Feature

# Contributing to the resolution of social issues through vehicle manufacturing

## Eternal themes –
## Taking on safety and environmental challenges


The authentic sports utility vehicle Levorg is the newest embodiment of Subaru's automobile manufacturing prowess made utilizing creative technologies and fusing high safety, drive enjoyment and environmental performance. We invited Ms. Iwasada, a journalist specialized in automobiles, to visit us and speak with our engineers in charge of developing the Levorg regarding Subaru's development concept and the possibilities and other aspects of safety and environmental technologies.

## Participants

**Rumiko Iwasada**
Auto Journalist

In addition to vigorously compiling information mostly on compact automobiles, she focuses on people, roads, autos and medical treatment to find ways to reduce traffic accidents, injuries and deaths. She works as an investigative commissioner for the Ministry of Land, Infrastructure, Transport and Tourism among others, providing suggestions and proposals to benefit transportation for society and formulate transportation related government policy from a citizen's perspective. She also focuses her efforts on providing lectures for instructors at various driving schools and participates in safe driving programs.

**Yasunori Kumagai**
Project General Manager
Subaru Product & Portfolio Planning Division

Mr. Kumagai joined FHI in 1983 and was engaged in exterior design and body development and design at the Body Design Division. After serving as assistant section chief and then section chief in charge of exterior design at that Division, he became Product & Portfolio Planning Division manager and came to be in charge of product development for the new Legacy in April 2005. From October 2009, he was appointed Project General Manager for the Legacy in charge of annual renewals and upgrades from the 1st to the 4th years (up to the latest model). From January 2012, he has been serving concurrently as Project General Manager for the Levorg.

**Minoru Kagawa**
Assistant Section Chief in Charge of Model Development
Vehicle Research & Testing Control Department
Subaru Technology Division

Mr. Kagawa joined FHI in 1990 and in the 2nd Power Unit Research and Experiment Department worked on power unit material research and strength, rigidity, seal functions and other essential factor development. From April 2007, he became assistant section chief at the Vehicle Research & Testing Control Department in charge of overall development model performance for the mini car, Tribeca, Exiga and others. From October 2011, he became charged with overall vehicle performance in Levorg development.

**Yasuichi Koike**
Tokyo 1st Power Unit Research and Experiment Department

Mr. Koike joined FHI in 1993 and, after working on engine testing and development for the third and fourth generation Legacy, second generation Impressa and the Subaru BRZ/Toyota 86, among others, he assumed his current position in 2013. He is involved in supervising engine testing and development for the Levorg.

**Kiyohide Shiojima**
Manager in Charge of Wheels & Axles
No. 2 Mechanism Design Section
Chassis Design Department

Mr. Shiojima joined FHI in 1987 and worked on the development and design of the first generation Legacy. He developed the suspension of the 4th generation Legacy and made its wheels and axles, launched the Tribeca, and made wheels and axles for the 5th generation Legacy before becoming Team Leader in charge of developing wheels and axles for the 4th generation Impressa from 2007 and the Levorg and WRX from August 2012. He has been charged with developing the next-generation Impressa XV since April 2013.

**Facilitator: Brain Center Inc.**

# 1 The paramount mission of an automobile manufacturer is the pursuit of safety

## Focusing on the fundamental safety of automobiles to avoid accidents

—— Although safety and environment are examples of the major social responsibilities of automobile manufacturers, the fortification of safety is an extremely crucial social issue that directly relates to human life. I would like to ask the concepts and initiatives of Fuji Heavy Industries with regard to safety.

Kumagai For an automobile manufacturer that provides vehicles to society, realizing safety is the most important mission. At Subaru, based on our "ALL-AROUND SAFETY" philosophy, we always look to improve safety with the ultimate goal of making an accident-free automobile.

Kagawa Our stance on safety as the most important consideration is a Subaru tradition since our founding. For example, in an advertisement for the Subaru 360 launched in 1958, we promote its wide windshield that allows drivers to check left and right at railroad crossings with one glance.

Kumagai Only a company such as ours that previously produced aircraft could have focused on the fundamental "primary safety" capability that consists of a wide field of vision and seating that provides operability and prevents fatigue when driving. Even today, Subaru vehicles are equipped with side windows designed to allow drivers to see objects 1 meter in height. This is so that children anywhere around the vehicle can be seen from the driver's seat without fail.

Iwasada Recently, prioritizing design has resulted in sacrificing the field of vision with nothing to compensate for it. However, there is an increase in the number of vehicles equipped with side-view cameras and other safety devices.

Kumagai Even with such devices installed, the Subaru design concept requires that first and foremost the driver's position can allow easy visual confirmation.

Iwasada Based on this fundamental safety, various safety technologies can be added.

Kagawa For example, we have “Active Safety” technology that prevents dangerous situations when driving. Subaru vehicles feature a horizontally-opposed engine mounted at a low position and a vertically-assembled transmission, with bilaterally symmetric powertrain that delivers superior weight balance for high drive stability. The symmetrical AWD incorporated in the powertrain provides even more safety.

Kumagai Some vehicles lose their footing when passing through puddles on the highway on rainy days. However, if equipped with symmetrical AWD, the vehicle is able to grip the road at all times with excellent balance using all four wheels to realize stable driving even under bad circumstances. Such a vehicle provides high stability and maneuverability even when avoiding danger on the road thanks to quick handling and braking.

Iwasada Four-wheel drive vehicles are best known for handling snow and ice covered roads and off-roading, however, Subaru is consistently on the forefront of development to unleash the great safety effects of four-wheel drive for regular road and highway driving.

Kagawa Yes, the Subaru concept is to link drivability and maneuverability to safety.

# Realizing top class safety performance from many years of persistent research

—— We have a well-established reputation in “passive safety” in accidents thanks to Subaru’s collision safety performance and other attributes.

Kagawa FHI believes that, even in automobile accidents, the protection of human life is the responsibility of the manufacturer and, since the time of the Subaru 360, we have made repeated crash tests and other activities to improve our collision safety performance. These accumulated research and development results have led to the introduction of the New Ring-Shaped Reinforcement Frame Body Structure, which protects passengers in collisions as in a metal basket, as well as an engine that slips under the chassis in a collision to prevent injury, among others. In addition, to alleviate the impact on pedestrians, we set a buffer space between the engine and the grill and make part of the bumper in a way that absorbs shocks. These are but a few of our added safety features.

Kumagai Today, Subaru automobiles are highly praised by evaluators both in Japan and overseas for their safety performance, however, this was not attained overnight. Over half a century of slow and steady accumulated effort went into the realization of safety in our vehicles.

Iwasada In addition, recently, the “EyeSight” pre-crash safe driving assist technology that detects collision danger is becoming synonymous with the Subaru brand.

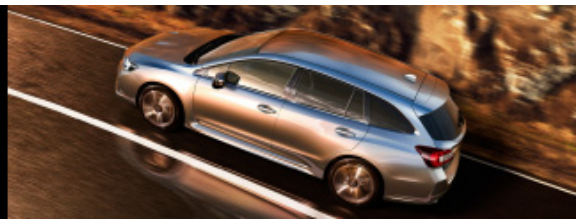
Kumagai Lately, many automobile manufacturers have launched vehicles equipped with pre-crash systems, therefore, our “EyeSight” is believed to consist of relatively new technology. But the fact is that FHI started developing it as far back as 1989. EyeSight is the product of continuous research spanning a quarter of a century, released in 2008 after the technology was enhanced based on a dual-camera system that came about following repeated trial and error and through a development sustainability crisis. Even after that, we tuned up EyeSight’s performance and functions, brought down Ver. 2’s price to a low ¥100,000 in 2010 and proliferated it. The new Levorg has the latest Ver. 3 onboard.

Kagawa There is much advanced technology and know-how compressed in EyeSight that cannot be easily replicated by pre-crash systems that have recently come on the market. Actually, EyeSight received the highest evaluation in tests of rival pre-crash systems by an automobile magazine.

Iwasada From the basic and reliable “primary safety” to drivability and collision safety that remains unaffected by weather or road conditions to an accident-free automobile with EyeSight, serious efforts to make Subarus safe from all aspects have made FHI exemplary in the automobile industry and, as a driver myself, I firmly believe it to be a manufacturer worthy of my trust.

**Subaru’s ALL-AROUND SAFETY**

# 2 Advanced safety and environment technologies embodied by the Levorg



## New generation downsizing turbo engine with high-dimension drive and fuel efficiency

—— Next I would like to ask those in charge of development regarding Subaru's safety and environment technologies embodied in the new Levorg model.

Kumagai The Levorg is the new sports utility vehicle launched as the essential successor to the Legacy Touring Wagon, which has been on the market for 25 years. The Levorg is the result of fully leveraging the technologies and know-how of "fun and safe" automobile manufacturing fostered over many years by Subaru with a careful and meticulous consideration for detail pursuing the essence of the automobile sought after by users.

Iwasada Where are the technological features?

Kagawa One place is the power unit. FHI newly developed the 1.6L and 2.0L DIT direct-injection turbo engine. The higher end type equipped with the 2.0L engine is the high performance model that unleashes overwhelming output capacity, while the 1.6L engine mounted model is the typical new generation Subaru featuring high-dimension drive performance akin to a sports utility vehicle with 17.4km/L fuel efficiency (JC08 mode: same below).

Koike By the way, since the fuel efficiency of the current model Impressa 1.6L FF is 17.6km/L, fantastic fuel performance is realized in both the AWD model with the turbo engine and the non-turbo FF model with the same emissions. It was also designed with a focus on low-speed torque for a comfortable ride even in the frequent stop and go conditions of Japanese roads.

Kumagai These engines are classified as "downsizing turbo," which have recently garnered attention as environmentally-friendly engines used mostly in Europe. The conventional turbo was mainly added to boost the power of high-output engines and improve drive performance. Downsizing turbos compensate for the loss in power that results from reducing the emissions of engines to make them more fuel efficient and realize superior drive performance.

Koike The most difficult task in development was to obtain the target output and fuel performance not with high octane but with regular gasoline in the 1.6L direct-injection turbo engine.

Kagawa The downsizing turbo in European automobiles requires high octane gasoline for almost all models. However, unlike Europe, because regular gasoline is prevalent in Japan, we absolutely had to make the high-fuel efficiency focused 1.6L run on regular as a contrast to European vehicles.

Koike In the development process, besides we engine specialists, we confer with various staff in charge of transmissions, chassis, tires, etc. to discuss drive and fuel performance. During discourses, whenever the target fuel efficiency could not be reached, I would often whisper to Mr. Kumagai, the development manager, “why not make it high octane?” However, looking back, keeping the regular fuel specification was a good thing.

Iwasada High octane fuel also costs more and so the longer you use an automobile the more advantageous regular fuel becomes.

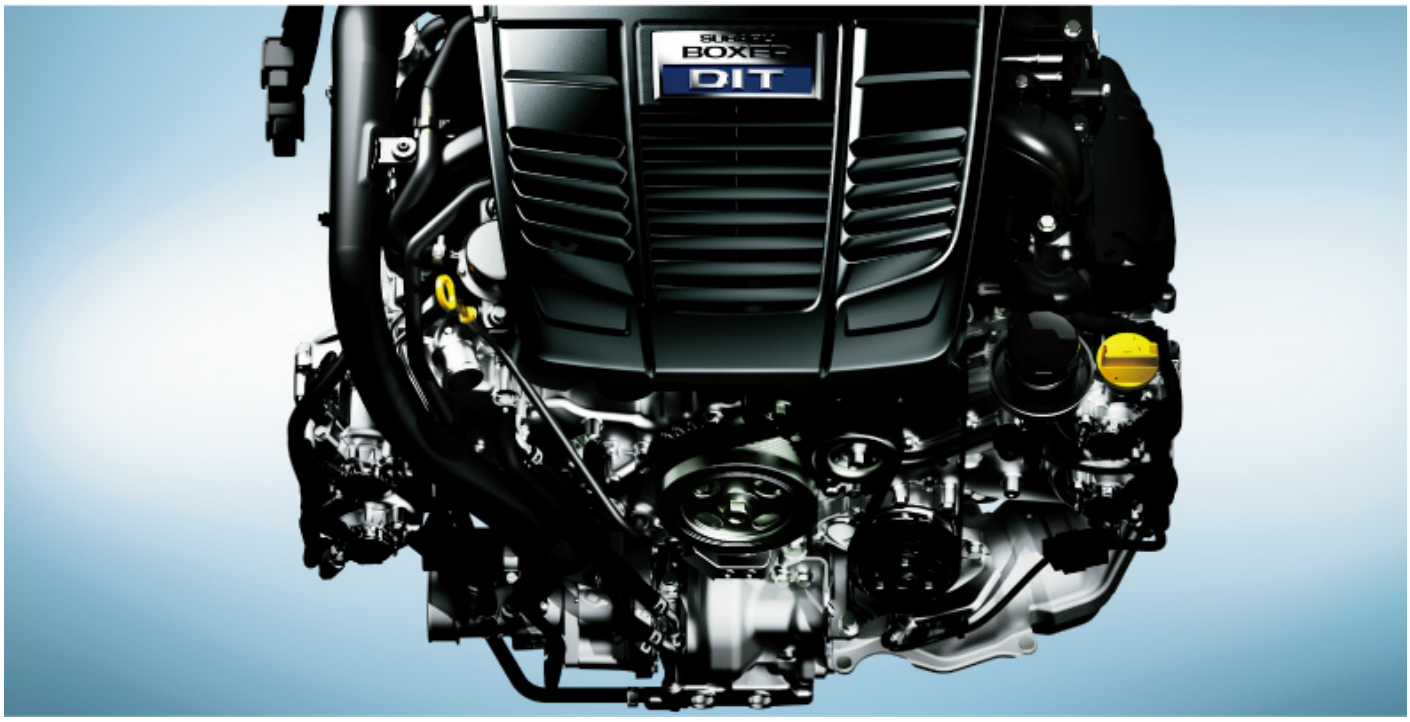
Koike From the perspective of maintenance cost, more users are happy with regular fuel vehicles, and the burning of low octane gasoline is good for the environment, a social issue. In addition, we succeeded in differentiating Subarus from European vehicles with two key features: 4-wheel drive and regular gasoline.

Iwasada How did turbo technology rank in Subaru’s development?

Kumagai Turbo is one of the core technologies of Subaru and was included in our vehicle lineup from the very first generation Legacy all the way to the current Impressa. As environmental regulations become stricter and fuel efficiency increases, the industry is cutting out the turbo and some makers put an end to research, however, Subaru made improvements to meet the gas emission requirements and fuel efficiency demands of the age and tenaciously conducted continuous turbo power unit research and development as a means to realize an enjoyable drive.

Iwasada So your aggressive efforts to develop proprietary technologies resulted in an early response to the market inflow of the downsizing turbo, which came about for environmental considerations.

Kumagai That’s exactly right.




## Joint development of optimized tires specially made for the Levorg

—— To achieve the Levorg’s drive and environmental performance, not only the power unit but also the tires must play an important role.

Kagawa Yes. Such high level drive and fuel performance are the result of close collaboration between the engine development team and the vehicle development team that includes tires. Mr. Shiojima was charged with tire development.

Shiojima For the Levorg, we jointly developed new specialized tires optimized for that model with a tire manufacturer in order to achieve our high drive and fuel efficiency targets.

Iwasada What type of performance was the focus during development?

Shiojima Tires are the only components of an automobile that touch the ground. Their features greatly affect drive performance, safety performance and fuel performance, among others. They first have to demonstrate basic performance, namely “run, turn and stop,” at high levels. Among them, stopping, or braking features, depends greatly on the tires themselves, and development has been centered on their ability to stop without fail not only on dry road surfaces but also on wet ones.

Iwasada Automobiles today feature various safety technologies such as ABS and sideslip prevention, among others, however, without tire performance, these technologies will not deliver the anticipated effects. This is why we, unsatisfied with commercially-available tires, deserve credit for working in conjunction with a manufacturer to develop specialized tires.

Shiojima Another difficult task was increasing fuel efficiency while maintaining basic performance. Enhancing a tire’s grip strength improves braking and maneuverability, however, this is met by a great counterforce against the tire’s turning action thus negatively affecting drive while gaining fuel efficiency. To resolve this, we worked to obtain optimal grip strength and turn resistance values to realize a tire that makes possible both a safe and enjoyable drive and superior fuel performance.

Kumagai Although commercially-available low fuel consumption tires (eco tires) provide good fuel performance, they cannot realize the sports utility vehicle drive conditions of the Levorg. For this reason, a tire with both the characteristics of a low fuel consumption tire and a sports car tire was necessary.

Kagawa When we started development, we presented target performance and budget figures to multiple tire manufacturers, however, their initial response was to state technological difficulties in their attainment. Despite this, rigorous negotiations resulted in development with a tire manufacturer with a track record for making low fuel consumption tires.

Iwasada For this manufacturer to agree to such stringent development requirements rejected by other companies, it is likely that the Subaru passion exhibited to realize the Levorg was passed on to them.

Kumagai Yes. It is thanks to the work done by the engineers of both companies together that the tire was realized. Repeated prototypes and evaluations led to an extremely high performance tire.

# 3 Further evolving EyeSight for the future

## Innovating the stereo camera and enhancing danger aversion functions

—— How is safety performance evolving?

Kumagai During the development of the Levorg, the latest EyeSight ver. 3 was installed in addition to high levels of safety from all aspects based on Subaru's "ALL-AROUND SAFETY" concept.

Kagawa Drive performance, braking power, maneuverability and other aspects that assist safe driving were thoroughly enhanced. Grip the steering wheel and you will understand the truly remarkable level of stability such as when cornering on wet road surfaces.

Iwasada Because you perfected the fundamental automobile performance of "run, turn and stop" in the Subaru, pre-crash systems that function to avoid and alleviate danger in emergencies are more effective. How has EyeSight ver. 3 evolved from its earlier versions?

Kumagai With ver. 3, the advent of the stereo camera that expanded the field of vision and visible confirmation distance by approx. 40% enhanced recognition performance. In addition, color imaging enabled the recognition of braking by automobiles located in front. Such high level performance and function made way for further evolution of pre-crash braking functions that avert collisions when danger is detected along with new functions such as side controls based on steering operation assist.

Kagawa For example, enhanced recognition performance increased the velocity range at which collision avoidance or injury alleviation is possible with pre-crash braking from 30 km/h or less with ver. 2 to 50 km/h or less with ver. 3. Also, we added the "Pre-crash Steering Assist" function that automatically applies the brakes and increases turning ability on the inward wheel when the driver operates the steering to turn the vehicle in an effort to avoid colliding with a wall or barrier. Furthermore, we newly installed the "Active Lane Keep" function that maintains the vehicle in the center and restricts its movement outside the lines by using stereo cameras to identify the white lines on both sides of the road and assisting steering when driving over 65 km/h on highways and automobile-dedicated roads.

Kumagai In addition to the above, ver. 2 had “AT Unintended Forward Movement Prevention Control” to prevent accidents from false starts caused by mistakenly stepping on the accelerator pedal instead of the brake pedal, however, ver. 3 not only prevents unintended forward movement but also has “AT Unintended Backward Movement Prevention Control” that sounds an alarm and restricts output when it detects stomping on the accelerator when backing up the vehicle and the system determines that an unintended backward movement was made.

## Striving to create an accident-free automobile for the aging society

Iwasada I think these new functions are very effective because automobiles are frequently driven in reverse in parking lots and we often hear of falls from multistoried parking garages by drivers who mistaken the brake and gas pedals. Particularly in Japan, the number of elderly drivers will continue to increase sharply. Although each individual is different, since driving ability deteriorates with aging, each of the functions of EyeSight ver. 3 driver assist may likely play a crucial role in the car society of tomorrow. I would like to see more and more vehicles equipped with EyeSight ver. 3 going forward.

—— Moreover, cases of serious automobile accidents occurring due to a loss of capacity by the driver resulting from the onset of a sudden illness while on the road are becoming a social problem in recent years.

Iwasada Thanks to Subaru's pursuit of better safety technologies, even if the driver makes a mistake or his or her operation is impaired by a sudden medical emergency, technology that functions to avoid an accident or keep injury at a minimum is applied to the extent possible.

Kagawa As we envision future automated driving, FHI will not only plan the further evolution of EyeSight functions, but also enhance safety from all aspects including primary safety, drive stability safety and collision safety.

Iwasada Beyond this, your dream is to realize an accident-free automobile.

Kumagai Yes. If accidents can be prevented with EyeSight and other features, there would be no victims or perpetrators and there would be no need to repair or replace automobiles that weren't necessary in the first place. If we could reduce the number of accidents, then traffic congestion as well as ambulance and police dispatches could be reduced.

Iwasada In other words, to make an accident-free automobile, safety is the obvious focus, but we are also able to decrease the loss of society including with respect to the environment.

Kumagai With our sights set widely all the way up to this field, our goal is to provide better vehicles for society.

Kagawa Of course, to us as an automobile manufacturer, the environment is one of the important issues that can never be avoided, akin to safety. Going forward, we expect the introduction of stringent environmental regulations in Europe, the U.S. and China, among other jurisdictions, with respect to which we will of course comply without fail, but also strive to achieve the highest environmental performance in the industry through engine fuel savings and electrification.

Koike Through early compliance with the world's highest environmental standards, we believe we will be able to deliver environmental performance that surpasses the expectations of even Japanese users.

—— Lastly, Ms. Iwasada, since you have interviewed all other automobile manufacturers, how do you rate Subaru and what are your expectations and desires.

Iwasada I believe that Subaru is an extremely serious manufacturer of automobiles that seeks to perfect the basic vehicle values of safety, environment and drive. Despite its limited research and development resources compared with large automobile manufacturers, I feel that Subaru succeeded in pioneering the worldwide application of EyeSight and other revolutionary technologies because of your unwavering conviction with respect to making vehicles and tradition of valuing the challenges faced by of engineers. Even though Subaru is expanding its business globally centered on the U.S. market, the development of automobiles with careful consideration for road conditions and user needs in Japan, as in the case of the Levorg, is heartening to Japanese people. Going forward, the industry will likely experience intensifying rivalries in the area of development as manufacturers face environmental regulations and automated drive, among other issues, however, despite this, I want for you to continue providing vehicles with the Subaru appeal that showcase the technical genius of each and every engineer and the results of their teamwork.

—— Thank you very much for taking the time for this interview today.