Ministry of Enterprises and Made in Italy

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The Directorate General for the Protection of Industrial Property

Italian Patent and Trademark Office

Division VII - Patents

Automotive Sector Definition

Patents represent one of the main tools for detecting and evaluating the innovation activity of a country and are widely used as a technological indicator.

The Directorate General for the Protection of Industrial Property - Italian Patent and Trademark Office (UIBM) receives and examines about 10,000 national patent applications for industrial inventions every year and is responsible for maintaining and updating the industrial property rights national databases which have been used to extract the information presented in this report.

The definition of the patent classes relating to automotive technologies are univocally defined in Annex 1 of the Report of the *European Patent Office* (EPO) " ***Patents and self-driving vehicles*** " which can be consulted at the following link

https://documents.epo.org/projects/babylon/eponet.nsf/0/65910DF6D3F02057C125833C004DB1E6/$File/self_driving_vehicles_study_en.pdf

The group of patent classes identified in the Report includes all technologies that can be found in currently mass-produced vehicles, including connectivity and automated driving capabilities.

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In particular, the following technical areas and the related classes of the Cooperative Patent Classification (CPC) were taken into account[1]:

Signalling and lighting (B60Q), braking systems (B60T), clutch controls (F16D), steering & chassis (B62D), suspensions (B60G), peripherals e.g. airbags (B60R), engine exhaust (F01N), turbochargers, air intake manifolds, pistons etc. (F02B), control of engines (F02D), pistons (F02F), carburettors, fuel injection (F02M), starting of combustion engines (F02N), ignition (F02P), sparking plugs (H01T), wheels (B60B), tyres (B60C), vehicle connections (B60D), heating, cooling etc. of vehicle cabins (B60H), windows, windscreens (B60J), seats (B60N), conjoint control (B60W), transmission in vehicles (B60K)

In addition, for future studies, all communication and connectivity technologies applicable to the automotive sector can also be considered, and in particular:

1. *Communication:*
   1.1. *Communication infrastructure, anti-collision, infotainment, cellular network, signal encryption security;*
   1.2. *5G network;*
   1.3. *MM-Wave antenna array;*
   1.4. *Cloud for learning and updating maps, including traffic data, algorithms for object detection, classification and decision making via wireless communication;*
   1.5. *Smart road and vehicle connectivity, wireless communication, emergency services and roadside assistance;*
2. *Smart logistics:*
   2.1. *Traffic monitoring, traffic congestion, fleet management;*
   2.2. *On-demand delivery and automated parking;*
   2.3. *V2G connection (grid), power grid, inductive battery charging, charging stations, vehicle identification and billing;*
3. *Perception analysis and decision making:*
   3.1. *Detection (multiple sensors including lidar, sonar, radar and cameras for object and obstacle detection, classification and tracking;*
   3.2. *Long-range radar for adaptive cruising; control, emergency braking, pedestrian detection, collision avoidance and short-to-medium range radar for cross traffic warning, park assist with side and rear collision warning;*
   3.3. *Lidar for environment mapping, surround view, blind spot detection, parking assistance;*
   3.4. *Digital Lane Departure Warning and Control Camera, Traffic Sign Recognition, Side Mirror Surround View;*
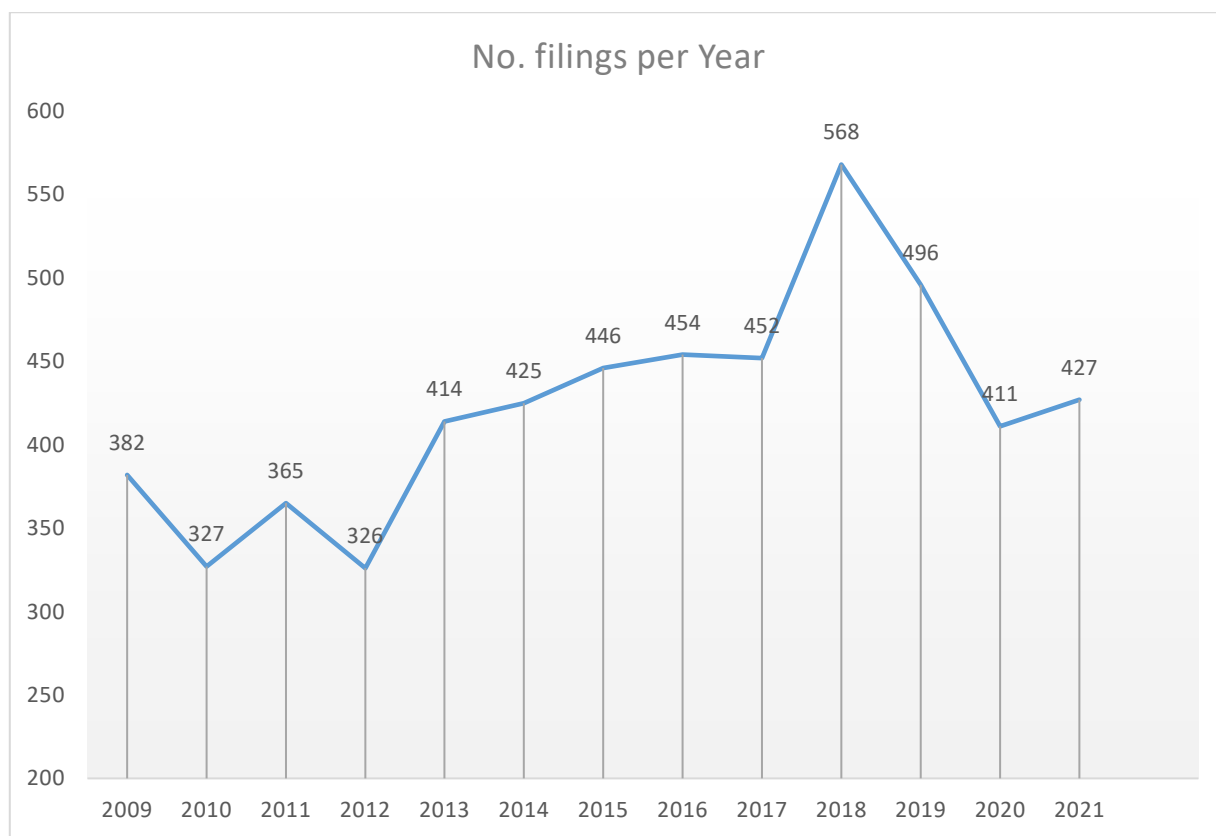   3.5. *Other types of sensor;*

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[1]The Cooperative Patent Classification (CPC) is an extension of the International Patent Classification (IPC) and is jointly managed by the European Patent Office (EPO) and the United States Patent and Trademark Office. It is grouped into nine sections, A to H and Y, which are in turn divided into classes, subclasses, groups and subgroups. There are approximately 250,000 classification entries. In the present case, CPC and IPC rankings coincide.

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3.6. Sensor fusion, semantic understanding, model building, localization and navigation (data fusion)

3.7. Creation of driving scenarios, driving assistance systems, driving stability, safety and comfort;

4. *Computing (applied to industry):*

   4.1. hardware & computer architecture;

5. *Vehicle Management Technologies:*

   5.1. Powertrains;

   5.2. battery electric vehicles;

   5.3. Hybrid vehicles;

   5.4. Efficient internal combustion engine control.

*The complete correspondence of the technologies listed with the CPC patent classes is reported in the aforementioned EPO report "**Patents and self-driving vehicles** ".*

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Data presentation

The first graph shows the total number of patent applications for industrial inventions filed at the Italian Patent and Trademark Office (UIBM) taking into account the technologies included in the CPC patent classes listed above. As shown in the graph, the number of patent applications in the automotive sector, as defined above, has exceeded 400 units in the last ten years, with a peak of 568 in 2018 and a growing trend since 2020.

No. filings per Year

| Year	Filings
2009	382
2010	327
2011	365
2012	326
2013	414
2014	425
2015	446
2016	454
2017	452
2018	568
2019	496
2020	411
2021	427

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The following two graphs show data aggregations according to the first classification assigned to applications for industrial invention patents as well as the year in which they were filed.

The following graph shows the weight of each patent class in the composition of total number of filings for each year. It can be noted that the patent classes of technologies relating to the tyre sector, named B60C, represents the class with the highest number of applications for each year considered.
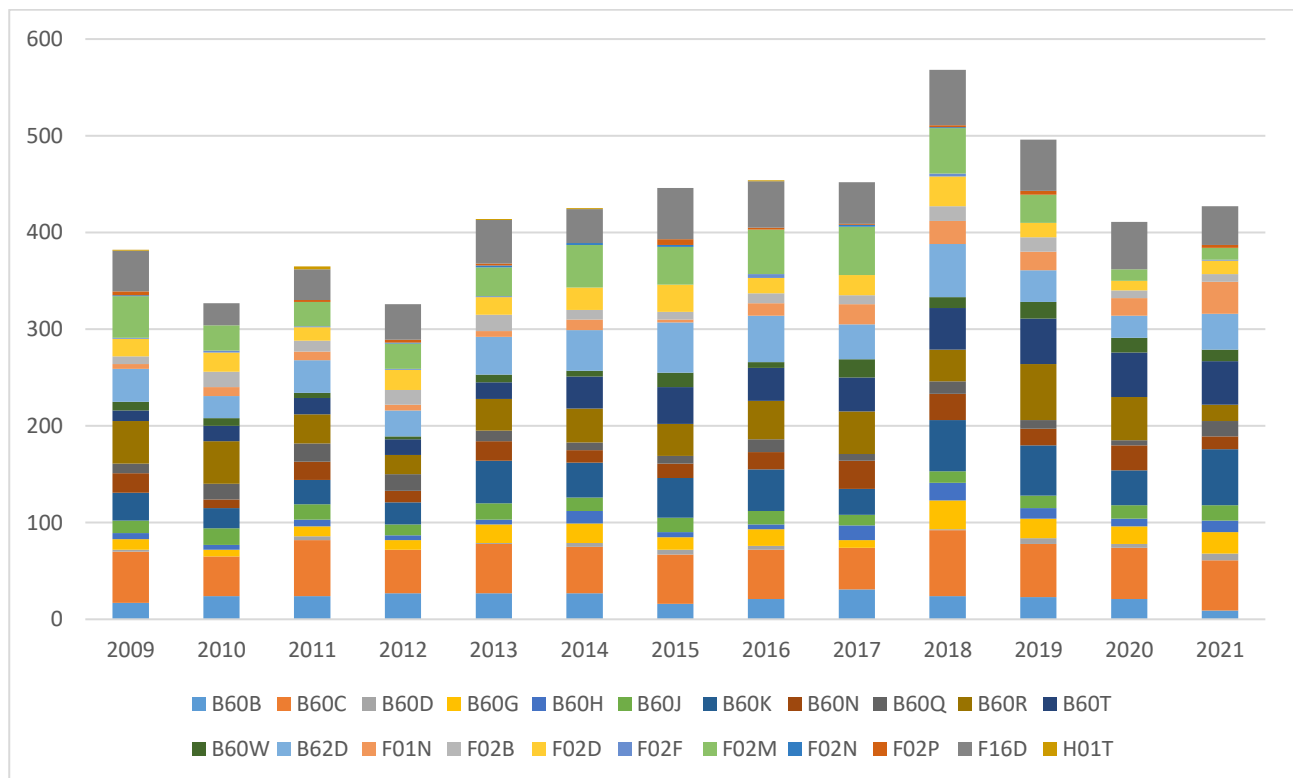

- Wheels (B60B)
- Tyres (B60C)
- Vehicle connections (B60D)
- Suspensions (B60G)
- Heating, cooling of vehicle cabins (B60H)
- Windows, windscreens (B60J)
- Transmission in vehicles (B60K)
- Seats (B60N)
- Signalling and lighting (B60Q)
- Peripherals e.g. airbags (B60R)
- Braking systems (B60T)

- Conjoint control (B60W)
- Steering & chassis (B62D)
- Engine exhaust (F01N)
- Turbocharg., air int manif., pistons (F02B)
- Control of engines (F02D)
- Pistons (F02F)
- Carburettors, fuel injection (F02M)
- Starting of combustion engines (F02N)
- Ignition (F02P)
- Clutch controls (F16D)
- Sparking plugs (H01T)

The following graph represents the total number of patent applications for each CPC class during the entire period of time considered in the report. The classes relating to technologies in the field of tyres (B60C), rotation joints, clutches and brakes (F16D) and vehicle gearboxes (B60K) are respectively the first three patent classes by number of applications in the period from 2009 to 2021.
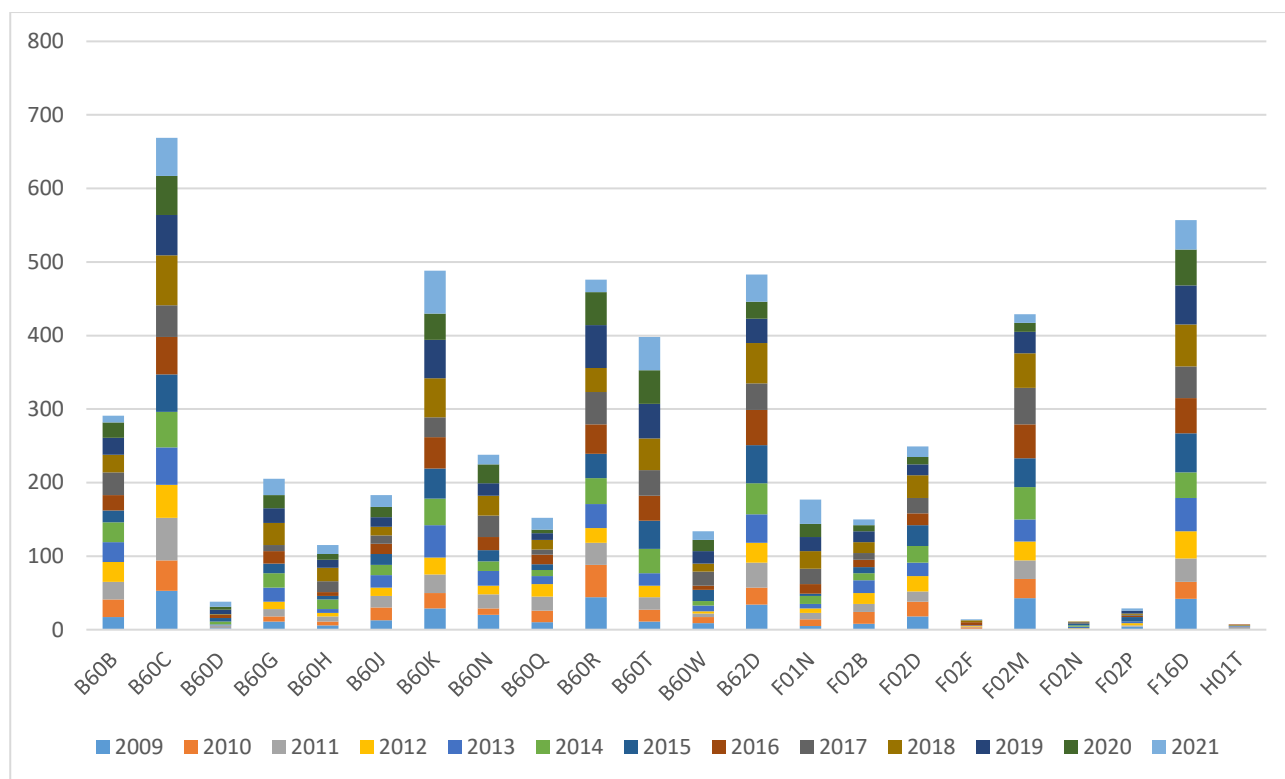
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- Ignition (F02P)
- Clutch controls (F16D)
- Sparking plugs (H01T)

The following graph shows the percentage composition, calculated considering the total number of applications for each reference year, grouped by nationality of the applicant. The country showing the highest percentage is Italy followed by Germany, Belgium and Switzerland
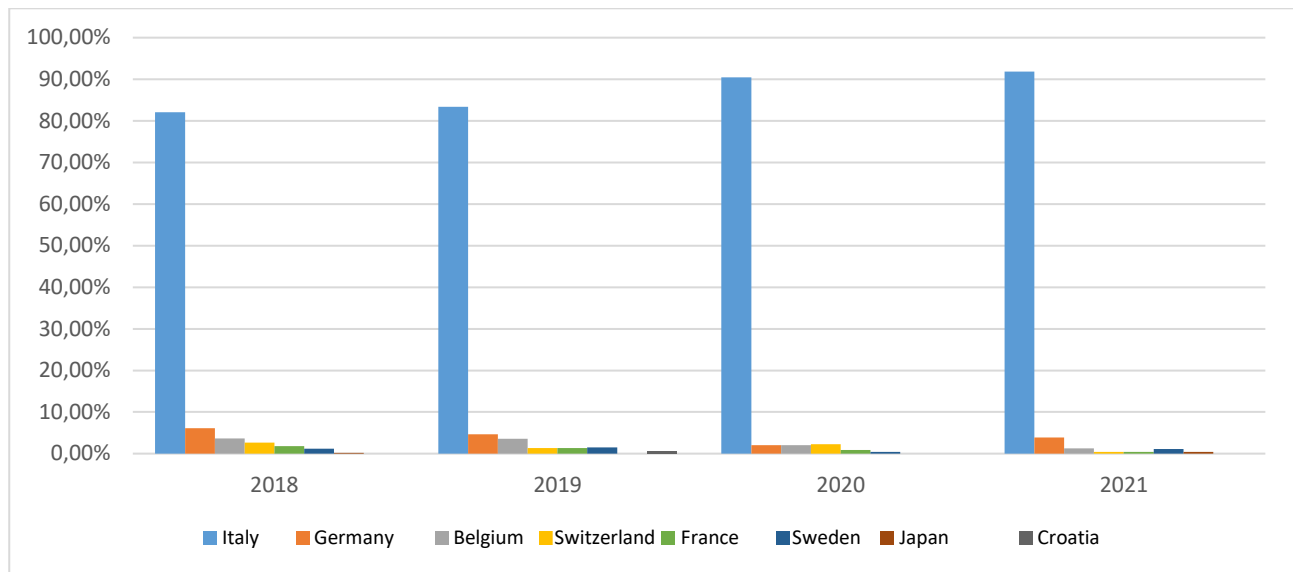
In order to have a detailed analysis at a national level, the total number of applications for industrial invention patent, for each year, has been grouped according to geographical subdivision adopted by the Italian National Institute of Statistics

(https://www.istat.it/it/archivio/222527#~:text=The%20borders%20of%20administrative%20units%C3%A0%20,in%20dispute%20and%20administrative%20islands)

The greater number of patent applications are filed by applicant who live in the North-West area of the country that includes the regions of Valle d'Aosta, Liguria, Lombardy and Piedmont.

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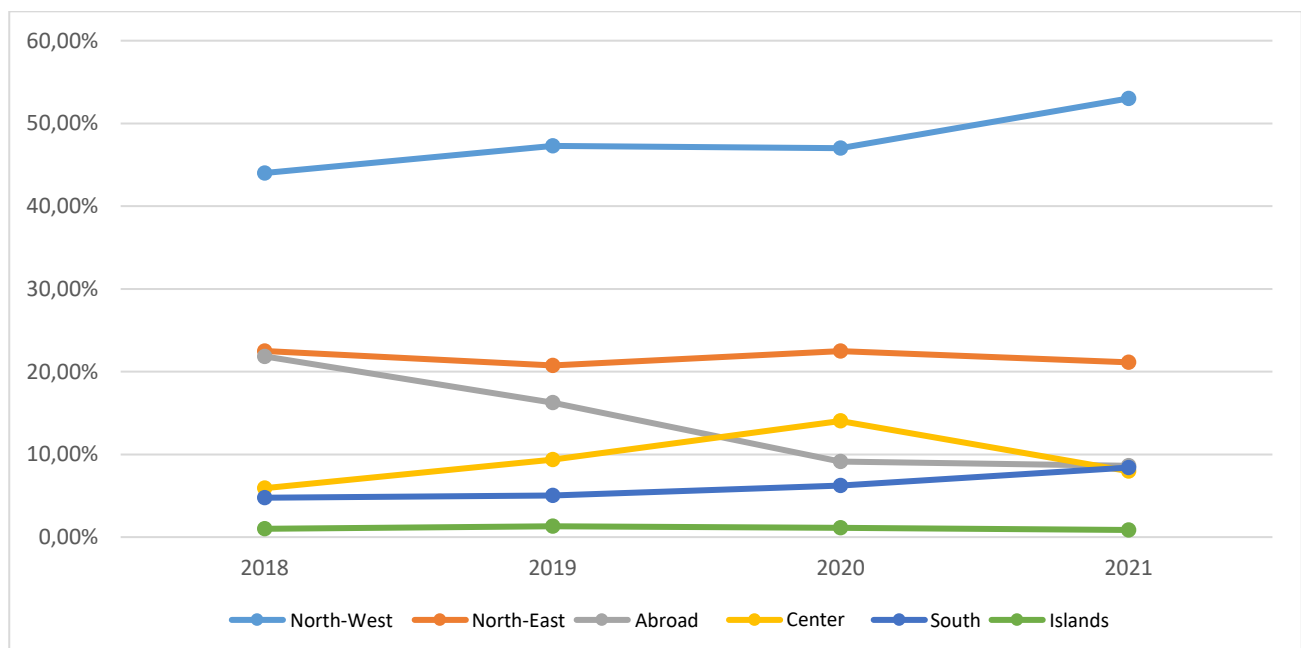
The following graph shows data relating to the automotive sector top 10 applicants ordered according to the percentage average calculated on the total number of patent applications for years 2018 - 2021,.

Each average is then compared with the percentage calculated with respect to the total number of applications filed in 2021 by each top 10 applicant.

That comparison shows how most of the top 10 applicants in the automotive sector have increased in the 2021 their percentage weight in industrial patent applications in the same sector.

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