Vehicles(BUS)



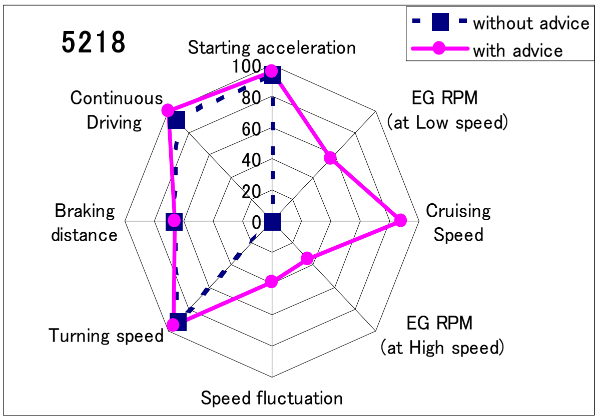

Dangerous drive (Count):0.14 → 0.10

Fuel economy(km/L) : 2.9 → 3.2



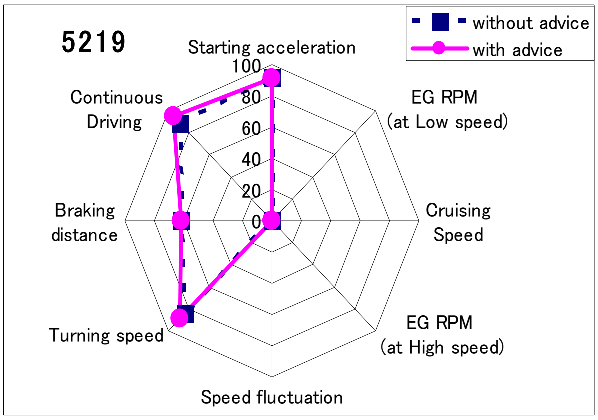

Dangerous deive (Count):0.09→ 0.03

Fuel economy(km/L) : 2.6 → 2.7




Dangerous drive (Count):0.16 → 0.10

Fuel economy(km/L) : 2.9 → 2.9




Dangerous drive (Count):0.10 → 0.06

Fuel economy(km/L) : 2.7 → 2.7

2) Detailed research on safety effects

(1) Count of dangerous drive

As a result of research on dangerous drive, we found about 20% reduction of the count of dangerous drive (per 100 km drive), of overall average of 13 vehicles, in a period with advice as compared to a period without advice. (Fig. 4-2-1-1-1) Data for respective counts of all the vehicles (per 100 km drive) are shown in Fig.4-2-1-1-2 and Table 4-2-1-1).

Fig. 4-2-1-1-1 Count of Dangerous Drive (per 100 km), Overall Average of All Vehicles

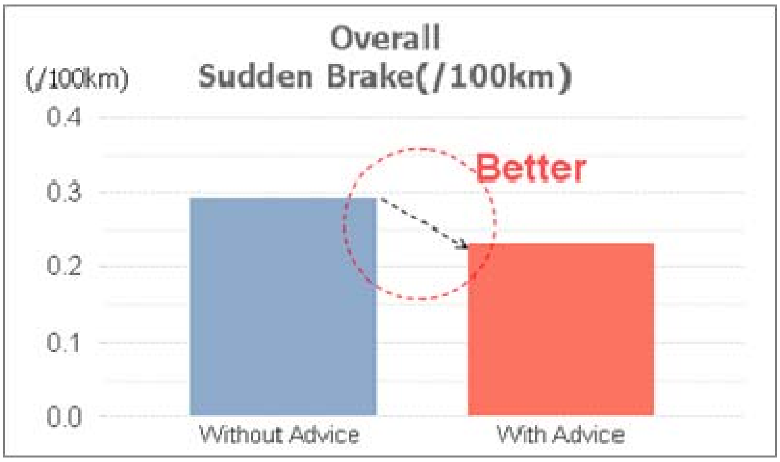



Fig. 4-2-1-1-2 Count of Dangerous Drive (per 100 km), of Each Vehicle

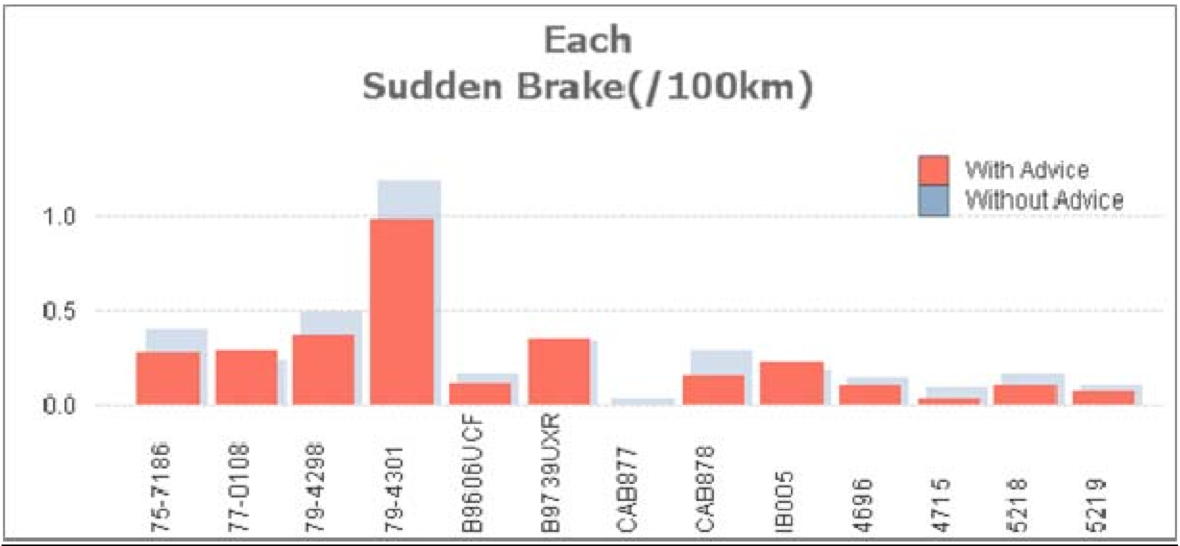


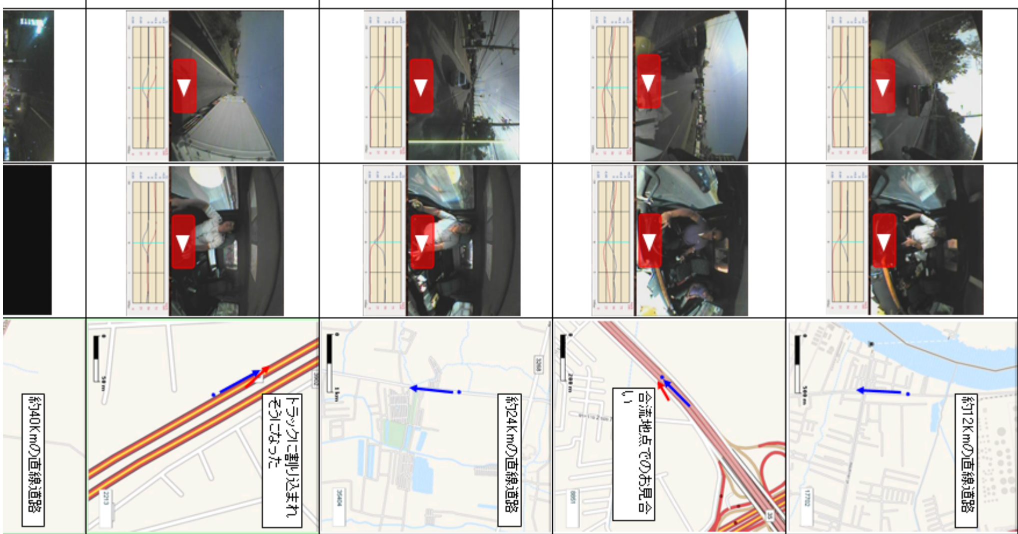

Table 4-2-1-1 List of Dangerous Drive Data

| Vehicle No | Without Advice (/100km) | With Advice (/100km) | Diff |
|---|---|---|---|
| 75-7186 | 0.390 | 0.280 | -0.110 |
| 77-0108 | 0.239 | 0.287 | 0.048 |
| 79-4298 | 0.491 | 0.358 | -0.133 |
| 79-4301 | 1.183 | 0.987 | -0.196 |
| B9606UCF | 0.161 | 0.108 | -0.054 |
| B9739UXR | 0.334 | 0.336 | 0.002 |
| CAB877 | 0.036 | 0.000 | -0.036 |
| CAB878 | 0.292 | 0.148 | -0.144 |
| IB005 | 0.181 | 0.226 | 0.045 |
| 4696 | 0.141 | 0.097 | -0.043 |
| 4715 | 0.088 | 0.032 | -0.056 |
| 5218 | 0.156 | 0.101 | -0.055 |
| 5219 | 0.099 | 0.063 | -0.036 |

(2) Near-miss scenes

Selected from various images taken at dangerous drive scenes, we analyzed in details some images which actually led to a near-miss (Fig. 4-2-1-2).

As a result of the analysis, we found out many of them were caused due to an insufficient distance to the front car on a straight road, and that more than a half of the near-misses (17 out of 32 cases) could have been prevented by following a sudden brake warning advice while driving.



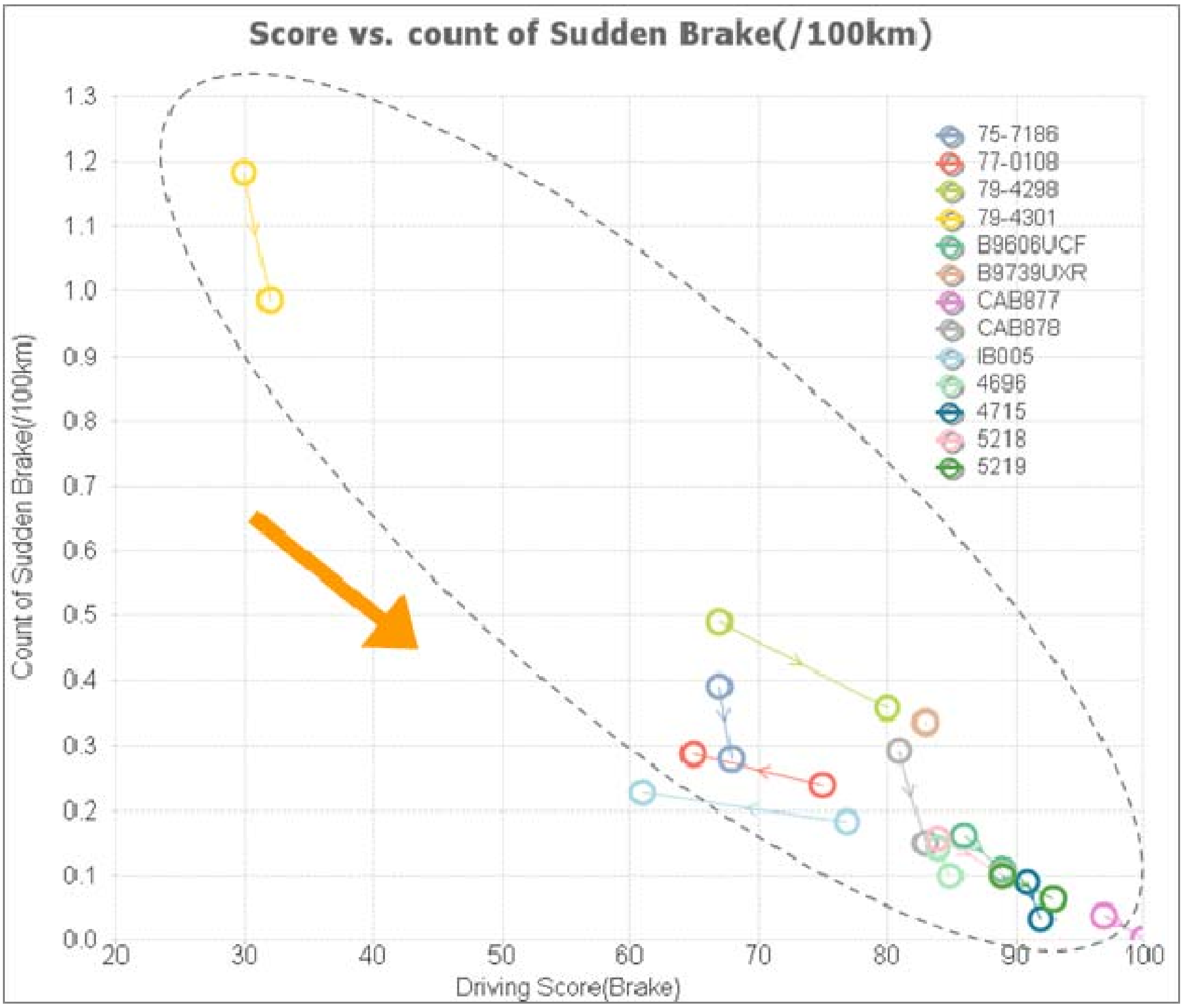
| No | Scene | Cus. | No. | Date Time | Type | Road | Point | Action | 原因 | 自責／他責／両者 | 原因詳細 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 約12Kmの直線道路 | V-SERVE | 75-7186 | 2013/10/15 15:22:00 | Truck/Bus | Low | T-Junction | 直進中 | 前方不注意 | 自責 | 車間距離不足 |
| 2 | 合流地点でのお見合い | V-SERVE | | 2013/12/21 11:58 | Truck/Bus | Low | Junction | 直進中 | その他 | 両者 | 合流地点でのお見合い |
| 3 | 約24Kmの直線道路 | V-SERVE | 79-4301 | 2013/11/9 15:03 | car | Low | T-Junction | 直進中 | 前方不注意 | 自責 | 車間距離不足 |
| 4 | トラックに割り込まれそうになった | V-SERVE | | 2013/12/4 12:01 | Truck/Bus | Low | Other | 直進中 | その他 | 他責 | トラックに割り込まれそうになった |
| | 約40Kmの直線道路 | | | | | | | | | | |

図 4-2-1-2 ニアミス詳細分析

(3) Relationships between safety score and the count of dangerous drive on smart tachograph

Graph of safety score and the count of dangerous drive, a function of smart tachograph, is shown in Fig. 4-2-1-3 below. From the figure, we can see the count of dangerous drive reduced as the score improved, and that dangerous drive can be reduced by driving in a way to increase the smart tachograph score.

Table 4-2-1-3 Safety Score vs. Count of Dangerous Drive




※The arrows at each plot indicates the details in a period with advice

3) Detailed research of fuel saving effect

(1) Fuel economy (km/L)

As a result of investigation on fuel saving drive data, we found out the average fuel economy (km/L) of the 13 vehicles in a period with advice (advice function is activated) improved 4.4% from a period without advice (advice function is not activated) (Fig. 4-2-2-1-1). Fuel economy for respective vehicles are shown in Fig. 4-2-2-1-2 and Table 4-2-2-1.

Fig. 4-2-2-1-1 Fuel Economy (km/L), Average

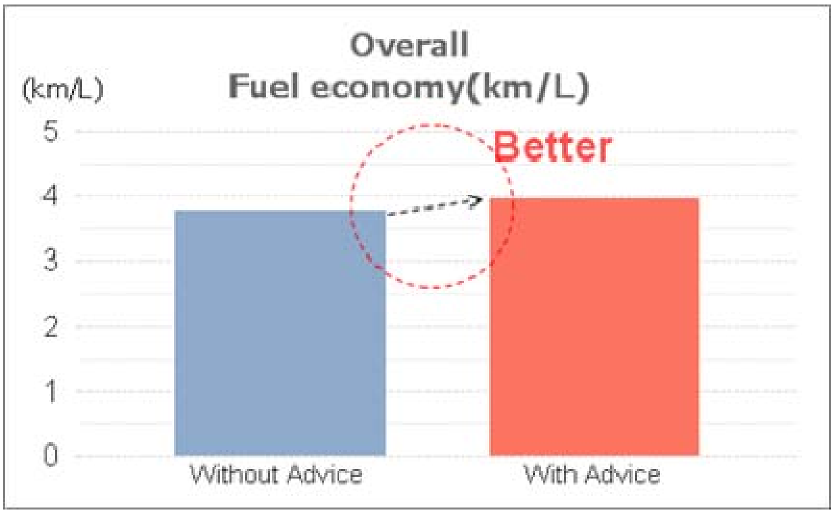
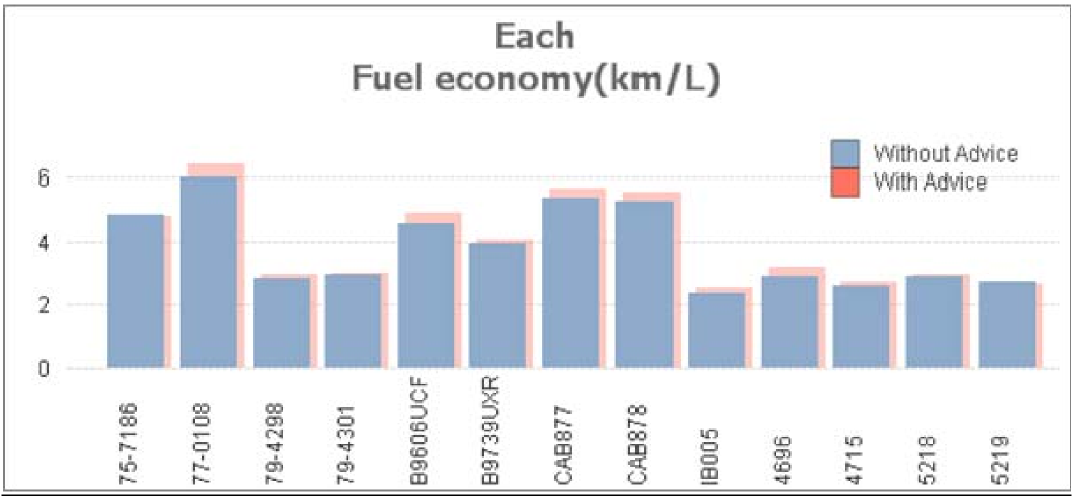



Fig. 4-2-2-1-2 Fuel Economy of Each Vehicle (km/L)




| Vehicle No | Without Advice (km/L) | With Advice (km/L) | Diff(%) |
|---|---|---|---|
| 75-7186 | 4.883 | 4.794 | -1.81 |
| 77-0108 | 6.030 | 6.416 | 6.40 |
| 79-4298 | 2.840 | 2.977 | 4.81 |
| 79-4301 | 2.932 | 3.014 | 2.80 |
| B9606UCF | 4.595 | 4.925 | 7.17 |
| B9739UXR | 3.946 | 4.048 | 2.57 |
| CAB877 | 5.364 | 5.685 | 5.99 |
| CAB878 | 5.258 | 5.554 | 5.63 |
| IB005 | 2.379 | 2.572 | 8.14 |
| 4696 | 2.895 | 3.197 | 10.45 |
| 4715 | 2.584 | 2.709 | 4.85 |
| 5218 | 2.870 | 2.947 | 2.69 |
| 5219 | 2.741 | 2.676 | -2.38 |

(2) Relationships between fuel saving score vs. fuel economy (km/L) on smart tachograph

Graph of fuel saving score and fuel economy (km/L), a function of smart tachograph, is shown in Fig. 4-2-2-2. Fuel saving speed data and fuel saving engine rotation data, which especially influence fuel economy, are used here. From the figure, we can see that fuel economy improved when the respective scores increased, and found out that fuel economy can be improved by driving in a way to increase fuel saving score on the smart tachograph.

Fig. 4-2-2-2 1　Fuel Saving Score (Cruising Speed) vs. Fuel Economy (km/L)

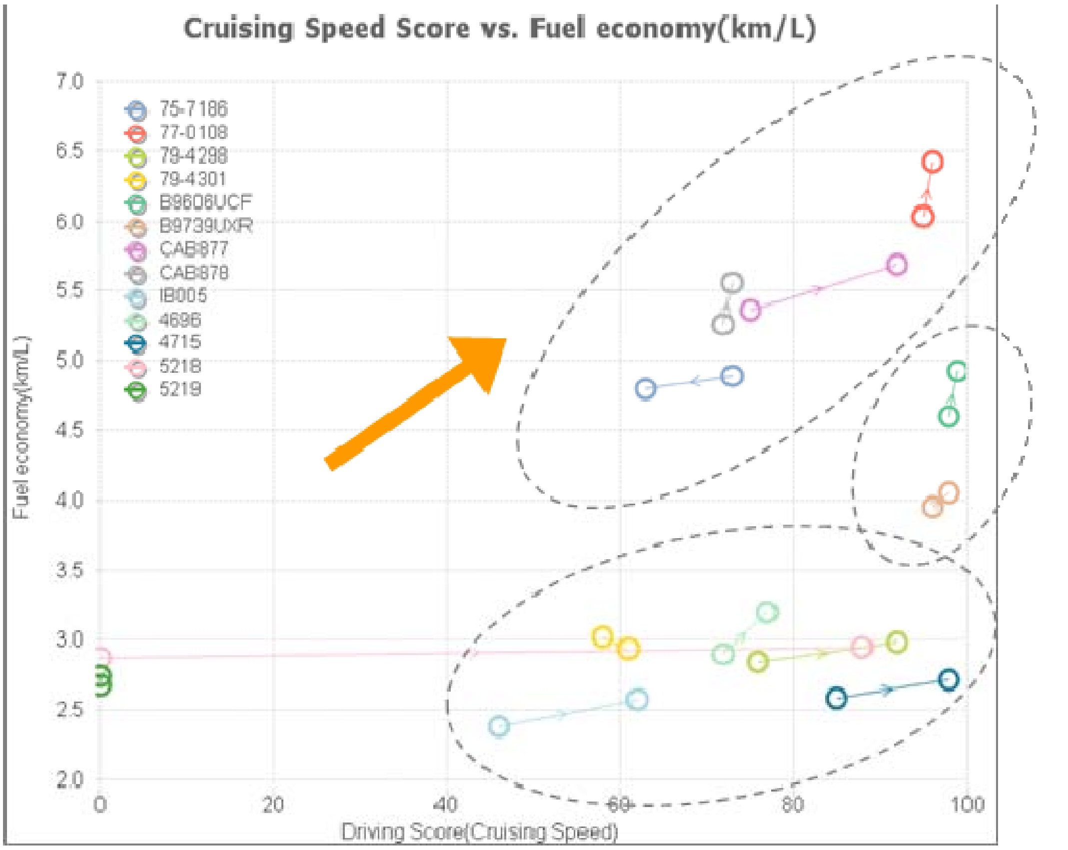
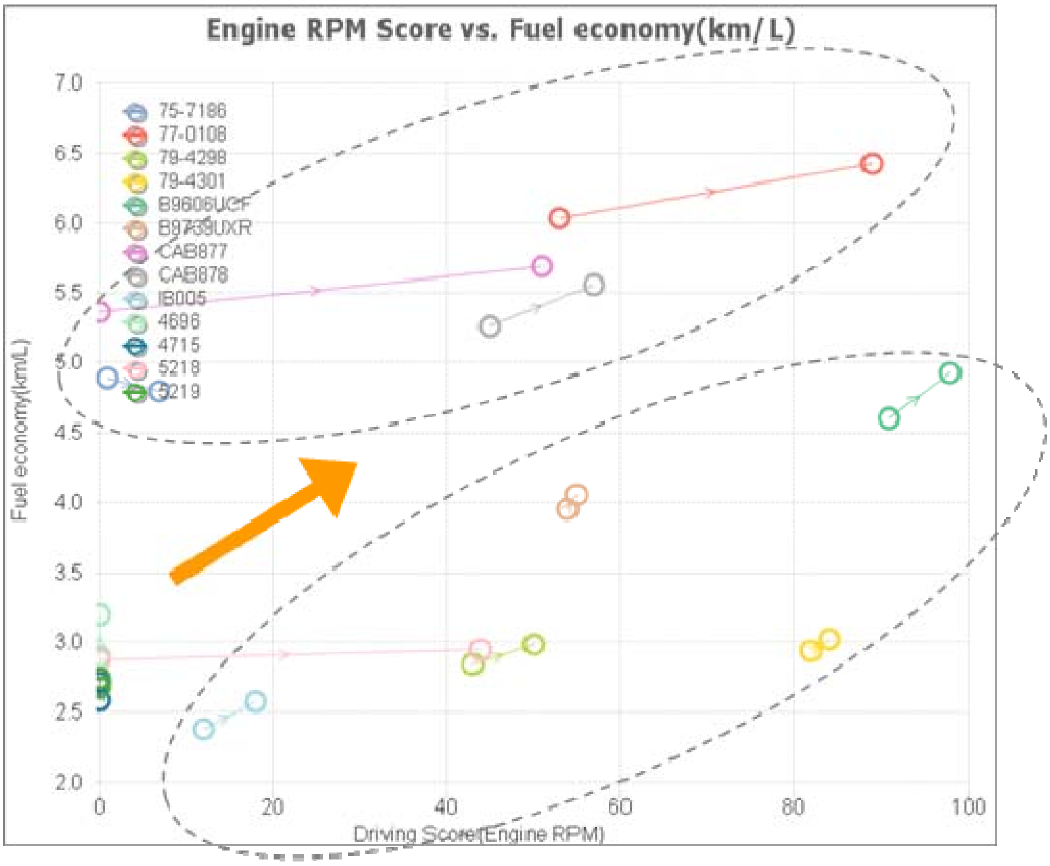


Fig. 4-2-2-2 2 Fuel Saving Score (Engine Rotation) vs. Fuel Economy (km/L)




4) Summary of improvement results

This analysis was based on the data obtained in the first two months of the total three months experiment period (refer to the aforementioned 3.3), and indicates the improvement effect of a 0.5 months period with advice. From the analyses as aforementioned in the previous sections, it was indicated that dangerous drive as well as fuel economy can be both improved by following the advices/scores of the smart tachograph.

From the figures, we can see that safety as well as fuel saving were both improved in most of the vehicles, but that no improvement effects were also seen in some of the vehicles. For the vehicles which were not improved, improvement will be expected by teaching drives in consideration of the advice of smart tachograph. For the vehicles which were improved, further improvement will be expected by teaching improvement points in consideration of the advice and the scores of the smart tachograph.

4-3. GHG（CO2 generated from energy）emission reduction effect (Upon feasibility study/large scale campaign)

1) CO2 emission reduction effect upon feasibility study (pilot experiment)

To verify the fuel saving effect as explained in the previous 4-2-2), the fuel consumption reduction of the vehicles in the pilot experiment is shown below, with data by the country.

| | Indonesia | Thailand |
|---|---|---|
| No. of experiment vehicles | 9 vehicles | 4 vehicles |
| Fuel economy before experiment（km/L） | 2.38～5.36 | 2.84～6.03 |
| Fuel economy after experiment (km/L) | 2.57～5.69 | 2.98～6.42 |
| Average fuel saving rate (%) | 5.01 | 3.05 |
| Days of experiment | 20～81 | 77～90 |

Because it took time to adjust with experiment participating companies and to prepare for the pilot experiment, we estimate annual fuel saving effect and CO2 reduction by using the data of about two months out of the total three month experiment period.

In the research of this time, although the fuel saving rate was only less than 10% because the experiment period was short, we can expect fuel saving effect can be increased by continuously teaching and providing advices on safe and fuel saving drive (eco-drive).

Annual driving distance, annual fuel consumption and annual CO2 emission, where annual number of working days is 200, are calculated as follows.

Annual driving distance (km/year) = ((driving distance of the experiment period (km))/((experiment days (days)) x 200 (annual working days))
Annual fuel consumption (L/year) = ((annual driving distance (km)) / ((fuel economy(L))
Annual CO2 emission (t/year) = ((annual fuel consumption (L/year)) x ((CO2 emission factor (kg/L)) / 1000 (kg)

$F_{BL}$(L/year): Fuel consumption before smart tachograph is introduced (annual basis)
$F_{PJ}$(L/year): Fuel consumption after smart tachograph is introduced (annual

basis)
$F_{PJ/D}$(L/year): Fuel consumption after smart tachograph is introduced using fuel economy rate α(annual basis)
$E_{BL}$(tCO2/year): CO2 emission before smart tachograph is introduced
$E_{PJ}$(tCO2/year): CO2 emission after smart tachograph is introduced

Calculation of fuel consumption
$F_{BL}$ =((driving distance of experiment period before introduction (km)) / ((experiment period (days)) x 200 days (annual working days) / (fuel economy (km/L))
$F_{PJ}$ =((driving distance of experiment period after introduction (km)) / ((experiment period (days)) x 200 days (annual working days) / (fuel economy (km/L))
$F_{PJ/D}$ $= F_{BL} \times (1 - \alpha / 100)$

Calculation of CO2 emission
$E_{BL}$ = CO2 emission before introduction = $F_{BL}$×CO2 emission factor (kg/L) / 1000kg
$E_{PJ}$ = CO2 consumption after introduction =$F_{PJ}$×CO2 emission factor (kg/L) / 1000kg
$= F_{BL} \times (1 - \alpha / 100) \times$ CO2 emission factor (kg/L) / 1000kg

Calculation of CO2 emission reduction

ER $= E_{BL} - E_{PJ}$

In the feasibility study, CO2 emission reduction in the pilot experiment and its annualized reduction (estimate) are as follows.

| | Indonesia | Thailand |
|---|---|---|
| No. of Experimented vehicles | 9 | 4 |
| Total annual CO2 reduction (t/year, CO2) | 21.4 | 3.0 |

*Excluding abnormal values where fuel consumption increased.

2) CO2 reduction effect in a large scale campaign

CO2 reduction effect is estimated for a case as assumed below where a large scale three year campaign is introduced respectively in Indonesia and Thailand. Estimate is based on the fuel reduction rate of minimum 5% and maximum 15%.

| | Vehicles introduced (No. of vehicles) | | | | $CO_2$ reduction over 3 years (1000t) |
|---|---|---|---|---|---|
| | 1st year | 2nd year | 3rd year | Total of 3 years | |
| Indonesia | 10,000 | 20,000 | 30,000 | 60,000 | 161.3 to 483.8 |
| Thailand | 5,000 | 10,000 | 30,000 | 45,000 | 209.6 to 628.9 |

4-4. Co-benefit effect other than GHG

Owing to the result of the pilot experiment (feasibility study), the improvement of safe drive and safety mind of drivers , and the improvement of working environment for drivers provided by truck/bus companies were realized as a co-benefit effect other than a GHG reduction effect (Refer to 4-2).

Furthermore, once a large scale campaign is introduced, we can expect operation control systems will be widely constructed, and that systems to improve safe driving, safety mind of drivers and management of working environment will be widely accepted and established among the entire industry. Also we can expect that once safe/eco-driving is enforced for a large scale of a tens of thousands of vehicles, social/economic benefits such as mitigation of the present serious traffic congestion, reduction of traffic accidents, economic losses due to traffic congestions, etc. will be will be attained.

<table>
<tr><th colspan="2"></th><th>Indonesia</th><th>Thailand</th></tr>
<tr><td rowspan="2">Co-benefit effect</td><td>Upon feasibility study (this time)</td><td>● Safe driving and improvement of safety mind of drivers<br>● Improvement of working environment</td><td>● Safe driving and safety mind of drivers<br>● Improvement of working environment<br>● Construction of operation control system (1 company)</td></tr>
<tr><td>Upon a large scale campaign</td><td colspan="2">● Same as above<br>● Construction of operation control system<br>● Reduction of economic losses due to traffic congestion<br>● Reduction of traffic accidents caused by commercial vehicles</td></tr>
</table>

4-5. Total project cost and cost benefit

In this research, our technical staff, using the equipment of the existing system center in Japan, visited the subject countries, installed, provided advices/instructions for the introduction/operation, and conducted data collection/analysis, etc. When the project is expanded to a large scale, we can expect cost can be reduced by using the system equipment and specialist technical staffs available locally..

## 5. Study for commercialization

As a result of business feasibility study, we would like to start a large scale commercialization in the respective countries one after another from the next fiscal year on. The following are the future business images to promote and establish our smart tachograph system, on-board equipment technology and our know-how of software support we have built up in Japan and tasks to be carried out.

### 5-1. ercialization/JCM scenario

1) Image of commercialization in Indonesia (goal)

Smart tachograph operation control system in accordance with the Japanese standard is legislated and mandatory, and the digital tachograph is widely used as JCM credit equipment. Its use is expanding in a favorable environment for introduction aided by schemes such as leasing under government subsidies

2) Image of commercialization in Thailand (goal)

Safe driving mode, CO2 reduction function and operation control system of smart tachograph are added to the present GPS legislation standard, and schemes such as leasing including government subsidy which enable easy introduction are established, and promotion progresses.

3) Commercialization scenario using JCM in Indonesia[2]

Government of Japan and government of Indonesia agreed in 2013 to implement and promote JCM, and Ministry of the Environment of Japan and Ministry of Economy, Trade and Industry of Japan are accelerating the start of the JCM project.

We consider that utilizing JCM equipment aid program is useful to encourage local pioneer companies and public buses to introduce as soon as possible and as many equipment as possible, to accomplish a concrete effect as flag ship companies, and also useful to enhance the support of MOT and recognition by logistic/transportation companies in that country.

### 5-2. MRV methodology, monitoring method

In consideration of future use of JCM equipment aid program, we studied and prepared MRV methodology, and the framework and concept of monitoring

[2] JCM (Joint Crediting Mechanism) is a program where Japanese technology for global warming mitigation measures is exported and transferred to emerging/developing countries so that they can conduct their project to introduce equipment/machines and to reduce GHG (greenhouse gas),CO2, etc. in their countries.

system.

1) Outline of MRV methodology

- Smart tachograph is installed on large commercial vehicles (trucks/buses), and assisted with the safety/eco-drive advice functions of the on-board device and eco-drive guidance and advices from operation control managers, drivers can conduct drive improvement activities, and thereby fuel economy of vehicles can be improved.
- Calculate and evaluate the reduction effect of CO2 generated from vehicle fuel, attained by fuel saving of vehicles.

For other CO2 reduction methods, there are 1) fuel conversion method (bio fuel, natural gas, electricity, etc.) and 2) transport efficiency improvement method (operation control of vehicles, control of loading weight, control of driving route, etc.), but we do not take such optional methods into our study. We simply limit to the evaluation of effects by the introduction of smart tachograph for the methodoloty.

2) Eligibility criteria for MRV methodology (draft)

Improvement of fuel economy can be attained by the support of on-board smart tachograph (hardware function) for drive improvement activities as well as by the concrete guidance/advice for safe/eco-driving by the operation control managers (software function). It is especially important to emphasize the superiority of Japanese technology/service so that the system shall be securely introduced. The following are the eligibility criteria (draft).

- Introduce smart tachograph for large commercial vehicles (trucks/buses)
- Drivers practice driving improvement activities in accordance with the information provided by the safe/eco-drive advice function of the on-board tachograph.
- Companies engaged in the project (truck/buss companies) appoint operation control managers and implement periodic driving improvement activities by drivers who are supported by the guidance/advice for eco-drive from the operation control manager.
- After the smart tachograph is introduced, do not change vehicles, engines, fuels, operation of vehicles, etc. In case of changing vehicles/engines or fuels, or conducting transport efficiency measures, separate medhodology will be provided.

3) Calculation method of $CO_2$ emission reduction

In the aforementioned section 4-3, calculation scenario 1 is provided to calculate $CO_2$ emission reduction.

(i) Calculation scenario 1: Method to take the actual measurement of experiment vehicles

Take the measurement of reference fuel and driving distance before starting the project (before the introduction), and take the measurement of the project fuel and the driving distance after the project (after the introduction). In this scenario, it is assumed that the fuel economy rate is fixed before the project start and that its reduction varies as the fuel saving activity progresses after the project start.

(ii) Calculation scenario 2: Improvement rate method (using default values)

In one year after the project is started, set the fuel economy improvement rate as the default value, and fix it until the end of the project period.

4) Monitoring system

For the information/data needed for monitoring and the monitoring frequency, the following procedures (draft) are considered.

| Information/data | Method | Frequency |
|---|---|---|
| Driving distance (km) | Driving record calculated from the monthly operation report and the log data of the meter provided by operation control managers or drivers. | Every month |
| Fuel consumption before project start (L) | Fuel purchase slip (fuel receipt) provided by operation control managers or drivers. | Preferably for six month or one year before the introduction of fuel saving measures, every month |
| Fuel consumption after project start (L) | | Every month |
| Fuel economy rate before project start (km/L) | To be calculated from the above | Preferably for six month or one year before the introduction of fuel saving measures, every |

| | | |
|---|---|---|
| | | month |
| Fuel economy rate after project start (km/L) | | Every month |

5-3. Financial plan

The Government of Japan once promoted digital tachograph by providing subsidies. Neither Indonesia nor Thailand has a subsidy system for the introduction of on-board equipment for transport safety or operation control, and therefore, we cannot presently expect subsidies to be provided by such countries. On this present basis, financial plan is studied as follows.

1) Using JCM equipment subsidy program (Indonesia)

Although the local companies and public buses in Indonesia are interested in introducing a smart tachograph, the equipment must be imported from Japan and system design cost is also needed, making the initial investment cost high. Therefore, we can expect that incentives for the users (local introducing companies) can be enhanced by using JCM subsidy program (50% assistance).

In order to apply for the JCM equipment subsidy program, it must be verified in the operation test of fiscal year 2014 for JCM, and prepare MRV methodology and PDD (project design document), etc. in advance, and we can expect to use the JCM equipment subsidy scheme in the fiscal year 2015 at the fastest.

2) Using eco-finance provided jointly by international financial institution/Japanese leasing companies (Indonesia/Thailand)

IFC (International Finance Corporation, a subsidiary of World Bank) and Japanese leasing company (‘Mitsubishi UFJ Lease and Finance Company Limited) set up eco-finance programs for the introduction of machines/equipment which contribute to energy efficiency and recyclable energy in Thailand and started to provide to local companies. According to the hearing of the Japanese leasing company, they commented that although smart tachograph may also be eligible for the program, some means should be devised by the financial scheme side regarding the asset management of the on-board equipment combined with the vehicle and the procedure for the collection of fund.

Fund of JCM equipment subsidy program is limited, so we consider that project support such as financial scheme like leasing should be necessary for a large scale campaign.

We consider it important for Ministry of the Environment and manufacturers of on-board equipment to jointly work together on international financial institutions such as JBIC (Japan Bank for International Cooperation), ADB (Asian Development Bank) and the above mentioned IFC (International Finance Corporation), etc. and Japanese leasing companies to establish eco-finance program and allow us of its use, for the promotion of smart tachograph to be used for fuel efficiency/safe drive.

5-4. Idea to promote the introduction of Japanese technology

1) To insert into the legislations/regulations in Indonesia/Thailand

For systematic implementation of smart tachograph now under way all over the world

As a way to approach Ministry of Trade (of Indonesia), we consider it effective to follow the legislation by Ministry of Land, Infrastructure, Transport and Tourism of Japan to proceed system design.

Concretely speaking, an idea of the following action plan is considered.

- Explain the results and the measures of digital tachograph promotion in Japan for better understanding.
- Lobby lo local industries to proceed system design in Indonesia (Cooperate with local industries such as associations of trucks, buses, etc.)
- Propose a legislation of on-board standard (function suitable for Indonesian needs) and regulations
- Support program and economic support scheme for the promotion (subsidy, low-interest loan, lease, etc.)
- Training of drivers, and establishment of after-networking systems such as manpower and organization for installation/maintenance of on-board equipment, as a social infrastructure.

2) Support of software to help operation control managers/drivers for the promotion of safe driving (co-benefit) and promotion method of the set

We consider it effective to use co-benefits other than GHG(CO2) reduction, such as helping operation control managers and supporting safe driving, as benefits when commercializing.

Concretely speaking, by installing on-board equipment/system, advice is given to drivers to enable fuel saving drive and safe drive, and the operation control managers can train drivers based on the driving report to attain further effects of improvement. For this purpose, systems to support the operation control managers must be needed, and a program such as safe drive education, etc. must be planned, provided and systemized for and at a driving school or a seminar.

Daily driving report to describe driver's driving details is an important item for operation control system. Presently, however, the system is used mainly to advice drivers, but is not used and understood for practicing PDCA cycle. (This was clarified in the pilot experiment and hearing of this research.) The report form of Japanese version used in this research is used by experienced drivers of many years and prepared to describe in details and of the levels for them, and the report format of Japanese version seems complicated and difficult for use in Indonesia and Thailand, where know-how and customs to understand operation control system and data are not established yet. We, therefore, are studying a way to simplify to a format and a level understandable by local users and a way to educate and train by point system and by setting a pass/fail line for operation.

5-5. Tasks/requests for commercialization

Task 1: It is needed in Indonesia to establish standard for on-board smart tachograph, standard for operation control, and further, legislation including mandatory regulation.

Task 2: Mandatory installation of GPS was already legislated for a certain model of vehicles in Thailand, and it is necessary to work to have smart tachograph approved additionally as an on-board equipment in the present system and to systemize the mandatory (or recommendation) operation control system.

Task 3: If the initial investment is too large for the local companies in the two subject countries, it will be a barrier for the introduction and promotion. Financial schemes (such as leasing method) which enable local companies to introduce more easily will be needed.

Finishing the feasibility study of this project, we consider that we would like to work more concretely on upstream approaches of government to government to further proceed and realize. Concretely speaking, cooperation and sharing information with Ministry of the Environment, who promotes JCM and a large scale commercialization, Ministry of Land, Infrastructure, Transport and Tourism, who conducts transport policy of Japan and promotes export of technology infrastructure and technology transfer, and relevant ministries and agencies, will become much more important. Japanese government offices and companies prepare data/documents very carefully for sharing information, but sometimes, too much, and we would need to avoid sparing much time and energy which should be utilized for effective activities. The market of smart tachograph is exposed to fierce competitions with US, Europe, Russia and China, and it is extremely important that we should endeavor to discuss, negotiate and realize results more speedily in order to promote pan-Asian local model and technology transfer under such global level competitions.