strategy&
Part of the PwC network

Full speed ahead: What patents can tell us about the future landscape of autonomous driving

Marcus Gloger,
Partner, Strategy&

Hartmut Güthner,
Director, Strategy&

Martin Gerhardus,
Manager, Strategy&

Edelbert Häfele,
Chief Executive Officer, PATEV

Stefan Hofmann,
Director Competitive Intelligence, PATEV

Aaron Miller,
IP Analyst, PATEV

In recent years, the number of patents for innovative products related to automated and autonomous driving has surged. So, to better understand this surge, we – in partnership with PATEV Associates GmbH & Co. KG – analyzed the global development in patents among the major automotive patent applicants. The goal of our analysis was to evaluate the R&D activities in automated and autonomous driving among key players, assess their innovation speed, and identify collaborations between the applicants.

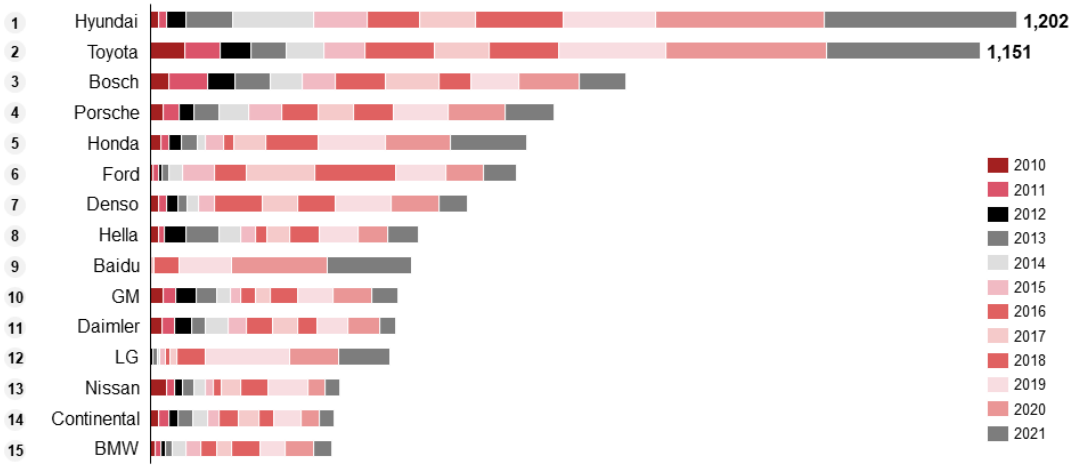
For our analysis, we first selected and structured relevant autonomous driving technology areas for our data acquisition, such as traffic jam assist, highway pilot or valet parking. We then looked at more than 38.000 patent applications, across industries and regions, grouped into almost 15.000 patent families published from 2010 to 2021. Finally, we used the PATEV Innovation Intelligence system to prepare the huge amount of data for evaluation and interpretation. With the interactive evaluation, data can be presented from different perspectives, such as regional trends, dynamics of applicants, and shifts in technology focus.

Asian OEM have the most patents for automated and autonomous driving

Our analysis of the top 15 patent applicants by number of published patents showed that traditional automotive companies are still leading the patent landscape, with Baidu and LG appearing as the only non-traditional automotive tech players in the top 15. It is particularly remarkable that two Asian companies clearly dominate the top positions, although no significant technology carriers from these two companies are using Level 3 automation on the road. From our perspective, that is a clear indicator that their high R&D activity will soon be visible in future vehicles and allow them to catch up with OEMs that already offer Level 3 automation on the road. Meanwhile, German manufacturers and suppliers are mostly in the middle of the pack.

ADDING VALUE TO IP
PATEV

Top 15 applications with number of published patent families from 2010 to 2021



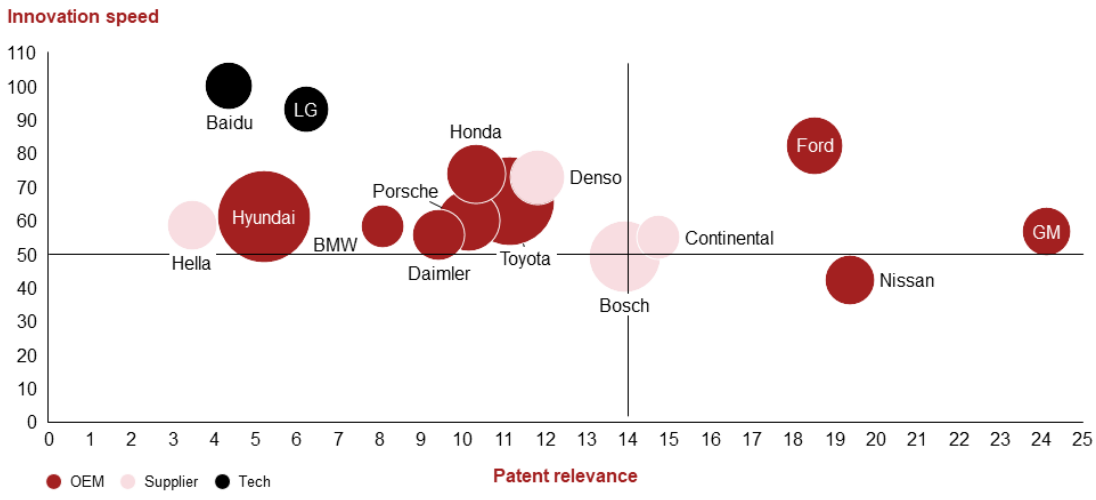
Note: Analysis was aggregated on parent / holding level (e.g., Porsche stands for Porsche Automobil Holding, which includes Volkswagen AG, AUDI AG, Porsche AG, etc.; GM also includes their Autonomous Driving Company Cruise LLC)

Ford and GM are demonstrating fast innovation speed and the highest relevance of patents

Beyond the number of patents, we focused on innovation speed and the relevance of innovations. Based on our data, Ford and General Motors exhibit a very good combination of innovation speed and proven patent relevance. The highest innovation speed is demonstrated by Baidu and LG.

More specifically, Ford and GM are referenced very often, and Ford in particular has been accelerating in speed. On the other hand, the relevance of patents by Baidu and LG might prove to be even higher in the future, as their portfolio is still very young and already doing quite well in acquiring forward citations.

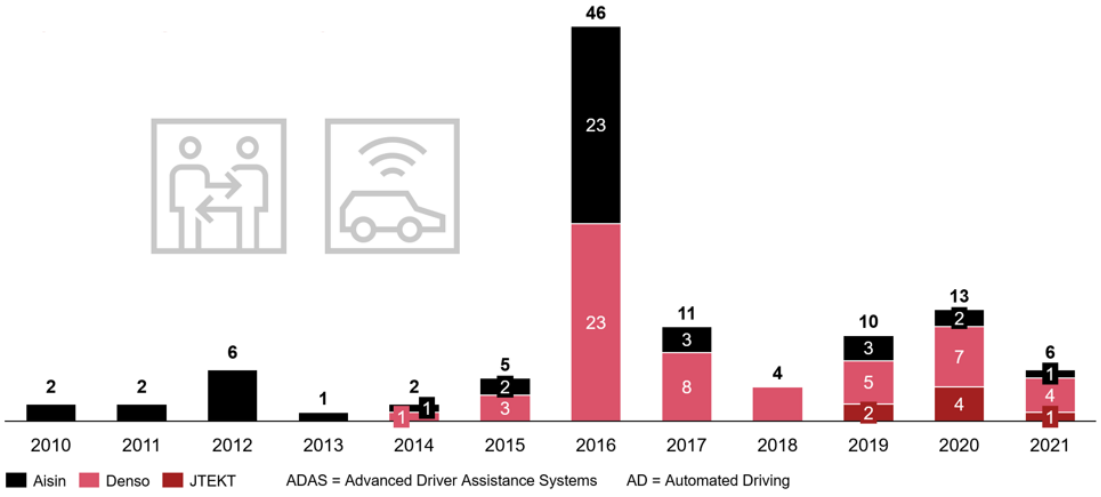
Patent relevance and innovation speed competitor benchmark



Collaborations are most common in Asia

According to our patent analysis, it seems that only Toyota, Denso, and Aisin have been collaborating consistently over a long period of time. Despite a multitude of cooperations and announcements that we analyzed, they are the only ones who are not only innovating together but also applying for patents together.

Cooperation between Toyota and other companies on automated and autonomous driving



Asian companies are focusing more on Level 4 and Level 5 technology

To complete the view on the patent landscape, we also looked at regional differences. A key takeaway is that Asian companies have a very strong focus on level 4 and 5 besides level 1. Hyundai also has a big focus on sensor technology, which suggests that the OEM is aiming for improvements in object detection to significantly reduce the error rate and thus make automated driving safer. Baidu and LG put a greater focus on level 4 than on level 1, underlining their intention to enter the market of level 4 autonomous driving.

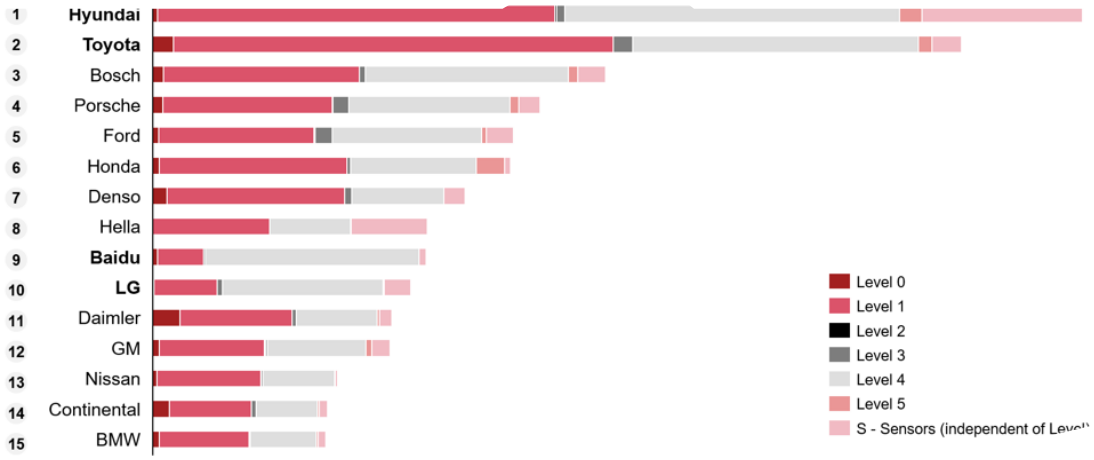
Autonomous Driving Levels

Level 0 (No Automation)	The human driver controls the car completely without any support from a driver assistance system.
Level 1 (Driver Assistance)	The vehicle has an automated system that sometimes assists the human driver to conduct some parts of the driving task.

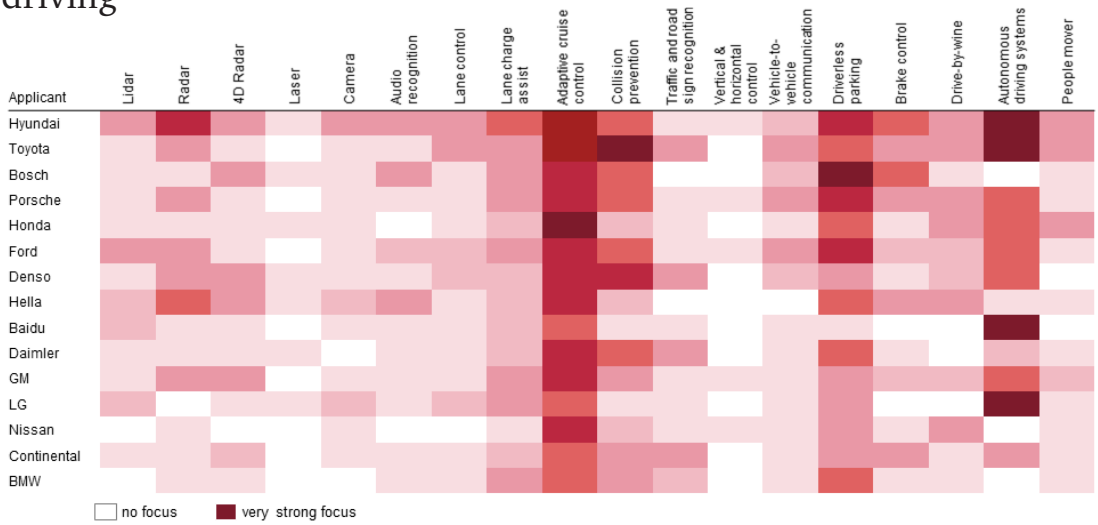
Level 2 (Partly Automated Driving)	Semi-autonomous driving assistance systems make daily driving much easier. They can brake automatically, accelerate and, unlike level 1, take over steering.
Level 3 (Highly Automated Driving)	Drivers gain freedom to turn their attention away from the road under certain conditions, as they can hand over complete control to the car.
Level 4 (Fully Automated Driving)	The technology is developed to the point that a car can handle highly complex urban driving situations without any driver intervention.
Level 5 (Full Automation (Driverless)	True autonomous driving becomes a reality. There is no steering wheel, drivers don't even need to have a license, and everyone in the car is a passenger.

With regard to adaptive cruise control, Hyundai, Toyota, and Honda concentrated intensely on these patents from 2010 to 2021. Baidu, Toyota, Hyundai, and LG put a very strong focus on autonomous driving systems, while most other manufacturers were relatively underrepresented.

Main ADAS/AD focus of published patent families from 2010 to 2021

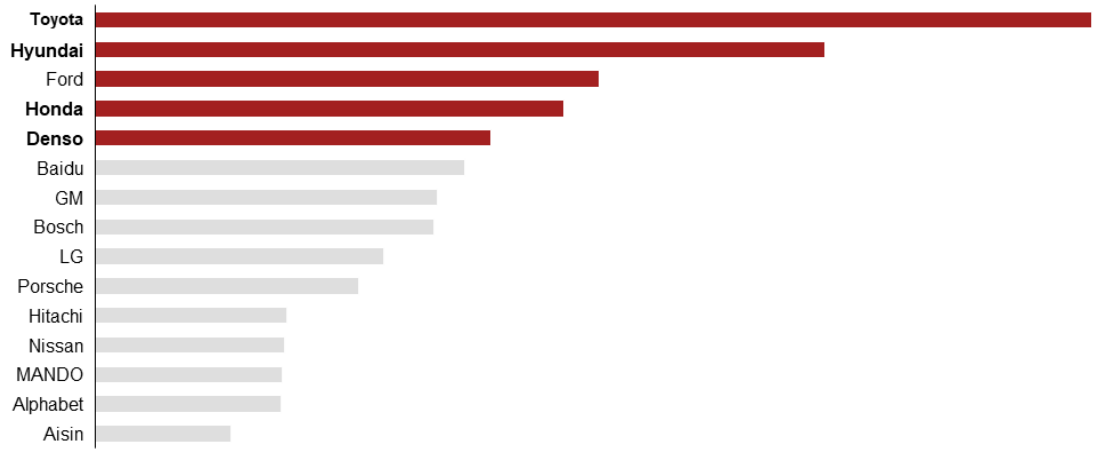


Focus of the Top 15 applications of automated and autonomous driving



Asian companies are also publishing new automotive-related patents in the United States. As Asian car OEMs and suppliers have discovered the market potential that autonomous and highly automated driving could create for them, they seem to be making more targeted investments in that area.

Top 15 applicants of ADAS/AD published patents in the US from 2010 to 2021



Conclusion

Our analysis shows that traditional automotive companies still lead in patents on automated and autonomous driving. The data also makes it clear that Asian companies are catching up on technology innovation, based on the high number of patent applications. However, US-based OEMs GM and Ford are also showing a high degree of innovation speed and high patent relevance, measured by number of citations. This might also be due to their heavy investments in autonomous driving technology (e.g., GM with Cruise LLC). The regional analysis reveals interesting findings as well: We see that the strategic direction of Asian players has shifted more toward level 4 and level 5 technology, compared to European and US players. Furthermore, it shows that four of the top five OEMs making patent applications in the United States are Asian companies. This indicates that they expect a high market potential in the US, which they want to address with those targeted investments.

European OEMs should review their partnerships and strategic focus based on these findings.

Contact us for further discussion

PwC Strategy&

Marcus Gloger
Partner,
PwC Strategy& Germany
marcus.gloger@pwc.com

Hartmut Güthner
Director,
PwC Strategy& Germany
hartmut.guethner@pwc.com

Martin Gerhardus
Manager,
PwC Strategy& Germany
martin.gerhardus@pwc.com

PATEV

Dr. Edelbert Häfele
Chief Executive Officer,
PATEV Associates
GmbH & Co. KG
edelbert.haefele@patev.de

Dr. Stefan Hofmann
Director Competitive Intelligence,
PATEV Associates
GmbH & Co.KG
stefan.hofmann@patev.de

Aaron Miller
IP Analyst,
PATEV Associates
GmbH & Co.KG
aaron.miller@patev.de

Strategy& insights

Subscribe to receive our latest thought leadership >

www.strategyand.pwc.com

© 2022 PwC. All rights reserved. PwC refers to the PwC network and/or one or more of its member firms, each of which is a separate legal entity. Please see www.pwc.com/structure for further details. Mentions of Strategy& refer to the global team of practical strategists that is integrated within the PwC network of firms. For more about Strategy&, see www.strategyand.pwc.com. No reproduction is permitted in whole or part without written permission of PwC. Disclaimer: This content is for general purposes only, and should not be used as a substitute for consultation with professional advisors.