

Vehicle Lighting in Japan

Technics • Automakers • Tier 1 • Tier 2

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About the author



Jean-Paul Ravier graduated from ISAE SUPAERO (the Institute for Space and Aeronautics Engineering) and IAE Paris (Institute for Administration of Enterprises).

He worked for over 41 years at Valeo, including 29 years at Valeo Lighting where he held a variety of management positions first in IT and finance, and then in R & D, projects, and innovation, including in Japan from 2005 to 2009 at Ichikoh as a board member and managing director. He retired from Valeo in 2013. Shortly thereafter he was appointed chair of the ELS programme ([Embedded Lighting Systems](#)) for Advanced Master training and Research in Lighting at the Institut d'Optique Graduate School, ESTACA and Strate School of design. He held that position through the end of 2017.

Author's foreword

To build this report, I visited Toyota, Nissan, Honda, Koito, Stanley, and Ichikoh during March 2018. I am deeply thankful to all the companies and people who have helped me to realise this study, particularly for the interviews at Toyota, Nissan, Honda, Koito, Stanley, and Ichikoh; to Hitoshi Takahashi for his assistance on my visit to Japan while doing the research work to build this report, to Daniel Stern for editing and information on Japan's technical standards and regulations and Geoff Draper for his description of Japan's participation in the UN regulatory process, and of course to DVN President Hector Fratty for his advice and support.

Executive Summary

In the adoption of new technologies, the balance of benefits versus cost is decisive. That's why some of the latest innovations like high definition matrix beam, laser, and OLED are not yet widely applied by Japanese car makers. However, Japanese industry has developed a lot of innovations for concrete realisations of compact and efficient LEDs systems, for instance the new bi-function modules with no fan developed by Koito for many models of Toyota, or the direct-lens optical system developed by Ichikoh for the Nissan Leaf. Also interesting innovations to propose new style for instance with the double-reflection lenses developed by Stanley for Honda headlamps. Japanese car makers and set makers are in the worldwide race for ADB with a highly performant second generation, with 24 LEDs in two rows for the Toyota-Koito modules, or with the Mazda-Stanley Low beam-High beam ADB recently launched.

Japanese car makers take into account that a majority of their sales are in countries where the cost factor is extremely important, for instance in America where Japanese car makers are realising more than 38% of their sales, or in developing countries, and even in their native country where most driving is done in cities where headlamp performance isn't as crucial as in Europe and elsewhere. So for generalisation of LEDs, even if technically every car maker or set maker wants to do it, there is no current plan to end the use of halogen headlamps.

In this report, after an introduction to the automotive Japanese industry with its main figures and targets, the facts and figures of vehicle lighting companies are presented, and we describe in detail the leading car makers and their realisation and targets for lighting, and we do similarly for their main lighting suppliers. There's an interview with each of the big companies, featuring one or more of their leaders in research and development.

Introduction



Sumi-e – ink painting



Hanami procession in Ueno Park



Koyo—maple trees

Japan is a fascinating country, strongly attached to traditions rooted in the ages—including the Edo period, when Japan closed its relations with the outside world during two centuries before the Meiji revolution—and widely influenced by a culture mixing imported elements into its own intrinsics. For instance, the simultaneous use of two religions: Buddhism more for birth and death, and Japanese homegrown Shinto that is first and foremost a way to live. And the Japanese language mixes its own words with those that came from China with the Kanji characters.

Japanese have a pervasive adoration of nature that manifests in concepts such as *hanami*, the traditional custom of enjoying the transient beauty of flowers (*sakura*, cherry blossoms; *ume*, plum blossoms) and *koyo*, the red-leaf maple trees, to the Zen practice of delicate *ikebana* flower arrangement, of meticulous *bonsai* small tree cultivation and Japanese gardens more generally, and the popular favour of spending weekends in the mountains to decompress and refresh. And so a seeming preoccupation with the environment found in every annual report of Japanese companies is partly a marketing target, but it is directly linked to this real, popular, cultural connection to nature.

Japan has a very strong automotive industry with a global market share reaching 29%. That is far ahead of American carmakers (18%) or German makers (16%). The Japanese industry includes Toyota, N° 1 in capitalisation value; Nissan, who with the Renault-Nissan Alliance are N° 1 for quantity of cars produced, as well as Honda, Suzuki, Isuzu, Mazda, and Subaru.

In vehicle lighting, Japanese set makers command about 35% of the worldwide market. Koito are world's top set maker with 22% market share by value, with Stanley and Ichikoh being the other main Japanese set makers. And Japan's tier 2 is likewise quite strong, with the likes of Nichia, Panasonic, and Toyoda Gosei supplying the LEDs and related components which are increasingly key to vehicle lights. Naturally, the Japanese tier 2 ecosystem includes a very strong network of suppliers for electronics, materials, and suchlike.

For a long time the Japanese automotive industry's growth was based on production mainly done in Japan, with huge exports thanks to a strong competitiveness achieved by dint of a strong focus on quality and process using methods such as just-in-time, *kanban*, and *kaizen*. These results are based on the fantastic recovery of Japan after the second world war, but also find root in the more recent successes in the economic globalisation with the installation of many factories in their more important markets—mainly America, Europe, and China. Having first decentralised production while retaining most R & D activities in Japan, now Japanese companies are installing centres abroad initially for development, but now increasingly for the more advanced research involved in the likes of artificial intelligence and advanced styling.

Technical Standards & Regulation

Technical regulation of vehicle lighting in Japan was for many years unique, set forth in Japanese Industrial Standard JIS D-5500 (Automobile parts—Lighting and Light Signalling Devices). This was conceptually similar to the North American MVSS 108 in that it specified the design, construction, performance, and installation of the whole lighting system with reference to other standards including JIS D-5504 (Sealed-Beam Headlamp Units), JIS C-7506 (Lamps for Road Vehicles, analogous to UN Regulations 37 and 99), JIS C-7709 (Lamp Caps and Holders, analogous to IEC 60061), and JIS C-7035 (Light Emitting Diodes for Indication).



The Japanese technical prescriptions incorporated elements of American and European practice: during the time when North America exclusively used sealed-beam headlamps and Europe used replaceable bulbs, Japan used both—and the bulbs were a mix of European types (H1, H3, H4...) as well as types unknown outside Japan (702K, H4H, IH01, D6...). In the 1990s, American-type bulbs (HB3, HB4, HB5) and Japanese variants of them (9005J and 9006J with transverse filaments) joined the list. The Japanese beam pattern specification did not explicitly permit a left-traffic ECE beam, but neither was it simply a horizontally-mirrored SAE specification; it had provisions for both beam philosophies while stipulating its own actual requirements. Headlamps could emit white or selective-yellow light, which gave rise to the spectacle of Philips, amongst other companies, offering selective-yellow D2S and D2R (pictured) HID bulbs in Japan as an aftermarket product for drivers

preferring the yellow light—historically interesting, because HID headlamps were entering high-volume production right around the same time the unique French national requirement for selective-yellow headlamps was ending. Japanese lighting engineers brought forth the H14 halogen bulb, a development of the Japan-only IH01 bulb with twin axial filaments and no shield. H14 was added to UN R37, but was later withdrawn for lack of application.



Front position lamps in Japan could emit white light as in Europe, or amber light as in America. Sidemarker lights and reflectors weren't required as in America, but weren't forbidden on passenger cars as in Europe; when present they tended to use the American front amber/rear red pattern. Side turn signal repeaters had mounting and visibility angle requirements similar to the European repeater, but were often were placed near the front of the vehicle (as on the Japan-spec Toyota pictured here), located similarly to an American front sidemarker, rather than behind the front wheel as in Europe. Amber rear turn signals as in Europe rather than red as in America were required starting in 1973. Lit-area requirements applied to most signal lamps as in America, but the requirements were not the same; for example, front turn signals on passenger cars had to have at least 40 cm² and rear ones at least 20 cm²—almost the opposite of the American requirement for 22 cm² in front and 50 cm² in the rear. The JIS D-5500 standard specified intensity ranges similar to the US regulation rather than the lower intensity ranges of the UNECE Regulations.

Though not directly related to lighting, another unique Japanese driver-vision requirement was that sideview mirrors be placed such that the driver viewed them through an area of the windshield swept by the wipers; this meant they were much further forward on the fenders than in other countries—generally at or ahead of the front wheel axis. This requirement was phased out early in Japan's regulatory internationalisation process.

Japan became a contracting party to the UNECE 1958 Agreement on 24 November 1998, and began phasing in the UN lighting regulations around late 2005. For new vehicles starting with the 2006 model year, UN headlamps—white ones—and other lighting equipment became required. A [Mazda press release](#)

of that time has a *Changes to lamps/reflectors* section describing the shift to amber rear sidemarkers and the installation of headlamp levelling systems, "with the goal of promoting mutual recognition of international automotive standards". Now, Japan is almost fully onside with Europe in the implementation and ongoing development of the UN Regulations. Daytime running lights remain a sticking point; Japanese authorities disfavour the 400-to-1,200 candela R87 DRL intensity level, on grounds that these lights could make motorcyclists difficult to perceive in traffic. Negotiations are ongoing; for now, some automakers reduce the intensity of their UN DRLs to not more than 300 candela, the upper limit for miscellaneous substantially-unregulated auxiliary lamps—a principle and intensity value very common in North American vehicle lighting regulatory philosophy. Japan plays a major leading role in the UNECE World Forum for Harmonisation of Vehicle Regulations (WP.29) and has a strong record of promoting global harmonisation along with the European Union and the USA.

[JASIC](#)—the Japan Automobile Standards Internationalisation Centre was founded in 1987 and has actively supported cooperation between the Japanese government and industry for the internationalisation of automobile regulations and certification systems by the government. As an ongoing member of WP.29, JASIC has been involved in the establishment and amendment of UN Regulations, the promotion of mutual recognition of approvals based on the UN Regulations, and the further internationalisation of Japanese vehicle regulations and type approval systems.

In addition to Japan's accession to the UNECE 1958 Agreement (Reciprocal Recognition of Type Approvals) in November 1998, Japan signed the UNECE 1998 Agreement (Global Technical Regulations) in August 2000. At the United Nations, to support the activities of the Japanese government, JASIC regularly sends experts to meetings of WP.29 and its working parties including GRE, the working group on lighting and light-signalling. Among others, Japan holds the following positions relevant to the regulation of lighting through the UNECE system:

WP.29 WORLD FORUM

| | | |
|---|----------------|-------|
| Administrative Committee -1998 Agreement (AC.3) | Mr. H. Inomata | Chair |
| Intelligent Transport Systems (ITS) | Mr. H. Inomata | Chair |
| International Whole Vehicle Type Approval (IWVTA) | Mr. T. Onoda | Chair |
| IWVTA Subgroup on UN Regulation No. 0 | Mr. T. Onoda | Chair |

GRE (Lighting and Light Signalling)

GRE meets twice annually and Japan is normally represented by 10 experts.

In addition, JASIC is involved in the establishment of vehicle regulations and type approval systems in Asia and cooperation for internationalisation of these regulations and systems. In December 2015, for example, a project named MAJAICO—the Malaysia-Japan Automotive Industry Cooperation—was implemented under the Japan-Malaysia Economic Partnership Agreement. In the area of automotive lamps, with the aim of improving the Malaysian government's capabilities relating to vehicle type approval, JASIC sent to Malaysia three experts of four-wheeled vehicle lamps, of motorcycle lamps and of lamp components, respectively. Through these experts, JASIC provided information regarding uniform standards on vehicle structures and equipment related to safety and environment, and also offered advice on certification testing and facilities.

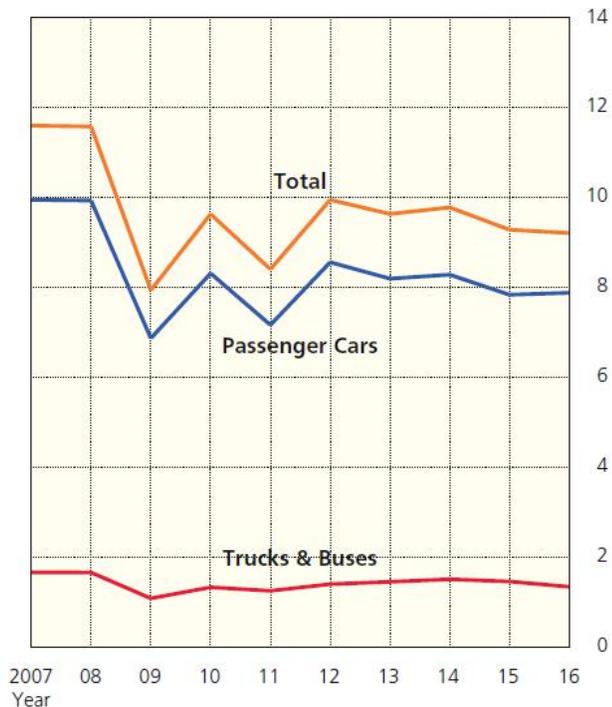
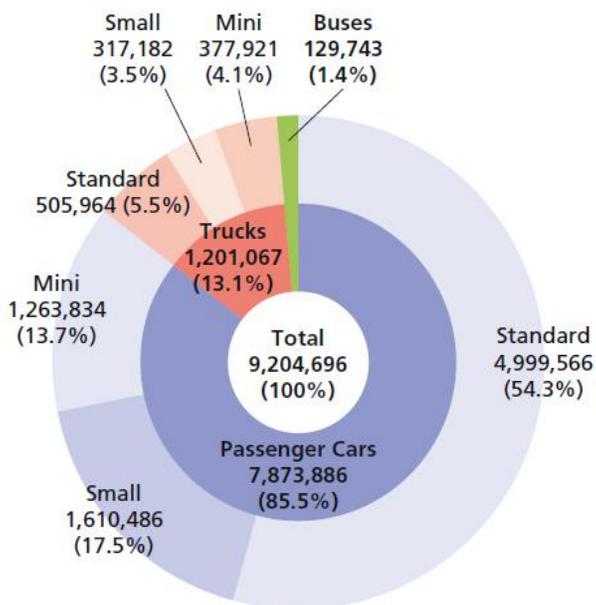
In Japan from April 2018 onward, ADB will be covered by JNCAP as a reason for an additional point. From April 2019 onward, ADB activation will be counted as an element in assessing automatic emergency braking systems for pedestrians at night.

The Japanese Auto Industry

The automotive sector is the Japanese economy's most important one with 814,000 direct employees, including 188,000 in vehicle manufacturing and 609,000 in auto parts and accessories manufacturing. Naturally, many other people are employed around the automotive services including retailing (1,031,000), road transport (2,694,000), fuel and insurance (349,000), and materials and equipment (456,000). All in all the sector counts 5.34 million employees—that is 8.3% of Japan's workforce.

Expressed in value, automotive manufacturing accounts for 17.5% (¥53.31tn, €410bn)—the largest single-sector share—of the total manufacturing in Japan. It also represents 23.9% of R & D expenditure in the manufacturing sector, and 21.6% of exports from Japan at ¥15.12tn (€116bn).

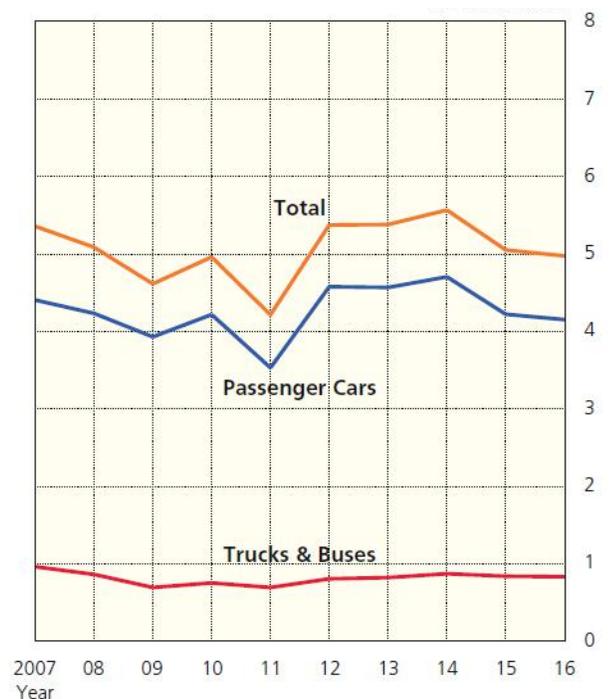
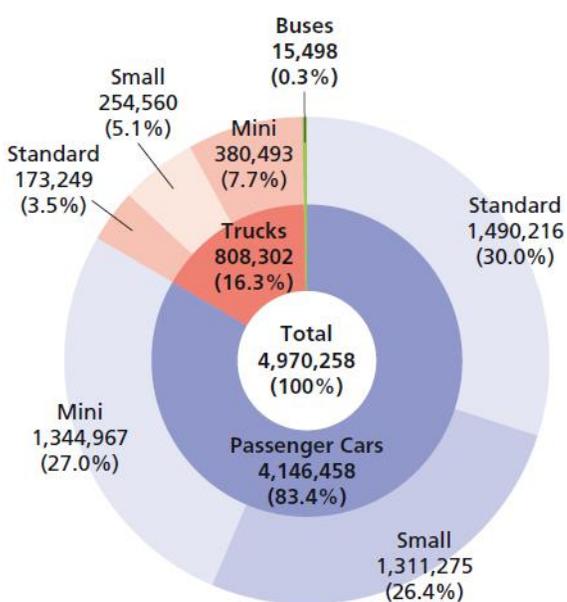
Motor Vehicle Production in Japan



Motor vehicle production by type Trends in motor vehicle production (JAMA, 2016)

Japanese Domestic Market

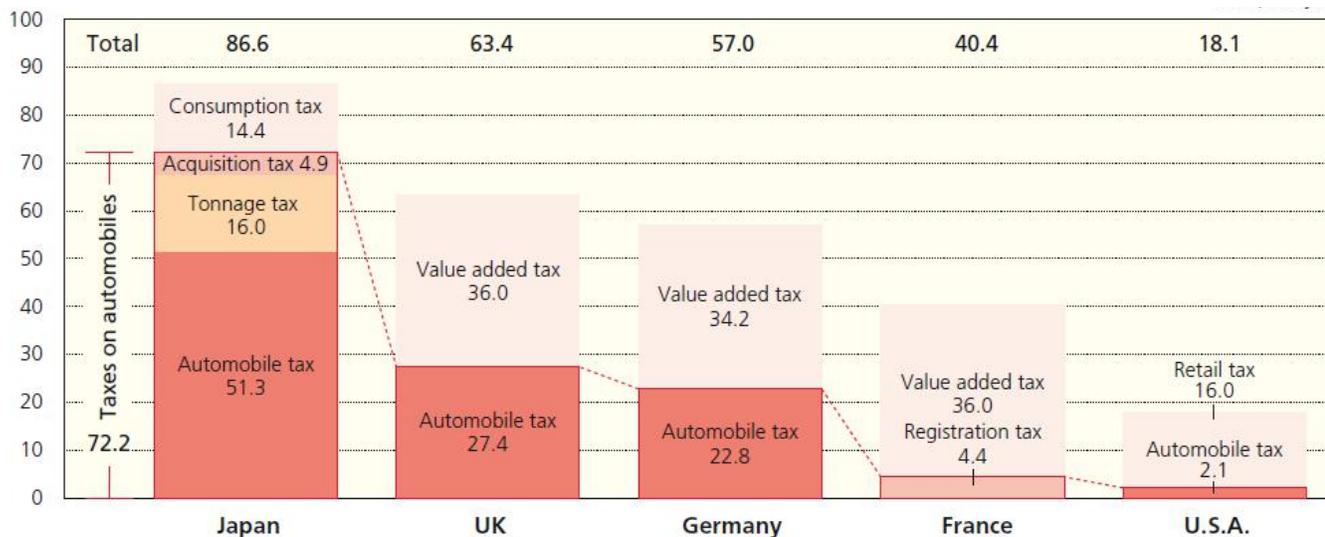
This production in Japan is partly for the domestic market, which is at a registration level of 5 million per year. Foreign cars account for only about 350,000 units, of which 300,000 are from non-Japanese car makers, and the remainder imported from abroad by Japanese makers.



New motor vehicle registrations by type Trends in new motor vehicle (JAMA, 2016)

There are 106 cars per 100 Japanese households on average, but this average elides huge differences by prefecture (the Japanese local entity bigger than villages, towns, and cities). Prefectures with relatively low population density, such as Fukui and Toyama have more than 170 cars per 100 households, while in Tokyo the rate is 45 cars per 100 households. In Japan, a vehicle may not be purchased and registered until the owner demonstrates ongoing access to a parking place for it—and space of all kinds is scarce and costly in cities, where excellent public transport renders private cars substantially unnecessary.

Cars are very heavily taxed in Japan compared to other countries; JAMA (the Japanese Automobile Manufacturer Association) have calculated that for a new car with purchase price of ¥1,800,000 (€13,812) taxes during the car's 13-year lifespan will amount to ¥2,324,000 (€17,833), about 30% higher than the purchase price.



International comparison of automobile taxes (JAMA)

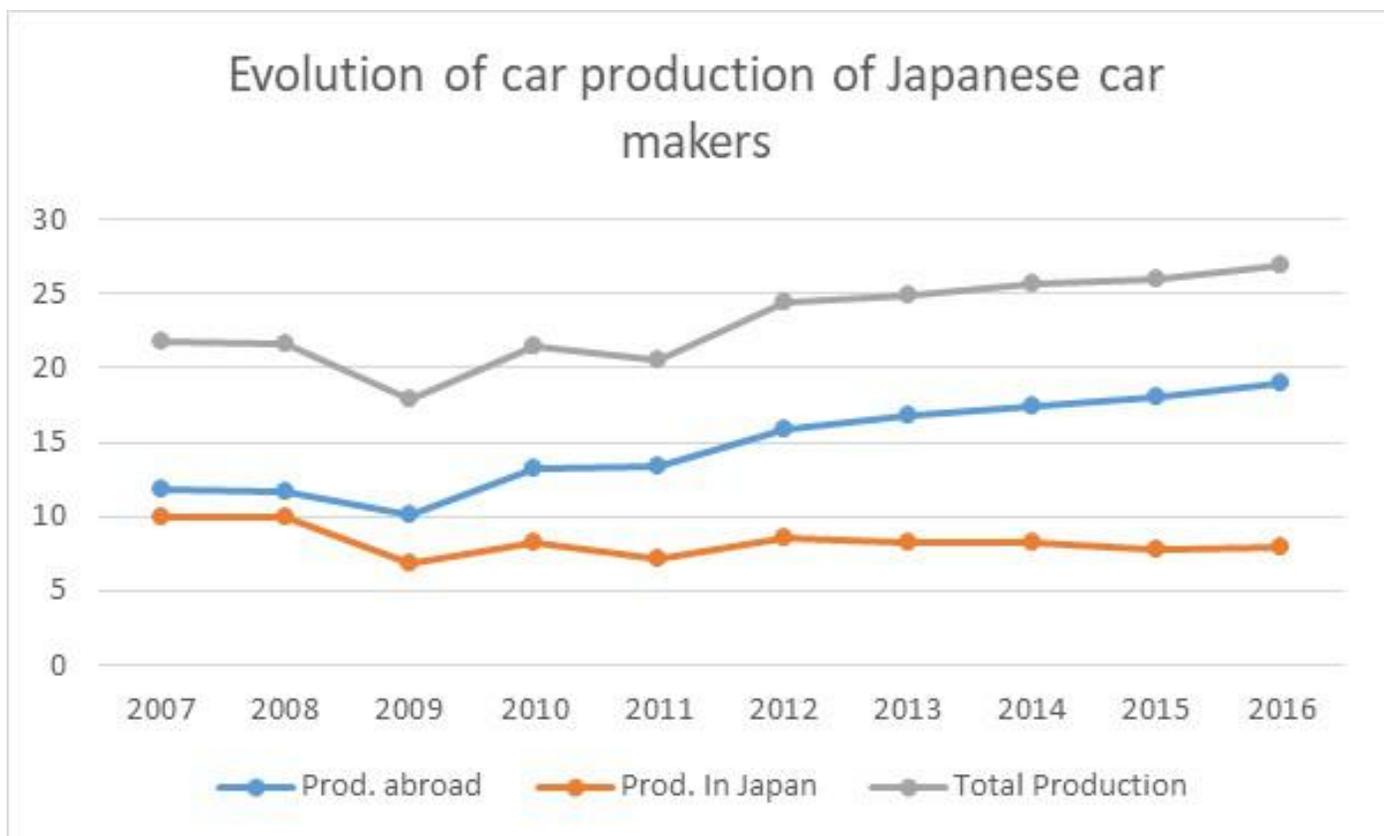
A very rigorous annual roadworthiness inspection called the *shaken* makes it expensive to maintain an older vehicle to the required standards. A vehicle which cannot pass inspection is not permitted on public roadways, so must be repaired, exported, or destroyed. Many Japanese used vehicles are exported to countries such as New Zealand or Russia once it is no longer cost-effective to keep them in service in Japan. Nevertheless, as in other developed countries, the average age of a passenger car in Japan is increasing: from 7.1 years in 2007, it rose to 8.4 years by 2016. In parallel the average service life was increased from 11.7 in 2007 to 12.8 years in 2016.

Japanese automotive industry worldwide

The Japanese car industry is strong worldwide, with production outside Japan growing more and more important.

Japanese makers' passenger car production (millions of units):

| Year | Outside Japan | In Japan | Abroad + Japan | Total worldwide (all makers) | Japanese share % |
|------|---------------|----------|----------------|------------------------------|------------------|
| 2007 | 11.86 | 9.94 | 21.80 | 71.56 | 30.5 |
| 2008 | 11.65 | 9.92 | 21.56 | 68.31 | 31.6 |
| 2009 | 10.11 | 6.86 | 17.97 | 65.57 | 25.9 |
| 2010 | 13.18 | 8.31 | 21.49 | 74.97 | 28.7 |
| 2011 | 13.38 | 7.16 | 20.54 | 78.17 | 26.3 |
| 2012 | 15.82 | 8.55 | 24.37 | 82.13 | 29.7 |
| 2013 | 16.75 | 8.19 | 24.94 | 85.60 | 29.1 |
| 2014 | 17.47 | 8.28 | 25.75 | 88.34 | 29.2 |
| 2015 | 18.09 | 7.83 | 25.92 | 89.68 | 28.9 |
| 2016 | 18.97 | 7.87 | 26.84 | 93.86 | 28.6 |

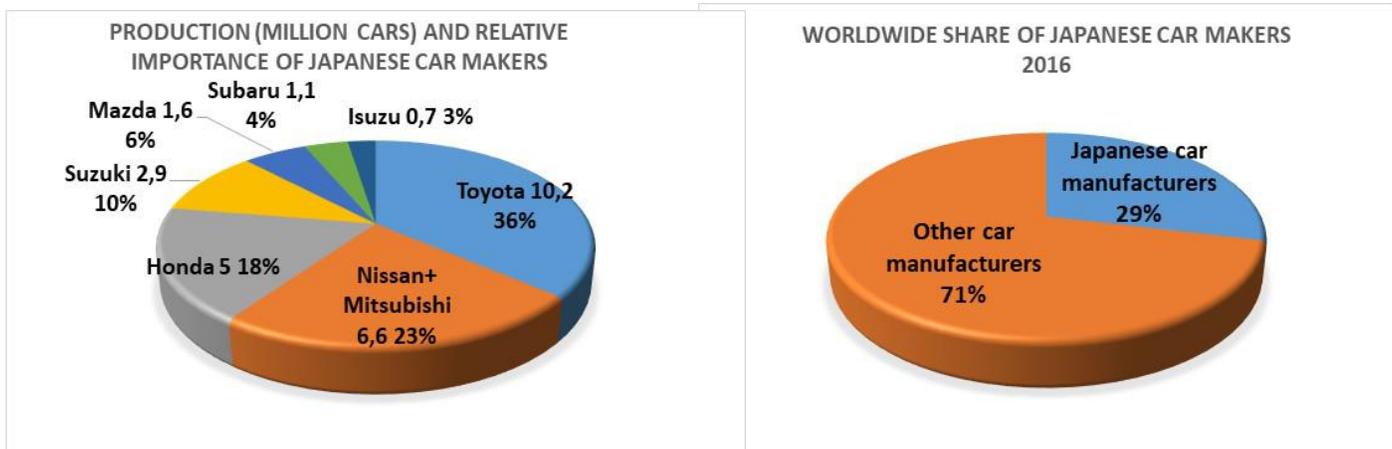


Japanese makers (in red) do about 29% of the global worldwide car production:

| Rank | Group | Country | 2016 Vehicles | 2017 (estimation) |
|-----------|----------------------------------|--------------------------------|------------------|----------------------|
| 1 | Toyota | Japan | 10,2 | 10,5 |
| 2 | Volkswagen Group | Germany | 10,1 | 10,7 |
| 3 | Nissan-Renault-Mitsubishi | Japan- France | 9,9 | 10,6 |
| 4 | Hyundai / Kia | South Korea | 7,9 | |
| 5 | General Motors | United States | 7,8 | |
| 6 | Ford | United States | 6,4 | |
| | Nissan | Japan | 5,6 | |
| 7 | Honda | Japan | 5 | 5,2 |
| 8 | Fiat Chrysler | Italy / United States | 4,7 | |
| 9 | Renault | France | 3,4 | |
| 10 | PSA group | France | 3,2 | |
| 11 | Suzuki | Japan | 2,9 | |
| 12 | SAIC | China | 2,6 | |
| 13 | Daimler | Germany | 2,5 | |
| 14 | BMW | Germany | 2,4 | |
| 15 | Changan | China | 1,7 | |
| 16 | Mazda | Japan | 1,6 | |
| 17 | BAIC | China | 1,4 | |
| 18 | Dongfeng Motor | China | 1,3 | |
| 19 | Geely | China | 1,3 | |
| 20 | Great Wall | China | 1,1 | |
| 21 | Mitsubishi | Japan | 1,1 | |
| 22 | Subaru | Japan | 1,1 | 1,1 |
| 23 | Isuzu | Japan | 0,7 | 0,7 |
| | | Total all manufacturers | 90,3 | |
| | | Total Japanese | 28,2 | |

(OICA)

NB: Total car production in 2016 was 93,856,000 vehicles. This chart excludes small makers, and some Chinese makers count twice by dint of their partners.



Toyota

Introduction • History

Toyota are the 10th most important company in the world according to Forbes Global 2000, are the world's most prolific automaker with 10,470,000 cars produced in 2017, roughly at a similar level with Nissan-Renault and VW, and naturally are the leader in Japan.

The company got started 80 years ago, founded by the family Toyoda—ancestors of Toyota's current President Akio Toyoda. Toyota began making cars in 1936, but their expansion really took off in the sixties. For a long time Toyota were focused only on automobiles, but since 1996 have been developing complementary activities in biotechnology, robotics, environment, and energy. They launched hybrid vehicles—the well-known Prius—in 1997, and are clearly still the leader in this domain today in the world, with a range extended today to plug-in hybrids. For electric vehicle technology, they are associated with Tesla. Toyota own 16.6% of Subaru and 5.9% of Isuzu, and have two main joint ventures in China.

In 2016 Toyota invested in a new company called TRI (Toyota Research Institute) in America for artificial intelligence, pursuing the target to eliminate car accidents. Toyota president Akio Toyoda says he wants Toyota to be "not just an automotive company, but a human movement company. 'Move' refers not just to transport, but also to inspiring deep emotion or excitement. We intend to take on all areas of human transport, working always from a desire to make transport itself an exciting, moving experience."

Recent news 2018

- 3 April: Toyota and Park24 to sign an agreement on a car sharing service trial in central Tokyo, marking the start of exploration into joint cooperation to achieve new mobility services.
- 2 April: Toyota announce a merger, from 1 April 2019, of their four sales companies in Japan to improve sales efficiency.
- 29 March: Basic agreement with Suzuki for mutual supply of hybrid vehicles.
- 9 March: Mazda and Toyota establish a joint venture "Mazda Toyota Manufacturing USA"

Toyota Management

President: Akio Toyoda

Vice Presidents: Koji Kobayashi, Didier Leroy, Shigeki Tareshi, Mitsuru Kawai, Shigeki Tomoyama, Moritaka Yoshida

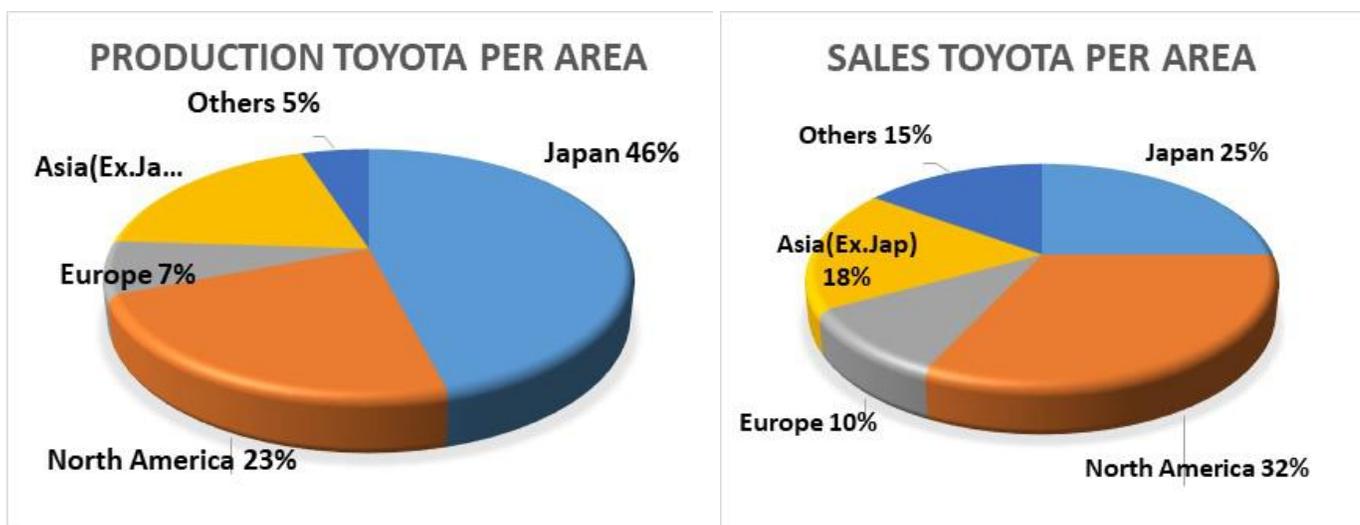
Main shareholders • % of stock • Approximate shares

Toyota are mainly owned by Japanese financial institutions (31.6%), other Japanese institutions (23.2%), Japanese individual (21.4%) and relatively few foreign institutions (24.3%).

| | | |
|--|-------|---------|
| Japan Trustee Services Bank, Ltd. | 11.1% | 364,338 |
| Toyota Industries Corporation | 7.0% | 229,274 |
| The Master Trust Bank of Japan, Ltd. | 4.8% | 156,668 |
| Nippon Life Insurance Company | 3.7% | 120,605 |
| State Street Bank and Trust Company (proxy: Settlement & Clearing Services Division, Mizuho Bank) | 3.2% | 104,004 |
| Denso Corporation | 2.7% | 86,882 |
| JP Morgan Chase & Company (proxy: Settlement & Clearing Services Division, Mizuho Bank) | 2.6% | 72,050 |
| Mitsui Sumitomo Insurance Company | 2.2% | 60,965 |

Figures

- **Revenues:** ¥27.6tn (\$260bn, €211bn)
- **Operating income:** ¥1,994bn (\$18.8bn, €15.3bn) so 7.2% of revenues
- **R & D expenditure:** ¥1,037bn (\$9.8bn, €7.9bn), so 3.8% of revenues
- **Employees:** 364,000
- **Production** (passengers cars only): 8,975,000



Brands

Toyota



New 2019 Toyota RAV4

Lexus



New 2019 Lexus UX

Daihatsu



Daihatsu Mira

Toyota Lighting

Toyota have introduced some decisive innovations in the market for lighting, the main one being the first series-production LED low beam headlamp in 2007 on their Lexus 600hL with five LED modules, extensive optics, and heat pipes. This first system had a very high price and mass, and relatively limited performance (500 lumens). In 2014 they put high-performing LED low beams as standard equipment on the very popular, affordable Corolla throughout the North American market.

Toyota have high specifications for lighting, with particular requirements concerning the width of the beam—very important in Japan for intersections—and the seeing distance. Progressively, with improvements in LED performance, it has been possible to reduce the number of modules. Now Toyota are using for mainstream cars a Koito bi-function module producing both low beam and high beam in the same unit thanks to a very powerful LED (at around 2000 lm). For upper-range cars, multiple low-profile modules are used for style. Toyota are working to standardise their various modules for cost and quality reasons.

For new functions, Toyota have developed several cars with AFS, particularly with bending lights. They introduced ADB systems in 2012 with a mechanism on the Lexus LS, and matrix beam on the Lexus RX in 2015. The new Lexus LS launched in 2017 has two rows of 24 LEDs.

Examples of design for Lexus headlamps

Round modules for mainstream cars and ADB functions with triangle shape for high-class cars



Lexus RX Hybrid ADB



LS Hybrid



Lexus ES Hybrid



LC Hybrid

Toyota Interview

Kazuhiko Nakashima, Toyota Group Advanced Safety Systems Manager



DVN: What do you make of Toyota President Akio Toyoda's comments about wanting Toyota to be not just a car company, but a human movement company, referring not just to transport but also emotional excitement? How do you interpret this goal in the lighting domain?

KN: I am not able to answer on behalf of the Toyota Company, but I am giving the feeling of a Toyota lighting systems manager. Headlamps have two functions: one is giving an impression to the customer by the design, and the other one secures the visibility at night and gives peace of mind. I interpret the words of President Toyoda as "What kind of impression we can give with a headlamp to this movement" and my interpretation of that impression is something which gives added value beyond customers' expectation. For example, if visibility is secured at night like daytime, it would be impressive. And it would be amazing if we could secure visibility in mist or rain the same as fine daytime. I interpret it as developing such things. Although it is difficult to realise this only with the equipment of one vehicle, it may be feasible by connecting with other vehicles and infrastructure. I think we should develop such a headlamp.

DVN: Several megatrends in relation to environmental concerns and zero fatalities in traffic are now influencing the car industry. What could be the actions of your company to prepare this future?

KN: It may be important to discuss global issues, but first of all we need to think about the parts we are developing, so headlamps. Originally LED is a low power capable device. However, it is not currently only used for low power consumption, but too for miniaturisation of style design. So, we should develop a headlamp which has compatibility between styling improvement of headlamps and power control. Many developed countries also have lots of street lights and even in places where visibility is secured, they are illuminated with headlamps. I think that if we can create efficient lighting by connecting vehicles to society, we can reduce the global power used for lighting and contribute to environmental measures. Making efforts to the extent possible can lead to a sustainable society.

DVN: Do you feel that newcomers—Apple, Google, Intel, and the like—will play a more important role in the future particularly with the development of AI? Do you anticipate any change in the value chain?

KN: I think they will play a role. If the future is a world that connects everything, we cannot connect without those newcomers. I think that we will provide new services by connecting with them. But a car is not only a moving thing, it is also something giving a specific feeling to the owner. Those newcomers

alone cannot give this perception given for instance by a Lexus or a Ferrari as they are not selling cars, even if they are able to do automatic driving and information provision. If the car keeps its value as a brand, I think that there will be no change in the value chain. I believe that car makers should lead the development of attractive cars that let customers feel the brand as a value.

DVN: The main directions for the evolution of car industry will be towards more electric, autonomous, and connected cars. What are the main actions in your company sustaining these directions? What could be the consequences for lighting?

KN: About autonomous cars, we have to consider that there is a large pallet of customers' expectations, and many of them will prefer in some circumstances to drive by themselves. On the other hand, during many years, totally manually driven cars will continue to be on the roads, and naturally pedestrians and cyclists too, and so lighting and signalling will continue to be necessary. The price gap for autonomous cars is currently very high. So, we have to prepare introduction of autonomous cars, but a good lighting function will continue to be important.

DVN: What have been your company's main achievements in lighting over the past 10 years concerning technologies and style?

KN: Toyota put on the market the first LED headlamp in 2007 with the Lexus LS. This headlamp did not impress by its power or its design, although it was technically difficult. But thinking about the customer's value, LED headlamp can bring new design (with possibility of thin appearance), power saving, space saving, weight saving, maintenance free and light distribution control. As I am an electronics engineer, I decided to develop an electronic platform in order to make all this possible with a flexible ECU allowing easy adoption of new functions like ADB. The first vehicle with ADB was the Lexus NX which was released in 2014. Naturally, to do complete products, we are also using highly efficient LED light sources, and specific optical design being done with people of affiliated companies.

DVN: Now LEDs are replacing HID and perhaps also halogen: have you any plan in your company to generalise that technology? When might your company have 100% of new cars equipped with LEDs for main front lighting?

KN: For LEDs, some parts have to be standardised and others to be specific. We developed a headlamp ECU based on the idea that standardisation should be done for parts which are not visible by customers. Since we knew that the LED headlamp is structurally simple and it was known that the system is also highly scalable, I proposed to develop a new system for LED in 2011, and it was put in place in 2012. Now for a generalisation of LEDs at 100%, it is the case for instance for the Lexus range, and not so far for many other vehicles. But there is still today an expectation from sellers to have elements of differentiation for the entry-level version. For some markets the extra price for LEDs is still difficult to overcome.

DVN: Reduction of accidents for pedestrians is a priority, particularly in Japan. In the last JAMA report, AFS is recognised as a key safety feature. Have you any action in your company to develop these AFS applications? What could be the best system for safety?

KN: ADB using the high beam function can secure better visibility than AFS using the low beam function. In fact, what we should develop is not the functions called AFS or ADB but an optimum light distribution control for securing the view of the driver while not glaring other users. However, as currently IHS can

give additional marks with AFS, I have heard that many companies are adopting AFS. But for safety, ADB is better.

DVN: ADB is well appreciated particularly in Europe, and likely the regulation will allow it soon in America. How do you see in the future the applications of this technology within your company?

KN: ADB was introduced on the Lexus LS in 2012 with a mechanical system. This system was replaced by matrix beam systems in 2015 first on Lexus RX. Then it was improved with the introduction in 2017 on Lexus LX of a system with two rows of 24 LEDs. However Toyota do not want to compete with the number of segments, and is considering that a 12 segments system can already give good results. The real added value is the priority. This ADB function should be too an appreciated function in the United States as it is in Europe. There is no customer who is annoyed by a good visibility. We will proceed in introduction to the United States when it will be accepted by laws and regulations.

DVN: Do you think that ADB HD (High definition) technology could be used soon and with which technology?

KN: The term 'HD' is too broad to have a simple answer. It can be used technically if it is considered in a limited area. However, what is important is the value offered to customers, and I think that we should discuss more about what we can offer with high resolution. We have not to propose a surprising function, but an impressive feature. I have not yet been able to propose an impressive function in HD.

DVN: What other technologies could become very important in lighting?

KN: I do not know what will become important in the future. It will be certainly a device that can offer cheaply to many customers an impressive function. DMD has the potential to impress, but I think that it will be difficult to disseminate it unless it could achieve an acceptable price.

DVN: What is your feeling about new lighting sources like laser for headlamps or OLEDs for signalling? Do you intend to use them?

KN: The key point is the value we can provide to customers. If laser and/or OLED can provide valuable things to customers, we should use them. Lasers and OLEDs are just a means to realise value.

DVN: How do you see the evolution of headlamp and rear lamp styling?

KN: I am not in the best position to answer, but if I consider a car as a face, the headlamps are eyes. Recent cars have more and more narrow eyes, and I think that this trend will continue in the future. Toyota's styling designers cherish the line of light, so in the future there may be integration of the low beam and the [front position] lamp. Also in the future, many additional functions are expected, and they could potentially be integrated in lighting if they can have a good look.

DVN: Many sensors are used for ADAS. Which of them would you like to see integrated in headlamps or rear lamps?

KN: Sensors on the roof as seen on some demo cars is a poor styling solution. So a good styling integration is a must-have. Integration in headlamps and rear lamps could be a solution for some of them. Space analysis and design would decide for each case.

DVN: Can you tell us your main directions to prepare lighting that will accompany future autonomous and connected cars?

KN: As nobody is knowing the future, it is important to develop lighting systems that could be compatible with automatic driving or connected cars. For that purpose, I am thinking of a digital headlamp which can be highly extensible and can create new value in cooperation with other systems, realising new functions to impress the customer.

Nissan

Introduction • History

Nissan are the second-biggest Japanese car maker. However, the Renault-Nissan-Mitsubishi alliance is now the worldwide leader for quantities of cars. Nissan are selling cars with the brands Nissan (main general brand), Infiniti (luxury/premium) and recently again Datsun (low-price cars in developing markets).

NISSAN MOTOR CORPORATION



The Company started automotive activity in 1911, created by three persons: Kenjiro **D**en, Rokuro **A**oyama, and Meitaro **T**akeuchi. Their initials, DAT, were used for the creation of the brand "Datson" in 1931—literally son-of-DAT—later changed to Datsun to refer to DAT and the sun symbol of Japan. In 1934 another company, Nihon Sangyo (literally: Industry of Japan) bought Datsun and created Nissan Motor, still selling cars under the Datsun brand.

Big expansion began after the second war, with some important successes like the Bluebird in 1959. The company acquired Prince Motor, producing high-range cars, the base of the Skyline and Gloria models. Internationalisation began in 1958 with exports to America and then to other countries. First plants outside Japan were in Taiwan (1959) and in Mexico (1961), followed by many other plants now in many developed countries. The strongest period of expansion was during the seventies, with Nissan becoming number two in Japan. A five-year worldwide phase-out of the Datsun brand began in 1981, and the Infiniti brand was created in 1989 as a reaction to the Lexus luxury brand launched by Toyota.

In the nineties Nissan began to have very serious economic difficulties, having few profitable years and accumulating unsustainable debt. On 1 March 1999, an alliance with Renault was formed, Renault taking 44% of Nissan stock, and Carlos Ghosn becoming chairman. His plan succeeded, and Nissan became again profitable and successful.

In 2013 the Datsun brand was revived for developing markets, first applied in India for a low-cost vehicle. In May 2016, Nissan became the primary shareholder of Mitsubishi with 34% of shares, and the Renault-Nissan-Mitsubishi Alliance is since 2018 the world's N° 1 in terms of number of cars sold.



RENAULT NISSAN MITSUBISHI

The vision of Nissan, defined by President and CEO Hiroto Saikawa, is "enriching people's lives, committed to deliver unique and innovative vehicles and mobility services with value that is recognised by customers".

Recent news

- Nissan North America are recognised by the U.S. Environmental Protection Agency with the 2018 Energy Star® Partner of the Year Sustained Excellence Award, the highest honour given to organisations dedicated to protecting the environment by making their operations more energy efficient.
- Nissan show three electric vehicles at Auto China 2018.
- The all-new 2018 Nissan Leaf, the world's best-selling electric vehicle, is named the "2018 World Green Car" at the 2018 New York International Auto Show. The Leaf is the icon of Nissan Intelligent Mobility, the company's vision for changing how cars are powered, driven, and integrated into society.

Management

Chairman of the Board and President: Carlos Ghosn, Hiroto Saikawa

Board of Directors: Hideyuki Sakamoto, Toshiyuki Shiga, Fumiaki Matsumoto, Kimiyasu Nakamura, Jean-Baptiste Duzan, Bernard Rey, Greg Kelly

Chief officers: Joseph G. Peter, Philippe Klein, José Muñoz, Yasuhiro Yamauchi

Executive Vice Presidents: Christian Vandenhende, Hideyuki Sakamoto, Tsuyoshi Yamaguchi, Daniele Schillaci

Senior Vice Presidents: Hitoshi Kawaguchi, Takao Asami, Jun Seki, José Luis Valls, Takashi Hata, Gianluca De Ficchy, Roland Krueger, Arun Bajaj, Asako Hoshino, Rakesh Kochhar, Hari Nada, Noboru Tateishi, Alfonso Albaisa, Peyman Kargar, Denis Le Vot, Hiroshi Karube, Kunio Nakaguro, Atul Pasricha, Makoto Uchida

Renault-Nissan-Mitsubishi Alliance Management

(from 1 April 2018)

Chairman and CEO: Carlos Ghosn

Executive VP of Engineering: Tsuyoshi Yamaguchi

Deputy Executive Vice President of Engineering: Gaspar Gascon

Senior VP of Research & Advanced Engineering: Takao Asami

Senior VP of Powertrain & EV Engineering: Philippe Brunet

Senior VP1 of Product Development: Christian Steyer

Senior VP2 of Product Development: Kunio Nakaguro

Global VP of EE and Systems Engineering: Alexandre Corjon

Global VP of Transformation & Performance Office: Karim Mikkiche

Global VP of Customer Performance & CAE / Test Engineering: Hiroshi Nagaoka

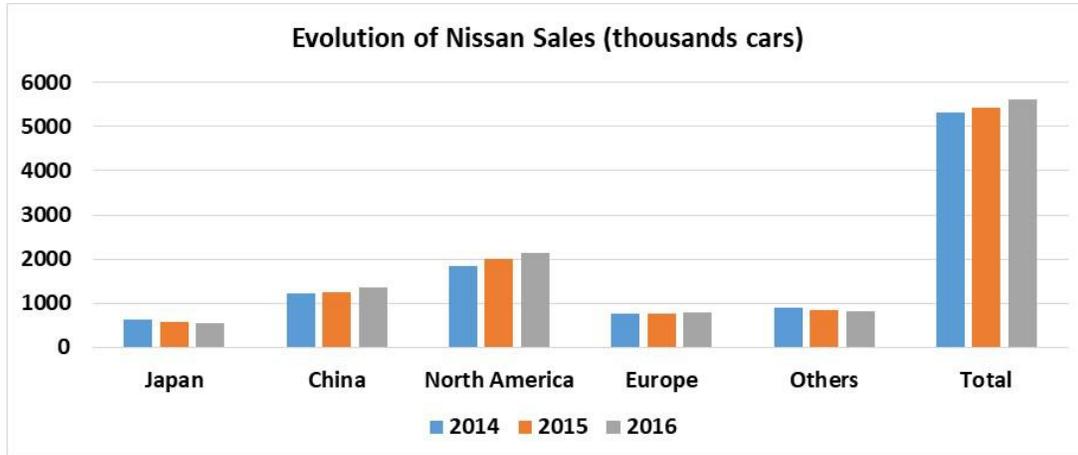
Main shareholders



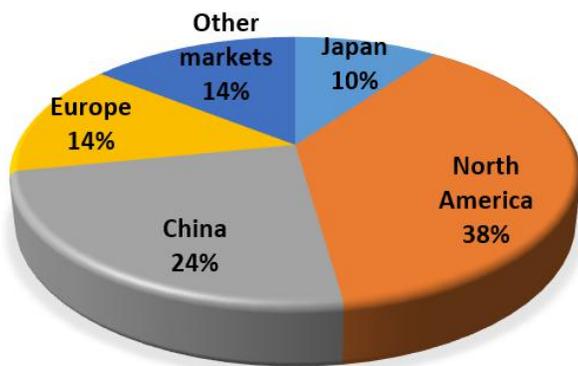
Main figures (Nissan alone, FY2016)

- Sales: ¥11.72 quadrillion (\$110.3bn, €89.8bn)
- Ordinary income: ¥864.7bn (\$8.1bn, €6.6bn)
- Employees: 137,250
- Cars produced: 5.6 million
- R & D as percentage of sales: 4.5% (Nine months fiscal year 2017-2018)

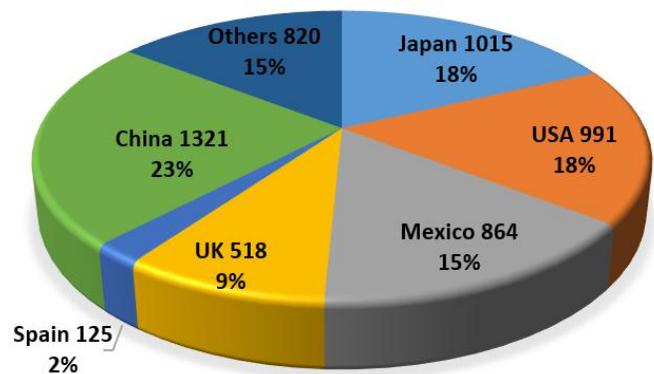
Sales and Production (Nissan alone)



NISSAN SALES FISCAL YEAR 2016



NISSAN PRODUCTION FISCAL YEAR 2016



Nissan Lighting

Nissan are now more and more using LEDs for front lighting, at 100% for the high-range Infiniti brand. Nissan are however still using halogen for cost reasons, particularly in small cars or for developing countries.

Nissan introduced front lighting LEDs mainly with projector systems, but introduced the reflector appearance on the first Leaf in 2010, and more recently a direct-lens system on the new Leaf. Nissan are still waiting for ADB introduction, particularly as their main market is America where the regulation is still pending.



Nissan Leaf: world's best-selling electric vehicle



Nissan Note



Infiniti UX3

Nissan and Infiniti Lighting Signatures

Lighting Signature (Nissan Brand)

➤ Front : Boomerang lamp signature



Lighting Signature (Nissan Brand)

➤ Rear : Boomerang lamp signature



Lighting Signature (INFINITI Brand)

➤ Front : Focused eye Head Lamp



Lighting Signature (INFINITI Brand)



Nissan Interview

Hitoshi Nakagaki - Senior Interior/Exterior and HMI Engineer



Hitoshi Nakagaki is Senior Engineer at Nissan for Interior and Exterior Engineering for the Interior / Exterior and HMI Engineering Group. In 1986 he graduated from university, subsequently taking a job in lamp design. Between 1991 and 1993, he was involved in lamp and mirror testing, and from 1993 to 2015 he took charge of lamp, wiper, mirror, and bumper design. In 2015 he got involved with standardisation, quality, and compliance. All in all he has 30 years' experience in vehicle lighting. He was joined for this interview by his colleagues Tsuyoshi Noda of the Exterior Trim Design Engineering Group and Manfred Jules of the Interior/Exterior and HMI Engineering Group.

DVN: With all the current megatrends on environmental concerns (CO₂, NO_x, fine particles), sustainability (recycling, hazardous materials), the car sharing economy, personalisation, urbanisation and megacities, and the reach toward zero fatalities in traffic, what do you think is the most important in the future and what could be the actions of your company to prepare this future?

NH: Everything is important, but safety is the most important. And lighting systems have to support that during day time and night time. For instance in Nissan, we are developing systems to switch on beams earlier as this is reducing accidents at dawn. CO₂ reduction is important, too, and Nissan were the first car maker to invest massively in electric cars. In our domain, the development of LEDs helps reduce electric power consumption, and so we reduce CO₂ emissions.

DVN: Do you feel that newcomers—Apple, Google, Intel, and the like—will play a more important role in the future particularly with the development of AI? Do you anticipate any change in the value chain?

NH: Nissan are naturally involved in this domain, and have opened an office in Silicon Valley. But we would like to guarantee the safety of the vehicle. Currently, the IT giants have big data connections, and that will be useful in the future connected cars, but their systems could fail against attacks. This cannot be accepted for future autonomous cars, and so Nissan will have to keep the global control to insure safety.

DVN: The main directions for the evolution of car industry will be towards more electric, autonomous, and connected cars. What are the main actions in your company sustaining these directions? What could be the consequences for lighting?

NH: Nissan have launched several electric cars including the best seller Leaf with a second generation last year. We have hybrid cars with a small fuel engine for recharging the battery to increase the autonomy of electric cars. Lighting is participating to increase the autonomy, for instance in the last Nissan Leaf, the direct lens system used gave the best efficiency and so a reduced consumption. For autonomous cars, new signalling functions will be important for pedestrians and motorcycles. However,

for now in Japan there is no cooperation between the actors of lighting and universities for such a development.

DVN: What have been your company's main achievements in lighting over the past 10 years concerning technologies and style?

NH: Nissan have established a signature for the three brands: Nissan with boomerang shape, Infiniti with focused eyes, and Datsun both for front and rear and that is key for lighting equipment. Nissan are proud to have developed nice products with a very good homogeneity giving a good appearance.



DVN: Have you any plan in your company to generalise LED technology?

NH: LEDs can achieve better performance, but it is not obvious to sell the technology to all customers. In some countries people are not so interested by that, and we have to take into account that lighting is used only 20% of the time. As there is a strong competition for adoption of new devices in the vehicle, it is analysed case by case; halogen still has an important place even though LEDs are growing. For sure, LEDs are used 100% for the Infiniti brand, and also extensively used for other-brand cars on the Japanese market, but halogen will stay for some other markets.

DVN: What is the most effective lighting solution to improve safety?

NH: High beam assist is very useful for safety improvement. ADB is also a good feature for safety.

DVN: When will Nissan start installing ADB systems?

NH: Several vehicles are under preparation with ADB. But it is a system with no strong interest in cities, so it's difficult to use in Japan except in Hokkaido. We have to take into account specific needs for each country.

If regulations will change in the USA, Nissan will certainly accelerate the adoption of this system. But in every case, Nissan will consider the benefits versus the extra cost.

DVN: Do you think that ADB HD (High definition) technology could be used soon, and with which technology?

NH: How to compare the benefit for customer of a 1000 segments system versus an 11 segments

system? We have first to analyse the real benefit of HD for adoption, as an 11 segments system is already giving good results.

DVN: What other technologies could become very important in lighting?

NH: An important direction will be to develop lighting systems able to collaborate with autonomous driving.

With new cameras and other sensors, perhaps there will be no need of lighting beam for driving at least for the car itself. For sure due to the environment, for other users as manual driving cars or for pedestrians, lighting will need to remain for a long time.

DVN: What is your feeling about new lighting sources like laser for headlamps or OLEDs for signalling? Do you intend to use them?

NH: We do not currently see the benefit of these sources for the customer as they are too expensive. Lasers could make important progress in the future, so the decision could be reconsidered if an important evolution happens. In the past, there were different generations of sources, each lasting roughly twenty years, with halogen and HID. Now LEDs...so, what could be the next one?

DVN: How do you see the evolution of headlamp and rear lamp styling?

NH: There is not a unique style. Style has to be adapted to each case. Personalisation will still be important.

DVN: Many sensors are used for ADAS. Which of them would you like to see integrated in headlamps or rear lamps?

NH: It is a good idea to integrate sensors. Currently this point is under discussion, but no decision has been taken yet.

DVN: Can you tell us your main directions to prepare lighting that will accompany future autonomous and connected cars?

NH: We are working to increase interactions between lighting and other departments to support three main strategic directions: EVs, AVs, and connectivity.

Honda

HONDA
The Power of Dreams



Introduction • History

Honda came to exist when Soichiro Honda and Takeo Fujisawa cooperated in 1948. In the beginning they produced motorcycles, and Honda quickly became the worldwide leader in this domain thanks to their 4-cycle engines. They fielded the first modern motorcycle, the CB750 Four, in 1969, and in the mid-1970s they launched the Gold Wing.



In 1963 Honda began making small cars—the T360 and S600—using motorcycles engines. After a strong expansion with continued technical innovations particularly in the domain of engines, Honda are now the 6th largest car manufacturer in the world with a production in 2016 of roughly 5,000,000 units. Honda have several times participated in the Formula 1 championship mainly by delivering engines, and won the championship six times from 1986 to 1991 in association with Williams and McLaren. Honda also make small aircraft, generators, outboard boat motors, lawn mowers and other yard and garden power



equipment, and general-purpose engines.

Recent news 2018

- 11 April: Millionth vehicle in the US with Honda Sensing, which reduces insurance claim rates by 11% for damage and 28% for injuries. Applied at 69% for the 2018 model year, it will be on 100% of Honda's vehicles sold in 2022.
- 3 April: Restructure of production in Brazil with a new plant in Itirapina.
- 28 March: Strategic alliance with ANA (All Nippon Airlines) to expand the HondaJet business plane market.

Honda Main figures

Honda global (Fiscal year finishing March 2017)

President and Representative Director: Takahiro Hachigo

Revenues: ¥14tn (\$131.7bn, €107.2bn)

Operating profit: ¥840.7bn (\$7.9bn, €6.4bn), so 6% of revenues

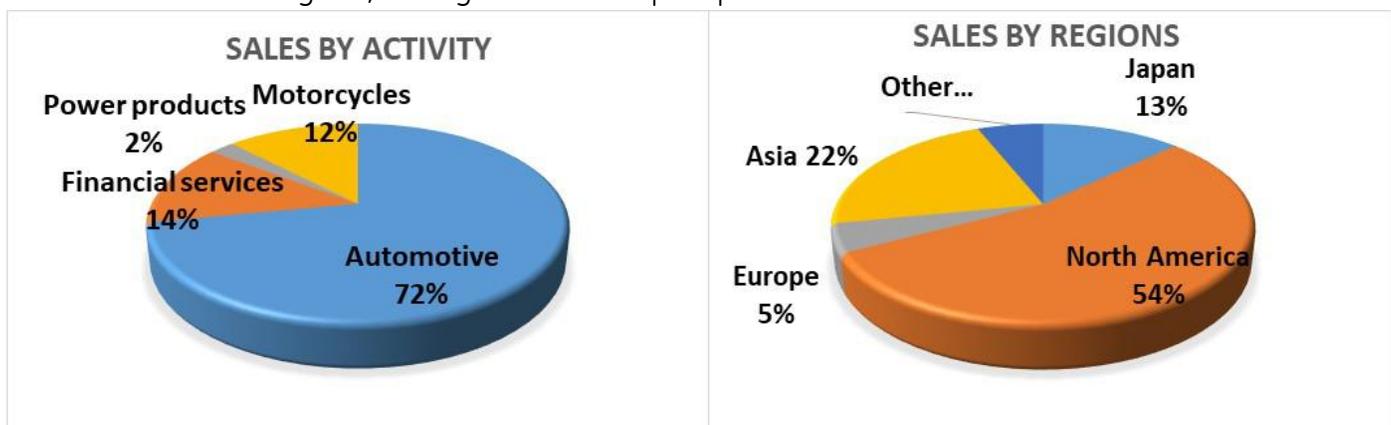
R & D expenditure: ¥685bn (\$6.4bn, €5.2bn), so 4.9% of revenues

Employees: 211,915 (plus 21,902 for non-consolidated operations)

FY17 Production: 5.01 million cars, 17.59 million motorcycles, 6.12 million power products

In February 2018, the forecast for FY18 called for sales at ¥15.2tn (+8.6%) and operating profit at ¥775bn

(-7.8%), with a trend for production compared to previous year of +4.3% for automobiles, giving an estimate of 5.2 million car for year finishing March 2018, and +10.4% for Motorcycles, giving an estimate of 19.4 million motorcycles, mainly for Asia except Japan.



Honda Automobiles (FY17):

Revenue: ¥10.26tn (\$96.5bn, €78.6bn)

Operating profit: ¥501bn (\$4.7bn, €3.8bn), so 4.9% of revenues

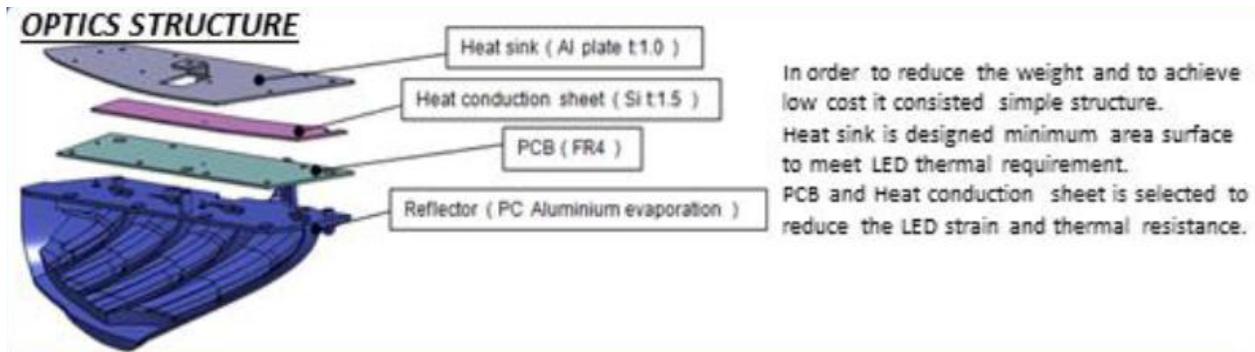
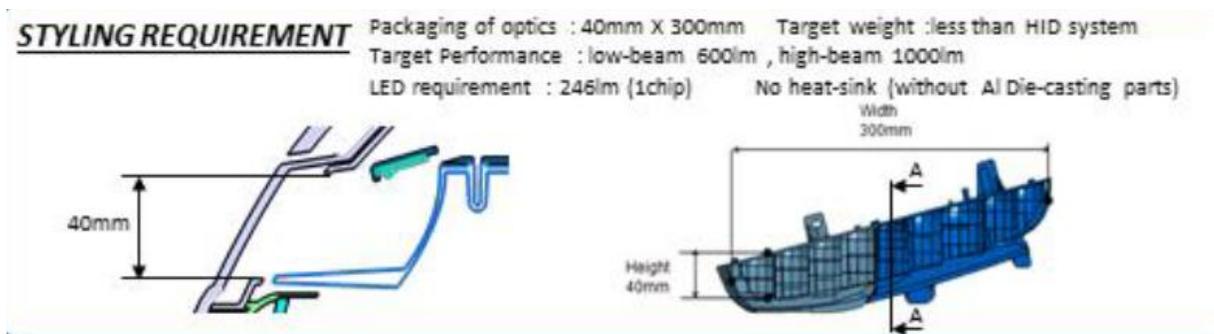
Honda Lighting

Honda were one of the first to introduce slim headlamps in the market. They've kept developing along this line with their latest designs, such as the 2018 Accord using nine LEDs for low and high beam functions with direct reflector technology.

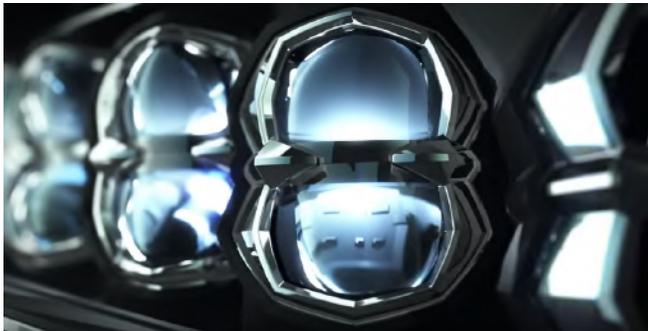


Past lighting innovations from Honda included the first headlamps with window-clear lenses and pure reflector optics on the 1990 Accord in America and the 1996 Civic in Europe).

Technology



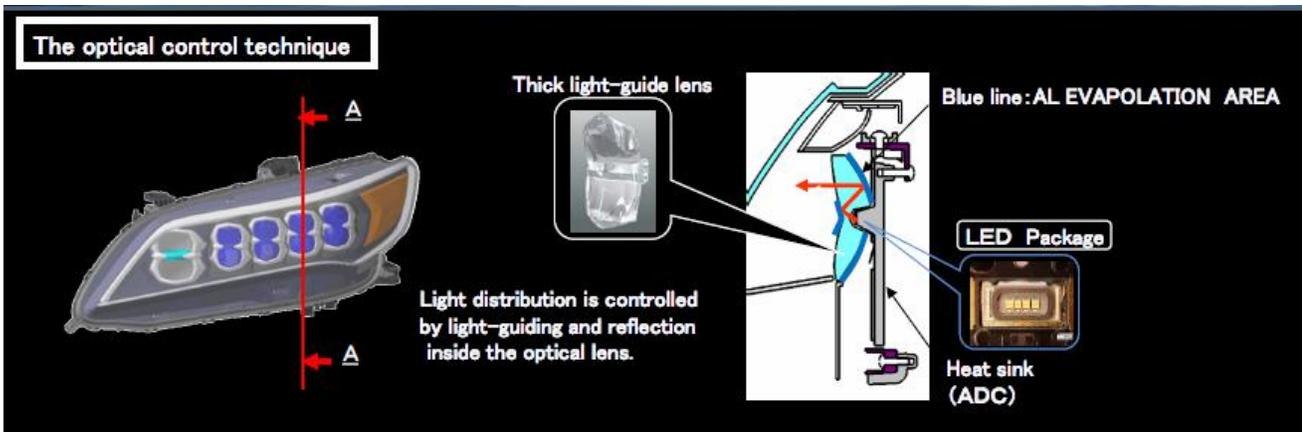
Jewel eye technology in Honda Acura headlamp



Principle
of double reflection
inside lens,
with improved efficiency
and novel style



Acura RLX LED Headlamp Concept



Preminent lighting performance to all Driving scenes.

| | Jewel eye | Projector | Reflector |
|-----------------------------------|--------------|-----------|-----------|
| Number of parts (One module) | 3 | 5 | 3 |
| Module depth (with heat sink) | 65mm | 125mm | 105mm |
| Optical size (front view) | H70 × W44 mm | φ 60mm | φ 120mm |
| Optical efficiency (as headlamps) | 50-60% | 40-50% | 45-55% |

From: T.Anzai(2013).Complex direct projection lens with reflection and Refraction for Headlamps

Latest lighting presentations

Honda's presentation at the last ISAL congress described a survey showing the benefits of high resolution systems for safety, particularly by highlighting white lines on the road, thus reducing driver anxiety.

Honda Interview



Ryo Chijimatsu: Manager & Chief Engineer, Exterior Lighting, Visibility, Door & Gate Systems (Excused during the interview)

Hidefumi Watanabe: Chief Engineer Group, Leader of Lighting Design (photo, centre)

Kazuo Aoyama: Assistant Chief Engineer, Lighting Design (photo, right)

Shigeto Iwamoto: Assistant Chief Engineer, Automotive Lighting Research (photo, left)

DVN: Honda President Mr. Takahiro Hachigo has defined the strategy of Honda for 2030: "To become № 1 in the areas of the environment and safety, Honda will invest more resources in these areas and strive to become a company that leads the efforts to realise a carbon-free and collision-free society". What are the main lighting activities pushing in this direction?

Honda: We are focusing on advanced safety technologies such as Honda Sensing and AVs. For lighting, we are proceeding with investigation and development of items which can support safety.

DVN: With all the current megatrends on environmental concerns (CO₂, NO_x, fine particles), sustainability (recycling, hazardous materials), the car sharing economy, personalisation, urbanisation and megacities, and the reach toward zero fatalities in traffic, what do you think is the most important in the future and what could be the actions of your company to prepare this future?

Honda: We are thinking a carbon-free, traffic accident-free society will be important and so we are targeting to actualise those goals. And we believe to tackle with those items are the responsibility of the company.

DVN: Do you feel that newcomers—Apple, Google, Intel, and the like—will play a more important role in the future particularly with the development of AI? Do you anticipate any change in the value chain?

Honda: Regarding the value chain, we think it will likely to change. But we have to carefully keep an eye on those trends.

DVN: The main directions for the evolution of car industry will be towards more electric, autonomous, and connected cars. What are the main actions in your company sustaining these directions? What could be the consequences for lighting?

Honda: The three items mentioned are the areas we have to focus on and we are continuing the investigation. For lighting we are also focusing on these item which can support autonomous vehicles, communication, and electric consumption reduction.

DVN: What have been your company's main achievements in lighting over the past 10 years concerning technologies and style?

Honda: We like the jewel eye optics, the inline type LED headlights, and the fine curved lens that we introduced. The jewel eye technology has a better efficiency than traditional projector systems. This technology is used for instance on Acura models. The inline reflector technology, with six LEDs for low beam with a flux of 650 lm and three LEDs for high beam with a total flux of 1100 lm is no more requiring heatsinks. This technology is used for instance on the CRV and Accord. These technologies are considered as standards and applied on many cars.

DVN: Now LEDs are replacing HID and perhaps also halogen: have you any plan in your company to generalise that technology? When might your company have 100% of new cars equipped with LEDs for main front lighting?

Honda: LEDs have clear technical advantages and so Honda would like to apply them systematically. Already the application rate is 82% for some B-segment minivans and even 98.8% for small SUVs in Japan. However, for some countries, particularly developing countries, halogen has still to be used for cost reasons.

DVN: The latest JAMA report says AFS is one of the top four priorities for pedestrian safety improvement. Have you any action in your company to expand AFS applications?

Honda: Honda are applying active cornering lights, activated both by turn indicator and steering wheel. We think that this solution is the most effective one for safety at intersections particularly in Japan, and so it is our first priority. We have developed in the past swivelling units, but we think it is not the best answer for customer benefit.

DVN: ADB is well appreciated particularly in Europe, and likely the regulation will allow it soon in America. How do you foresee future applications?

Honda: We feel ADB is not a high priority in Japan's conditions; due to the particularly dense traffic, the interest is more limited. However, we are continuing the investigation and assessments. We plan to use ADB in the future, and are awaiting opportunities for application for instance with the change of regulation in America. When this regulation will be changed, we shall be ready for ADB application.

DVN: Honda presented an interesting survey at the last ISAL demonstrating interest in HD ADB for line guiding. Do you think that ADB HD (High definition) technology could be used soon, and with which technology?

Honda: We are expecting that premium brands will adopt those technologies. For the method we think it needs to be investigated.

DVN: What other technologies could become very important in lighting?

Honda: Picture technology could be more and more important in the future, with information exchange in two directions, from environment to the lighting systems, and from the lighting system to the environment. Our systems will have to cooperate with lidar, radar, cameras, and other sensors. The controlling technology will become essential. But Honda has no precise target concerning the introduction of this technology.

DVN: What is your feeling about new lighting sources like laser for headlamps or OLEDs for signalling? Do you intend to use them?

Honda: We are finding many potentials in laser and OLEDs, and so we are keeping an eye on those technologies. Laser cost is currently a big challenge and we have no plan to apply them quickly. OLED is also very expensive, with the necessity to have specific sources for each application for styling interest, so we have no immediate target for application.

DVN: How do you see the evolution of headlamp and rear lamp styling?

Honda: Headlamps and rear lamps will continue to be very important for styling. For front lighting, we see a continuation of the trend for slim headlamp, with reduction of size of modules in both height and width. Compactness will continue to be a challenge. Signal lamps will be used too for communication, but they still require a decent area for their visibility.

DVN: Many sensors are used for ADAS. Which of them would you like to see integrated in headlamps or rear lamps?

Honda: We are analysing many possibilities, but the integration of sensors is not decided yet. Investigation has to be done to understand the true merit. We have no conclusion about the integration of cameras in lamps.

DVN: Can you tell us your main directions to prepare lighting that will accompany future autonomous and connected cars?

Honda: We believe the importance of lighting will be kept particularly as a communication tool for autonomous and connected cars. Communications in the two directions will be the most important new development.

Mitsubishi

Introduction • History



Mitsubishi Motors is the longest-established mass market car manufacturer in Japan, having produced their first car in 1917 (the Mitsubishi A). They make the best-selling PHEV in Europe with 30K units sold in 2015, and 21K in 2016. They have a strong presence in Southeast Asia, with a 7% market share in the region which represents 20% of their global sales. The best-selling Mitsubishi vehicle is the RVR (ASX/Outlander Sports) with 178,900 units sold mainly in China, America, and Australia in FY 2015. The Triton/L200 pickup truck is popular worldwide, with 4.4 million cumulative sales throughout about 150 countries. The Mitsubishi name means "three water chestnuts" or "three diamonds".

Following significant economic difficulties particularly for their false declaration of fuel consumption figures, Nissan took on 34% of Mitsubishi stock in October 2016; thus the Renault-Nissan Alliance grew to become the Renault-Nissan-Mitsubishi Alliance.

Main figures

Employees: 29,000

Manufacturing plants: 17

Revenue: ¥2.27tn (FY15)

Operating margin: ¥138bn, so 6.1% of revenue (FY15)



Outlander PHEV



Introduction • History

The company took root in 1920, when it was founded in Hiroshima by Jujiro Matsuda. At first it was called Toya Kogyo and produced machine tools. Their first vehicle was a three-wheeler in 1931 called the Mazda-go, giving the name to the brand. The Mazda name originates from Ahura Mazda, the ancient Persian god of light, wisdom, intelligence, and harmony. It is equally a stylised version of the founder's name; Matsuda is pronounced (more or less) "Mazda" in Japanese. Their first 4-wheel truck, the Romper, came out in 1958, with the first passenger car, the R360 coupé, following in 1960. They first fielded a Wankel-engined car in 1967, the Cosmo. In the 1960s, the company began and expanded worldwide exports. In the 1970s, they established production plants in the Philippines, Indonesia, and Malaysia.

In November 1979 came a capital tie-in with Ford. In 1985 they opened operations in the USA and Colombia, and in 1986 they opened a research and development centre in Michigan. In 1993 the Ford tie-in was strengthened and by 1996 Ford had increased their share from 25% to 33.4%.

In 2003 Mazda won the International Engine of the Year prize with their Renesis Wankel design, which improved fuel efficiency and reduced emissions compared to other rotary engines.

From 2010 to 2014, amidst the difficult economic environment in America, Ford sold down their Mazda share to just 2%.

In August 2017 an agreement was made with Toyota, who took on 5% of Mazda stock for common production in two plants in USA and for the development of electric vehicles.

Main figures (as of March 2017):

Sales: ¥3214bn (\$30.2bn, €24.6bn)

Operating income: ¥125bn (\$1.17bn, €960m)

Car production: 1.56 million units

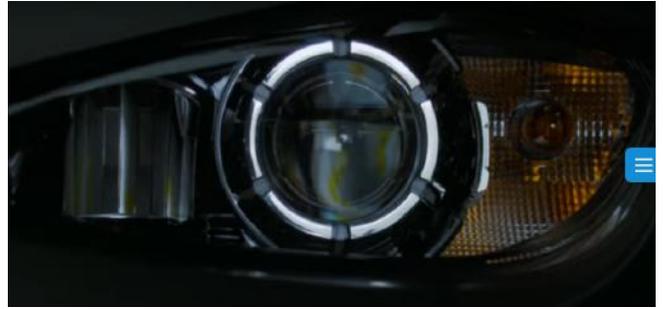
People: 48,849

Mazda in Lighting

Mazda have a long tradition of technology, especially for engines, but also for other components. In lighting, they are strongly pushing the new ADB technology, called ALH by Mazda (Adaptive LED headlamps), equipping the CX5, CX3, and the B-segment Demio.



Mazda CX5 with ALH (ADB)



CX3 with ALH (ADB)

Subaru

Introduction • History

Subaru is the vehicle brand of the Subaru Group, who from WWII until 2017 were called Fuji Heavy Industries. Until WWII the company were called Nakajima, and produced half of Japan's aircraft during the war. The company Subaru for the production of cars was created in 1953, after the Japanese name for the Pleiades constellation. In 2005, General Motors who owned 20% of Subaru's stock sold it to Toyota, who now own 16.5% of the Subaru Corporation. Subaru are well known for their horizontally opposed "boxer" engines and for their intense participation in rally racing.

Main figures

Sales: ¥3326bn (\$31bn, €25.4bn), of which ¥3152bn in automotive and ¥137bn in aerospace. The ¥3326bn figure represents an enormous increase from 2012's figure of ¥1500bn.

Operating income: ¥410.8bn, so 12.4%

Employees: 32,600 (and 14,700 non-consolidated activities)

R & D expenditure: ¥114bn, so 3.4% of sales

Production: 1.055 million cars, of which 720,000 made in Japan.

Subaru in Lighting

Subaru have offered AFS, they call Steering Responsive Headlights, for many years.



Subaru Impreza

Suzuki

Introduction • History

Suzuki got founded in 1909 by Suzuki Michio in Hamamatsu near Shizuoka, at first to make sewing machines. They began producing motorcycles in 1952, and in 1981 entered an agreement with General Motors for the development of their first car, the Cultus. GM took up some Suzuki stock at that time, but sold off their shares in 2008 during the economic crisis. In 1983 Suzuki took up an important part in the Indian company Maruti, first for the production of motorcycles. Maruti Suzuki are now owned 54% by Suzuki. In 2009, VW took 19.9% of Suzuki shares, but sold them in 2015 after a conflict with Suzuki. Since 2011, Suzuki are cooperating with Fiat.

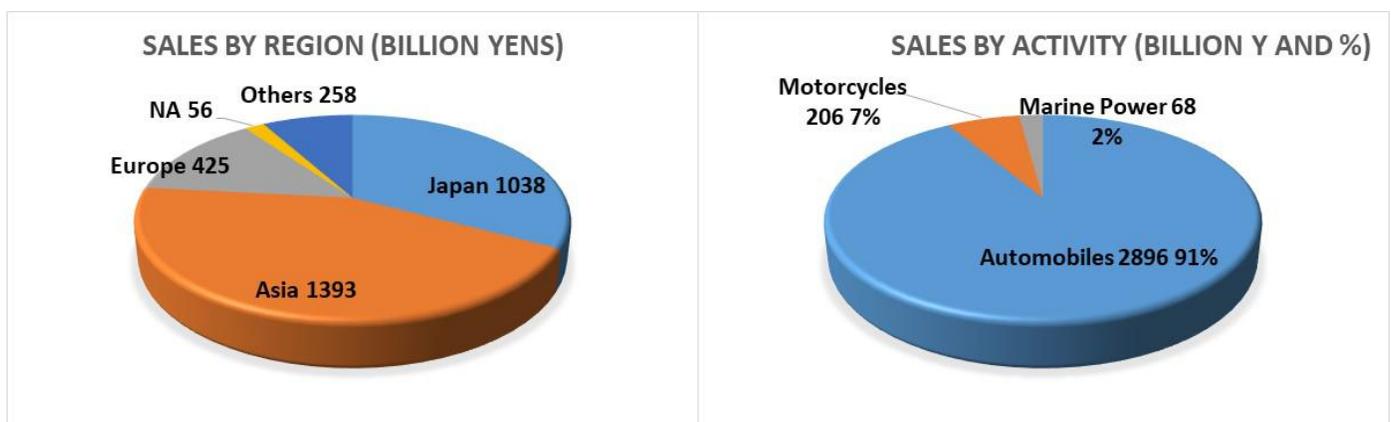
Main figures (FY2016)

Sales: ¥3170bn

Operating income: ¥267bn

Production: 3,074,000 cars (+6.8% since 2012) and 1,370,000 motorcycles (-40% since 2012)

Employees: 14,180



Introduction • History

Isuzu are an old company founded in 1893 to build boats; they were initially called Tokyo Ishikawajima Shipbuilding and Engineering. The Isuzu brand began with the production of trucks in 1916, and the production of cars in 1922. Isuzu remains mainly a truck brand, though utility vehicles and pickups and a few passenger car models have been produced over the years. They are also an important maker of diesel engines; the first one was produced in 1930, they have made over 28 million of them since then, and Isuzu introduced diesel engines for passenger cars in the early sixties.

Main shareholders

Mitsubishi: 8.1%

Itochu Automotive: 6.72%

Toyota: 6.34%

Main figures (End March 2017)

Sales: ¥1953bn

of which:

- **Heavy Duty vehicles:** ¥493bn

- **Light Duty vehicles:** ¥915bn

- **Engines and others:** ¥545bn

Production: 506,000 vehicles

- **Heavy Duty vehicles:** 72,300

- **Light Duty vehicles:** 43,400

Employees: 33,631



ISUZU D-MAX



ISUZU mu-X

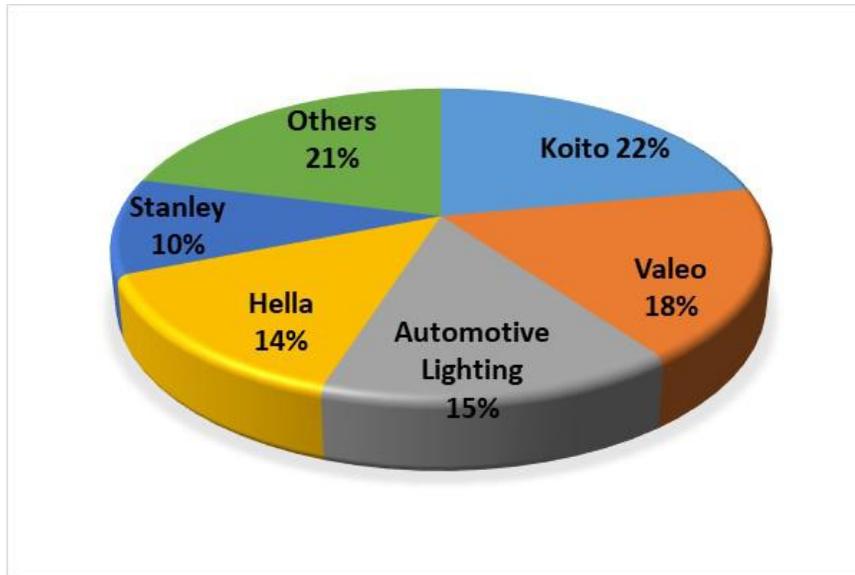


Panther (Indonesia model)

Tier 1

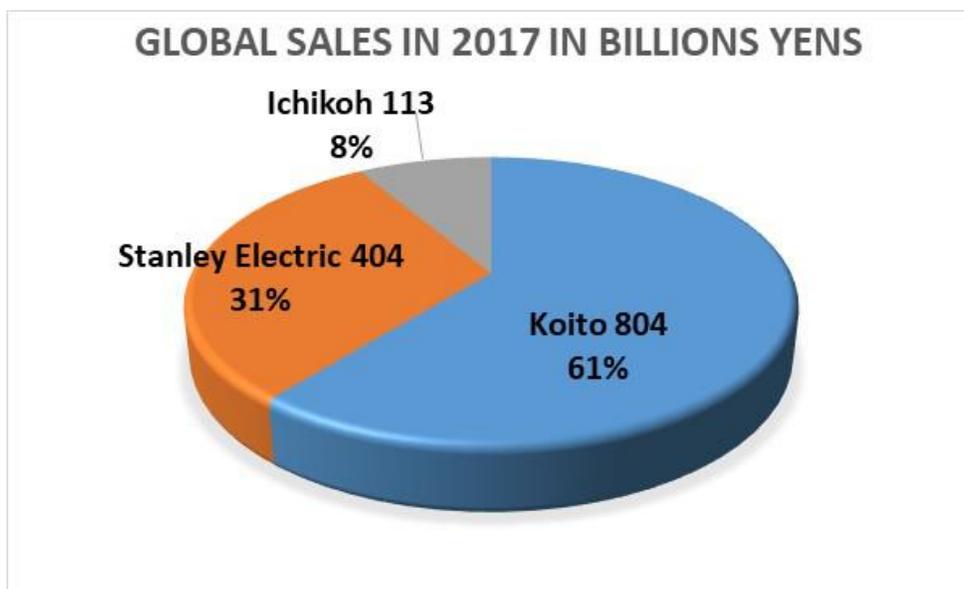
There are three main lighting set makers in Japan: Koito, Stanley, and Ichikoh. These three makers are in the top five worldwide lighting suppliers, as Ichikoh are now consolidated with Valeo. Their worldwide market share is always difficult to parse, as set makers don't always report complete data, and tend to use differing calculation methods. Nevertheless, based on reports and turnover, Koito would be the world's N° 1—though in volume, Valeo are presenting themselves as N° 1. Considering a worldwide market with global sales of \$29bn in 2016, the Koito turnover of ¥840bn (\$7.9bn) would mean a market share of 27%. Stanley had global sales at ¥404.1bn in FY2016 for the lighting business, representing a market share of 10%.

Worldwide market share of the main lighting suppliers



These lighting suppliers have their main bases and particularly their main R & D centres in Japan. But a very important part of their activity is now done abroad, particularly for Koito who are very active in America and China.

Consolidated sales worldwide for Japanese set makers (Ichikoh are also consolidated with Valeo)



Koito are the current worldwide leader for automotive lighting, with a worldwide market share evaluated at 22% (Koito themselves claim 20%) and 60% in Japan. Their sales for FY2016 were ¥841bn, (\$7.9bn), 90% of these being for vehicle lighting; the remainder for train, aircraft, and other lighting.

History

Koito Manufacturing was founded in 1915 to produce Fresnel lenses for railway signal lamps. The company were incorporated in 1936, and in 1957 Koito Electric Manufacturing was launched and began producing sealed-beam headlamps. In 1962 the two companies were merged and in 1972 Koito launched the production of miniature incandescent bulbs for automotive applications. They introduced headlamps with replaceable bulbs in 1979, and with plastic lenses in 1981. They launched their first HID headlamp on the market in 1996, and the first AFS in the world in 2003. Two more recent very important premieres were the launch of the first headlamp with LED low beam function done by five Nichia LEDs on the 2007 Lexus LS600hL, and the much less costly, much more powerful LED low beam fitted as standard equipment on the high-volume Toyota Corolla in North America.

Organisation

Koito are headquartered in Takanawa, Japan, with their main R & D centre in Shizuoka, and with additional R & D centres in China, Europe and America. Koito have 32 subsidiaries including 17 abroad: four in America, one in Mexico, two in Europe (UK, Czech Republic), four in China, five in South Asia (India, Indonesia, South Korea, Taiwan, Thailand) and one in Brazil. Recently they launched an R & D lab in Silicon Valley.

Koito were listed on the Tokyo Stock Exchange in 1988. As of 31 March 2017, Koito employed 23,568 people in their consolidated operations and 4,159 in non-consolidated operations.

Recent news

- In January 2018 Koito won the seventh Monozukuri Nippon Gran Awards given by the Ministry of Economy, Trade and Industry of Japan for their LED Compact Bi-Function headlamp modules.
- In September 2017 Koito announced plans to establish a new subsidiary in Malaysia, and sold all their shares in Shanghai Koito Automotive Lamp Company to Huayu Automotive Systems.
- In September 2016 Koito announced plans to establish a manufacturing subsidiary in Brazil.
- In November 2014 Koito transferred the entire business of Koito Europe to Koito Czechia and liquidated Koito Europe.

Key people

- Masahiro Otake: Chairman and CEO
- Hiroshi Mihara: President and COO
- Yuji Yokoya: Executive Vice President
- Koichi Sakakibara: Executive Vice President
- Kenji Arima: Senior Managing Director
- Masami Uchiyama: Senior Managing Director
- Michiaki Kato: Senior Managing Director
- Hideharu Konagaya: Senior Managing Director
- Takashi Otake: Director and Senior Adviser
- Katsuyuki Kusakawa: Director and Managing Corporate Officer
- Hideo Yamamoto: Director and Managing Corporate Officer
- Michiaki Kato: Director and Managing Corporate Officer
- Jun Toyota: Director and Managing Corporate Officer
- Haruya Uehara: Director

Key products

90% of the company's activity is related to vehicle lighting. They make virtually all lamps that can be found on or in a vehicle, with a wide array of technology, as well as cleaning units and many of the electronics components such as HID ballasts and LED drivers.

As well as still manufacturing halogen and HID headlamps, Koito produce more and more LED headlamps including their ADB systems that use an array of LEDs. Their other automotive LED products include DRLs, fog lamps, rear combination lamps, accessory lamps, and interior lighting. Koito are also doing research for laser headlights and OLED for automotive applications.

Outside the automotive field, Koito are producing lighting equipment for motorbikes, trains, aircraft, and marine, as well as some other electrical components.

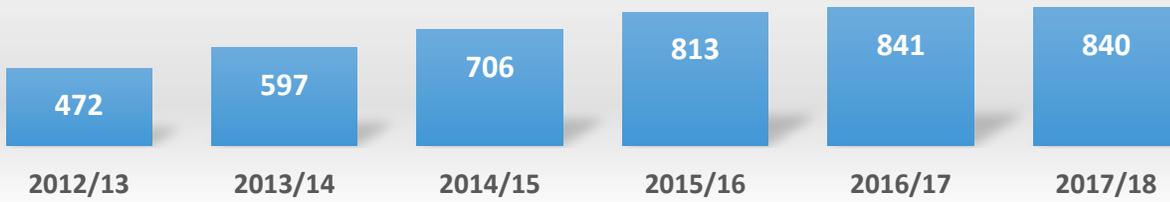
Clients & Partners

Over the years, Koito have established a presence in all major automotive markets to support the expansions of Toyota, both their major customer and main shareholder. Their other customers include Daihatsu, Ford, General Motors, Hino, Honda, Isuzu, Mazda, Mitsubishi, Nissan, Renault, and Suzuki.

Financial performance

Koito have achieved strong revenue growth during the last five years while substantially increasing their operating and net income throughout the period. For the financial year ended 31 March 2017, Koito's sales revenue was ¥841.4bn, up 3.4% from ¥813.4bn for the previous year. Operating income was ¥92.5bn, up 12.5% from ¥82.2bn for 2015/16 and net income was ¥56.6bn, up 22.2% from ¥46.3bn. The forecast presented in January 2018 for the fiscal year 2018 are a level of sales of 840 ¥bn (-0.2%) and a level of operating income of 100 ¥bn (+8.1%)

Sales of Koito in ¥bn



Significant Lighting Realisations

1996: First HID

2003 : First AFS

And for LED systems:

2007



Lexus LS:
Worldwide premiere with LED front lighting
Five LEDs for low beam

2012



Lexus LS:
Mechanical LED ADB

2014



Mazda 6:
LED-Array ADB 11 segments

2017



Lexus LS:
LED array ADB with two rows
24 segments



Koito's LED Compact Bi-function LED headlamp module (photo), widely used by Toyota and others, won the seventh Monozukuri Nippon Grand Awards from the Ministry of Economy, Trade and Industry (METI).

The main attractions are compactness with low and high beam from a single unit, readily adaptable for excellent standardisation. The main challenges to obtain such a system with a powerful LED at around 2000 lm were the good thermal control, the adapted optical definition, and a good mechanical design for compactness. No fan is required. These compact systems are very

successful with 60 applications done or under development.

ADB systems:

Koito first introduced ADB systems in 2012 with a mechanical system on the Lexus LS.

Matrix beam systems were then developed with 11 segments in 2014 and introduced on the Mazda Demio and CX3 with low and high Beam in 2016.



More recently in 2017, Koito presented the second generation of matrix beam system with two rows of



LEDs on the Lexus LS. This new module has the capacity to produce three new functions, including overhead illumination thanks to the specific row of 8 LEDs, and Adverse Weather by managing the 15 LEDs dedicated to high beam and some others for low beam and complementary beams.

Koito have also introduced for the first time ADB on a truck, on the Hino Profia in 2017.

ADB High Definition

Koito are looking at different solutions for ADB HD including the ones most often presented during

technical congresses: DLP and LCD. But to offer to their customer an economical solution for HD ADB, Koito have developed a very interesting solution with a wheel spinning at 6000 rpm, and reflecting light to the intended horizontal position with several small mirrors designed on this wheel, with a synchronisation of the LED source. Koito say the power efficiency of such a solution is close to that of traditional LED systems. Decision for adoption has been taken by car makers and so their introduction will soon arrive.



Sensor integration

Koito are preparing for the future with new headlamps and rear lamps integrating sensors (lidar, camera, etc) and otherwise able to communicate with the environment. The photo shown here is a mockup headlamp with inbuilt sensors.

Koito interview



Yuji Yokoya - Executive Vice President (second from left)

Yuji Higashi - Corporate Officer General Manager of Research & Development (fourth from right)

Masaru Sasaki - Deputy General Manager of System Product Planning Office

Takayuki Amma - Deputy General Manager of Regulation & Homologation

Satoshi Yamamura - Deputy General Manager of Research & Development

Shigetoshi Kajiyama - Manager of R & D planning

DVN: With all the current megatrends on environmental concerns (CO₂, NOX, fine particles), sustainability (recycling, hazardous materials), the car sharing economy, personalisation, urbanisation and megacities, and the reach toward zero fatalities in traffic, what do you think is the most important in the future and what could be the actions of your company to prepare this future?

Koito: We have always paid close attention to various megatrends and have developed technologies pre-empting resulting changes. So far, as eco-friendly products that contribute to CO₂ reduction, we have launched LED headlamps ahead of competitors and, by reducing their costs, have expanded the number of models they are on. In addition, we are actively contributing to CO₂ reduction not only by saving power consumption, but also by reducing the weight of parts by making outer lenses and other plastic parts thinner and downsizing units. It's hard to specifically name the megatrends we find most important in the long run, but as an immediate priority area for technological development, there is response to automatic driving. We believe that it is important to develop new means of communication that replace eye contact between you and pedestrians as well as technologies that let other road users know what you are doing now, what you are going to do next, etc.

DVN: Do you feel that newcomers—Apple, Google, Intel, and the like—will play a more important role in the future particularly with the development of AI? Do you anticipate any change in the value chain?

Koito: We think that the entry of outsiders such as Apple, Google, and Intel into the market is going to change the roles of set makers. For example, like the e-Palette Concept Toyota announced at CES 2018, automakers will openly work with service providers and developers to offer new mobility services. In this context, we believe that such changes in the value chain will provide us with a big opportunity to expand our business.

Car sharing could be a risk for car production reduction, but it could also be an opportunity. We think that the roles expected from us will expand and evolve from simple lighting parts such as headlights and rear lamps to communication tools such as V2X and even to digital signage.

DVN: The main directions for the evolution of car industry will be towards more electric, autonomous, and connected cars. What are the main actions in your company sustaining these directions? What could be the consequences for lighting?

Koito: For automatic driving, we are working on the development of lidar, millimetre-wave radar, headlamps with built-in cameras and the like, and rear lamps. These things offer a variety of advantages, such as:

- You can now locate sensors at the four corners of the vehicle, where they work at their most effectiveness, without spoiling the vehicle's design
- With an additional cleaner, they can stay free of snow and mud and be at their best even in a bad environment.
- It is now possible to adjust the optical axis of the sensors using the optical axis adjustment mechanism of the headlamps. One of the changes in the field of lighting tools is that, so far, we have worked to provide optimal lighting for the human eyes, but I think that, in the future, their roles will change, for example, to provide an optimal lighting for sensors.

DVN: What have been your company's main achievements in lighting over the past 10 years concerning technologies and style?

Koito: As you know, we succeeded in mass-producing LED headlamps in 2007 for the first time in the world. The primary direction since our technological development has been the spread and expansion of LED headlamps and, by strongly promoting cost reduction, downsizing, and power saving, we managed to have them adopted for most of the segments in a short period of time, including middle segment cars, key cars and even motorcycles. One of the standard units of LED headlamp of ours is the LED Compact series. This not only fulfils the primary lighting functions of a headlamp (high beam/low beam) with a single LED, but also gives a top-level performance in light distribution. Since its launch on the market in 2014, it has further evolved to eliminate the cooling fan for the LEDs, thereby further cutting cost and downsizing the headlamp, and is contributing to the spread of LED headlamps.

We also focus on spreading and popularising sophisticated products such as ADB and AFS. For the LED Compact series mentioned above, we line up units with AFS and ADB features as variations. The unit with the AFS feature has been adopted for kei cars (Daihatsu Move Canvas) and the units with ADB function for B segment cars (Mazda Demio), etc., contributing to further popularisation. On the design

side, for example, we developed a triple-projector ultra-compact LED headlamp system and got it adopted as a signature of the Lexus series. By adopting such a sophisticated design unit and the LED Compact for different grades of the same model, automakers can achieve grade management.



Lexus LS 2017



Koito Compact bi-function

DVN: In the 2017 JAMA report, the installation status for HID was at a very good level of 57% in 2015 in Japan. Now LEDs are replacing HID and perhaps also halogen: have you a plan in your company to generalise that technology?

Koito: According to JAMA I checked with about the rate of adoption of HID, the figure was the sum of both HID and LED. Considering that the rate of HID adoption had already significantly decreased in 2015, I guess a large part of the above figure is LEDs, showing that they have already reached a high level of popularisation. I can't say when they will reach 100%, because it is automakers who decide to adopt LEDs as their standard headlamps. The biggest barrier to replacing a halogen light source with an LED light source is cost.

We will continue working on replacing halogen lamps by cutting costs by using low-cost LEDs and reducing the number of parts.

DVN: Reduction of accidents for pedestrians is a priority, particularly in Japan. In the last JAMA report, it is indicated that for such a priority N° 1 for accidents involving pedestrians and cyclists, JAMA want to see more widespread application of AFS. So lighting is recognised as a key safety feature. But AFS was used only at 3.6% in 2015 in Japan. Have you any action in your company to develop these AFS applications?

Koito: ADB is expected to be more effective than AFS in improving safety. In Japan, the largest fatality group in traffic accidents are pedestrians, of whom 70% are killed at night. So reducing night-time accidents involving pedestrians is the most important. To quickly detect pedestrians at night, you need to illuminate them with high beams and spot them in time. An ADB system allows us to quickly detect pedestrian visually, regardless of whether there are vehicles ahead. The latest source for the statistics of JAMA is of 2015, but, in 2016, our ADB was adopted by two models (MAZDA Demio and CX-3) of the B segment. We will continue working on spreading ADB including the A segment.

DVN: Perhaps in JAMA vocabulary, ADB is included in AFS. What would be for you the most effective solution in relation to our Lighting domain to improve safety? Have you any specific actions for that development?

Koito: In cities, the AFS cornering light is useful for safety. But we believe that ADB is the most effective solution to improve safety. In Japan, from April 2018 onward, ADB will be covered by JNCAP as a reason for an additional point. From April 2019 onward, ADB's activation will be counted as an element in assessing automatic emergency braking systems for night time pedestrians. We expect that in North America, the evaluation criteria of IIHS will be changed to those that take ADB into account after the still pending ADB acceptance by American law. To be noted: Canada now allows ADB.

We are actively promoting the adoption of ADB on new models in 2019 and following years, and we have already got them adopted in many models. We are pursuing multiple developments in parallel, such as the development of sophisticatedly designed compact ADB units and ADBs aimed at even higher definition.

DVN: ADB is well appreciated particularly in Europe, and likely the regulations will allow it soon in America. How do you see in the future the applications of this technology within your company?

Koito: We are convinced that in the future, ADB will be on more and more vehicles as a system indispensable for night time driving. So far, we have seen such functions commercialised as glare-free high beams and highlights on pedestrians and animals with dangerous behaviours, etc. In the future, we will be able to control light distribution more minutely and project letters and symbols on the road surface. With test cars, we continue research on new functions such as alerting the driver to danger and prompting pedestrians to attention.

DVN: You have presented an original scanning technology for ADB HD. Can you summarise the advantages of this technology and when you think it could be introduced? What is your feeling about the other technologies under development such as LCD, DLP, laser scanning, LED microarray, and when do you think to use them?

Koito: Our scanning ADB controls light distribution by synchronising a rotating mirror that horizontally scans LED light with the control of the timing at which LED turns on and off. The characteristic of this ADB is that it achieves a seamless control of light distribution with fewer LEDs. Since it can illuminate also pedestrians around vehicles ahead, we expect that it will be highly effective in reducing accidents involving pedestrians. The development is under way aimed at commercialising it around 2020. We expect that LCD, DMD, and other technologies enable new functions such as higher definition light distribution control and road surface drawing, so we too are working hard on the development of these technologies. There are pending issues such as the difficulty of system development and their cost, but we believe that they are solvable issues.

DVN: What other technologies could become very important in lighting?

Koito: Many and various technologies will become important. High resolution ADB requires high precision parts and, for electric cars, it will become vital to improve lamp efficiency and reduce weight in order to save power consumption. For automatic driving, communication with other road users using

light will become important. In the future, a vehicle will be loaded with numerous sensors, some of them integrated with lamps. To process information from sensors and achieve advanced HMI, use of AI, too, will be indispensable.

DVN: What is your feeling about new lighting sources like laser for headlamps or OLEDs for signalling? Do you intend to use them?

Koito: Lasers and OLEDs each have characteristics of their own, such as high brightness and uniform light emission, which makes them very attractive light sources, because thus you can drastically downsize units, give your vehicle an innovative appearance, and so on. However, either of them cannot equal LEDs in terms of luminous efficiency and cost, which are their bottleneck in their adoption and popularisation.

For laser and OLED, we continue working on improving brightness and other performance and reducing cost.

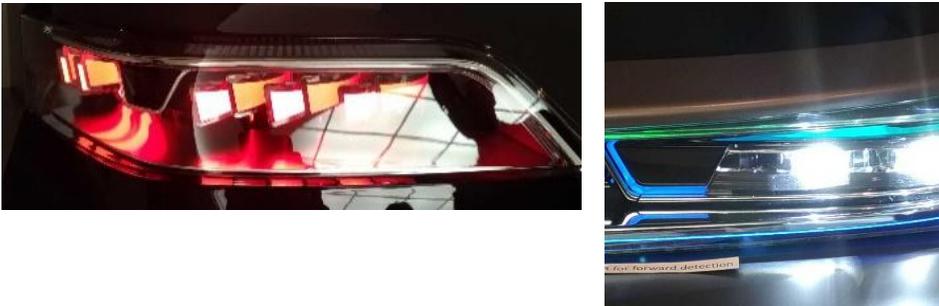
DVN: How do you see the evolution of headlamp and rear lamp styling?

Koito: Thanks to the improved performance of LEDs, optical units are getting smaller and smaller. With the light emitting parts getting slimmer and narrower and innovative unit arrangement now made possible, styling has diversified. Meanwhile, functions such as sequential turn and ADB are getting more and more complicated, so designs that handle them all together and express them in a simple presentation is becoming important.

As to rear lights, signature expression is getting saturated, and I think that how you can diversify the way they look using infinite reflex, holograms, etc. will become important. In the future, as vehicles respond to the needs of automatic driving more and more, it is possible that lamps change to displays eventually. From traditional static styling intended to fascinate you with shapes, they may shift to dynamic styling aimed at fascinating with what they show you.

DVN: Many sensors are used for ADAS. Which of them would you like to see integrated in headlamps or rear lamps?

Koito: I think that many sensors for ADAS systems such as lidars, millimetre-wave radars, and cameras will be installed everywhere in the vehicle. Sensors that monitor far ahead will be mounted near room mirrors and front grilles. On the other hand, the best place for sensors that monitor around the vehicle will be the lamps at the four corners of the vehicle. The leveling mechanism will adjust the sensors' angles and cleaners or hard coating will protect them from dirt and scratches. We are working on technology development to integrate various sensors in lamps, both in headlamps and rearlamps, specifications of sensors to be fitted, and mining small and inexpensive sensors.



Koito mockup rear lamp (left) and headlamp (right) with inbuilt sensors

DVN: Can you tell us your main directions to prepare lighting that will accompany future autonomous and connected cars?

Koito: Future automotive lighting aims to provide a good field of vision to the driver but also to sensors, especially camera sensors. Further, lighting in the years to come will create new functions and values such as communication with other road users through messages in light drawn on the road surface and lamps expressing the vehicle's sentiments instead of eye contacts. "Hi, pedestrians, I know you are there. Don't worry, I won't hit you!" That is what we would like to let them know in ways as natural as eye contacts.



Stanley Electric

Stanley Electric are the second-largest Japanese lighting supplier, with a worldwide market share estimated at about 10% in value, with sales in vehicle lighting at ¥308bn.

History

The Stanley Electric company was established in 1920 by Takaharu Kitano, at which time there were no more than 8,000 cars in Japan and they were all imported models. The company was named after the intrepid 19th-century explorer Sir Henry Morton Stanley, who was renowned for the vision and courage he had so abundantly demonstrated during his exploits on the continent of Africa. The company manufactures lighting equipment, accessories and electronic components, including semiconductors, for the automotive and motorcycle industries as well as general lighting products. Their automotive lighting products cover the full range of light source, reflector and projection technologies including HID and LED headlamps and AFS.

Recent news

- In April 2015, Stanley Electric Manufacturing Mexico was established in Jalisco State. Automotive production has been expanding in Mexico during recent years and the new facility will supply the Mexican automotive industry.
- In September 2015, Tianjin Stanley Electric Technology was established in Tianjin, China. In the growing Chinese market, the new company has in charge to strengthen local design and field development capabilities and develop human resources.
- In April 2014, Asian Stanley International, a subsidiary of Stanley Electric, opened a new manufacturing plant in Thailand. The plant manufactures LEDs, LCDs and SMLs, mainly for the ASEAN region.

Key people

- **Takanori Kitano:** President
- **Yutaka Hiratsuka:** Senior Managing director, Chief Purchasing Officer, Chief Logistics Officer, Chief Compliance Officer, Chief Domestic Subsidiary Officer, Chief Environment Officer
- **Toru Tanabe:** Managing Director, Chief Technical Officer, Chief Research and Development Officer, Chief Asian & Oceanian Business Officer, Chief Quality Assurance Officer
- **Katsutoshi Lino:** Director, Chief Corporate Management Officer
- **Hiroyuki Takamori:** Director, Chief Manufacturing Officer, Chief American Business Officer
- **Mitsuhiro Yoneya:** Director, Chief Chinese Business Officer, Chief Specific Customer Officer
- **Yasuaki Kaizumi:** Director, Chief Advanced technology Officer , Executive General Manager: Integrated Components Division

Products

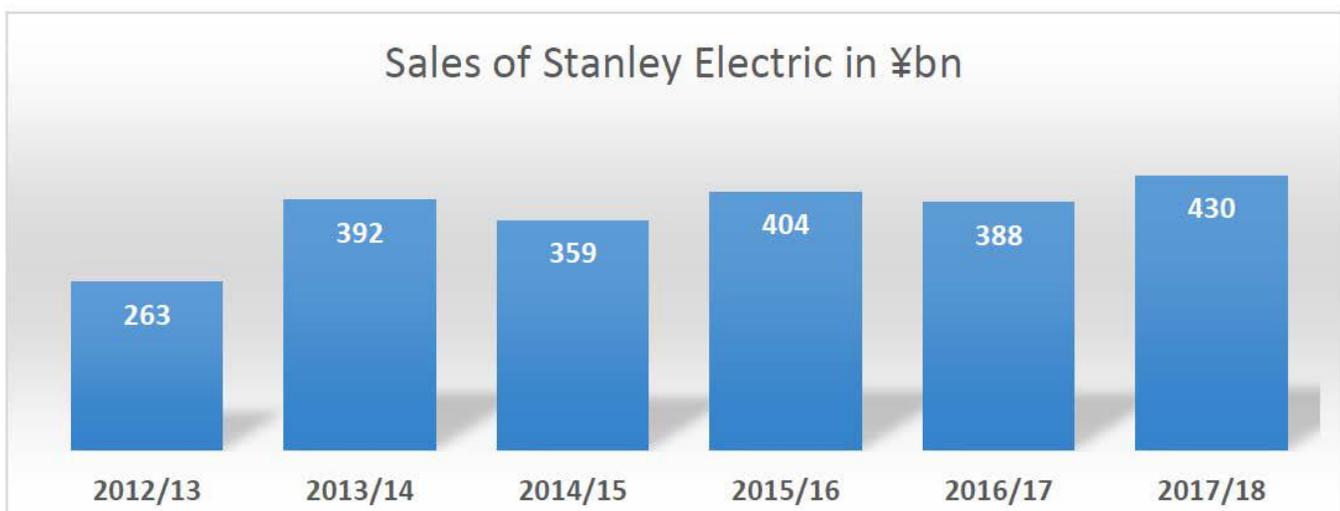
Stanley make domestic, commercial, and automotive electronics and LED devices including lighting and display screens. For passenger cars and trucks and motorcycles—Stanley are the worldwide N° 1 in motorcycle lamps—they make LED, HID, and halogen headlamps, AFS, rear combination lamps, high-mounted stop lights, fog lamps, and night vision systems and more and more LEDs systems both for frontlighting and rearlighting.

Clients & Partners

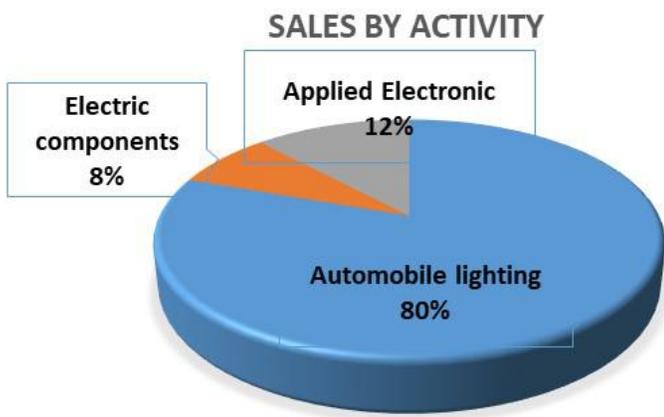
Honda are Stanley Electric's largest customer. Stanley lamps also equip vehicles from Mazda, Toyota, Nissan, Mitsubishi, General Motors, Subaru, Suzuki, and Daihatsu. With their growth strategy of expanding outside Japan, the company are placing themselves to supply makers in China, Asia, Europe, and North and South America.

Main figures

Sales: Stanley Electric's sales revenue decreased 3.9% to ¥388.56bn in the year ended 31 March 2017 from ¥404.15bn during the previous year, but the new forecast published in January 2018 for fiscal year 2017-2018 is ¥430bn for sales, so + 10.7%. The vehicle lighting division generated 79.4% of Stanley Electric's sales revenue in 2017.



Operating income increased 15.1% to ¥42.31bn and net income increased 12.3% to ¥28.69bn in fiscal year 2016-2017. The forecast for 2017-2018 is at ¥52bn (\$490m, €400m), an increase of 22.9% over the previous year. The company explained such an improvement by better sales than expected for LEDs systems.

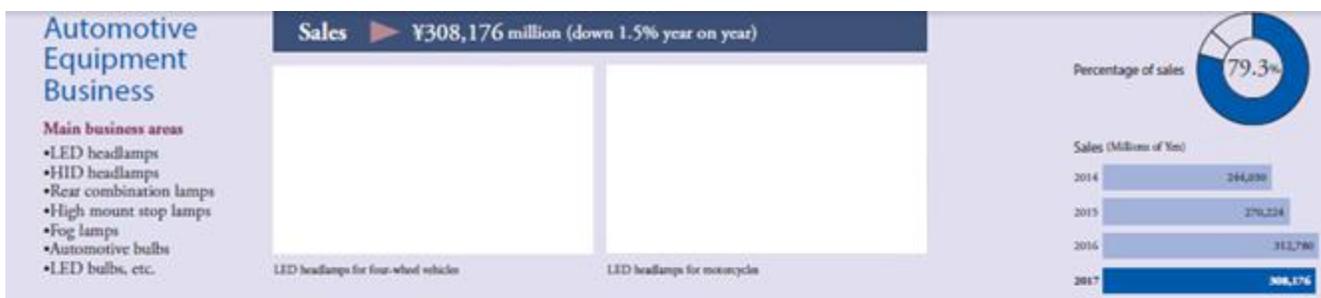


Employees (end March 2017): 16,244 people.
Manufacturing plants: 68 manufacturing plants, technical and research centres, sales and procurement offices and administrations centres in Japan, China, Europe, North and South America, and Asia-Pacific.

Stanley Electric product segments

Lighting systems are representing the majority of the activity of Stanley at around 80%, even increasing in the new 2017/2018 fiscal year with the strong development of LEDs systems.

Automotive Equipment Business



Electronic Component Business



Applied Electronic Products Business



Source: Annual report March 2017

Lighting Realisations

Headlamps with world's smallest vertical dimensions

Headlamps with world's smallest vertical dimensions



To maximize the design potential of automobiles, the demand for headlamps to use up as little space as possible is increasing.

In order to combine white and orange lighting functions into one and allow a uniform light source, the LED lights of the two colors are installed extremely close to each other at 1.6 mm, achieving a lamp size with the world's smallest vertical dimensions of 75 mm, installed in Honda's new NSX model. Furthermore, Stanley Electric not only produced the headlamps but all lamps for the new NSX model, including the rear lamps, which allow the streamlined design of the car itself.

ADB, evolved



ADB, Adaptive Driving Beam, is a system that detects the presence and location of oncoming and preceding vehicles through its image recognition cameras, and blocks the light of headlamps that might cause glare for drivers.

Stanley Electric has increased the number of LED lights on each side from 4 to 12 segments, to allow a smoother beam that provides safety support while driving at night. This technology is currently employed in Mazda CX-5 models. Stanley Electric aims to eradicate traffic accidents, and going forward strives to contribute to a safe and secure automotive society.



Jewel eye technology installed on Acura



Mazda "ALH" (ADB) LED headlamps

Stanley Electric interview

- Shigeru Sakayauchi - Group Manager, Engineering Technology Centre
- Masafumi Ohno – Chief Engineer, Product Technology Development Group

DVN: With all the current megatrends on environmental concerns (CO₂, NO_x, fine particles), sustainability (recycling, hazardous materials), the car sharing economy, personalisation, urbanisation and megacities, and the reach toward zero fatalities in traffic, what do you think is the most important in the future and what could be the actions of your company to prepare this future?

Stanley: In order to follow these future big changes of automotive environment, Stanley are preparing some technical items which are not only past days general technologies, but also some new items such as:

- Headlight for ADAS, mainly ADB systems
- Signal lighting, for autonomous car, HMI for other traffic participants.
- Low electric consumption, power supply, light source, and so on.

The preparation of the future cannot be done alone in Stanley, but with a close relationship with customers. We are confident that the new technologies that we are preparing will be able to give a good answer to the challenges arriving with these megatrends.

DVN: Do you feel that newcomers—Apple, Google, Intel, and the like—will play a more important role in the future particularly with the development of AI? Do you anticipate any change in the value chain?

Stanley: Some new players are arriving in the automotive field, and set makers will have to adapt themselves and lead those players. Nevertheless, in our domain, we have to consider other new players, for instance Chinese lamp makers that have done important improvements in quality and could impact us more than Apple, Google or Intel.

DVN: The main directions for the evolution of car industry will be towards more electric, autonomous, and connected cars. What are the main actions in your company sustaining these directions? What could be the consequences for lighting?

Stanley: With these evolutions, we shall have to work intensively in the future to adapt our products. Particularly, we need to prepare new lighting functions for communication, with the more and more corresponding complex control units.

DVN: What have been your company's main achievements in lighting over the past 10 years concerning technologies and style?

Stanley have developed important new technologies in the recent years, for instance:

- The jewel appearance modules with double internal reflexion inside lenses, introduced in Honda Legend in 2015, now on Honda Acura. This technology is not only able to give a new style, but higher efficiency compared to traditional projector systems generally limited to 50% efficiency.
- ADB systems introduced first with 4 segments on Mazda CX5 in 2014. Now, our new systems for ADB for instance on the new Mazda CX5 are using a unique module to produce among low beam, high beam and ADB of 12 segments.
- We are now preparing new systems to illuminate pedestrians thanks to a new infrared camera with time of flight measurement specifically developed by Stanley. Prototypes are already available.

DVN: LEDs have replaced HID and are expanding in application. Have you any plan to generalise that technology?

Stanley: Car makers make the choice of the technology used. LEDs applications are naturally growing, but there is still a difference of cost, and for some developing countries or for some entry level cars, this difference is too important for LED generalisation. There is a demand by car makers to decrease the cost of LEDs systems, and Stanley are working for that. The request for style will certainly accelerate the replacement of halogen by LEDs.

DVN: What is the most effective lighting solution to improve safety?

Stanley: Ideally, high definition ADB would be the best feature to improve safety by lighting. But we have to consider the balance between benefits and costs for each technology, and today, high definition systems are very expensive. Good lighting performance for each headlamp has first to be achieved. For improvement of safety in the future, we shall have to put in place communication systems with the environment for instance by LIFI.

DVN: ADB is well appreciated particularly in Europe, and likely the regulations will allow it soon in America. How do you see in the future the applications of this technology within your company?

Stanley: ADB will be developed more and more. However, we are not sure that the race for high definition has to be similar to the "pixel war" seen on consumer digital cameras, not necessarily bringing much more quality. For each new technology, we need to take into account performance, weight, cost and consumption for adoption.

DVN: You presented at the last ISAL a paper in relation to a laser scanning system as well as a paper with a 288-segment matrix LED system. What are the main interests of these technologies and when do you think you could introduce them in the market? Do you think that ADB HD (High definition) technology could be used soon and with which technology?

Stanley: We are continuously studying how to improve safety with development of such high definition systems. We have not yet chosen the technology to introduce, and we think that we need to develop several technologies to answer to the different needs of our customers, that could change their mind year after year. These systems are requiring very demanding control units. In either case, we shall take into account benefits for safety and drawbacks particularly costs for our choice.

DVN: What other technologies could become very important in lighting? What is your feeling about new lighting sources like laser for headlamps or OLEDs for signalling? Do you intend to use them?

Stanley: Laser systems are still very expensive, for a relatively limited benefit. Thermal issues are too difficult to manage. So we are looking at these solutions, but with no immediate applications. OLED is still expensive today for some function and the current benefits are not obvious.

DVN: How do you see the evolution of headlamp and rear lamp styling?

Stanley: The trend to have more and more compact lighting modules will continue. We shall need to reduce the height and the depth of these modules, both for styling reasons and for the integration of new sensors as lidars, cameras, etc. It could be different for signal lamps and particularly rearlamps, where the reduction of dimensions is not the priority. For these applications, the development of new appearance systems is the priority.

DVN: Can you tell us your main directions to prepare lighting that will accompany future autonomous and connected cars?

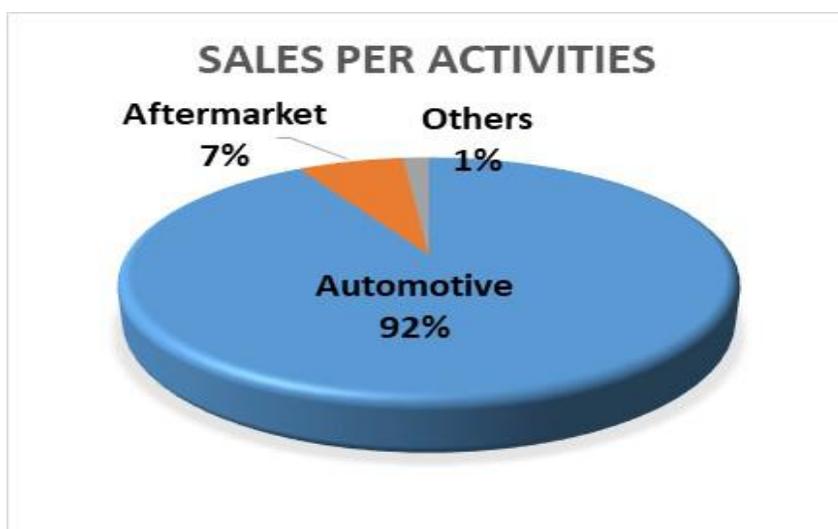
Stanley: Communications functions will certainly be the most impacting change for our lighting domain with the introduction of autonomous cars. Stanley are actively participating to the GTB group for a standardisation of these future devices. Lighting will remain important even for cameras that will need to receive visible or infrared light from headlamps. So we are convinced that the importance of lighting will remain.

Introduction and history

Ichikoh Industries got started in Japan in 1903 and began expanding overseas when they established a wholly-owned subsidiary in the US in 1987. Headquarters is in Isehara, Japan, and they have three production plants, one technical centre and six sales offices throughout the country. Now Ichikoh has other subsidiaries in China, Indonesia, Malaysia, and Thailand. As of 31 March 2017, there were 3,998 employees.

Ichikoh divide their business into two main segments: automotive parts making lamps and mirrors for the OE automotive market, and an aftermarket business also selling automotive bulbs and wipers. In 2000, Nissan who were the main shareholder with 20% of the stock sold these shares to Valeo, and a common contract for development and sales was established. From that time Valeo have progressively increased their share level up to 55.09% in 2017.

A reorganisation of lamp subsidiaries and affiliates of both companies was done, particularly in China where Ichikoh now own 15% of the different lighting plants of Valeo. Common processes and management tools were defined and applied with Valeo.



Recent news

In September 2017 Ichikoh announced a new production facility in Morinosato, Japan, which will gradually take over the production of the Isehara plant.

In April 2017 Ichikoh announced intent to purchase PT Pioneer's 30% stake in their joint venture in Indonesia, PT Ichikoh Indonesia, making it a wholly-owned subsidiary.

In January 2017, Valeo announced an increase in their Ichikoh stake to 55.09%.

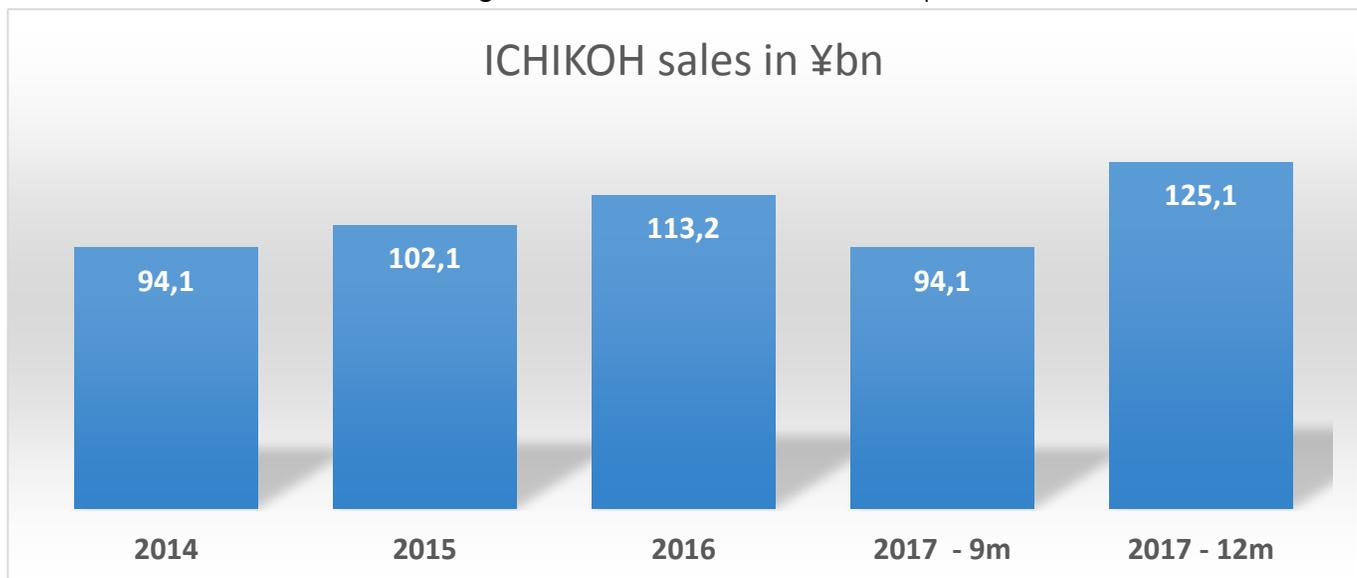
In November 2016 Valeo announced a takeover bid for the shares of Ichikoh. At the time, Valeo held 31.58% of Ichikoh.

In October 2015 Ichikoh announced plans to sell part of their business to Elematec Corporation. The business segment manufactures headlights for railcars, LED signal lamps and housing components.

Main figures

Ichikoh have changed the period of their fiscal year. Before, it ended in March. From 2018 on, it ends in December. 2017's official figures are therefore including 9 months from April to December 2017.

Ichikoh's sales revenue increased by 14.5% in 2017 to ¥94.1bn (compared to nine months 2016)



Ordinary income in 2017 was for 9 months at ¥4.3bn, an increase of 96.4% compared to the same period in 2016.

Employees: 3,998 (December 2017)

Main shareholders

- . Valeo (55.08% - January 2017)
- . Toyota Motor Corporation
- . Mizuho Bank, Ltd
- . Japan Trustee Services Bank, Ltd
- . Daihatsu Motor Co., Ltd
- . BNP Paribas Sec Services Luxembourg
- . Japan Master Trust Services Bank (Trust Account)
- . Nippon Life Insurance Company
- . Sankyo Co., Ltd
- . Morgan Stanley & Co., LLC

Main customers

- . Toyota Motor Corporation (Prius RL, Sienta HL, Alphard HL, Harrier RL, ...)
- . Nissan Motor Co., Ltd (Leaf HL and RL, Note HL and RL, Fuga side view camera, ...)
- . Subaru Corporation (Levorg HL and RL, ...)
- . Suzuki Motor Corporation (Hustler HL, ...)
- . Mitsubishi Motors Corporation (Outlander Rearview mirror, Pajero sport RL, ...)
- . Daihatsu Motor Co.,Ltd. (Move HL and RL,..)
- . Honda Motor Co.,Ltd. (Nbox RL, ...)
- . Hino Motors, Ltd.
- . Isuzu Motors Limited

Key products

Ichikoh's automotive lighting production includes front lighting with halogen, HID, and now more and more LED and adaptive headlamps, fog lamps, front turn signal lamps, rear lighting where Ichikoh have a strong position in Japan with tail lamps, reversing lamps, licence lamps, side flasher lamps, parking lamps, and activities for interior lamps and speed indicator lamps. Ichikoh are also an important supplier of interior and exterior rearview mirrors including exterior side mirrors with integrated turn signal lamps. They also produce rear-view camera systems. There is also a limited activity for wiper blades and arms, ashtrays, wheel covers, radiator grilles, ornaments, switches, and reflectors. Ichikoh are researching new advanced safety systems with adaptive and integrated lighting, in relation with Valeo.

Ichikoh in Lighting

Ichikoh first launched LED headlamps in 2010 with the equipment of the Nissan Leaf, the world's best-selling Electric Vehicle, with an original LED projector system, the first at that time with 2 LEDs and reflector appearance.



A new version of the Nissan Leaf in 2017 got a new Ichikoh headlamp using direct lens technology giving better efficiency.



Ichikoh ADB system for Toyota Alphard with 11 segments



The rearlamp activity is important in Ichikoh: here Ichikoh rear lamps on Nissan Leaf

Ichikoh interview

Interview with:

Kazuyuki Miyashita: Director- Senior Managing Executive

Takayuki Furuya: Managing Executive Officer, Development Headquarters Director

Sébastien Denis: Executive Officer, Advanced Development Headquarters Director

DVN: With all the current megatrends on environmental concerns (CO₂, NO_x, fine particles), sustainability (recycling, hazardous materials), the car sharing economy, personalisation, urbanisation and megacities, and the reach toward zero fatalities in traffic, what do you think is the most important in the future and what could be the actions of your company to prepare this future?

Ichikoh: For Ichikoh, the most important is safety, and many actions are done to help for reduction of accidents, particularly by better performance for lighting and by new functions like ADB. Development and commercialisation of safety functions for reducing accidents, dead and wounded, are mostly important, but also it's important to make technologies and services that everyone concerned with mobility can use as safely and conveniently as possible.

DVN: Do you feel that newcomers—Apple, Google, Intel, and the like—will play a more important role in the future particularly with the development of AI? Do you anticipate any change in the value chain?

Ichikoh: "What kind of services can offer" will increase the value in the future. Some newcomers may have in the future a more important place in the automotive domain. Nevertheless, car makers are also very active for the development of the system software of cars, and they will still remain the architects of the global system.

DVN: The main directions for the evolution of car industry will be towards more electric, autonomous, and connected cars. What are the main actions in your company sustaining these directions? What could be the consequences for lighting?

Ichikoh: Ichikoh are preparing for that big change period that is seen as presenting challenges and opportunities. Electrification requires better low-power lighting. Autonomous driving makes communication between road users more and more important. A new era of communication lighting is already here with projection, signaling, and display. And so Ichikoh have shown a mockup at the last auto show in Frankfurt presenting the possible communications achievable with 360° lighting to interact with the environment, particularly other drivers and pedestrians. The Japanese government are preparing a coordinated action on this, too. And to achieve better car connectivity, Ichikoh are considering the digitalisation and optical wireless communication.

DVN: What have been your company's main achievements in lighting over the past 10 years concerning technologies and style?

Ichikoh: Ichikoh has launched in 2010 their first LED headlamp with an original technology using projector systems with reflectors, being at that time the first to introduce a low beam with only 2 LEDs on the Nissan Leaf, the best seller Electric vehicle in the world. More recently, an evolution of this product used a direct lens system, so with an LED directly behind the lens, the lens doing alone all the distribution of the Low Beam function. This solution is very effective for the flux and very good for compactness, particularly the total depth of the system. Ichikoh has too launched an ADB system on the last generation of Toyota Alphard, with the matrix technology using 11 segments. We are also very actively developing affordable LED headlamps for kei cars (Daihatsu Hijet, e.g.) and compact LED sources (Toyota Prius rear lamp).

DVN: LEDs are now expanding their applications. Do you plan to have 100% LEDs headlamps soon?

Ichikoh: LEDs are interesting for power consumption reduction, style and compactness, but they are still more expensive than halogen. And for some applications, small cars or ASEAN markets for instance, cost is still a very important factor, requiring currently to continue with halogen. So Ichikoh have no specific target for the end of halogen, and is following the needs of their customers.

DVN: Reduction of accidents for pedestrians is a priority, particularly in Japan. In the last JAMA report, it is indicated that for such a priority N° 1 for accidents involving pedestrians and cyclists, more AFS-equipped vehicles would be good. So Lighting is recognised as a key safety feature. But AFS was used only at 3.6% in 2015 in Japan. Have you any action in your company to develop these AFS applications?

Ichikoh: Some customers are very interested in AFS and ADB, and to increase the equipment rate it is important to develop affordable solutions. Moreover we will encourage consumers to recognize that there are functions which can contribute safety through the exhibitions, events, and advertisements. Now, we think that ADB can bring even more safety, and particularly in the future with digital lighting that will allow to better illuminate pedestrians, for instance. Ichikoh are therefore developing these systems to participate in accident reduction efforts.

DVN: What is the most effective lighting solution to improve safety?

Ichikoh: Perhaps an ADB system extending its ability to cities. Current ADB systems are mainly interesting outside cities as they are increasing the range with no glare for others (GFHB, Glare Free High Beam). But in cities, they are not active and current GFHB cannot protect from dazzling to pedestrians and cyclists. If we can control with much smaller division, we can light them without giving glare. That would be an improvement for safety. Also by marking the lines or symbols on the road with high definition low beam, we can draw attention and give warning to pedestrians and cyclists.

DVN: ADB is well appreciated particularly in Europe, and likely the regulations will allow it soon in America. How do you see in the future the applications of this technology within your company?

Ichikoh: Yes. We see it will diffuse in Japan also. Moreover ADB itself is not uniform from entry-class to luxury car, and it is considered that multiple types with different performance and price ranges will coexist.

DVN: What is your feeling about technologies under development with LCD, DLP, laser scanning, LED Microarrays, and suchlike? When do you think to use them?

Ichikoh: HD front or rear lighting using such kinds of devices can provide to driver more information than conventional lighting. It is useful especially for autonomous vehicle. In automated driving mode, driver does not use gestures to communicate with pedestrian. Under these circumstances, HD lighting can express how the vehicle moves next to the pedestrian.

DVN: What other technologies could become very important in lighting?

Ichikoh: Laser for front lamps and OLEDs for signal lamp will not suddenly replace the LEDs. As these solutions remains complex and expensive, they will be mainly adopted on limited applications at first. In the future, OLED has the possibility of further cost reduction, therefore if the price competitiveness can be achieved it will speed up the adoption versus LED.

DVN: Many sensors are used for ADAS. Which of them would you like to see integrated in headlamps or rear lamps?

Ichikoh: ADAS development and autonomous driving will be important challenges for us, but there will be also nice opportunities of added value in the future. For instance, we can think of lighting solutions to enhance the detection performance of sensors.



Kazuyuki Miyashita: Director- Senior Managing Executive with DVN Jean-Paul Ravier

Tier 2

There are naturally many Japanese tier-2 suppliers for the Japanese automotive industry, and they have generally followed their customers in the world with affiliates companies. One of the most important for lighting are the suppliers of lighting sources, and particularly LEDs. Nichia are the world leader, but Panasonic, Toyota Gosei are also important suppliers of LEDs. But Japan has many other companies for all the needs of the vehicle lighting industry. They are grouped as [JAPIA](#), the Japan Auto Parts Industries Association.

In this report, we shall limit the presentations of some of these tier 2 suppliers as examples:

- Nichia, as the worldwide leader for LEDs;
- Panasonic as a large electronics company supplying the lighting industry with HID ballasts, LED drivers, and LEDs;
- Konica Minolta as an example of Japanese companies supplying instruments for optics. Japan leads in this domain, and devices from this industry are used everywhere in the world.
- Sumitomo as an example of the past huge Japanese *zaibatsu* (financial clique, industrial and business conglomerate), with still a myriad of companies forming a family involved in automotive equipment for instance for wiring, or in the capital of automotive companies through their financial institutions.

Introduction & History

Nichia are a relatively recent company founded in 1956. They have grown in the field of development, manufacturing, and sales of fine chemicals, particularly inorganic luminescent materials (phosphors). Nichia developed and commercialised the super high brightness Blue LED in 1993. After that they developed the world's first white LED by combining yellow phosphor and blue LED. This was followed by the successful development of practical level of blue-violet semiconductor laser diodes for the first time in the world. The invention of these Nitride-based LEDs and LDs caused the technological innovation of light source in the field of display, general lighting, automotive, industrial equipment, and medical care & measurement.

Recent news

In March 2018: Nichia and Osram announced intent to expand licence cooperation in the domain of Intellectual property. And Nichia announced a new Ultra-High CRI White LED range (Optisolis™), a new generation of white LEDs.

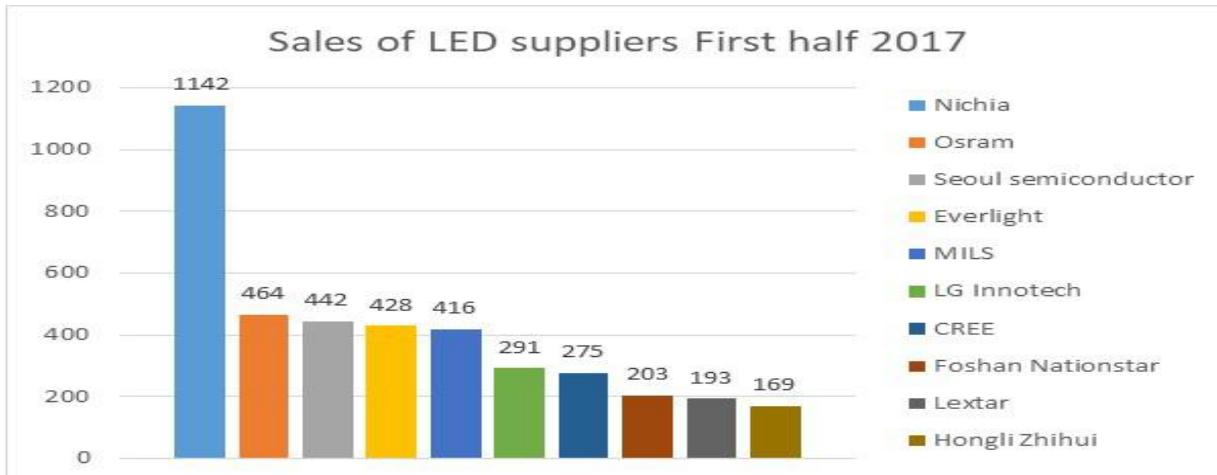
Products

- Light Emitting Diodes
- Laser Diodes
- Optical Semiconductor Devices
- Phosphors
- Fine Chemicals (Electronics Materials, Pharmaceutical Materials, Food Additives)
- Evaporation Materials
- Battery Materials
- Magnetic Materials



Main figures

Employees: 8,600



Introduction & History

Panasonic are an old and very important Japanese group producing a huge range of products mainly in relation with electronics. It was founded in 1918 in Osaka by Kinosuke Matsushita who, disappointed by the lack of interest of his hierarchy with an invention decided to realise it directly. Matsushita was the initial name of the company till the official change in 2008. The name Panasonic was already used since 1955 as a brand, alongside many other brands like National and Technics. Panasonic merged with Sanyo in 2008. It was a difficult period with huge losses, and severe reduction of employees: 15,000 in 2009-2010 and 35,000 in 2010-2013. Panasonic had quality problems with batteries, and lack of success with plasma screens and smartphones, so both activities were stopped.

Recent news

- November 2017: Panasonic win Gold & Special Awards at the Good Design Award 2017
- October 2017: Panasonic ranked 10th in the Forbes Global 2000 List
- April 2018: Panasonic bring highly accurate facial recognition to life, making it possible to recognise individuals even when wearing sunglasses.

Strategy and products

Panasonic are reducing their activities in mass-market electronics, and want to accelerate their development in automotive and in healthcare. For automotive, they are active in:

- Infotainment and electronics products (such as car-use-multimedia-related equipment, electrical components)
- Energy products (such as lithium-ion batteries, Primary batteries with a common plant with Tesla)
- Industrial devices (such as electronic components, electromechanical control components, electronic materials, semiconductors, display, electric motors). In this domain, Panasonic is producing LEDs.

Panasonic are also active in ADAS systems (cameras and recognition), and have recently acquired 69% of Ficosa, a Spanish company producing for instance rear-view mirrors.

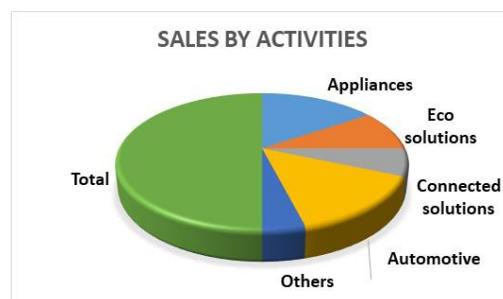
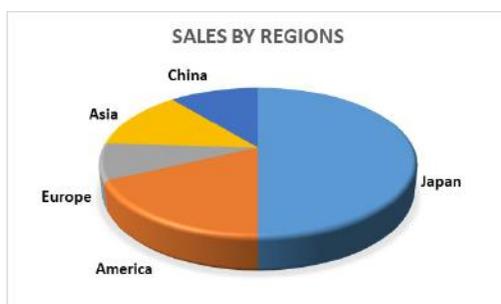
Main figures (FY2016-2017):

Sales: ¥7343bn (\$69bn, €56.2bn)

For such an important group, the level of sales in the domestic market is relatively exceptionally high

R & D expenditures: 7% of sales

Employees: 257,733

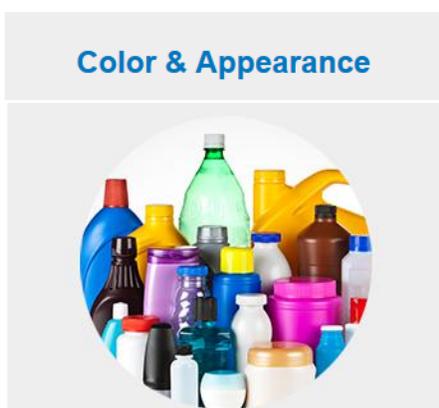
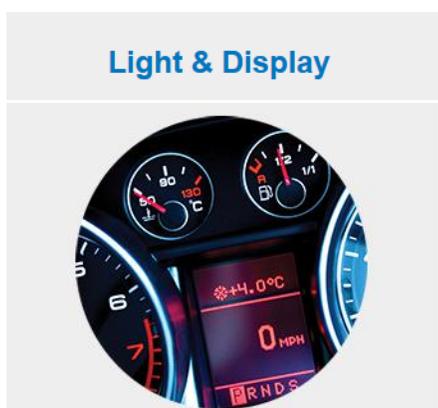


Introduction & History

The Konica Company took shape in 1873. Minolta sold their first photographic device in 1903. These two companies merged in 2003. The company decided in 2006 to sell the camera activity to Sony.

Products

- Business and Production Print Systems
- Industrial Inkjet
- Healthcare equipment
- Performance materials
- Planetarium equipment
- Measuring Instruments
- Optical Products
- OLED lighting



Light and display: Illuminance meters, illuminance colour meters, luminance meters, luminance colour meters, spectroradiometers, display colour analysers.

Colour and appearance: Spectrophotometers, colour and gloss meters, chroma meters.

LED and display: LED testers, imaging photometers, integrating spheres.

Main figures

Sales (2016) : ¥963bn

Operating income (2016): ¥50bn

Konica Minolta have assimilated other companies including Instrument Systems in 2012:

INSTRUMENT SYSTEMS



Founded by Richard Distl in Munich in 1986, Instrument Systems are today one of the world's leading manufacturers of high-precision array spectrometers as well as complex light measurement systems.

SUMITOMO

Sumitomo are a very old company in Japan founded in 1615 in Kyoto by Masatomo Sumitomo. It was before World War II a very important *zaibatsu* that was dissolved at the end of the war. The group was reformed as a *keiretsu*, a group of independent companies organised around the Sumitomo Bank (now Sumitomo Mitsui Banking Corporation) and bound together by cross-shareholding. Today there are many companies still using the word "Sumitomo" in their corporate names. Most of them are managed independently and listed at TSE and other stock exchanges with highly dispersed shareholders. For some, the name only shows their historic origin, and they are no longer considered part of the Sumitomo Group.

In the Sumitomo group, many are in relation to the automotive industry:

- Sumitomo Electric

Sales: ¥2814bn

Employees: 248,330

Main vehicle products: wiring harnesses (worldwide leader)

- Sumitomo Bakelite:

Main products: materials for information and communications equipment, high-performance plastics

- Sumitomo chemical:

Sales: ¥1954bn

Products for lighting: Polypropylene, PMMA.

- Sumitomo Wiring Systems Ltd

Sales: ¥4.3tn

Employees: 250,000

Main products: Wiring systems



- SMBC Sumitomo Mitsui Bank, Sumitomo Mitsui Trust banks, Sumitomo Life Insurance, Mitsui Sumitomo Insurance Company

These important financial institutions are in many cases holding shares of the automotive industry.

5. CONCLUSION

We have seen through careful scrutiny of a variety of entities with different figures and realisations that the Japanese auto industry is very powerful, as well as the organisations for lighting, the lighting departments in car makers, the set makers, and the tier 2 suppliers.

Japan was particularly innovative in the late nineties with the invention of the white LED by Nichia and the adoption of first LEDs for CHMSL, then rear lamps, and finally for front lighting.

Since that time, we have seen innovations like ADB, laser sources, and OLEDs first adopted in Europe. Now for the race to Pixel lighting with more and more light segments, Europe is again leading. Does that mean that Japan is no more leading the innovation in our domain? Perhaps by appearance, but we have to take into account that innovations are also present for mass markets in solutions to reduce costs and to offer to everybody safe and nice lighting systems. And in this domain, the Japanese industry is totally in the race to deliver compact, stylish, and cost effective standard systems.

Too, we must take into account that the new technologies like ADB and Laser, first introduced to improve the visibility range, are certainly not as important in Japanese urban roads as in Europe. And even if Japanese makers are in all markets, they are more sensitive to the influence of their own country or those of USA, their first market where the regulation for ADB is still pending.

But precisely, as urban conditions are more and more the conditions of driving of a majority of people in the world, with still an unacceptable level of accidents, we are awaiting from the Japanese lighting industry innovative solutions in this domain, perhaps in connection with some advanced new ADB systems specially adapted to offer new functions in cities. We are convinced that for the future autonomous, connected and electric cars, Japan is in a good position, as they have since a long time developed robotics, AI, and electric and fuel cell vehicles. Many of them are very much present in Silicon Valley which is more and more orientated to the automotive domain.

So the sun, symbol of Japan, will still be shining on the Japanese vehicle lighting industry for a long time yet to come.

Priorities for Japanese car makers

As defined by the 2017 JAMA report, Japanese car makers have three main priorities:

- Environment
- Safety
- Automated driving

Environment

For the priority Environment, the main effort is for CO₂ reduction, with development of hybrid, electric cars and more efficient gasoline and diesel engines. In the Japanese domestic market, hybrid vehicles are quickly expanding their market share, reaching in 2016 30% of the total registrations. On the other hand, electric cars are not developing as strongly as seen in the chart below, with a market share of only 0.6% of registration (compared to 1.4% in China, and to the absolute reference Norway with 28%)

Nevertheless, the total of these new generation vehicles were representing in 2016 34% of the Japanese market, a very high level compared to all other countries, with a very quick trend for increase.

There are some differences between car makers for their priorities concerning these new clean vehicles:

Toyota have put the priority on hybrid even as they are now too developing other technologies. Nissan have put the priority on pure electric vehicles, having with the Nissan Leaf the EV leader in the world.

Honda are thinking since many years that fuel cells will be important in the future and having a complete vision for that development, with different concept cars and vehicles to sustain such development.

● NEXT-GENERATION PASSENGER CAR NEW REGISTRATIONS, 2008-2016 In vehicle units

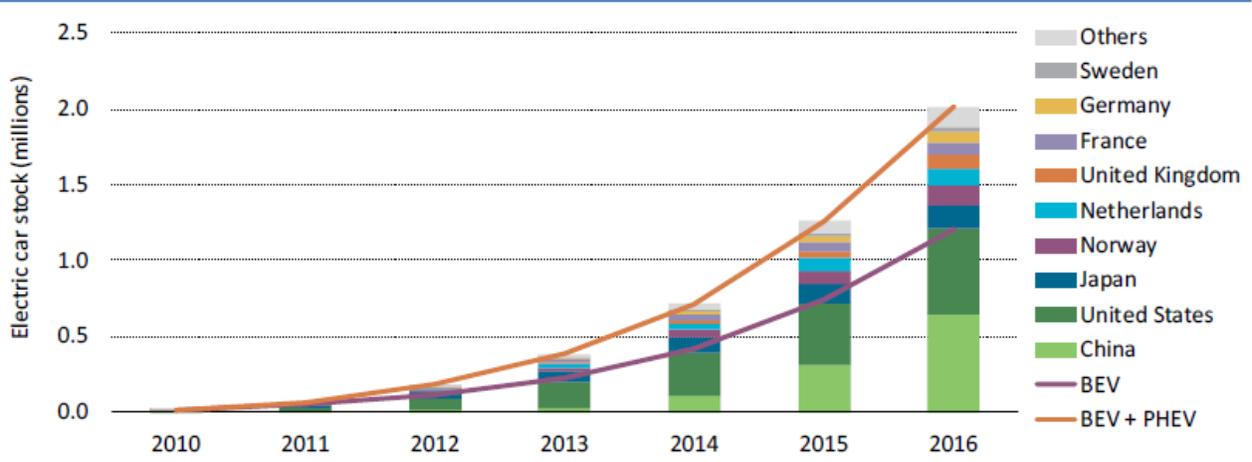
| Year | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|-------------------------|----------------|----------------|----------------|----------------|----------------|------------------|------------------|------------------|------------------|
| Hybrid vehicles | 108,518 | 347,999 | 481,221 | 451,308 | 887,863 | 921,045 | 1,016,757 | 937,575 | 1,275,560 |
| Plug-in hybrid vehicles | 0 | 0 | 0 | 15 | 10,968 | 14,122 | 16,178 | 14,188 | 9,390 |
| Electric vehicles | 0 | 1,078 | 2,442 | 12,607 | 13,469 | 14,756 | 16,110 | 10,467 | 15,299 |
| Fuel cell vehicles | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 411 | 1,055 |
| Clean diesel vehicles | 0 | 4,364 | 8,927 | 8,797 | 40,201 | 75,430 | 78,822 | 153,768 | 143,468 |
| Total | 108,518 | 353,441 | 492,590 | 472,727 | 952,501 | 1,025,353 | 1,127,874 | 1,116,409 | 1,444,772 |

Note: "Hybrid vehicles" Includes hybrid minicars as of 2016.

Source: Japan Automobile Manufacturers Association

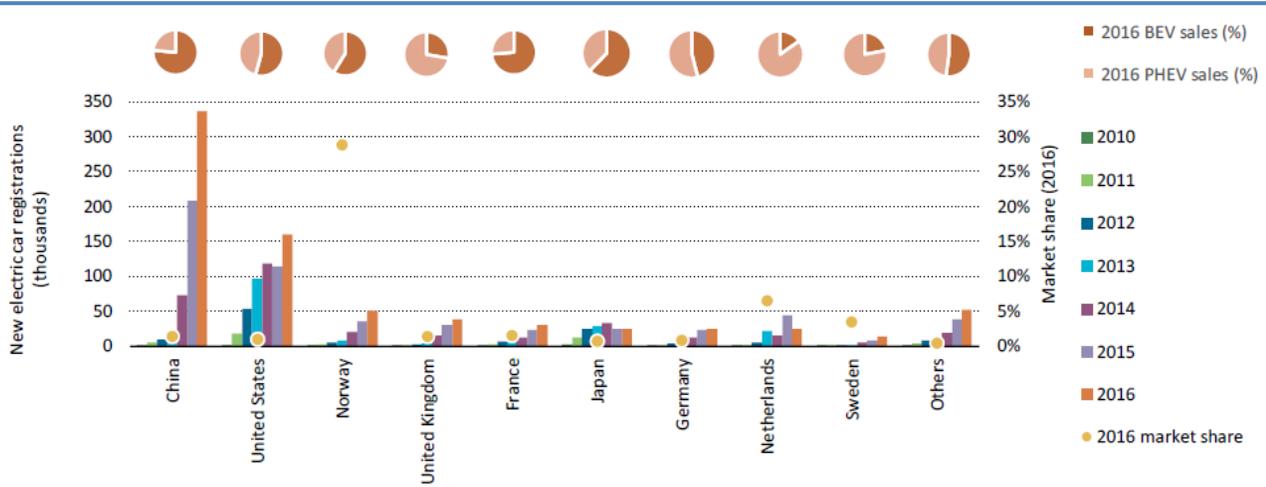
Electric car park in the world: Japan is relatively stable as hybrid vehicles are the clear current winner in this market.

Figure 1 • Evolution of the global electric car stock, 2010-16



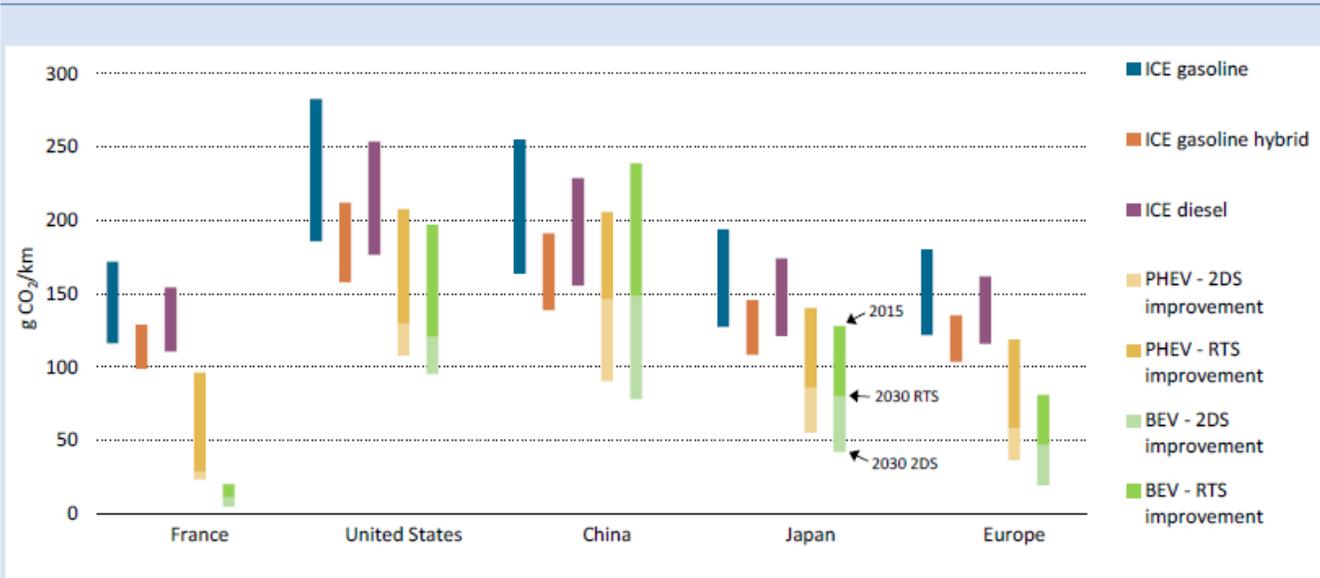
Source: International Energy Agency

Figure 5 • Electric car sales, market share, and BEV and PHEV sales shares in selected countries, 2010-16



Source: International Energy Agency

Figure 10 • On-road well-to-wheel CO₂ emissions for PLDVs for various powertrain technologies by country or region: RTS and 2DS, 2015 to 2030



Source: International Energy Agency

So in this domain of CO₂ reduction, Japan is on par with Europe, ahead of the US and China.

Safety

As defined by JAMA in the following chart, AFS is presented as one of the main solutions to reduce accidents involving pedestrians and cyclists and too for accidents occurring at twilight or night. So performance of lighting is for Japanese car makers a priority.

ADB is not indicated formally as a priority. It is clear that ADB is more adapted to roads with relatively low density, and as in Japan the majority of people are driving in cities, the interest of ADB is less.

For Japanese car makers, the lighting functions to be developed in priority for safety are so in relation to better illuminate pedestrians and cyclists, and the intersections.

● JAMA'S ROAD SAFETY INITIATIVES IN EIGHT PRIORITY AREAS

| Priority Area | Road Users: Public Awareness Campaigns | Vehicles: Safety Measures | Road Infrastructure: Proposals to Government |
|--|---|--|--|
| ① Accidents involving pedestrians or cyclists | • Continued implementation of road safety public awareness campaigns, based on the results of accident causation studies. | • More widespread application of AFS (1), ABS (2), BA (3), and stability control. | • For infrastructural improvements, based on the results of accident causation studies. |
| ② Special measures for the elderly | • Development of road safety educational programs specifically for the elderly. | • Development of technologies specifically geared to aging-related physical changes. | • For more widespread roadway/sidewalk demarcation and greater barrier-free mobility. |
| ③ Greater use of seatbelts | • Public awareness campaigns to promote the use of seatbelts. | | |
| ④ Delays in driver recognition and incorrect vehicle control | • Campaigns aimed at preventing faulty driver recognition and incorrect vehicle control. | • Research into the mechanisms of accident causation and human-machine interface conditions using data recorders, etc. | |
| ⑤ Accidents occurring at twilight/night | • Campaigns to promote the early lighting of automobile headlamps. | • More widespread application of AFS. | • For improved nighttime road illumination. |
| ⑥ Accidents occurring at intersections | • Public awareness campaigns to encourage drivers to exercise greater caution at intersections, where the majority of fatal road accidents occur. | • More widespread application of ABS, BA, and stability control. • Improvement of side-impact protection performance. | • For road infrastructure regulations for effective utilization of ITS technologies. |
| ⑦ Collisions with stationary objects | | • Improvement of side-impact and vehicle occupant protection performance and of side and curtain airbags. | • For expanded provision of underground power lines and impact-absorbing road installations. |
| ⑧ Compatibility | | • R&D on crash-compatible vehicle bodies and compatibility evaluation methods to improve vehicle performance. | |

(1) Adaptive front-lighting systems; (2) Anti-lock braking systems; (3) Brake-assist systems.

Nevertheless, compared to other equipment, AFS still had a very low rate adoption in Japan in 2015 as seen in the following chart with only 3.6%.

● SAFETY FEATURE ONBOARD INSTALLATION STATUS (for passenger cars produced in 2015 for home market)

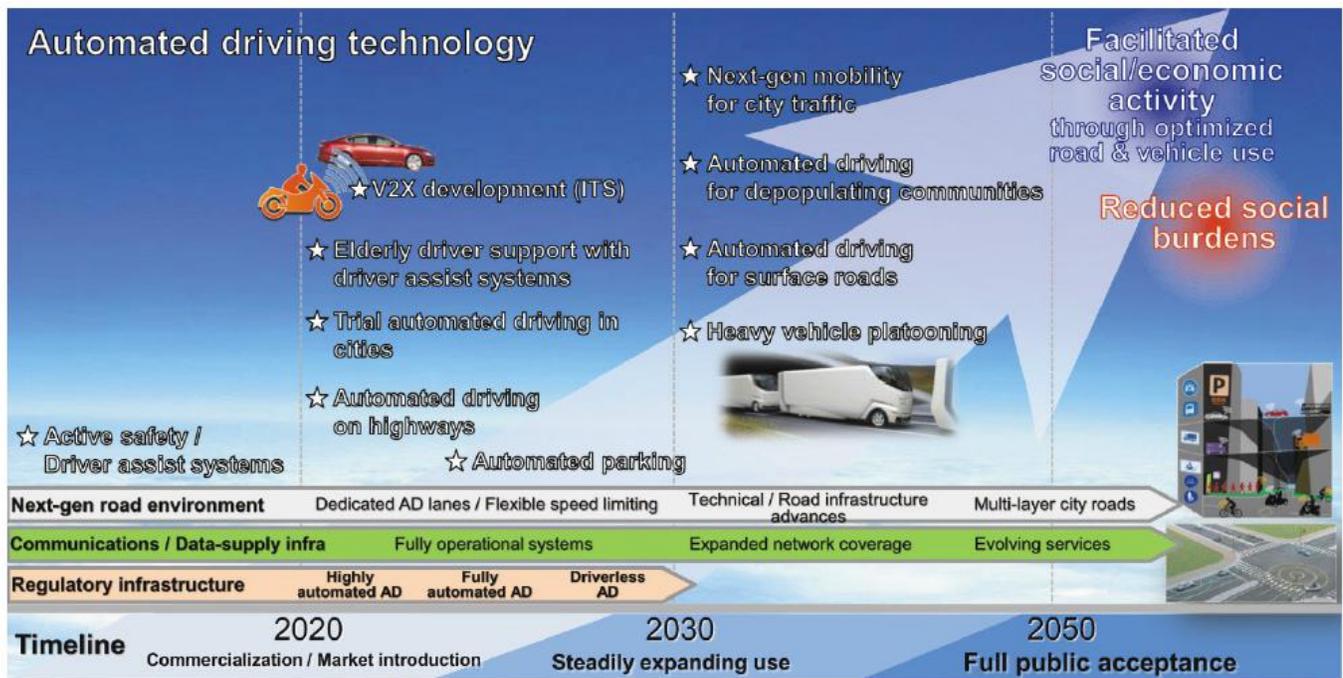
| | Safety Feature | Installation Status | | | |
|--|--|----------------------|----------|------------------|----------|
| | | In no. of models (1) | In % (2) | In vehicle units | In % (2) |
| Active Safety | Brake assist | 179 (170) | 98.4 | 3,718,099 | 97.0 |
| | Unfastened seatbelt warning (front passenger's seat) | 110 (105) | 60.4 | 2,618,825 | 68.3 |
| | Power-window jamming prevention (with auto-up function) | 178 (169) | 97.8 | 3,738,024 | 97.6 |
| | Power-window jamming prevention (without auto-up function) | 31 (30) | 17.0 | 671,726 | 17.5 |
| | High-intensity discharge headlamps | 162 (78) | 89.0 | 2,195,292 | 57.3 |
| | Adaptive front-lighting system (AFS) | 34 (15) | 18.7 | 139,729 | 3.6 |
| | Backing-up monitoring (rear obstacle detection) | 130 (32) | 71.4 | 1,494,945 | 39.0 |
| | Vehicle perimeter monitoring | 44 (14) | 24.2 | 365,005 | 9.5 |
| | Vehicle perimeter obstacle warning | 45 (7) | 24.7 | 393,142 | 10.3 |
| | Blind-corner monitoring | 28 (5) | 15.4 | 241,547 | 6.3 |
| | Night vision monitoring | 2 (0) | 1.1 | 522 | 0.0 |
| | Curve detection | 18 (4) | 9.9 | 69,193 | 1.8 |
| | Tire pressure monitoring | 20 (14) | 11.0 | 92,800 | 2.4 |
| | Driver inattention warning | 33 (10) | 18.1 | 278,196 | 7.3 |
| | Inter-vehicle distance warning | 78 (15) | 42.9 | 852,419 | 22.2 |
| | Lane departure warning | 69 (14) | 37.9 | 802,913 | 21.0 |
| | Rear collision warning-equipped headrest control | 3 (0) | 1.6 | 1,273 | 0.0 |
| | Forward collision-mitigation braking system | 75 (14) | 41.2 | 705,468 | 18.4 |
| | Adaptive cruise control | 48 (7) | 26.4 | 345,206 | 9.0 |
| | Adaptive cruise control with low-speed following mode | 18 (4) | 9.9 | 199,775 | 5.2 |
| Full-range adaptive cruise control | 26 (7) | 14.3 | 222,726 | 5.8 | |
| Lane-keeping assist | 23 (2) | 12.6 | 186,508 | 4.9 | |
| Backing-up monitoring (parking assistance) | 10 (1) | 5.5 | 38,194 | 1.0 | |
| Navigator-based gearshift control | 15 (1) | 8.2 | 48,715 | 1.3 | |

(Source: JAMA)

Automated Driving

Japanese car makers are naturally strongly involved in automated driving. Japanese interest in robots goes back many years and so they have developed a specific knowledge in artificial intelligence, allowing them to compete in the future with new entrants like Google, Apple, Intel, and others.

● THE JAMA ROADMAP FOR THE PROMOTION OF AUTOMATED DRIVING



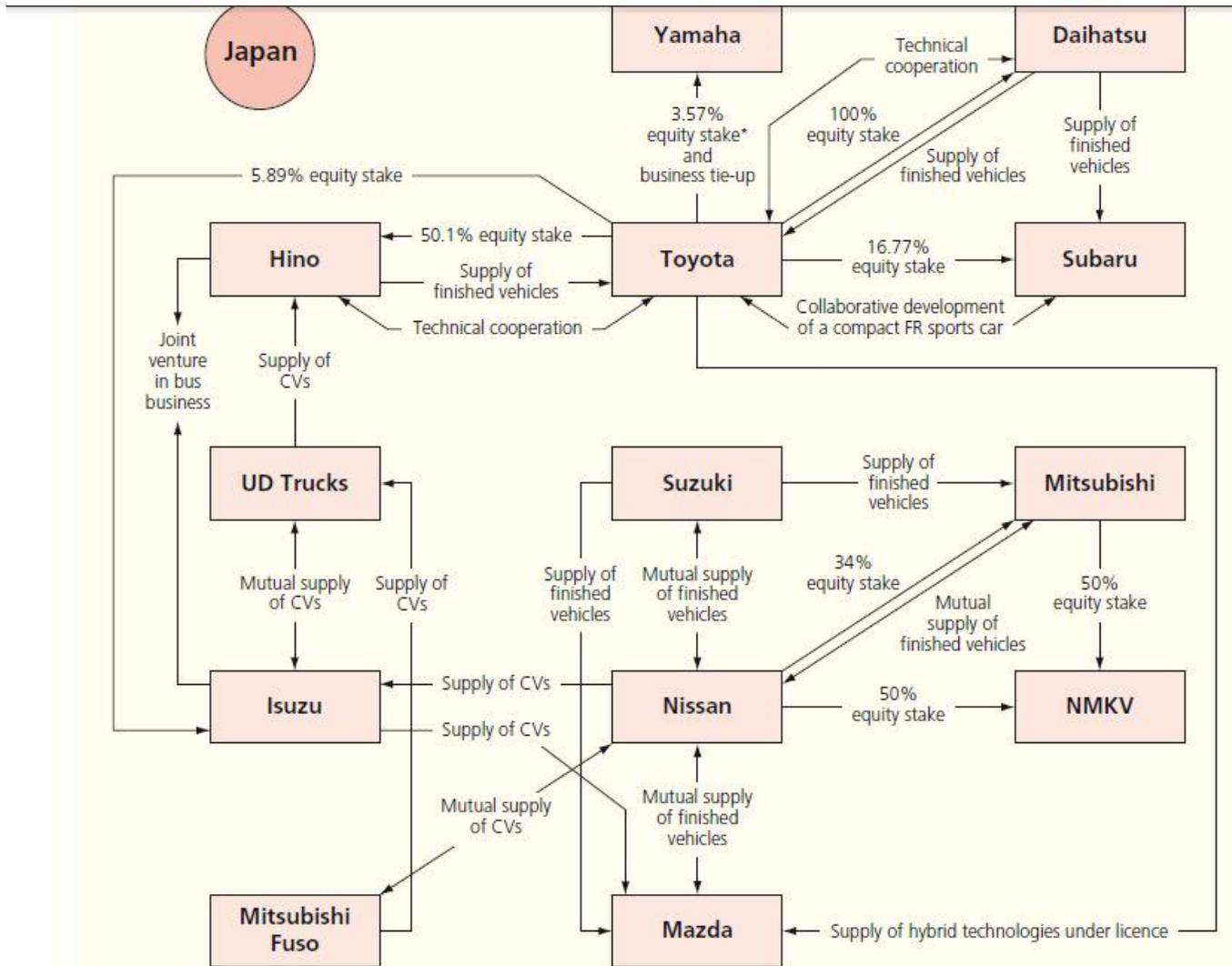
Note: "V2X" means vehicle-to-connected infrastructure.

Source: Japan Automobile Manufacturers Association

Organisation of Japanese car makers

The organisation of Japanese car makers in Japan

There are many relations between car makers in Japan, both financial and for production optimisation, mainly around Toyota and Nissan.



Source: JAMA

The organisation of Japanese car makers in the World

Japanese car makers have also developed a lot of relations with non-Japanese car makers in the world, for instance:

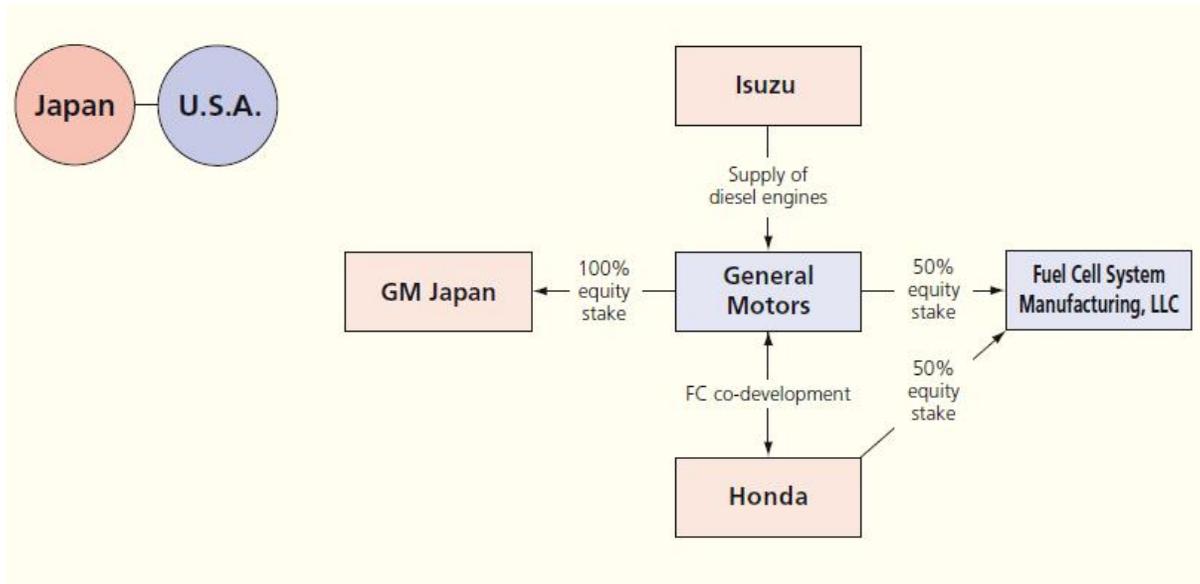
Nissan with Renault and now Mitsubishi, Dacia, and Lada Avtovaz, tops in the world for number of cars produced.

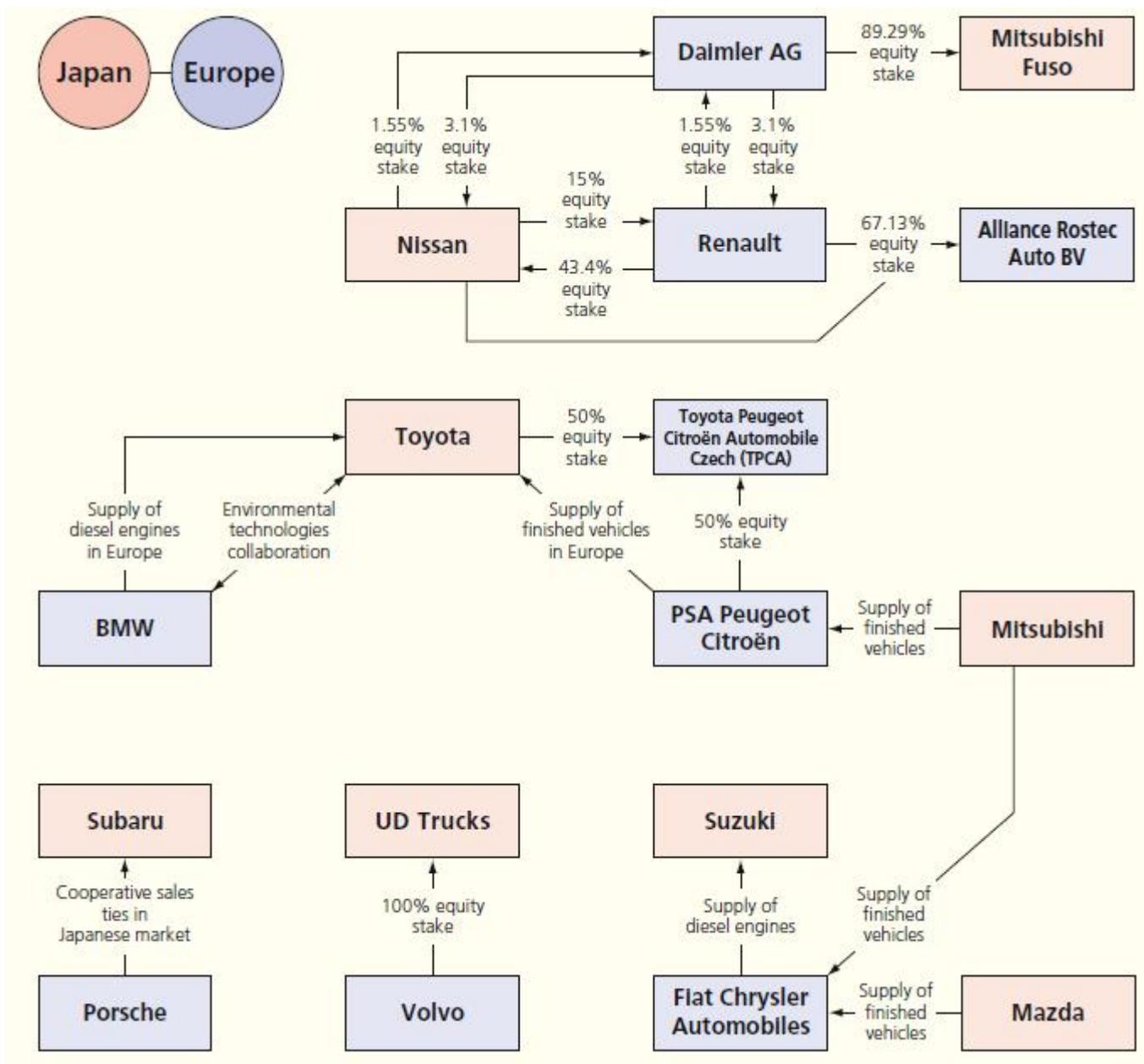
This Alliance has good relations with Daimler, with technologies developed in common. Their relations were reinforced recently by a cross participation of 3.1%.

Toyota in Europe with PSA for production of small cars and with BMW for the development of new technologies for CO₂ reduction.

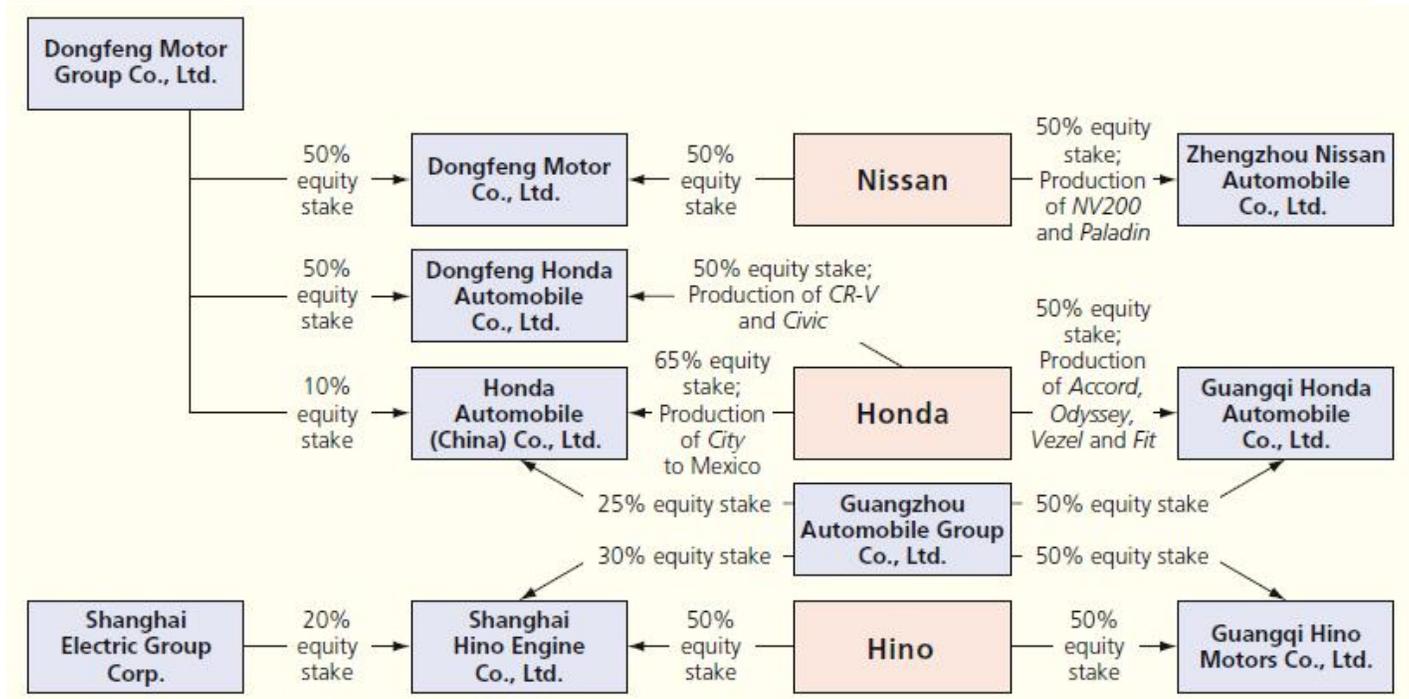
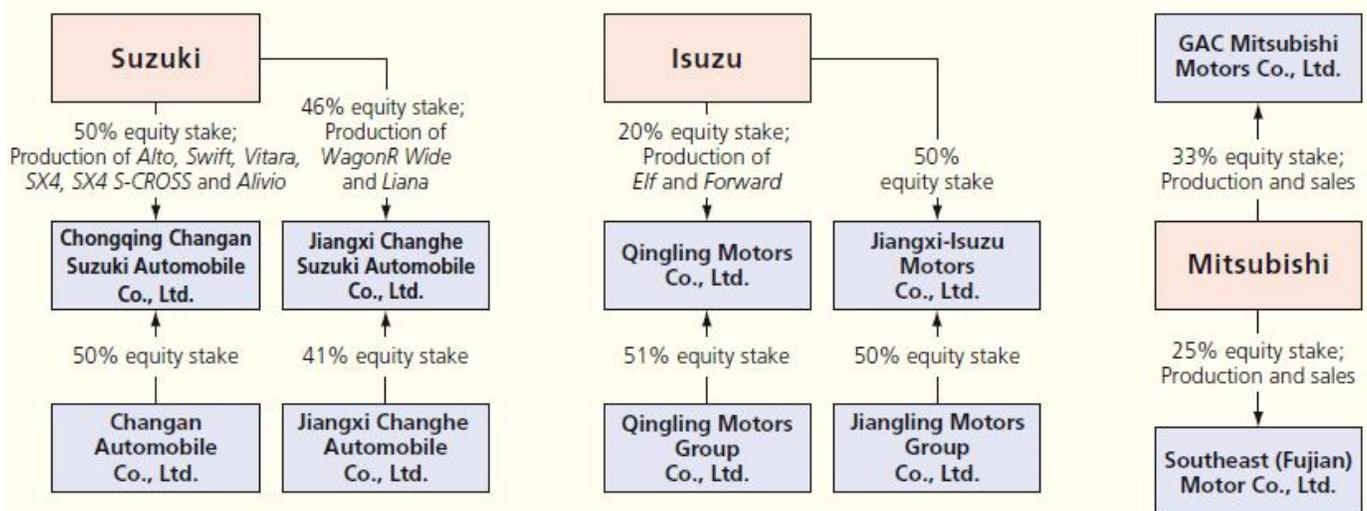
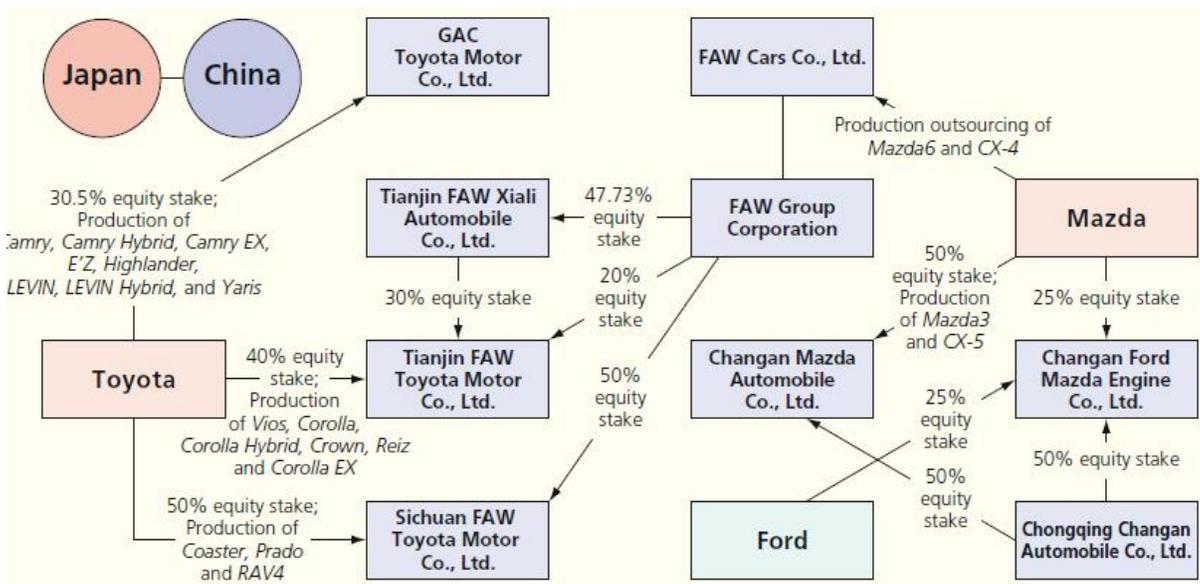
In China, the cooperations with local car makers are numerous, as they were imposed by the administration.

At the opposite, there are relatively few relations with American car makers.





Source: JAMA



Capitalisation of Japanese car makers

Japanese car makers are not only leading for quantities of cars produced, but also by the capitalisation of their automotive companies, as they are representing 41% of the first 15 capitalisations of the sector, demonstrating too their ability to be economically profitable.

| | 1st jan. | Capitalization (M\$) |
|---|----------|-------------------------|
|  TOYOTA MOTOR CORP | -5.70% | 211 799 |
|  VOLKSWAGEN | -2.60% | 100 662 |
|  DAIMLER | -2.30% | 89 688 |
|  BAYERISCHE MOTOREN WE... | -1.12% | 67 893 |
|  HONDA MOTOR CO LTD | -6.29% | 62 820 |
|  GENERAL MOTORS CORPO... | -7.44% | 53 010 |
|  NISSAN MOTOR CO LTD | -0.53% | 44 712 |
|  FORD MOTOR COMPANY | -10.73% | 43 985 |
|  HYUNDAI MOTOR CO | ---% | 38 174 |
|  RENAULT | 13.47% | 34 669 |
|  GEELY AUTOMOBILE HOLDIN... | -3.29% | 30 220 |
|  SUZUKI MOTOR CORP | -13.64% | 26 390 |
|  SUBARU CORP | 0.33% | 26 283 |
|  ASTRA INTERNATIONAL TBK ... | ---% | 22 017 |
|  PEUGEOT | 12.03% | 21 176 |
|  TATA MOTORS | -18.02% | 16 579 |
|  GREAT WALL MOTOR CO LTD | 7.48% | 15 198 |
|  MAHINDRA AND MAHINDRA LTD | -1.24% | 14 172 |
|  ISUZU MOTORS LTD | -13.69% | 13 192 |
|  PORSCHE | -4.56% | 12 693 |

(source: 4 traders)

Japanese shareholders in Japan are mainly financial organisations like banks and insurance firms. Generally, they have not a strong influence in the company as the board of directors, naturally appointed by the investors, are executives of the company itself and have served for years in the company.

Strategy of car makers

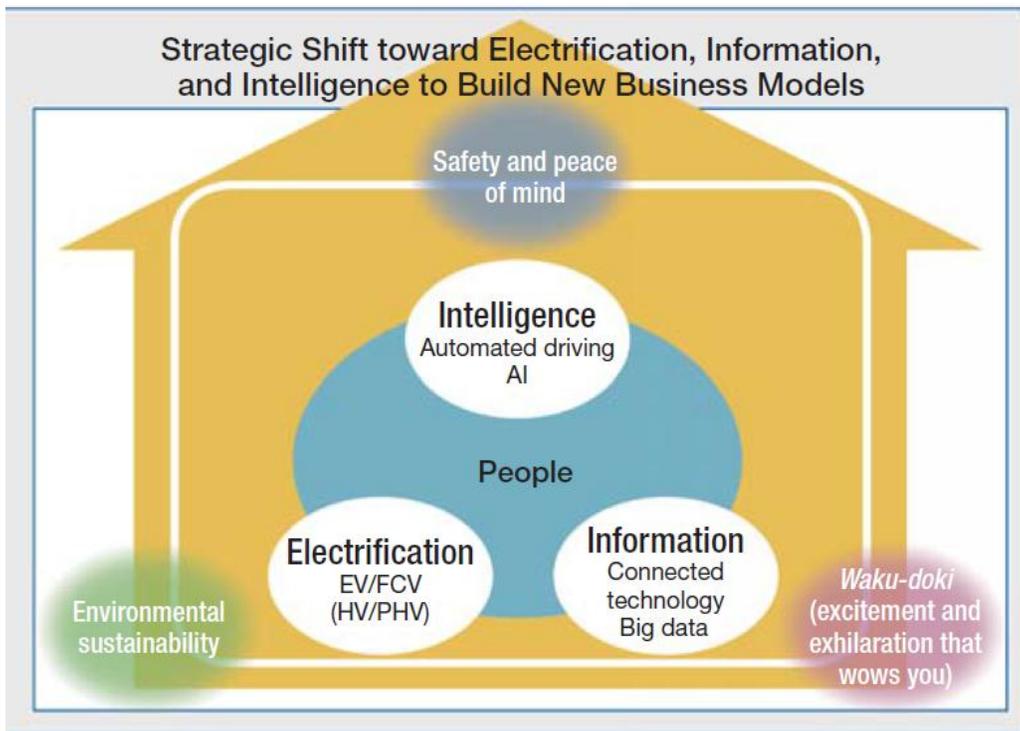
Toyota Global Strategy:

Toyota's Goals



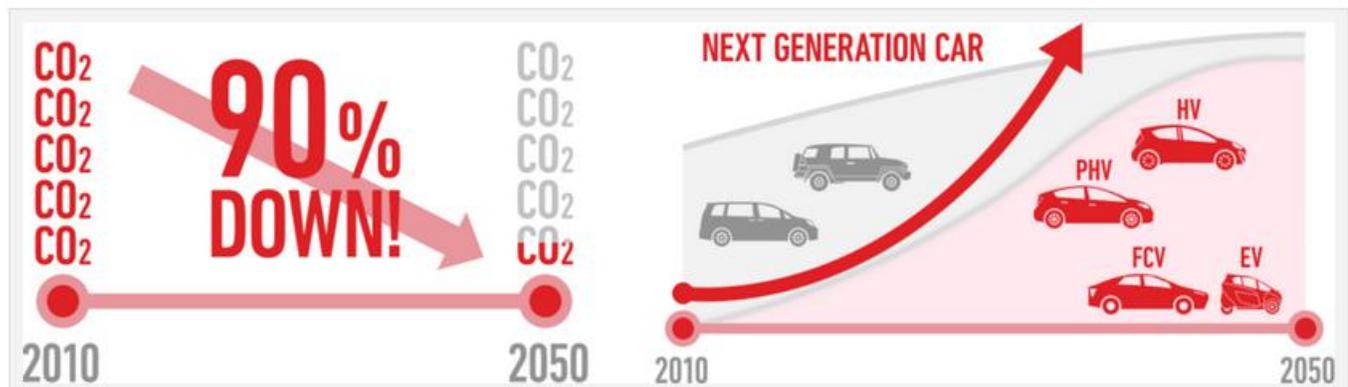
The three main strategies of Toyota for **Mobility of the future** are:

- . **Eco-Car strategy: Electrification** with EV, FC, HV, PHV.
- . **Connected cars strategy: Information** with vehicle data exchanging with general data
- . **Automated driving strategy using artificial intelligence:** Intelligence



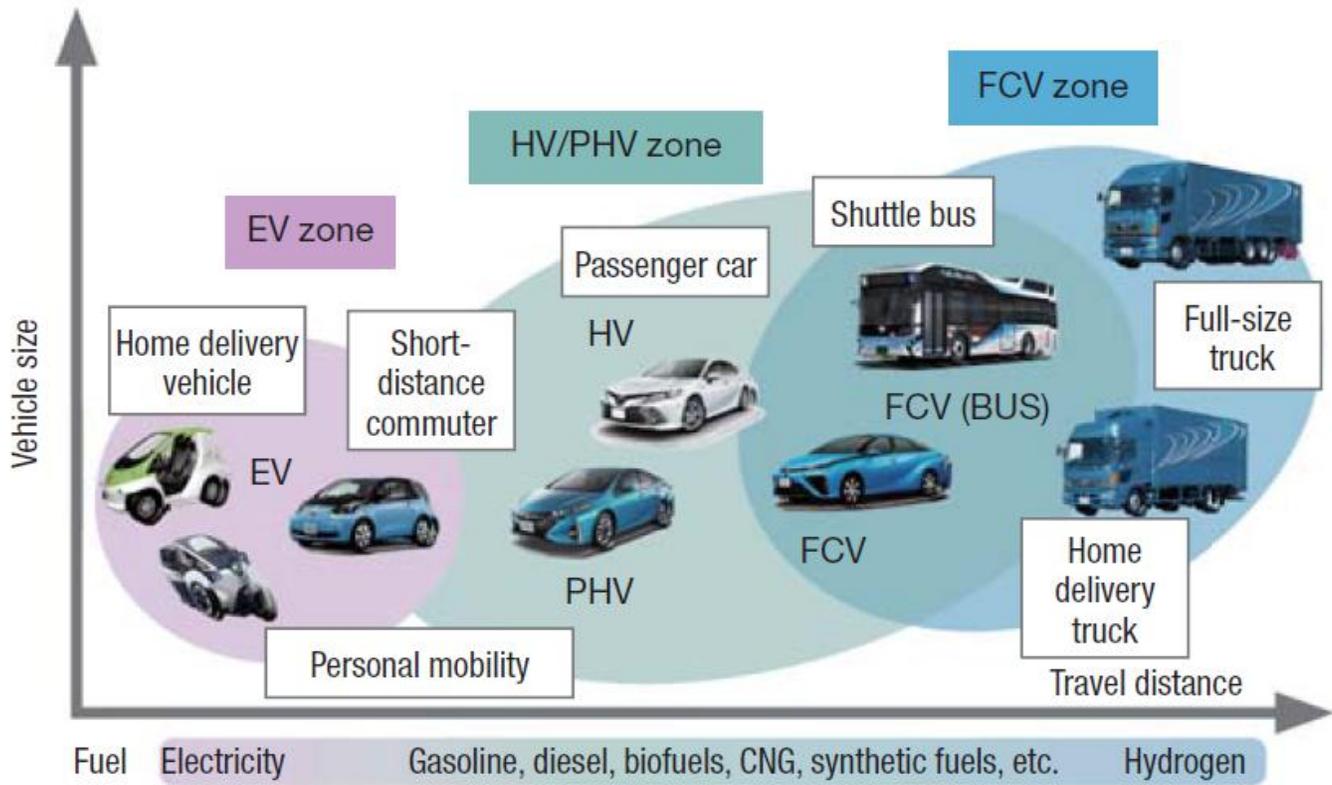
Toyota Strategy for Environment: Electrification

For environmental compatibility, Toyota's target is to reduce continuously the emission of CO₂, until by 2050 a 90% reduction has been achieved, particularly by progressively increasing hybrid and electric vehicle, with elimination of gasoline cars by 2050. A first target for Toyota will be to have 50% electrified cars in 2030. Toyota were the pioneer of Hybrid vehicles since 1997, but announced in 2016 that they will not only develop in the future Hybrid (HV) and Plug-in Hybrid (PHV), but also Electric Vehicles (EV) and Fuel Cell vehicles (FCV).



Toyota are not limiting their efforts to hybrid vehicles, though that is their current priority; they are also developing fuel cell technology particularly for trucks and buses, and working on small-vehicle EV technology as well.

Choosing the Right Eco-car for the Job



Source: Toyota annual report

Toyota Strategy for Safety

Avoid dangerous situations and prevent crashes with active safety technology:

To be noted that two technologies of six chosen by Toyota to reduce crashes are in relation to Lighting: AFS and automatic high beam. ADB is not currently on this list, but should soon be included.

| | | |
|-------------------------|------------------------|-----------------------------------|
| 01 Radar Cruise Control | 02 Lane Keeping Assist | 03 Adaptive Front-Lighting System |
| 04 Lane Departure Alert | 05 Automatic High Beam | 06 VDIM |

Source Toyota - VDIM: Vehicle Dynamics Integrated Management

Toyota are also strongly involved in automated driving, with development of AI, in Japan and in the Toyota Research Institute in America. Toyota announced in March 2018 intent to invest \$2.8bn in self-driving tech development with Denso and Aisin Seiki.

In January 2017, Toyota unveiled the Concept-i, a concept car developed with the aim of building a new driver-vehicle relationship in which artificial intelligence (AI) enables cars to understand the driver, allowing people and cars to grow together as partners. The Concept-i aims to be a beloved car of a new era.



Toyota cars

Toyota have many models of car in production with several brands: Toyota, Lexus, Hino, Daihatsu, Rank, and with very well-known names as Yaris, Corolla, Camry, Avallon, Sienna, C-HR, RAV4, Prius, Mirai.

Latest serial cars presented at Geneva 2018:



New Auris Hybrid Geneva 2018



New Aygo Geneva 2018

Toyota Concept cars for hybrid vehicles:



Crown Concept 2017



Toyota Camry



Fine Comfort ride Concept



GR HC Sports 2017

Toyota concept car for Electric Vehicles:



TOYOTA Concept-i RIDE

Universal small mobility
vehicle - The 45th Tokyo
Motor Show 2017

Toyota concept car for Connected Vehicles:



*Toyota concept car connected AI
Geneva 2017*

Toyota are also a first car maker to sell a fuel cell vehicle, the Mirai being sold from \$58,000 in USA.



NISSAN INTELLIGENT MOBILITY

Nissan Intelligent Mobility makes our cars more exciting by:

Nissan Intelligent Driving

More confidence through increased safety, control and comfort for all on board.



Serena ProPILOT



Nissan IDS Concept Sensing image



Autonomous drive technology ProPILOT on-road test

Nissan Intelligent Power

More exhilaration through driving pleasure that is also clean and efficient.



Battery Electric Vehicle



e-POWER



e-Bio Fuel-Cell

Nissan Intelligent Integration

More connected by conveniently linking our cars and the wider society.



Energy management system (Vehicle to Home)



Energy management system (Vehicle to Building)

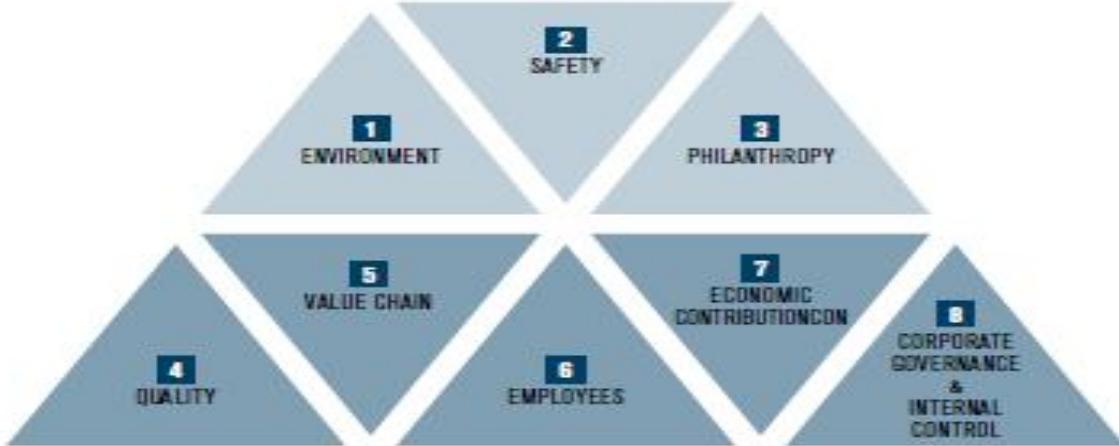
CORPORATE VISION
NISSAN: ENRICHING PEOPLE'S LIVES



Blue Citizenship

SUSTAINABILITY
STRATEGIES

NISSAN MOTOR CORPORATION



DEVELOPMENT OF A SUSTAINABLE SOCIETY

Nissan cars

Sales volume by region:

China

Venucia T90



Total Sales Volume: **1,355** thousand units

North America

Rogue



Total Sales Volume: **2,130** thousand units

Other Markets

Datsun redi-GO
KICKS



Total Sales Volume: **808** thousand units

Japan

Serena ProPILOT
Note e-POWER



Total Sales Volume: **557** thousand units

Europe

Qashqai



Total Sales Volume: **776** thousand units



Nissan Leaf- Most sold Electric vehicle



Nissan Note

Honda R & D Strategy

Honda have always been strongly orientated to engineering and technology. They have a ratio of R & D expenditure much higher than the average of car manufacturers with roughly 4.9%.

Now their main mission is stated as "Realising a carbon-free and collision-free society".

For CO₂ reduction, Honda are targeting to produce two-thirds of their production in 2030 with electrified vehicles. They have already hybrid, plug-in hybrid and fuel cell vehicles and are introducing a pure electric car in China this year.

Honda strategy for electrified vehicles:



Robotics:

Honda R & D also focuses on robotics for many years as they presented the robot ASIMO in 2005. Now their strategy in robotics is called 3E, for:

Empower: representing Honda's concept that robotics and people can work together while leveraging each other's strengths.

Experience: for the idea that people and robotic devices grow together by interacting with each other, becoming even more useful for people and society as a whole.

Empathy: about the concept that robotics devices have compassion toward and can achieve a mutual empathy with people while providing support for human activities.

At CES 2018, Yoshiyuki Matsumoto, president & CEO of Honda R & D, said "Honda views robotics not as something in conflict with people, but as an opportunity to expand their potential. We have entered an era when robotics will become increasingly visible and essential in our everyday lives and have the ability to unlock human potential." This strong experience in robotics will certainly be very useful for the development of AI (Artificial Intelligence) for future AVs.

Honda 2030 strategy (by Takahiro Hachigo, President & CEO)

In order to serve people worldwide with the joy of expanding their life's potential, Honda will strive to lead the advancement of mobility and enable people everywhere in the world to improve their daily lives.

Creating value for mobility and daily lives

To provide people with the joy and freedom of mobility and the joy of making their lives better, Honda will focus on three areas, namely mobility, robotics and energy.

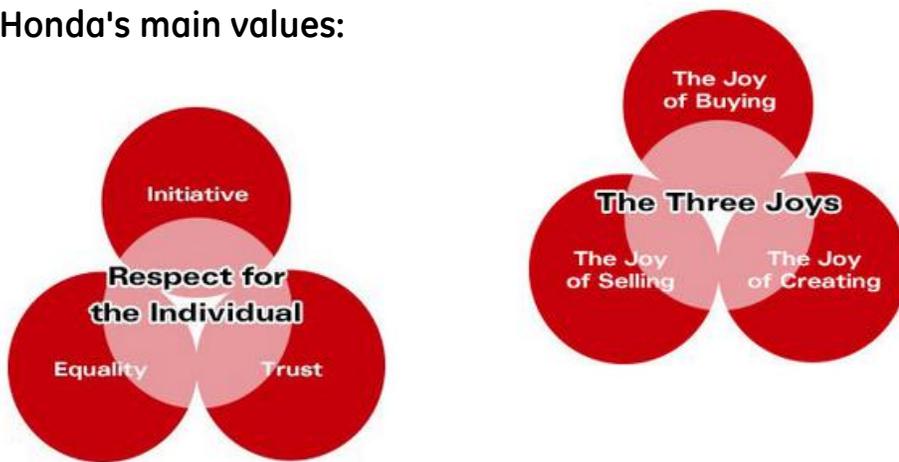
Accommodate the different characteristics of people and society

Honda will strive to further expand the joy of people by offering products and services that are optimised based on Honda's desire to utilise technology to help people, while putting people at the core.

Toward a clean and safe/secure society

Striving to become N° 1 in the areas of the environment and safety, Honda will invest more resources in these areas and strive to become a company that leads the efforts to realise a carbon free and collision-free society.

Honda's main values:



Honda Cars

Honda are producing global cars sold in many countries as Fit, Civic, Accord, Vezel/HR-V, NSX, and CR-V. They are too producing some models locally like the Mobilio and BR-V in Asia, Ridgeline and Odyssey in North America, Crider, Avancier and UR-V in China, and N-Box in Japan.

Global Cars



Fit-Jazz

B-Segment Exterior.
C-Segment Interior.



CIVIC

Fuel Efficiency coupled with
Style



ACCORD

Honda's Best-Selling
Vehicle



HR-V



CR-V

Go anywhere in the
versatile CR-V



NSX



Clarity Fuel Cell

World's First Five-
passenger Sedan-type FCV



Hybrid Cars

Acura is the premium brand, including models like the ILX, TLX, RLX, RDX, MDX, and NSX. The 2019 RDX is shown here.



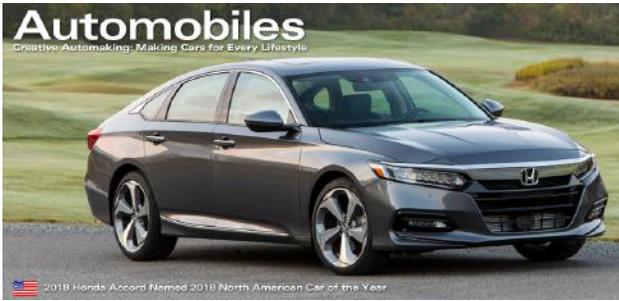
Cars presented by Honda at the 2018 Geneva Motor Show

As with other car makers, Honda are now showing EVs at motor shows, with a new concept Urban EV and an electrified prototype based on an Accord car.



All-New Honda Insight Prototype Redefines Segment while Expanding Honda's Electrified Vehicle Lineup

New Honda Insight Prototype Electrified



2018 Honda Accord Named 2018 North American Car of the Year

New Honda Accord 2018— North American Car of the Year



Honda to Unveil All-new CR-V at Geneva Motor Show

Honda New CRV



Order Books for Production Version of Honda Urban EV Concept Open from Early 2019

Honda Urban EV Concept



Honda Accord 2018 tenth generation

List of DVN Gold Members

27 Car Makers

Audi, Germany
Bentley, UK
BMW, Germany
Changan Design Center, Italy
FCA, USA
Daimler, Germany
Ford, Germany
GM, USA
Great Wall, China
Harley-Davidson, USA
Honda, Japan, USA
Hyundai, Korea, Europe
Jaguar-Land Rover, UK
Mahindra & Mahindra, India
Nio, China
Nissan, Japan, Europe, USA
Opel, Germany
Porsche, Germany
PSA, France
Renault, France
SAIC TC UK
Shanghai-Volkswagen, China
Seat, Spain
Skoda, Czech Republic
Toyota, Japan, Europe, USA
Volkswagen, Germany
Volvo Cars, Sweden

19 Univ., labs, Consultants

Darmstadt university, Germany
DEKRA laboratory, Nederland
FEP, Franhauffer, Germany
Fudan university, China
GranStudio, Italy
Hannover Leibniz Univ.(HOT), Germ.
Institut d'Optique Graduate School, Fr.
Karlsruhe Lighting Institute, Germany
LAB, France
Light Sight Safety, Belgium
Nuremberg university, Germany
Pacific Insight, USA
Parma university, Italy
Rensselaer university, USA
SLD Laser—formerly Soraalaser
UMTRI, USA
University of California, Santa Barbara
YoungNam University, South Korea
Mr Shunxing Wang, China

38 Set Makers and Tier 1s

AL, Germany, USA
Denso, Japan
Elba, Romania
Farba, Turkey
FIEM Industries, India
Flex'N'gate, USA
Grote, USA
Harbin Good Time, China
Hella, Germany
Hyundai IHL, Korea
Ichikoh, Japan
J.W. Speaker, USA
Koito, Japan, Europe
Lear, USA, Europe
Lite-On, Taiwan
Lumax, India
Magna, USA, Austria
Microlight Auto Parts, Taiwan
Mobis, Korea
NAL, USA
Neolite ZKW, India
Nordic Lights, Finland
Odelo, Germany
Olsa, Italy
Plastic Omnium, France
Peterson, USA
Rebo Lighting&Electronics, China, Germany
Shanghai Koito, China
SL Corporation, Korea
Stanley, Japan
Truck-Lite, USA
Valeo, France, Spain, China
Varrac, Germany, Czech R.
Wipac, UK
Xingyu, China
ZF-TRW
ZKW, Austria
Zodiac, France

56 Lighting Suppliers

A2Mac1, France
AKKA, France, Germany
AML Systems, France
Anrui Opto, China
Auer-Lighting, Germany
Bicomoptics, China
Bühler Alzenau, Germany
Covestro, US, China, Europe
DBM Reflex, Canada
Delvis, Germany
Docter Optics, Germany
Dominant Opto Tech., Malaysia
EcoGlass, Czech Republic
Elmos, Germany
Enmech-Mektec, Germany
Everlight Electronic, Taiwan, Germany
GXC Coatings, Germany
Hologhane, France
IAV, Germany, USA
Infineon, Germany
Innotec Group, USA
Instrument Systems, Germany
Jenoptik, Germany
Keboda, China
LG Innotek, South Korea
LG Electronics, South Korea
LMT, Germany, China
Lumileds, Netherlands
Maxell Joei Tech, Japan
Merck, Germany
Mentor Graphics, Europe, USA
Mitsubishi Electric, Germany, Japan
Myotek Industries, USA
Nalux, Japan
Nichia, Japan
NXP, UK
ON Semiconductor, Europe, Asia, USA
Optis, France
Optoflux, Germany
Osram, Germany
Oxyphen, Switzerland
Panasonic, Japan
Proper Group, USA
Sabic, USA
Samsung Electronics, Korea
Sapphire, USA
Sea Link International, USA
Segula Technologies, France, Austria
Seoul Semiconductor, Korea
Soraalaser Diode, USA
Synopsys, USA, Germany
Texas Instruments, USA
TQ Technology, Taiwan
Vosla, Germany
WL Gore, USA
Zollner, Germany

Selected DVN Reports 2008-2018

Hella company profile
Audi company profile
AL company profile
DRL, brand signature
Valeo company profile
Koito company profile
China lighting market
The Wonderful World of Passenger Car lighting Regulations
Tier 2and3 contribution on automotive lighting
ZKW company profile
Simulations in automotive lighting
Mercedes-Benz profile
LED technologies in Automotive Head lighting
LEDs Thermo-Electrics
Interior Lighting
BMW and lighting
Lighting and Driver Assistance
OLED technology
Materials in lighting
Laser Head lighting

2016 reports

Peterson Manufacturing
NAIAS Auto Show
Delhi Auto Expo 2016
DVN Delhi workshop
Geneva Auto Show 2016
Vision of lighting 2025-2030

2017 reports

NAIAS autoshow
DVN Rochester workshop.
Geneva autoshow
Simulation Tools
Shanghai autoshow
DVN Shanghai workshop

2018 reports

NAIAS and CES autoshows
DVN Munich Workshop
Geneva autoshow
Engineering Consultancies
Vehicle Lighting in Japan
DVN Tokyo Workshop (forthcoming)

Korea Lighting Market
SL Corp profile
ADB/Matrix Beam
J.W. Speaker Profile
2015 Geneva Auto Show
ADAS and Lighting
India Car Industry and Lighting Market
Advanced Motorcycle Lighting
IAA Auto Show 2015
ISAL 2015
Peterson Manufacturing
NAIAS Auto Show
Delhi Auto Expo 2016
DVN Delhi workshop
Geneva Auto Show 2016
Vision of lighting 2025-2030
DVN Tokyo workshop
Automotive lighting Regulations worldwide
New ADB technologies
Mondial Paris Auto Show
VISION Congress Vehicle Lighting in USA

DVN Tokyo workshop
Automotive lighting Regulations worldwide
New ADB technologies
Mondial Paris Auto Show
VISION Congress Vehicle Lighting in USA

Interior Lighting
Israeli Startups
IAA Frankfort autoshow
ISAL
Jaguar Land Rover and lighting

Varroc profile (forthcoming)
Camera technologies (forthcoming)
Mondial Paris Autoshow (forthcoming)
VISION congress (forthcoming)
Volkswagen profile (forthcoming)