

Isuzu launched its new ELF in December 2006, followed by the launch of the new FORWARD in May 2007. We will report on the enthusiasm of the people who were directly involved with this development, called the "700 Project" (700P) internally.

Development of light-duty and medium-duty trucks as a group

Yamamoto: Isuzu's base concept for development is See Technology. See is the acronym for Safety (S), Economy (E) and Environment (E), each of which is the target of our technological sophistication. "700P" is a project for developing globally-popular trucks based on the global deployment of See Technology, which we call SEE GLOBAL.

The most characteristic point of 700P is the development of light-duty and medium-duty trucks as a group. Our light-duty truck, the ELF has been marketed in over 100 countries around the world and the infrastructure of its overseas production has been established at a certain level. Furthermore, our medium-duty truck the FORWARD has the potential that can compete with international forerunners in this market. With improved price competitiveness, this model could drastically increase its market share in overseas markets. This is why the FORWARD is significantly benefited by parts-sharing with the infrastructure established for the ELF.

700P is one of the biggest projects in our corporate history, where drastic modifications have been made to cabs, engines and chassis with a focus, not only on the domestic market, but also on the world market from the early stages of development, by considering the ELF and FORWARD as a set.

Hirao: A noticeable characteristic of the new ELF is the introduction of a 1,770 mm wide high-cab, reflecting a regulatory change in drivers' licenses¹ and an engine downsizing. While the standard displacement of a light-duty truck is 4.5-5 liters, we employed a 3-liter model for the new specifications, from environmental and economical standpoints. We were concerned about the power at first. But, after all, we could develop an engine equivalent to those

in the 4.5-5 liter class. As a result, conformance to the new long-term emissions regulations, certification for low-emission heavy-duty vehicles and the 2015 fuel efficiency standard could be achieved, ahead of our competitors.

In the framework of the new drivers' license, vehicle weight had to be reduced by approximately 250 kg versus conventional models in order to ensure a total load capacity of 2 tons, within the gross vehicle weight category of less than 5 tons. A reduction in chassis weight was an important factor in achieving the total vehicle weight.

Challenging the limits in weight reduction with step-by-step efforts

Fujii: While the development of the FORWARD had been conducted by the group that was involved in the development of our GIGA heavy-duty truck, the FORWARD was "married" to the ELF in 700P. The cab was listed as one of the main development points. The unique point of the ELF is the extremely frequent vehicle entry and exit by the driver because of its targeted urban application. Meanwhile, the FORWARD will more often be used for medium-or long-distance driving. It was extremely difficult for us to develop the cabs of each of these models based on an identical base. However, we successfully addressed this challenge, which is one of most significant



Vehicle Planning and Engineering (Chief Engineer):
Etsuo Yamamoto



New FORWARD



Vehicle Planning and Engineering (FORWARD Team):
Mikiya Fujii

Creation of a comfortable truck

Hirao: One of the sales points of the new ELF is its extreme quietness. We have received many encouraging evaluations from our customers, who mention tranquility as their initial impression. Some say that they feel as if they are driving a passenger car. Such a positive evaluation honored us because noise reduction was one of our special emphases during development.

Fujii: The same evaluation is applicable to the FORWARD. We are proud that we could create a truck that is quieter than those of our competitors. Another positive reaction from customers was the fuel efficiency and environmental performance. Certification for low-emission heavy-duty vehicles and the achievement of the 2015 fuel efficiency standard for heavy-duty vehicles as well as a 2% reduction in vehicle acquisition tax (valid until March 31, 2008) had the most significant influence on this project. While we faced many challenges during development, we now feel that we have been rewarded when hearing such encouraging reactions.

Yamamoto: Public perception of diesel engines was not favorable because of the high noise level of trucks. However, we think we can change this image with the 700P project. We are confident that both the ELF and FORWARD are truly comfortable vehicles to drive, though some might think that I am boasting. The cabin is very quiet with low vibration levels. Thanks to the improved Smoother models (ELF: Smoother Ex, FORWARD: Smoother Fx), drivers do not need to use the clutch pedal or change gears. Because of this improvement, drivers fatigue is significantly reduced and they can concentrate more on driving, resulting in safer driving.

Based on our experience with the 700P project, we are determined to give our best efforts to addressing contemporary needs in vehicle development.

merits of the new cabs. The 4-cylinder engine is a most significant point because the conventional engine was a 6-cylinder type.

In addition to the cab, engine and transmission, weight reduction was also carried out on the chassis, resulting in a total reduction of 200 kg. Furthermore, to address the requirements of the new drivers' license of medium-duty trucks², we developed a new 11-ton truck with the purpose of offering versatile models. The lighter the vehicle, the more customers can use it efficiently in respect to load capacity, in addition to the reduction in CO₂ emissions because of improved fuel efficiency. Our efforts to achieve weight reduction were intended to achieve both of these objectives.

Hirao: One of the reasons for the high evaluation of the ELF is the aspect of high reliability and durability. To be honest, we went to tremendous lengths to achieve weight reduction without betraying this expectation. Specifically, the chassis is a component that you cannot modify significantly. Therefore, we reviewed its parts one-by-one in an attempt to reduce the weight of each part slightly.

Fujii: While rigidity is the essence of cabs, our challenge in the FORWARD project was to reduce the weight by 30 kg. This is a weight reduction of about 10% assuming that the weight of the steel panel is about 300 kg. We managed to achieve this reduction by fully utilizing computer-assisted analysis methods to maintain and improve basic structural strength.

Yamamoto: Another characteristic of 700P was the full utilization of 3D CAD (a computer-aided design tool) together with the analysis method. Before the actual fabrication of a pilot vehicle, a virtual vehicle was constructed using a computer and various design factors were reflected in the drawings by conducting a series of processes. Because the actual pilot vehicle was fabricated after this process, we could achieve very efficient development by minimizing the number of pilot vehicles that had to be fabricated. In this sense, we are proud that we could contribute to resource conservation in the development stage as well.



Vehicle Planning and Engineering (ELF Team):
Satoshi Hirao



New ELF

1: The regulatory change in drivers' licenses refers to a new drivers' license system to be implemented in June 2007. The maximum limit of a general drivers' license has changed to less than 5 tons for GVW (gross vehicle weight) and less than 3 tons for load capacity.

2: The new drivers' license for medium-duty trucks refers to a new drivers' license system to be implemented in June 2007. In the new system, vehicles with a GVW of 5-11 tons and maximum load capacity of 3-6.5 tons are categorized as medium-duty trucks, for which a driver's license for medium-duty truck becomes mandatory.

Seven Stories: Supporting the 700P Project

700P is a large project that is supported by the commitment of an enormous number of staff who carry out various functions. We will focus on the stories of seven people who were involved in this development project.



I am excited by the news of winning the Good Design Award

The main objectives of the design development of the new ELF/FORWARD were: 1) a functional design, taking safety into consideration; 2) aerodynamically excellent geometry that contributes to improved fuel efficiency; and 3) the promotion of using environmentally friendly material to enhance recycling performance. To achieve these objectives, we set our style concept as "Solid & Sculptured" for the exterior and "Evolved Professional Gear" for the interior. Meanwhile, we conducted design assessment by aggressively seeking aerodynamic performance and through driving tests. The most challenging aspect was the process used until we could produce a design that completely matched the styling concept. Although our cabs are designed to realize a rectangular structure, the goal of achieving the tumble form with vertical geometry of the side of cabs in conjunction with other departments proved trying from the start of this project to the stage immediately before commercial production. This battle included arguments about the door glass layout and press forming. Furthermore, to improve aerodynamic performance, we repeated the cycle of modeling, analysis and wind tunnel testing almost endlessly. As a result, we are proud that we can present an innovative new styling. We are honored that our high and wide cabs won a Good Design Award in 2006.



Design Engineering Team:
Takahiro Uematsu

* Solid & Sculptured: Taut, massive feeling and sculptural forming with depth/Evolved Professional Gear: User-friendliness as a professional tool

Designing safe and light-weight body



Body/Exterior Engineering Team:
Tatsuya Okamoto

Development promoted the objectives of: 1) an improvement in fuel efficiency by improved aerodynamic performance; 2) employment of a modular design* by using common specifications between the ELF and FORWARD for unit parts*; and 3) a reduction in the type and number of parts, by designing common parts. Furthermore, we tried to eliminate the resin finish on the interior trimming* from the specifications, employing the slogan "Bare Skin Beauty." Concerning the aerodynamic characteristics of the body, we had repeated discussions until we felt that both design and stylistic requirements could be satisfied, while giving full consideration to the compatibility of the common factors between the ELF and FORWARD. To achieve the "Bare Skin Beauty" target, we tested the review from the cabin by using CAD in setting the bead* to ensure surface rigidity. We also spent a lot of time modifying body panel configurations. We often worked until midnight. For weight reduction, we reduced the panel thickness to the limit, while high-tensioned material* or tailored blank material* was used for sections requiring high strength and rigidity in order to design a safe and light body. Recycled materials were used in the interior and exterior with the focus on our approach to addressing VOC (volatile organic chemicals such as formaldehyde and toluene) regulations to be implemented in future. In addition, we minimized the use of harmful controlled chemicals and employed a surface treatment free of hexavalent chromium.



* Unit parts: an assembled part that constitutes a unit/Module design: A design to allow a consolidated function by gathering several parts, each of which constitutes a single unit/Trimming: Interior wall components/Bead: Control the strength and rigidity using extrusions or concavities/High-tensioned material: Steel panel with high tension treatment/Tailored blank material: Panels made by welding together multiple steel panels with different panel thickness or quality

Striving for light weight and compact size

I was involved in the planning and development of the 4JJ1 engine, an innovative component integrated in the new ELF as its main engine. To address the reinforcement of emission gas regulations, ecological trends supporting CO₂ reduction and the introduction of the new drivers' license system, we tried to enhance the torque per emission level as much as possible while striving for weight and size reductions so that various dynamic performances required for engines such as fuel efficiency, weight and emission gas would be drastically improved. As a result, conformance to the new long-term emissions regulations and certification for low-emission heavy-duty vehicles of a 2005 standard could be achieved. Furthermore, it is the first vehicle in the diesel 1.5 tons/2-3 tons class (except for hybrid vehicles) that satisfies the fuel efficiency standard for heavy-duty vehicles (T1-T3 categories.) In addition, further improvement was made in respect of the much acclaimed noise reduction performance. Specifically, we took pride that we could minimize the idling noise to the lowest level, in comparison to our competitors. At first, there were some concerns about the durability of the light and compact engine. Nevertheless, after skeptics experienced a test drive, all of them voiced their surprise and admiration. Undoubtedly, this is a result of a design that focused on maximizing the advantages made available by adopting a smaller displacement engine.



Engine Planning and Engineering Team:
Yoshihisa Koizumi



Satisfying both emission gas reduction and improvements in fuel efficiency



Engine Planning and Engineering Team:
Makoto Takeuchi

I was involved in the planning and development of the 4HK1 and 6HK1 engines: the main engines integrated in the new FORWARD. As development objectives, a reduction in emission gas and noise levels in the ecological aspect, the improvement in fuel efficiency and reduction in running costs in the economic aspect, and the development of a highly-reliable engine in the safety aspect were targeted. By positive use of electronic control technology, supported by in-house software and based on Isuzu's unique next-generation clean I-CAS technology and next-generation high efficiency diesel D-CORE engine series, the new long-term emissions regulations and the 2015 fuel efficiency standard could be achieved. These engines also comply with the requirements for low-emission heavy-duty vehicles certification. Concerning the ecological aspect, these models can operate in the early morning and at night in residential area, thanks to the vehicle's superb tranquility. A reduction in running cost has been also achieved by extending the replacement interval of the engine oil filter from 15,000 km to 20,000 km. We are confident that these engines successfully address the needs of contemporary society by satisfying various requirements, such as a reduction in emission gas, improved fuel efficiency, noise reduction and an assurance of reliability. Many customers who drive these models gave us a very positive evaluation, pointing out their superb dynamic performance and quietness.

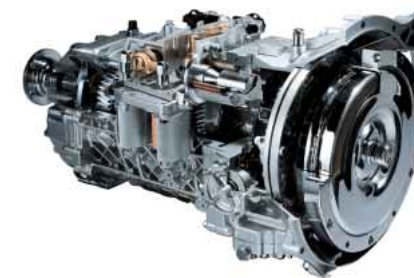


Smooth starting and acceleration



Smoother Engineering Team:
Masahiko Hayashi

I was involved with the design and development of the general aspects of "Smoother Ex," a transmission system that has been integrated in the new ELF. Smoother Ex is the developed and improved version of the Smoother E Series. It is a new drive system developed to achieve the fuel efficiency equivalent of a manual transmission as well as a maintenance-free clutch and easy-driving characteristics. With the realization of automatic transmission and sequential manual transmission, even drivers with a license limited to automatic vehicles can drive this model. In developing the new ELF, we placed special emphasis on improving performance, driving comfort and weight reduction. Concerning performance and driving comfort, we fabricated prototypes under a tie-up with the Isuzu Advanced Engineering Center. By identifying optimal specifications based on prototypes, we made our decision on the specification changes for the clutch mechanism. Regarding weight reduction, we managed to produce a high-quality hydraulic unit on a commercial basis through cooperation with the manufacturing division, from the prototype phase, by positive use of Isuzu's die cast technology. Thanks to these efforts, Smoother Ex achieves a significant improvement over shift operation performance. Moreover, it is exceptionally well matched with the new 4JJ1 engine, allowing smooth starting and acceleration, which could never have been expected in conventional trucks. Through significant mitigation of shock and transmission time lag, the feel of the transmission could be drastically improved.



Development from the customers' standpoint



Validation Team:
Tsutomu Yamazaki

With the recent trend of increased concern about global warming, fuel efficiency in itself means environmental performance. Giving consideration to the fact that the increasing crude oil price has become a serious concern for corporate management, we set our development target as the improvement of fuel efficiency compatible with dynamic performance through high output with smaller displacement. Even if the fuel efficiency is excellent, customers will not be satisfied if dynamic performance is poor. To achieve dynamic performance that matches the customers' expectation without compromising fuel efficiency, we carried out repeated evaluations by conducting vehicle tests by constantly changing engine characteristics. Focusing on the question "How can we satisfy our customers?" we finalized the specifications one by one. In addition to the assurance of both fuel efficiency and dynamic performance, we could achieve excellent noise reduction inside and outside the vehicle as well. Such quietness will minimize neighborhood disturbance caused by early morning and late night deliveries and also contribute to mitigating driver fatigue levels. Frankly speaking, I felt that this project would be hard to tackle in the early stages of development. However, it was unexpectedly completed with great success. Based on this experience, we are determined to make further commitments with the enthusiasm necessary to make the impossible, possible.



Recognizing the significance of the responsibility for quality



Manufacturing Team:
Tadanao Yamamoto

As a member of the manufacturing division, I am responsible for assessing whether or not the project can proceed to commercial production. Now, an awareness of the significance of the responsibility for our products is greater than my excitement at launching a new model into the market. Once commercial production has started the products are distributed in the market and we can do nothing more. To prevent quality problems, we need to continue producing high-quality products. I often felt the pressure of our responsibility through our commitments to 700P: for instance, when I gave permission to proceed to commercial production, when the first vehicle left the mass production line, when I attached an "OK" sticker to the vehicle for shipment in the line-off ceremony and so forth. It was around 10 p.m. when the first vehicle left the mass production line. When I attached the sticker to the vehicle, I felt as if my daughter was leaving home for her wedding ceremony. The biggest challenge now before us is to achieve horizontal deployment of product quality equivalent to that of the Fujisawa Plant around the world. As a first step, we need to promote standardization in the country where KD (knockdown) production of 700P will be started.

