

POLITECNICO DI TORINO

Master of Science: Engineering and Management

Master's Degree Thesis

**Analysis of the Variables that affects the Turnover in
an E-commerce Aftermarket Initiative**



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CONTENTS

INTRODUCTION	6
1. AUTOMOTIVE MARKET.....	9
1.1. Worldwide Automobile Industry.....	9
1.2. European Automobile Industry	14
1.3. Italian Automobile Industry	17
1.4. Future Challenges and Opportunities	20
2. AUTOMOTIVE AFTERMARKET	22
2.1. Aftermarket Industry	22
2.2. Sector in Evolution	26
2.3. Agents involved.....	30
2.4. Authorized and Independent Channels.....	34
2.5. Spare parts	37
2.6. Regulations	40
2.7. Prospective	44
3. DESCRIPTION OF SPARE PARTS PROJECT	46
3.1. SpareParts Service	46
3.2. Context	48
3.3. Key Data	53
3.4. Organization	55
3.5. Hierarchy	55
3.6. Monitoring.....	63
3.7. Operation of the Portal	67
3.8. Registration.....	68
3.9. Orders Management	71
4. INTERNSHIP ACTIVITIES	74
4.1. Identification of improvement opportunities.....	75
4.2. Proposal: Model to identify the variables that affect turnover	76
4.3. Conceptual Model Definition	76
4.4. Methodology.....	80
4.5. Sample Description	81
4.6. Exploratory Data Analysis	85
4.7. Model definition	106
4.8. Analysis and results	107

4.9. Model Validation.....	110
5. CONCLUSIONS	114
REFERENCES	117

List of figures

Figure 1. Worldwide automobile production from 2000 to 2017	11
Figure 2. Passenger vehicle registrations worldwide from 2005 to 2017	12
Figure 3. Leading motor vehicle manufacturers worldwide in 2017.....	13
Figure 4. Selected passenger car manufacturer's European market share	14
Figure 5. New passenger car registration in the EU. Source ACEA	15
Figure 6. New passenger car registration in Italy	17
Figure 7. Number of passenger cars sold in Italy by leading car brands.....	18
Figure 8. Number of passenger cars sold in Italy in 2014 and 2017, by segment.	18
Figure 9. Number of passenger cars sold in Italy from 2013 to 2016, by buyer	19
Figure 10. Number of passenger cars sold in Italy in 2014 and 2017, by type fuel. .	19
Figure 11. Number of passenger cars sold in Italy in 2016 and 2017.	20
Figure 12. Export value of automotive parts and accessories* by countries	24
Figure 13. Trade of parts and accessories for vehicles in the 2017 source: ANFIA .	26
Figure 14. Spare Parts Market Share	33
Figure 15. Distribution scheme of spare parts	37
Figure 16. Use of OES in body shops.....	39
Figure 17. Expansion of the SpareParts portal	51
Figure 18. Training and recruiting Process.....	51
Figure 19. Orders in the SpareParts portal from January to June 2017 vs 2018	54
Figure 20. Sorted divided by Channel	54
Figure 21. Between hierarchical levels.....	56
Figure 22. Sales Force Hierarchical Matrix.....	59
Figure 23 Process of sending-receiving-order fulfillment.....	67
Figure 24. Registration process	69
Figure 25. Model for predicting turnover increasing of the repairer in the project...	78
Figure 26. Registrations through the time from the data selected	82
Figure 27. Registrations of repairers by month	83
Figure 28. Number of Repairers by province in the regions selected.....	84
Figure 29. Region under study diagram.....	85
Figure 30. Number of Repairers by quantity of dealer bounded	87
Figure 31. Workforce number of each repairer	88
Figure 32. Representation of the order status	89
Figure 33. Frequency of Purchasing	90
Figure 34. Frequency of promotions used by repairer in 2017.....	90
Figure 35. Operative years since the initial registration	92
Figure 36. Correlation analysis	94
Figure 37. Correlation Coefficient.....	95
Figure 38. Elimination of variables from the model proposed	96

Figure 39. Normality test variable Workforce.....	97
Figure 40. Normality test variable Bonded Dealer	97
Figure 41. Normality test Purchase Frequency.....	97
Figure 42. Normality test Number of Promotions	98
Figure 43. Normality Operative years	98
Figure 44. Outliers workforce.....	101
Figure 45. Outliers bonded dealers	101
Figure 46. Outliers Purchasing Frequency	101
Figure 47. Outliers Operative years	102
Figure 48. Transformation of variables: Workforce	104
Figure 49. Transformation of variables: Bonded Dealers.....	104
Figure 50. Transformation of variables: Purchasing frequency	104
Figure 51. Transformation of variables: Number of promotions.....	105
Figure 52. Transformation of variables: Operative years	105
Figure 53. Variables selected from the model proposed	108
Figure 54. Model Estimators	108
Figure 55. ANOVA Analysis.....	110
Figure 56. Residual analysis	111
Figure 57. Variance of the residuals	112
Figure 58. Durbin-Watson test.....	113
Figure 59. Residual Independence.....	113

List of tables

Table 1. Market Share by European Channel (ICDP)	31
Table 2. Order management.....	72
Table 3. Sample by region	82
Table 4. Regions considered in the study	83
Table 5. Repairers selected by region	84
Table 6. Frequency of Bonded Dealers	86
Table 7. Descriptive statistics of the variable	86
Table 8. Descriptive statistics of the variable Workforce.....	87
Table 9. Frequency of workforce.....	88
Table 10. Frequency orders status	89
Table 11. Descriptive statistics of the variable Purchase Frequency.....	91
Table 12. Competitiveness classification.....	91
Table 13. Descriptive statistics of the variable Purchase Frequency.....	92
Table 14. Analysis of outliers	100
Table 15. Box-Cox Transformation parameters	104

Acronyms

AR	Authorized Repairer
FIL	Fatturato Incrementale Lordo
IAM	Independent After Market
IR	Independent Repairer
OE	Original Equipment
BER	Block Exemption Regulation
OEM	Original Equipment Manufacturer
PCDE	Promoter Coordinator and Dealer enabler
KPI	Key Performance indicators
DMS	Data Management System

INTRODUCTION

The present study revolves around the Automotive aftermarket, which can be defined as a secondary market that is part of the Automotive industry, englobing equipment and accessories by the Original Equipment Manufacturer (OEM). Aftermarket parts are divided into two categories: replacement parts and accessories. The former refers to automotive parts built or manufactured to replace Original Equipment (OE) parts before they become damaged. Instead, the latter refers to parts made for comfort after the original sale of the motor vehicle.

The main feature of this market is the increase of the competition and the change of the industry to a digital approach, which has led the industry to focus on understanding the customer needs to build personalized services, entailing brand loyalty and switching costs for the customer. Therefore, the satisfaction of the clients has a high value because of the lifetime cashflows it can generate because of repeated purchases. In this context, the loyalty is as important as the simple sale of the vehicle. Even so that to assess the quality of the vehicle, the first evaluation parameter by the customer is the relationship with the customer service; this makes the service department a core business at the same level of the sales department in the automotive companies.

To achieve their goals, the companies in this sector are looking to adopt dynamic strategies and react more quickly to the changes of the market. Considering these facts, the consultant firms' services are key to the success of the strategies introduced by the companies. This study was developed during an internship experience in ACN, which is a Consulting Company that provides consulting services in digital, technology and operations.

ACN is one of the main multinational companies in the domain of management consulting and outsourcing, and they offer services in, widely, five categories, which are: Communications, Media and Technology, Financial Services, Resources, Health and Global Resources. Within these broad groupings, ACN provides strategic, technological, business, operational and digital solutions to the Automotive Market. ACN helps automotive companies to create innovations across their extended value chain to help them become high performers.

Nowadays, the industry is experiencing several changes, the digitalization and the increase of the competitors make more difficult grabbing a bigger piece of the lion's share. For this reason, the industry is seeking new alliances that allow the members to take advantage of economies of scale and more dynamism to react efficiently to the needs of the market. Hence, initiatives like the *SpareParts* project, offer the customers the opportunity to get spare parts from a unique portal where they can find all the catalogs and different services in a more pleasant way.

One of the most strategic activity in this sector is the analysis of data, because high level decisions are always backed up by the data analysis. Thus, it is important to get reliable information applying statistical and data management techniques to ensure that the credibility of the numbers.

This study was done with the interest of getting more knowledge about the dynamics of Automotive aftermarket, with the aid of large quantities of data. In this industry, identifying the variables that affect the turnover in an e-commerce aftermarket initiative, helps to recognize the customers with a high potential of increasing a company's turnover, which allows them to get more market share. This analysis was made with a statistical tool, the Multiple Linear Regression Model.

The information was collected from the database of the customers, through software specialized in data extraction (MySQL). Then, the data was controlled to ensure the correct extraction, due to the use of databases with different structures, the definition of queries was an important phase, to obtain the desired data.

Then, different statistical methods were applied to prepare the data, along with an exploratory data analysis to identify the behavior of the variables and the relations between them. These analyses were done with R, a statistical software specialized on the analysis of a large quantity of data. The objective of this study is to show an alternative method to analyze the selection of potential customers, describe a structured methodology for data processing and the types of validation required to get an accurate information.

The thesis work is structured as follows: in the first chapter, the context of the automotive market, the current trends, and key concepts are explained to understand

the automotive industry. Also, the future challenges and opportunities for the automotive industry, especially in the Aftermarket.

The second chapter is focused in the Aftermarket industry, presenting the evolution of the sector, the agents involved, the description of the classification, the structure of the spare parts market, the perspective and, last, the regulation applicable to the industry.

In the third chapter it will be described the structure of the analytics team, how the *SpareParts* services operate, what is the key data for the organization, the hierarchical structure of the team and the monitoring mechanism to evaluate the performance inside the project. In the fourth chapter, the main activities realized during the internship and why they were important to the project.

Finally, the last chapter presents a proposal to improve the process of data analysis, based on the findings of the statistical model developed during the thesis. Moreover, in this chapter, the conclusions of the study are presented with the results from the analysis realized.

1. AUTOMOTIVE MARKET

In the next paragraphs will be explained the context of the automotive market, aftermarket, trends, and the different important concepts to understand the automotive sector, this will be shown through graphs, data related to sales and industry growth, also data that reflect the state of the market nowadays.

1.1. Worldwide Automobile Industry

The automobile industry is one of the most fast-growing industries, an important employer, investor in research and development, and is an important sector of the European Union economy. In Europe the automotive industry has a privileged place, is important for the national economy of individual countries due to the generation of new jobs, its demands for metals and other materials and its connection with other industries. (Vošta & Kocourek, 2017).

The car manufacturers are greatly linked with component suppliers that tend to provide 70 percent of the value of the final product. The relative number of sub-suppliers is growing for the most part due to the modularization of components and increasing know-how making more forceful their specialization. Just a while ago, the processes of production have become more fragmentized and have been increasing the inclination to establish new production facilities apart from traditional production areas, to regions with supportive production environments and extensive unsaturated markets. Newly, the automotive industry has been facing many problems, it was hit by the economic crisis in the years 2008 and 2009 and the successive years have carried a high competition coming principally from Southern and Eastern Asia.

According to NACE (Nomenclature Statistique des activités économiques dans la Communauté Européenne) the automotive industry is divided into the following groups: Manufacturer of motor vehicles (i.e. passenger cars, commercial vehicles, buses, trolley-buses and coaches); Manufacture of bodies for motor vehicles,

manufacture of trailers and semi-trailers; and Manufacture of parts and accessories for motor vehicles and their engines (Commission, 2007).

According to Eurostat data, the EU automobile industry consists of a total of 20,500 companies. The bigger share of the added value was generated by the manufacture of motor vehicles (64%), followed by the production of parts and accessories (33%). In terms of turnover in the automobile industry, the largest was generated by motor vehicles division (526 billion euro), the production of parts and accessories has a turnover of 188 billion, followed by the production of bodies, trailers, and semi-trailers.

There are three distinctive characteristics of the automobile sector: Stages of production, Global production Chains, and Ownership Pattern. “Production in the automobile sector is defined by greatness segmentation between different stages in production frequently connecting different ownership and geographical location, has been identified six different types of production activity within the automobile sector: assemblers; systems suppliers, first, second and third tier suppliers; and aftermarket suppliers” (Commission, 2007).

Automobile manufacturing is increasing over the years since the creation of the automobile the industry has experienced several changes. The car’s production has a steadily increase, several events on the history supported the advance of the industry such as the development of the gasoline engine, the consolidation of new carmakers, the World War I, and the European automotive firms tended to be more self-sufficient.

The pioneer automobile manufacturers had to decide what to produce and solve the technical and financial projects, the advance in the different types of engines like the electrical one, at the beginning was very accepted because it was quiet and easy to operate but the battery capacity was very limited. Another car adopted early was the steam car, it was easy to operate, it did not require an elaborate transmission, but high steam pressures were needed to make the engine light enough for use in a road vehicle; here the engines were needed expensive construction and that was difficult to maintain. After, the invention of mass production automobiles due to several conditions in the United States, their conditions of localization, large distances, and high levels of life;

they create a system of standardization that contributes to producing automobile rapidly and efficiently.

Nowadays, the production is growing steadily, Figure 1 shows the worldwide automobile production from 2000 to 2017 in million vehicles, in worldwide terms is observed that in 2017 were produced 73.5 million units of cars and 23.9 million units of commercial vehicles.

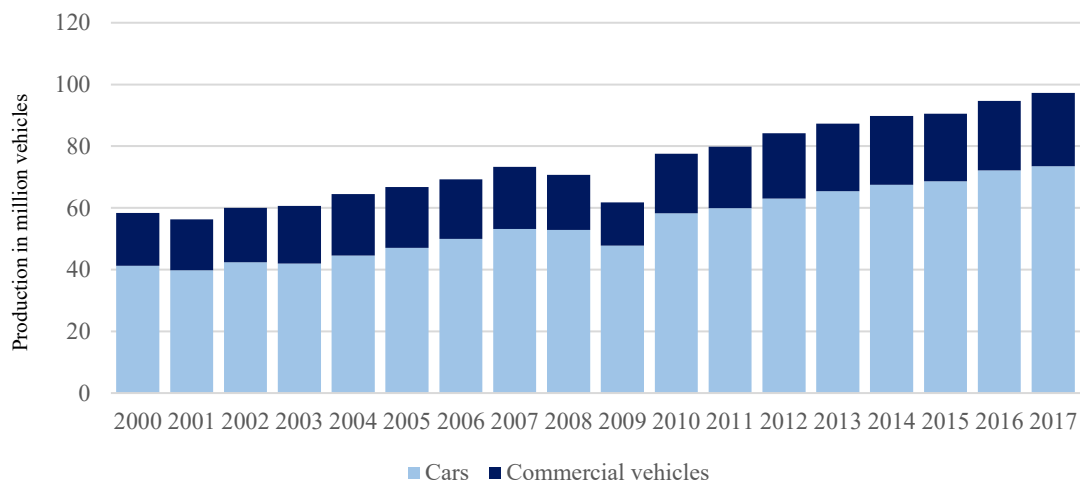


Figure 1. Worldwide automobile production from 2000 to 2017 (in million vehicles)

In 2017, the largest producers of passenger vehicles were China, Japan, Germany, and India. It is expected that the passenger car sales are going to increase to about 81.6 million units in 2018. Between 2008-2009 due to an economic crisis, the car sales began to fall. Nowadays, the quantity of automobiles sold is returned to pre-crisis due to the rise in demand, particularly from Asia markets. China is classified as the principal passenger car constructor in the world, China has produced further 24.8 million cars in 2017, that represents nearly 34% of the world's passenger vehicle production.

The company Shanghai General Motors is one of the largest car manufacturing, it produces and sells passenger vehicles with the Chevrolet and Cadillac brands, among others. Apart from the cars GM also produces engines and transmission systems. In the past decades, China has appeared as one of the principal development markets for companies in the global automobile industry, with car sales of 24.72 million units of vehicles sold in 2017 (UNRAE, 2018).

As the production of vehicles, the sales of passenger cars are increasing over the years, Figure 2 shows the sales of registration of new vehicles from 2005 to 2017 in millions. Over the period of consideration is detected a positive trend, in 2017 were registered at 70.8 million units. (OICA, 2018)

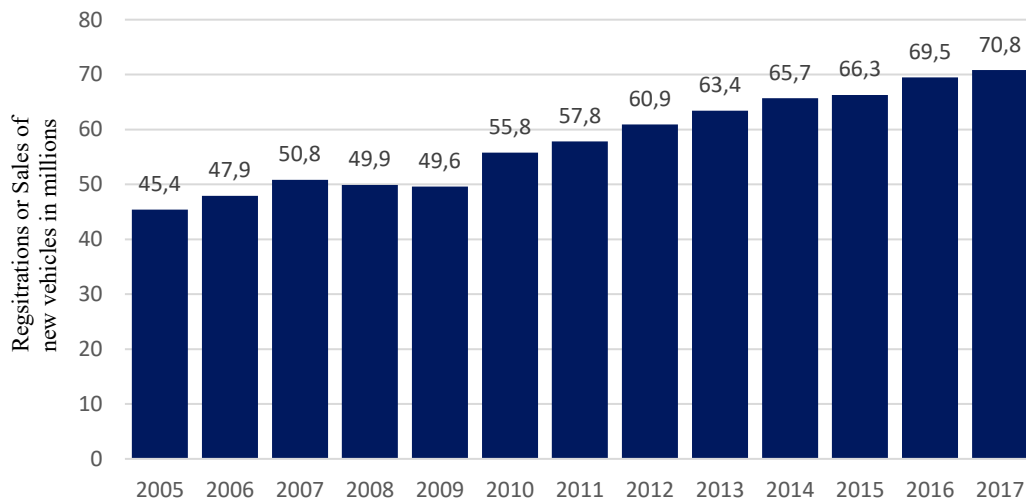


Figure 2. Passenger vehicle registrations worldwide from 2005 to 2017 (in millions)

According to the forecasting, demand for cars from customers in Asia and North America with an improving automotive industry in the UK, Germany, Sweden, Poland and other European Union members, it will balance the falling in vehicles sales from Russia and Brazil and support the automobiles manufacturers sell over 81 million vehicles by the end of 2018. To increase worldwide car sales, manufacturers are mostly strong in beating into the growing prosperity of Asian markets, where passenger vehicles have increased the double about the past seven years. Between 2008 and 2016, car sales were increased in Indonesia and India; in China, vehicle sales increased to 28.9 million units in 2017. Asia is not only the principal producer of automobiles, likewise, is the number one producer of light vehicles (UNRAE, 2018).

The main manufacturers in the world are classified by the number of automobiles sold, in 2017 the principal automaker was Volkswagen Group with 10,74 million units sold globally (see Figure 3).

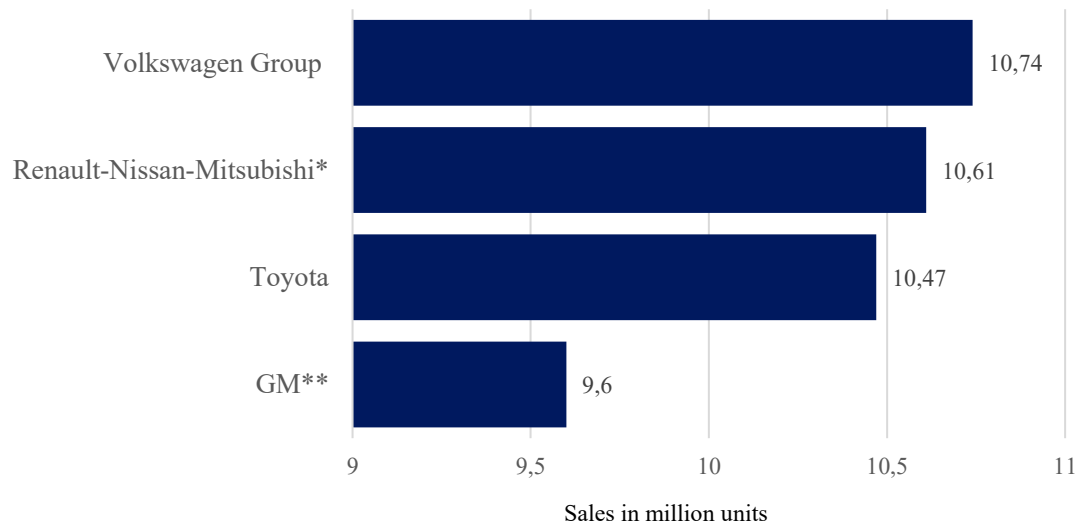


Figure 3. Leading motor vehicle manufacturers worldwide in 2017, based on global sales (in million units)¹

Despite the recall problems and emissions scandals, the global automotive industry is passing by a virtuous period. Nowadays, the car manufacturer has several opportunities for growth by the increasingly connected world. Hereafter, the car manufacturers are starting to focus on smart vehicles technologies and alternative propulsion systems. The major automotive suppliers are setting up research offices in Silicon Valley. Therefore, automobiles are becoming transporters of big data. The idea of open new plants and offices is mostly because the manufacturers must face the challenges in the market with “growth prospects in new segments and in emerging markets comes greater risk. It remains to be seen how carmakers around the globe will cooperate with the new challenges facing the industry.” (UNRAE, 2018)

¹ This figure is taken from a press release published in January 2018 on Renault-Nissan’s website. This figure is taken from GM’s annual report. VW value includes MAN and Scania trucks.

1.2. European Automobile Industry

The automotive industry is crucial for Europe's prosperity. The sector provides jobs for 12 million people and accounts for 4% of the EU's GDP. The EU is among the world's biggest producers of motor vehicles and the sector represents the largest private investor in research and development (R&D).

The automotive industry is important because has an important multiplier effect on the economy. It is important for upstream industries such as steel, chemicals, and textiles, as well as downstream industries such as ICT, repair and mobility services. Further, around 12 million people work in the EU automotive sector. Manufacturing accounts for 3 million jobs, sales and maintenance for 4.3 million and transport for 4.8 million (European Commission, 2018).

The automotive sector is used to be a main field of the European economy, in 2017 were produced almost 19.6 million vehicles, that represents the 19,8 percent of the world production (98,9 million). The EU automobile industry produces an average of 7.8 motor vehicles per worker annually and Italy produces 6.4 on average.

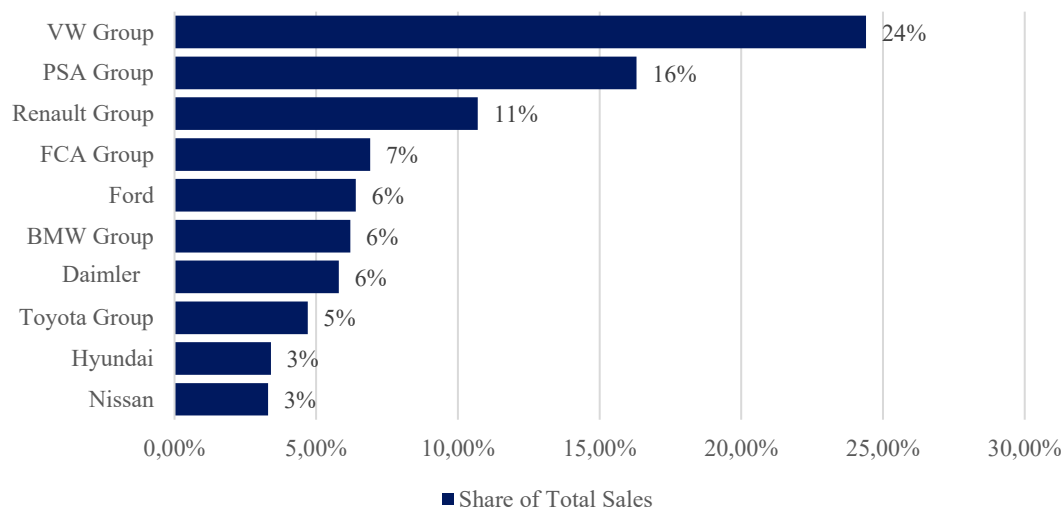


Figure 4. Selected passenger car manufacturer's European² market share in June 2018, based on new registrations.

Figure 4. S shows the year-to-date selected car manufacturer's share of the passenger car market in Europe as of June 2018, based on new registrations. The FCA (Fiat Chrysler Automobiles) Group reached a market share of around 6.9 percent.

² The figures refer to the countries within the EU-28 region and the EFTA; all values are ACEA estimations based on total by the market. The abbreviation ACEA stands for Association des Constructeurs Européens d'Automobiles.

During the last decades, China has become a major in the growth market for players in the global automobile industry, with car sales ascending to 24.7 million vehicles in 2017. “The Volkswagen Group has been supported almost a quarter of the European car market in the fifth month of 2018. Considering the Volkswagen diesel scandal, the Volkswagen Group confirmed in October 2015 that more than ten million vehicles were affected by the scandal worldwide, around 2.8 million of which were sold to customers in Germany. It remains unclear if it is safe for the owners of affected vehicles to ignore the recall, of they will see a downgrade in their vehicles’ performance due to software adjustments – or if the vehicles will be fitted with a different engine version. Second-placed PSA Group is headquartered in Paris, France. Along with fellow French car manufacturer Renault, PSA has a strong presence in Europe: The two French automakers account for a European auto market share of 27 percent. These two groups share among them just over seven percent of the global passenger car production market share. PSA acquired GM's Opel and Vauxhall brands in 2017” (ACEA, 2018).

In terms of passenger car registration, it has posted a robust increase (+5.2%) across the EU, totaling almost 1.6 million new cars (

Figure 5). In volume terms, this result marked the highest June total on record to date. Results were diverse among the five major EU markets. The United Kingdom (-3.5%) and Italy (-7.3%) both posted declines, while demand cars increased in France (+9.2%), Spain (+8.0%) and Germany (+4.2%).

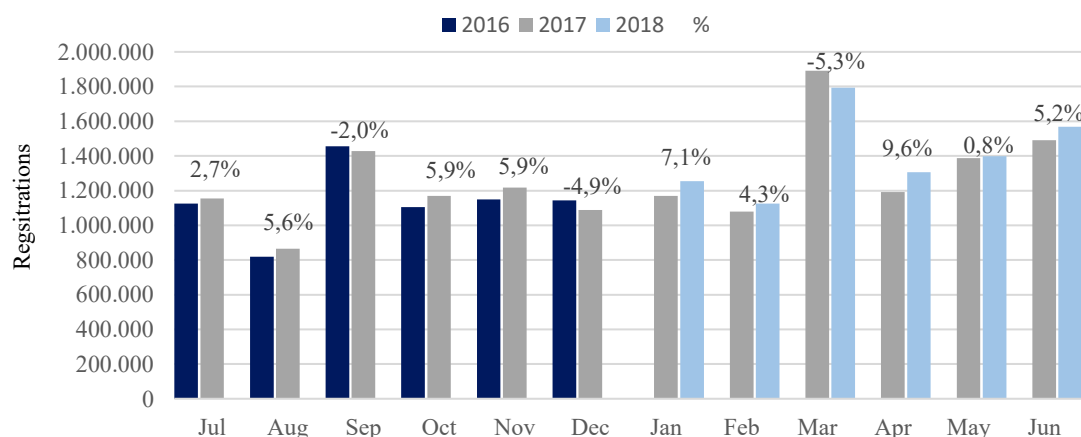


Figure 5. New passenger car registration in the EU. Source ACEA

Over the first half of 2018, the European passenger car market grew by 2.9% to reach 8.449.247 units. The strong performance of the new EU member states is worth highlighting, as registrations increased by 11.4% so far, this year. Looking at the major markets, demand went up in Spain (+10.1%), France (+4.7%) and Germany (+2.9%), although sales contracted in the United Kingdom (-6.3%) and Italy (-1.4%) during the first six months of this year. (ACEA, 2018)

1.3. Italian Automobile Industry

Italy is the fourth largest European Automotive market after Germany, the United Kingdom, and France. The Italian Automotive industry is concentrated in Turin and in a grand Piedmont region, around 50% of the 2,600 companies are active in the sector. In 2016, Italian manufacturers had a 29% market share of the passenger vehicles market. The Italian alternative fuel vehicles market totaled \$3,8 million in 2016, this market is composed of both new vehicles and used vehicles.

Into the more distinguished auto manufacturers, FCA (Fiat Chrysler Automobiles) is has a strong position as a local manufacturer, producing car and light automobiles. The last company has a 50% joint venture with the French PSA Group and dominates the market in the light commercial vehicles sector.

In Italy, foreign brands represent 71% of the market, of which 21% from Germany and 10% from France. “American manufacturers Ford and General Motors covered 6.8% and 5.2% respectively of the Italian market in 2016. Jeep models are either imported from the United States and more broadly from North America or manufactured locally.

The most successful jeep model sold in Italy is the Renegade, which is manufactured in Southern Italy, namely in Melfi near Potenza. This plant also manufactures other FCA models. The Jeep Renegade is manufactured in Italy and then exported to the United States.” (Export, 2018)

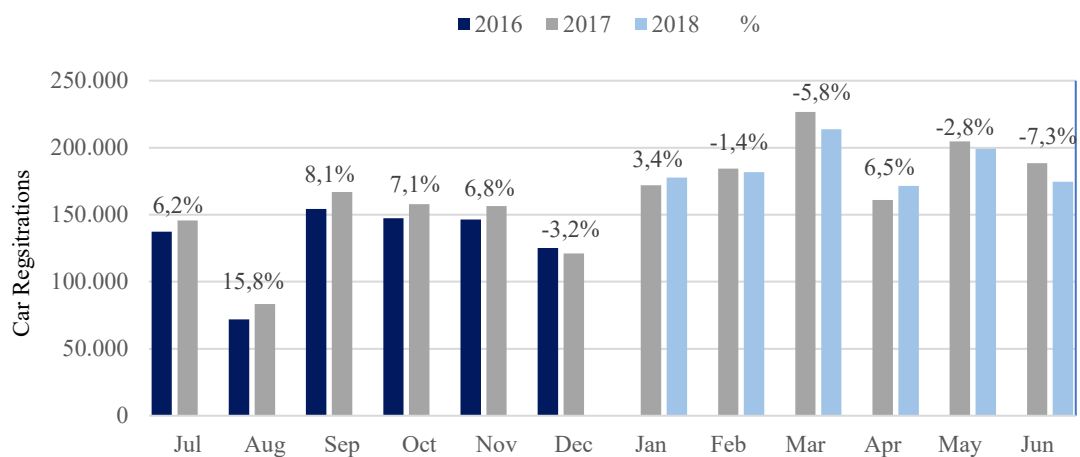


Figure 6. New passenger car registration in Italy

Figure 7 shows the variability of the new passenger car registration in Italy in the last year, from July 2017 to June 2018. The registration of new passenger cars follows a positive trend in 2018, but in comparison with the precedents years, the trend is negative, passing from 188,363 units in 2017 to 174,702 units in 2018.

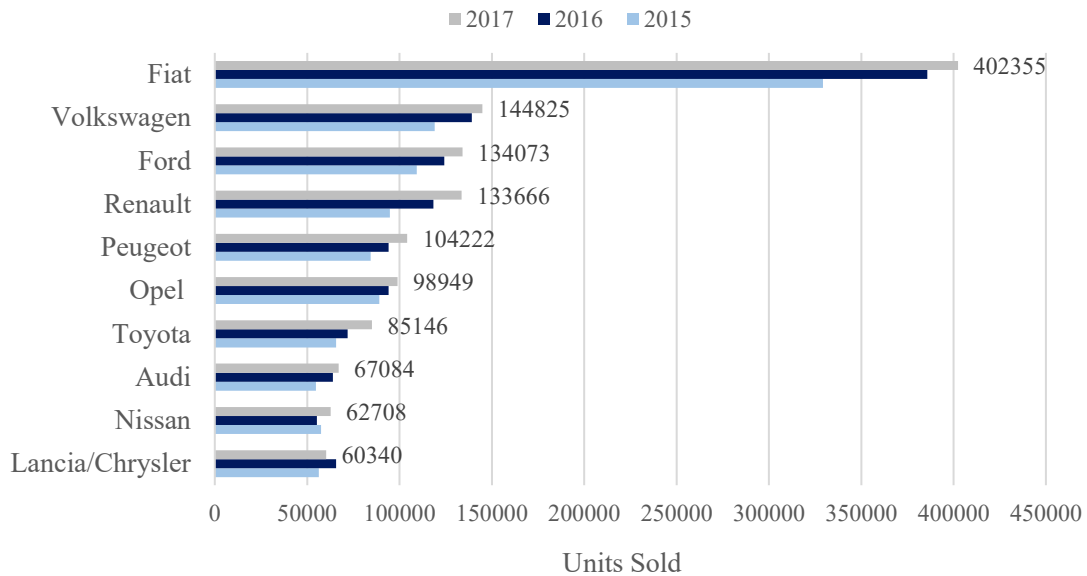


Figure 7. Number of passenger cars sold in Italy by leading car brands from 2015 to 2017

Figure 7 represents the number of cars sold by leading passenger car brands in Italy between 2015 and 2017. “According to data, all the car producers experienced a sales increase. The Italian car manufacturer Fiat is leading in terms of sales the market, with a positive trend passing from 385,798 units sold in 2016 to 402,355 units sold in 2017 (+4%). Companies such as Volkswagen, Renault and Ford are following the Italian brand with more than 100.000 units sold in 2017.” (UNRAE, 2018)

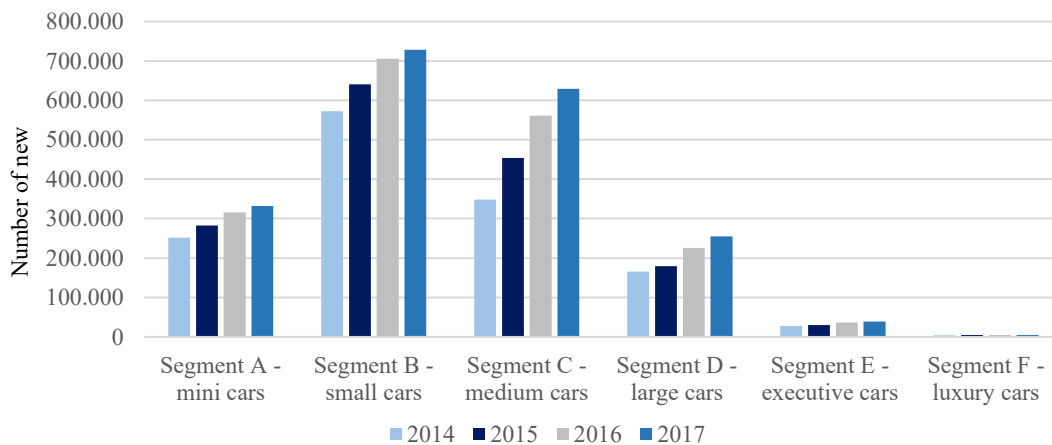


Figure 8. Number of passenger cars sold in Italy in 2014 and 2017, by segment.

Figure 8 displays the number of new passenger car registration in Italy in 2014 and 2017, by segment. “Over the period of consideration, small cars confirmed to be the most common segment size of passenger cars reaching 705,240 units sold in 2017. According to data, all segments had risen in terms of new registrations. Mini cars, like Toyota Aygo and Volkswagen Up!, grew by 11 percent while small cars such as the Fiat Punto and Ford Fiesta, by 8 percent. Luxury cars, slightly increased by 4.85 percent, passing from 4,614 units to 4,838 units sold in 2016.” (UNRAE, 2018)

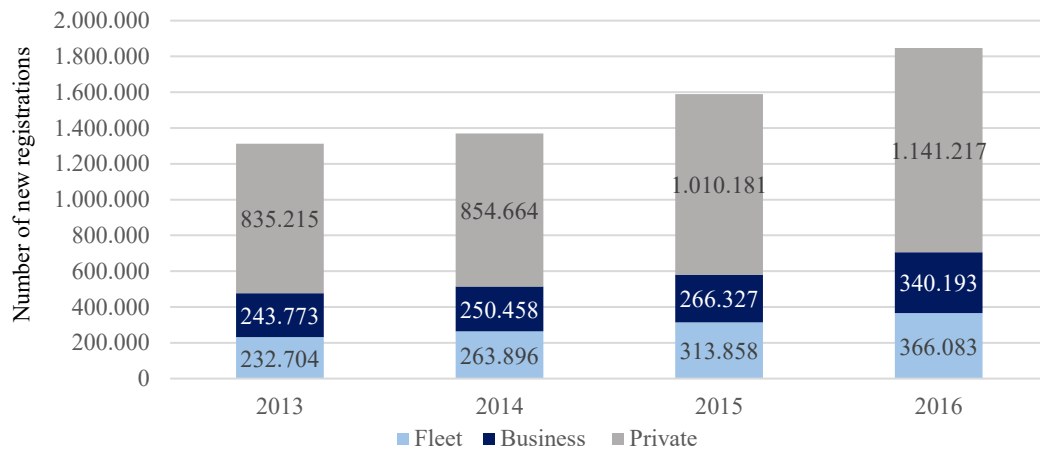


Figure 9. Number of passenger cars sold in Italy from 2013 to 2016, by buyer type.

Figure 9 displays the number of new passenger car registration in Italy from 2013 to 2016, by buyer type. According to data, “all the three categories show a positive trend. Private buyers are leading the positive trend, followed by rental firms and businesses. The number of cars purchased by private buyers increased, passing from 1.01 million units to 1.14 million units sold. Sales increased as well regarding business buyers, passing from 266,327 units in 2015 to 340,193 units in 2016.” (UNRAE, 2018)

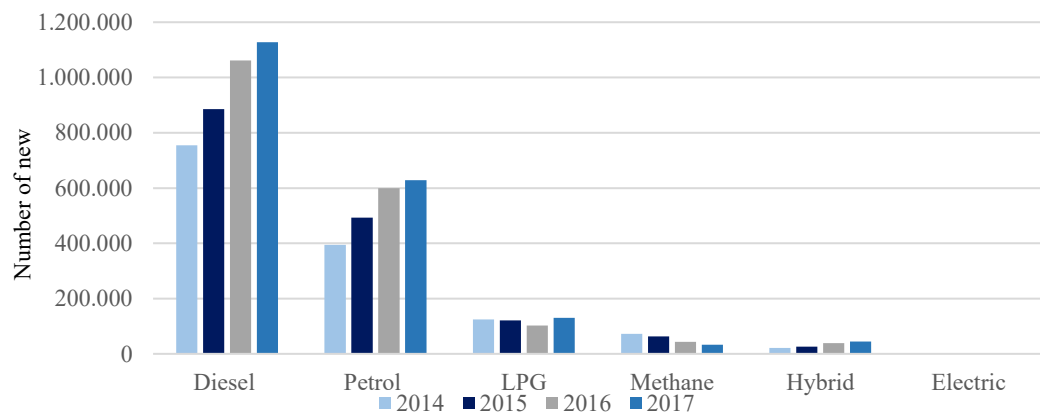


Figure 10. Number of passenger cars sold in Italy in 2014 and 2017, by type fuel.

Figure 10 displays the number of new passenger car registrations in Italy, by type of fuel. “Over the period in consideration, Diesel-fueled cars had the strongest year-on-year growth passing from 755,115 units sold in 2014 to 1.1 million units sold in 2017. A similar rise in registration figures is observable in Petrol and Hybrid cars.” (UNRAE, 2018)

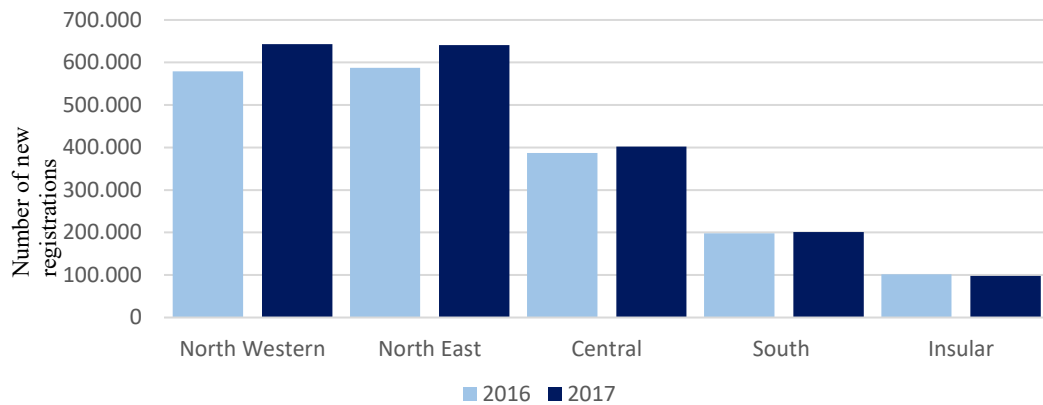


Figure 11. Number of passenger cars sold in Italy in 2016 and 2017, by geographical area.

Figure 11 shows the distribution of the new passenger registered by geographical area. Over the period in consideration, the principal regions are North Western and North East that have the biggest concentration of car passengers, with a positive trend both.

1.4. Future Challenges and Opportunities

In the near and medium-term future there are four challenges that matter for established markets and for emerging ones (McKinsey&Company, 2013):

Complexity and cost pressure: Due to the regulations in term of environmental and safety standards the costs and the complexity will raise, as they need to be managed apart from domestic markets. The increase in the number of derivatives helping several vehicle segments and markets using a single platform raises complexity too. In the same way, the OEM’s will have to mature alternative powertrain technologies for lower-emission vehicles as a prevailing technology of the future and for this, they will require high investments. This all are pressures plus the flat net price development due to less budget available for new features, it will be more difficult for OEM’s to

differentiate themselves with new features whereas extracting economic value from these forces.

Diverging markets: Emerging market's share of global sales will rise to 60 percent by 2020, whereas their share of global profits will similarly rise by 10 percentage points. But, the position and recent production and supply bases are not sufficiently aligned with future sales. Besides, it is a potential "portfolio mismatch", because the smaller vehicles classes are growing more powerful than others, mainly in fast-growing emerging markets. Lastly, OEM's need to prepare for the Chinese aftersales market, which is grown an estimated 20 percent year.

Digital demands: For customers buying a car the primary information sources are digital channels. For many, the next step could be online purchasing. This is an opportunity for OEM's, but it means the potential risk of competition from online retailers and sets pressure on the existing dealer's structure. In the driving experience also is growing the role of digital, in the measure that the consumers want to combine communication with mobility. This might be an opportunity for OEM's if they can foresee how to make money from this prospect.

Shifting industry landscape: As an OEM's pursue mature alternative powertrain technologies, suppliers will probably deliver more of the value-added content per car. Further, OEM's need to guarantee their suppliers' production footprint – particularly on emergent markets – match future market demands and their own production plans. OEM's in Europe have one single challenge: managing the restructuring that is evidently required. In addition, everyone will have to deal with emerging Chinese players entering new segments and markets. Outside base case assumptions, these challenges could give increase to extra risks to automotive profits. Current restrictions on China's pharma and dairy industries might presage a constriction of regulations to the automotive industry. Consequently, assuming a negative scenario, which could induce a 50% margin drop, a negative profit impact of up to 15 billion (Euro) is probable.

2. AUTOMOTIVE AFTERMARKET

2.1. Aftermarket Industry

Having described the automobile European market, this study requires a focus in the aftermarket and aftersales sector, this market is complex, robust and highly competitive that offers the support network for Europe's millions of cars, vans, trucks, and buses. The automotive aftermarket's complicated and diverse segments cover the entire repair, maintenance and service field from parts supply to the fixture and repairing.

Nowadays, the global economy is looking for possible opportunities for differentiation from the other competitors, reduce their costs and add value to their supply chains and end customers. One progressively attractive option is to reintegrate used or returned product into the supply chain to retake the materials for economic and sustainability purposes. An important concept remanufacturing, which refers to activities that restore used products or their major modules to operational condition for use in place of a new product or for use in other channels. Remanufacturing has usual been common in such industries as the automotive electrical equipment, furniture, machinery, tires, and toner cartridges. (Kumar, Chinnam, & Murat, 2017). In the automotive industry, production parts are divided into Original Equipment (OE) parts and Aftermarket parts, OE concern the parts used in producing new vehicles, although, aftermarket parts refer to those trade after original equipment sale, that includes both OE service (for vehicles under OEM warranty) and independent aftermarket (IAM) services.

The aftermarket is an important segment of the automobile value chain, the market for replacement parts is the sector of the firms in developing countries, even before local assembly sectors are developed. Presently, "there is an international trade in aftermarket products. Firms in this sector compete mainly on price. Access to cheaper raw materials and process engineering skills is important. Innovation is not required because designs are copied from existing components, but reverse engineering capability and competence to translate designs into detailed drawings are important." (Commission, 2007)

The automotive aftermarket is involved with the supply of replacement parts, accessories, maintenance items, batteries, and automotive fluids and has experienced a significant growth. Covering the intense market competition, several companies tend to reduce their overall cost while keeping high customer satisfaction. One method is to make a forecast several months in advance of anticipated sales, which is used for subsequent operation planning and management (Chen, Zhao, & Yu, 2010). The sales of auto parts are affected by many factors directly or indirectly, such as the economic environment, customer preferences, weather conditions, etc.

The focus of this project is the spare parts market, original, not original and post-sales. This is the context of this project and it is important to know the dynamic and the structure of the market. The Automotive market is identified from the high public committed to the production and sales of automobiles. Because of the high unanimity, the diverse manufacturers were obligated to invest highly in advertisement through different communication massive channels.

However, is growing the interest from the manufacturers of consolidating and launch the own brand at intern of the aftermarket, this is, the assistant and spare parts commerce of the automobiles. This is a sub-market that has poor visibility from the biggest part of customers, the repairer companies, like workshops and body shops, are the recipients of the commercial communications.

The commercial relations are part of a specific typology of business called B2B (Business-to-Business). For this reason, the commercial strategy of the spare parts is little known to the mass market. However, in the lasts years the Automakers had been changing its target, the final customer, they are sending the commercial message directly to the final customer, in a way that original spare parts demand comes from the owners of the automobile in reparation. As a result, they are seeking to integrate the push strategy with an efficient system of pull demand.

Despite the automotive aftermarket is poorly known from the major part of the customers, the spare parts market is fundamental for the manufacturers due to the profits generated by this sector.

Figure 12 shows the total export value of automotive parts and accessories by European countries in 2017, measured in thousand euros. Germany was by far the largest exporter of these goods in 2017, exporting a higher value than the next four largest exporters combined. (International Trade Centre, 2018)

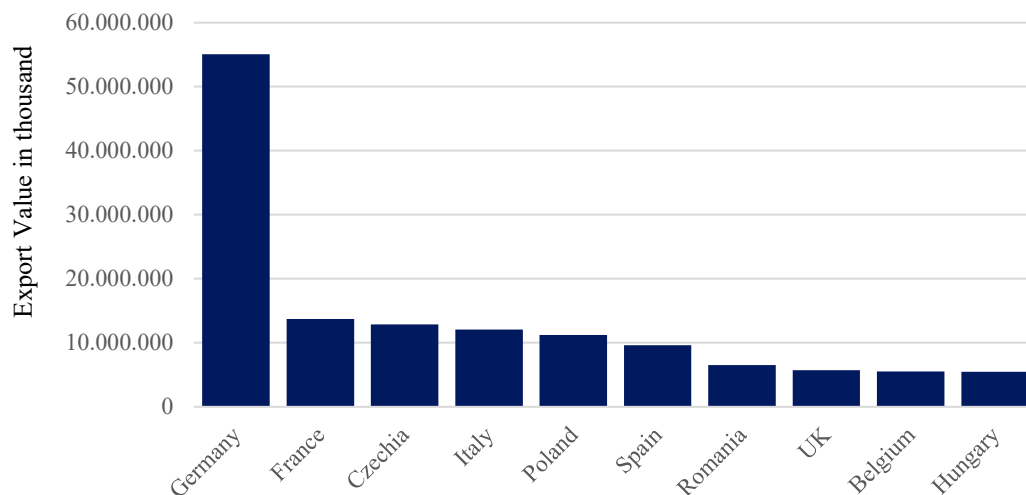


Figure 12. Export value of automotive parts and accessories*³ by European countries in 2017 (in 1.000 euros)

Passenger car and commercial vehicle owners trust on a network of parts suppliers and repairers to preserve their vehicles in order. 90% of the consumers are satisfied with the repair and maintenance offerings of the extremely competitive market. The take the decision on where to repair their vehicle depend on the price, convenience, quality and the age/value of their vehicles. The preferences of the customer are not fixed and changes as their vehicles become old. Therefore, vehicle manufacturers are not dominant players in the aftermarket maintenance over the lifetime of the average vehicle.

The small and medium companies that include the “authorized” repair networks are an essential part of the total aftermarket and deliver an appreciated service for the customer who is interested in the quality, transparency, and expertise. Customer

³ Parts and accessories for tractors, motor vehicles for the transport of ten or more persons, motor cars and other motor vehicles principally designed for the transport of persons, motor vehicles for the transport of goods and special purpose motor vehicle

chooses to visit the authorized repairer (AE) based on their own criteria likewise that another customer chooses to use the services of the independent network.

Authorized repairer increase value by concentrating on a limited number of brands and by meeting the standards of the vehicles manufactures such as high service, training, equipment and customer service. They are an independent business, but it is concentration on quality repair and maintenance which is responsible for reliably high quality and consumer satisfaction rankings. AE network customers value the transparency concerning the price and parts quality offered by the authorized networks.

The automobile industry is working to ensure the automotive aftermarket and guarantee a fair and balanced market in which the customers can enter trusting, cost-effective repair and maintenance services that ensure the correct treatment of their vehicles over the course of their life-cycles (ACEA, 2018).

2.2. Sector in Evolution

The aftermarket is living a prosperous time in Italy, this is confirmed by the turnover from sales and exportations. That income is putting the bases for becoming innovative projects in the automotive industry and the approach to more strategic foreign markets.

The spare parts in Italy show a positive production and new markets, is knew that the 75% of the vehicle is composed parts and components, that percentage highlights the important role played by the manufacturing chain of companies that form the sector of the Automotive Aftermarket. This sector emerges in Italy for dynamism and growth performance, as well an important dissemination into new countries. The aftermarket is a sector where Italy counts about 2,000 companies and 136.000 employees, with a yearly turnover of about 39 billion Euros (De Donno, 2017).

In 2017, the data presented by ANFIA settle Italian spare parts manufacturer's capability of keeping their export volumes high (Figure 13), guarantee high quality and high innovation level of products and processes to the market, reinforced by an advantageous position on international markets.

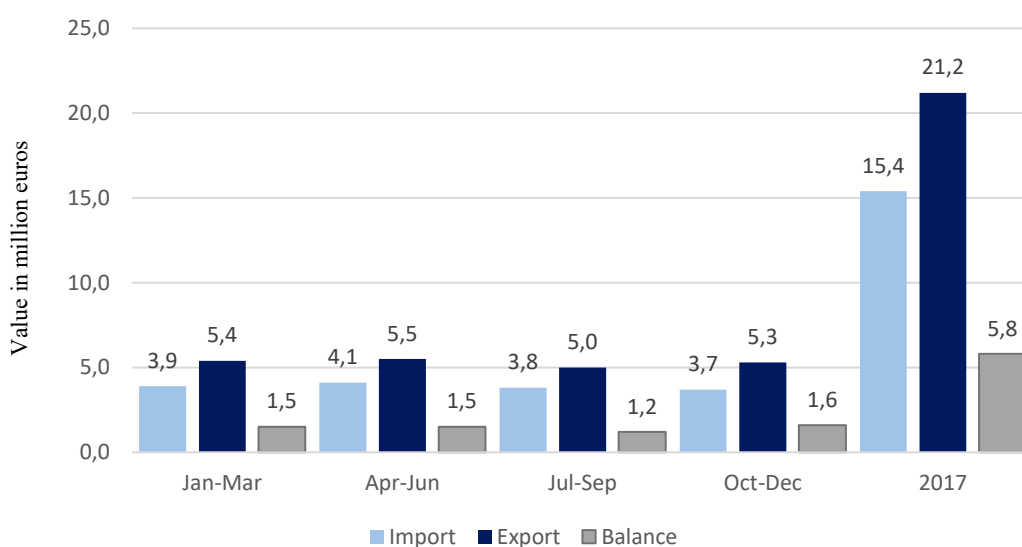


Figure 13. Trade of parts and accessories for vehicles in the 2017 source: ANFIA

The analysis of the market for spare parts demands the focus in the after-sales, that is related to the activities of assistance and reparation of the cars. In this chapter, the focus will be on the principal phenomenon that influences the dynamic of the spare parts market.

At the beginning of the year's half 90, the after-sales has lived a profound phase of re-organization, including all the agents of the supply chain, from the spare parts manufacturers until the final customers.

The increasing of the competitiveness and the complexity of the sales process, with the reduction of the profit margins for the diverse operator involved in the commercialization, there is a progressive increase in the attention in the aftermarket by all the agents in the automotive sector: manufacturers, concessionaires, spare parts products and distributors, technology's suppliers, franchising chains, offices and mechanics independent.

The analysis of the sector is complex by the difficulty of identifying the information that shows the value of the activities develops in the after-sales in the market intern. The reasons are several, such as the high number of operators, the absence of national associations in the representation of the activity in overall, the insufficient statistical data about the market.

It is important, construct an overall view and complete to understand the huge after-sales market and frequently low knowing by the same operators.

To analyze the distribution spare part chain is important to show the facts that have an influence on the evolution of the Automotive Aftermarket:

- The increasing externalization of the development activities and foresee from the car manufacturers to the spare part producers.
- The phenomenon of mergers and acquisitions that it have been important to the creation of the huge manufacturers of components to influence the power decision of the concessionaires, in economic and strategic terms.
- The creation and development of spare parts distribution groups with an international dimension.
- The creation of franchising (Bosch. AD. Point Service, Rhiag, BluOfficina, etc) and of fast fit from part of the producers, and spare parts distributors with the fine of maintaining or increasing the market share.
- The contraction in the number of local suppliers a cause of the presence of a distribution group more powerful and organized.

- The introduction of new norms that regulate the market in terms of production, distribution, and use.

These aspects have had a different impact in various countries, creating significant differences in the structures of individual markets. In some situations, there has been one consolidation of large international groups specialized in the distribution of spare parts, in others (including Italy) the presence of many independent local spare parts makes the market still rather fragmented.

The evolutions in progress have been to some extent accelerated by the introduction of the "Block Exemption" (1400/02), which has defined new rules to regulate and redefine assistance and the sale of spare parts.

The European regulation, for the first time, introduces a clear distinction between spare parts originals and spare parts of corresponding quality, adjusting their use. There is, however, still a legislative gap regarding other types of spare parts, such as those of non-matching quality, adaptable or regenerated ones, for which it results how much adequate regulation is never appropriate. In any case, the new Block Exemption has made the scenario of the after-sales, considering the high stakes and the actual trend towards one greater market liberalization.

The car manufacturers, in fact, very reluctant to give up their market share in the sale of spare parts, they have implemented aggressive strategies, often through campaigns direct to the end user, arriving to offer a range of multi-brand spare parts for older cars. Even the other actors in the supply chain are not immune to changes. Manufacturers of spare parts are internally reorganized to identify the best solution to meet the continuous requests of the car manufacturers to make price reductions and, at the same time, maintain the possibility of selling directly to the service networks the original spare parts (with the risk, however, of losing the important orders in the event of retaliation by the car manufacturers themselves).

Further down the spare parts distribution chain are the Dealers (in as distributors of original spare parts) and on the other independent distributors. In many markets the latter is taking on significant dimensions, on which to do leverage to make agreements

with car manufacturers (becoming distributors authorized) or directly with the producers, thus approaching the spare parts market original.

It should be noted, however, that until today the direct effects of the so-called "Regolamento Monti" are rather modest, although it may be premature draw a balance of the effects induced. Any benefits of the new regulation they will be more likely to be realized with the passage of time, given the greatness fragmentation of the market, the high number of actors in the supply chain but above all the lack of propensity to find innovative solutions consolidated in the sector.

2.3. Agents involved

The operators that make up the downstream level are now illustrated in detail of the distribution chain. These are all those activities, grouped into 4 categories, able to provide an assistance service to those who buy vehicles:

Service points authorized by the manufacturer: They can be connected or not a sales point and represent the medium most qualified part of the sector, being able to receive training, tools and information directly from manufacturers. They can perform any type of intervention at a cost on average higher than other operators, but progressively reducing due to the restructuring of sales and service networks.

Independent repairers (IR): They offer support services on various brands of vehicles and may be specialized in a specific activity (electrician, mechanic, coach-builder, etc.). The prices charged are more contained but meet increasingly difficult to intervene on new generation vehicles, in how to deal with these cases are required investments not compatible with their volume of business. Furthermore, they suffer from poor access to information relevant techniques for repairs.

Fast-fit chains: It is a reality not widespread in Italy, but they have achieved great success in Europe where they spread following the paths of the great distribution. They usually perform operations of reduced complexity related to ordinary maintenance and replacement of the most insurable parts. These interventions they do not require large investments (training, equipment, etc.) and allow developers a profitable business by practicing low prices on a high number of interventions for point of sale.

Franchising of component manufacturers: They are highly specialized workshops in a specific branch of repairs. They, therefore, need investments noticeable in terms of training, which is performed by the network to which they are associated.

As is reasonable to expect, the performances between authorized and independent distributors are quite different from each other, so it is difficult to make an effective

comparison. And in any case useful to report on the possible distribution of the market shares of main types of operators.

Table 1 shows the indications, subdivided by the main European countries, market shares related to the sale and use of spare parts of the authorized networks (Concessionaries and sub-networks), of the independent channel (that includes body shops, independent distributors and soft franchise networks) and so-called service chains (fast-fit, auto-centers, tire chains, crystal repairers) characterized by an exclusive relationship in the purchase of spare parts. This category also includes other categories of operators such as hypermarkets and chains of "do it yourself".

As it results evident, the structure of the market in the principal European Countries introduces remarkable differences, resulted from the entrepreneurial cultures and organizational forms well different. In the French and English marketplace, the market share of the service chains and hypermarkets results superior in comparison to how much recorded in other countries, where, instead it results particularly important, the weight of the authorized (Germany) nets or of the traditional (Italy and Spain) independent channel.

Table 1. Market Share by European Channel (ICDP)

Channel	SPA	ITA	GER	UK	FRA
Authorized	35%	43%	55%	40%	45%
Independent	55%	50%	35%	34%	27%
Channel Chains and other operators	10%	7%	10%	26%	28%

Moreover, the different nature of the possible types of intervention introduces a second one breakdown between scheduled, routine and repair maintenance operations. The first set includes all the simple periodic maintenance operations already planned by the manufacturer when designing the vehicle.

The car manufacturers provide, together with the vehicle, a calendar of ordinary maintenance operations, with deadlines that consider both the distance and the time since the last intervention. The customer is therefore invited to contact his assistance network to carry out these operations.

The ordinary maintenance operations consist of the simplest operations of oil replacement, filters and checking the state of wear of the components most subject to it. These are the most profitable operations because, although they are quick and easy to perform, they involve the use of spare parts that allow the installer to obtain a good profit margin.

On the other hand, all the extraordinary interventions that require greater work, with the replacement of parts that require a greater use of labor, fall into the definition of reparation.

Analyzing the market shares of the three types of operators present (official, independent assistance, other forms) a problem of detection methodology arises. To base the evaluation on the value of the operations carried out and, on the prices, charged for consumption would mean to benefit the official assistance networks, recognized for higher prices on the hourly rate of labor and higher margins on spare parts. Hence the consistency in relying on the flow of spare parts that can be observed as an indicator purified of the value of the interventions carried out.

It should be remembered that official assistance mainly uses original spare parts (OES, Original Equipment Spares), while independent repairers mostly use spare parts coming from non-Case channels (IAM-T, Independent Aftermarket, Traditional). The third operator, i.e. fast-fit chains, instead use parts coming from a channel defined as IAM-ND (Independent Aftermarket, New Distribution): this in practice translates into a direct purchase from the producers. Therefore, observing the flow of spare parts, there is an illustration of the distribution of the assistance market: the picture that emerges shows a substantial equipping between official assistance (OES) and non-official assistance (IAM-T), overall prevalent compared to other forms of assistance.

Also, in this case, there are clear regional differences. In Germany, official assistance prevails has a clear advantage, while in France and in England there is a strong presence of "other operators" (IAM-ND); Italy also proves itself in this circumstance inclined to independent repairers (Figure 14).

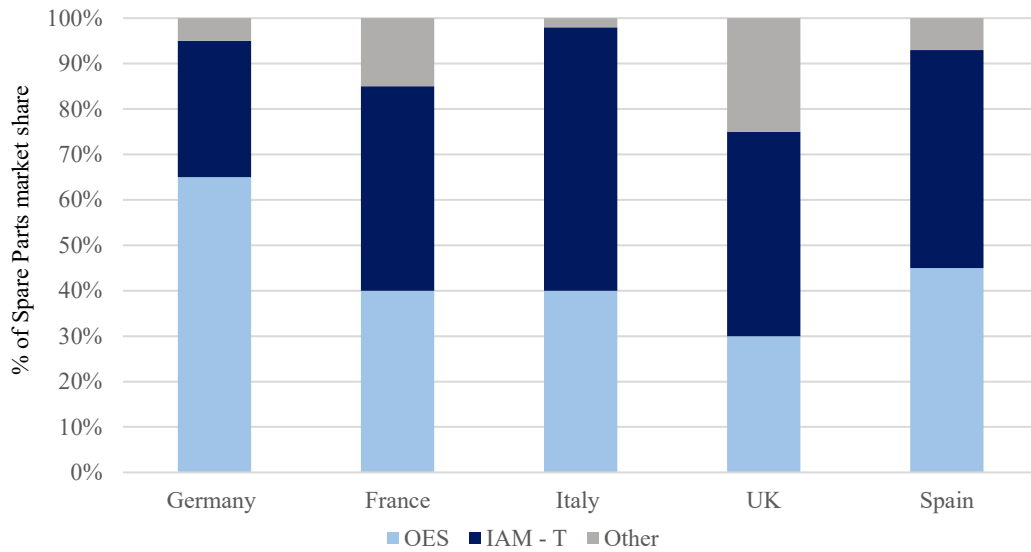


Figure 14. Spare Parts Market Share

The reasons why, in Italy, the Dealers and the Houses strongly support the current distribution system are due to the remuneration scheme of the sales networks. The maintenance of a close link between sales and service (sales & service link) forms the basis of the dealer's remuneration scheme, since it only weighs, between spare parts and labor, for about half of a Concession holder's budget.

2.4. Authorized and Independent Channels

One of the most frequent assumptions made by the constructors in defense of the current system is that only the official networks can offer a quality service, while the other operators would only be able to perform interventions of less technical complexity.

The European Council for Motor Trades and Repairs has intervened several times on the issue, stating repeatedly that there is no reason to discriminate professionalism in minor interventions between the operators of an official and an independent service point: both need adequate training and tend to specialize on the most frequent interventions. For the independents, however, (Figure 14) parts market share considerable disadvantages remain in the availability of technical information and in the fact that all the works covered by the guarantee are reserved for official networks.

To complicate the picture, there is the fact that a user can hardly know exactly the extent of the fault for which he needs assistance, and even more difficult to understand if the price requested is proportional to the intervention performed. So, in the presence of information asymmetry, it happens that in doubt the official assistance is preferred. The higher cost requested by the Dealer is however justified by the indirect presence of the manufacturer as a form of guaranteeing the quality of the interventions carried out. Finally, another point in favor of the official networks is the advertising support of the houses, against which independent repairers cannot really compete.

In some countries, to guarantee the quality of the interventions carried out by the independent repairers, there is a supply chain of quality training: in Germany those who want to manage a point of assistance must, by law, obtain a substantial training in 3 and a half years of training on the job at a mechanic (or electrician). This guarantees that whoever proposes on the market is professionally prepared for a quality intervention. As for the technical equipment, the investment in work tools is in the order of 50 thousand euros for an average workshop, of which about 20% for brand-specific equipment, which in fact penalize the independents who help all brands of vehicles.

As confirmation of the comparability between the two categories of actors, the ZDK, an acronym that welcomes the German assistance operators, has proposed ISO 9000 certification as the sole reference parameter for all the parties involved, both independent and non-independent. Accession was 31% for independents, compared with 5% for repairers belonging to official service networks. The data emerged is significant of how the latter feel already certified by the house to which they are linked, and which respect the stringent requirements required.

However, the initiative taken by the German body is original and very interesting, since it entrusts to an independent body the task of super parts the quality of the service offered, placing all operators on the same level and creating a new point of reference for consumers who seek reassurance on the professionalism of the offer. One of the monopolies in the hands of the official assistance networks would thus fall the guarantee of quality.

In France there has been a phenomenon of recourse to certification more limited than what happened in Germany: under the constant pressure of the insurance companies only the body shops have begun to introduce an ISO 9002 certification scheme. In this case, it is observed that the penetration is in equal proportions between the authorized and the independent: about half of the total.

If we then look at the evolutionary trend in assistance, there is an increasingly frequent tendency to outsource some of the repair phases, due to the increasing technological complexity of some of the components on which we must operate. This applies not only to independent assistance but also to the official one: currently, 100% of engine reconditioning and 60% of the revisions of the publications are carried out by specialized workshops.

But even for many more frequent interventions such as cleaning and ordinary maintenance of air conditioning systems, brake disc adjustments and reconditioning of power brakes, the use of external workshops weighs more than 90% of the total. Therefore, although the end customer feels the need to turn to authorized assistance as a form of quality assurance, he will not be satisfied by the person to whom he has left

his vehicle, but by external specialized subjects interviewed by the independent operator.

It is therefore increasingly evident that, on an objective level, there is no good reason to believe that the assistance provided by independent repairers is of lower quality than that provided by official networks. There remain some distortions caused by the current assistance system and the failure to comply with the provisions of the Community regulations, which prevents the equality of the conditions from which the two groups of operators leave. There is also a clear problem of the lack of quality certification, which is very strong in areas where there is no serious training chain that prevents the market from unqualified personnel. This affects the overall perception that consumers have of independent assistance, favoring official assistance as it is the only one that offers guarantees of homogeneity of the professionalism of its network. The removal of the distortion factors and the introduction of external certification systems that all operators can access, in the wake of the German or French example, is therefore desirable.

2.5. Spare parts

Most of the replacement materials used for maintenance and repair fall within the category of original spare parts or in the category of equivalent quality spare parts, however, produced according to the manufacturer's specifications. The distribution scheme of all the parts treated in Europe follows roughly the following structure:

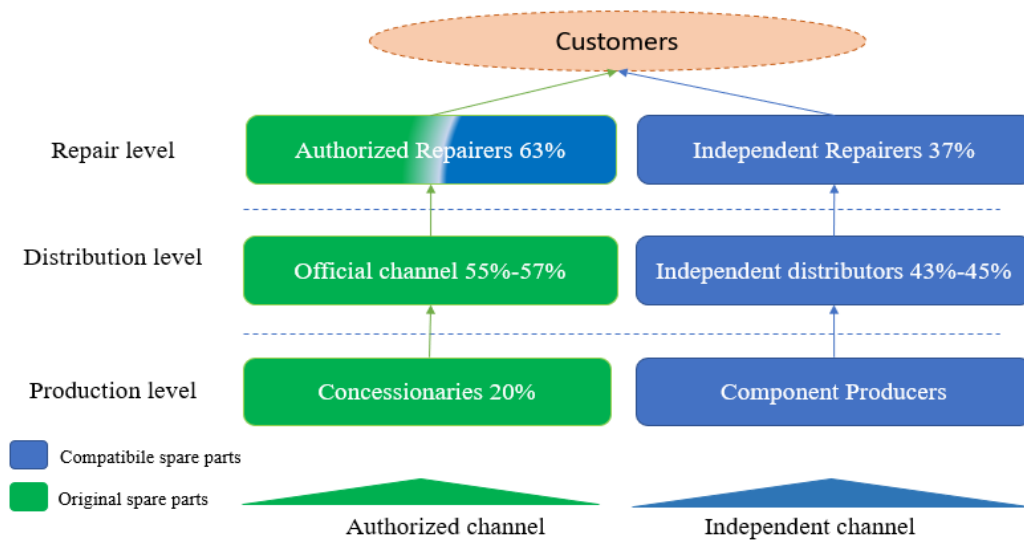


Figure 15. Distribution scheme of spare parts

Figure 15 shows that only 20% of spare parts are produced directly by car manufacturers, while the majority (the remaining 80%) is produced from components companies. As far as the distribution level is concerned, car manufacturers account for about 55-57% of the European market, while the independent distribution is awarded the remaining 43-45%. Finally, regarding repair work, the ratio between authorized and independent repairers is around 3:2. These are average values calculated in Europe, which can vary greatly depending on the individual markets and individual brands.

However, there are some significant differences in distribution systems. The original spare parts are those distributed through the official networks, a high-quality system able to guarantee a quick availability of all spare parts, including those with low turn-over.

Non-original parts may instead be offered via an independent channel to both Dealers and Independent Repairers. However, the Dealers do not use this type of spare parts due to the policies of the houses to which they are linked, which provide for a series of incentives to achieve certain sales targets. Moreover, the Concessionary's fear that the houses refuse to renew the contract if the Dealer himself does not prove loyalty is always strong.

The original parts are then sold to Dealers at prices over 50% off the list price applied at the time of repairs, which leaves a large profit margin for the official assistance operator. However, estimates of the percentage of equivalent-quality spare parts used by official networks are discordant: the figures range from 5 to 20% according to Manufacturers, while trade associations quantify the market around 8%.

The distribution network of non-original spare parts certainly does not stand out for the organization of the delivery system. There are in fact numerous inefficiencies due to the multiplication of intermediaries: often the distribution is managed by national warehouses, connected to regional warehouses that supply, in turn, local warehouses. The manufacturers also state that this channel fails to provide the customer with an adequate level of service, since it focuses only on high-rotation items, leaving the remaining part of spare parts uncovered.

Nevertheless, it is necessary to underline how, the observations made up to now on these issues, can lose meaning if we take into consideration the simple market of spare parts connected to the bodywork (sheet metal, glass, lights, etc.). The rationale behind this sub-market is substantially different from those underlying the generic parts market.

Body repairs involve highly technical interventions requiring specific skills and abilities. Substantial investments in technical instrumentation and training are also needed, as the cases in which the expertise for repairs of this type are brand-specific are very rare.

This has shaped the market for bodywork repairs in a very different way compared to that of the most common workshops: in fact, 70% of operators are independent. In terms of the supply of spare parts, the structure is also very different here compared to the distribution of mechanical parts: most of the spare parts required for repairing

bodywork are distributed via official networks. Behind this particularity, there is a set of motivations.

Firstly, all bodywork parts are by nature highly specific and therefore are purchased only on commission. Moreover, the investments necessary for the realization of these parts are high, especially for the molding of sheet metal. Finally, there is no very strong pressure on prices, as most of the interventions are covered by an insurance guarantee. What emerges is a panorama of distribution of spare parts totally dominated by the official networks (OES) especially on the side of the sheet metal, while the space remains for the independent distribution of spare parts (IAM) applicable also outside the bodywork repairs: the lighting systems can, in fact, be subject to substitution also due to wear, while for the crystals, specialized repairer networks have developed (Figure 16)

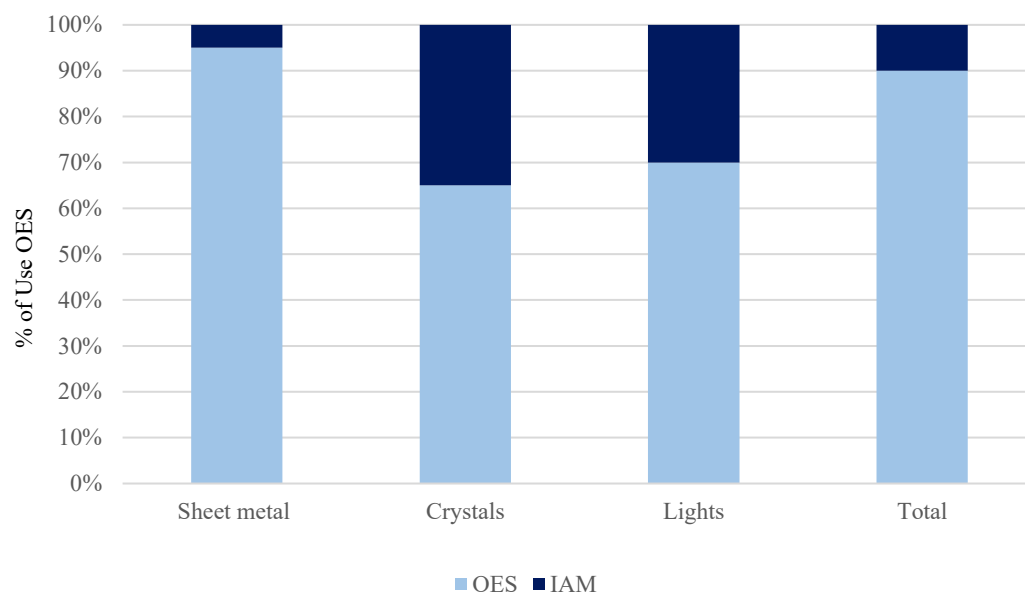


Figure 16. Use of OES in body shops

2.6. Regulations

European Regulation 1400/02

After having widely discussed the structure of the spare parts market, it is right to open a parenthesis on the directives that regulate the competition. The before mentioned BER (Block Exemption Regulation) is in fact considered as the basic regulation for the Automotive sector; originally designed to regulate the relationships between car manufacturers and their partners, it then became the general law regulating competition in the automotive aftermarket.

Until July 31, 2002, the consumer was forced to comply with certain restrictions for routine maintenance, with costs set by the house; a normal coupon performed outside the official network would certainly have induced the house to deny the application of the guarantee. The manufacturer, in fact, assumed responsibility for the good operation of the vehicle purchased by the consumer, repairing or replacing any defective parts, through an authorized workshop. In this way, the house responded to parts assembled on the vehicle, regardless of the supplier of the same. The manufacturer subordinated his responsibility on the defective parts to the ordinary maintenance, typically structured in coupons to be carried out on the road or time deadlines prescribed.

Before going into the changes made by the “Regolamento Monti”, it is good to understand the concept of ordinary maintenance. By this term we mean the whole process formed by periodic inspections and replacements of consumables, to which the vehicle must be subjected to maintain the state of efficiency envisaged and designed by the manufacturer. The important aspect of ordinary maintenance and coupons is the systematic inspection of the car, aimed at preventing serious inconveniences, identifying defects or anomalies in the initial phase. This inspection, to be valid, had to be done through the official network of the House.

In fact, the information content relating to the coupons is described, in outline, in the use and maintenance booklet, which the consumer has as the owner of the vehicle. However, the inspection procedures and the criteria for assessing the state of wear or

malfunctioning are reserved for documents and circulars that the car manufacturer supplied exclusively to the official service network.

Today, however, thanks to the changes introduced by the BER, the seller is required to ensure the warranty on the cars sold by him and is responsible for any defect that appeared within twenty-four months of the sale. In addition, information related to coupons and numerous technical assistance information, previously only accessible to the official network, are obligatorily made available also to independent repairers.

With the Monti Directive, therefore, it is possible to buy the car where you prefer and have the necessary maintenance carried out, without losing the warranty, in all the independent workshops able to meet certain requirements. The repair activity, in fact, must be in possession of the technical information distributed by the House and must use original or corresponding quality parts. The consumer can, therefore, choose the most economical and/or convenient solution for him, benefiting from the competition between the authorized and independent workshops.

The “Regolamento Monti”, therefore, proposes itself as a regulation of rupture with respect to the past, opening the doors to competition in the Automotive sector for the benefit of consumers, finally eliminating the customary practices judged in contrast with free competition (the price of maintenance is no longer fixed by the Houses, but vary according to the rules of the free market). The BER establishes, above all, the right of the workshops to use original spare parts in the same way as the spare parts of corresponding quality, supplied by independent producers and distributors able to certify the conformity of the spare parts with respect to the original specifications.

Before proceeding with the practical meaning of the introduction of the BER it is better to stop for a moment to deepen the terms used and provide some definitions. The fundamental novelty, at the legislative level, is the new definition of the original spare parts, whose name means spare parts whose quality is the same as that of the components used for the assembly of the vehicle and which are manufactured according to the technical specifications and production standards provided by the manufacturer, assuming that such spare parts are original spare parts if the manufacturer of spare parts certifies that the quality of the same corresponds to the

components used for the assembly of the vehicle in question and it said spare parts have been manufactured according to the technical specifications and production standards of the vehicle manufacturer.

In practice, the originality of the spare parts is no longer defined according to the manufacturer's distribution system, but according to the quality of the components. The law also defines "corresponding quality spare parts" in such a way that "they must correspond to the original replacement at least in terms of construction, production, and functional standards". To facilitate sales by independent distributors to authorized partners and to avoid legal disputes with manufacturers, manufacturers of spare parts are required to issue a certificate certifying the quality of their components.

In fact, with the introduction of the Regolamento Monti, both dealers and Authorized workshops can freely buy original or quality spare parts equivalent from independent distributors. In this regard, any restriction imposed by car manufacturers is considered by the European Community to be a serious violation of free competition. The European Commission has also explicitly clarified that the mechanics independent can perform normal maintenance services and repair work during the warranty period and that the Houses cannot oblige their Dealers or workshops to use necessarily and exclusively spare parts produced by the manufacturer, on pain of violation of the Directive. For cases of effective warranty application, the manufacturer has the right to request the partners (authorized workshops and dealers) to use only the spare parts supplied by him, as the manufacturer must pay for the defective product and repair the give free.

The consumer is therefore at the heart of the European regulation since this directive offers him a valid alternative to save on the cost of repairing his car. For this reason, BER offers independent operators a broad right of access to technical information, tools, updates and free use of computerized diagnostic systems, creating more opportunities for the independent market:

- The right to access to the same technical information as mechanics and authorized dealers, for servicing, maintenance, and repair.

- The right to reprogramming (i.e. the possibility of resetting and resetting of the control unit to return to the initial conditions of the vehicle).
- Appropriate cost of access to technical information, so that it is not discriminatory towards the independent operator, and an optimal structuring of the information in such a way as not to force the operator to purchase a quantity of information that exceeds what is necessary.
- The right to access technical information that can be used in practice.

2.7. Prospective

Competitive Pressure

In the last decade until 2020, the European automotive services market will continue to come under pressure from various sides. The technical developments in vehicle manufacturing and parts production is a factor in the rising of competitive pressure.

Improved parts quality will mean longer parts lifetimes and consequently longer service and repair intervals. At the same time, repair shops will also need to invest to address the rise in vehicle electronics. This applies both to information requirements and to ongoing training for employees to stay up to date on technical developments.

Long-term, electrical vehicles and hybrid (Which require considerably less maintenance than traditional combustion motors) will further change the automotive services market.

Along the entire value chain and range of service, the competitive situation for repair shops will intensify. This goes for both authorized repair shops as well as for independent service providers and chains, which will be able to expand their market shares only with the squeeze-out competition. Creative strategies will be needed to address the opportunities and risks of the market developments early on.

Opportunities for independent repair shops

Independent repair shops and chains have many options for securing their future market positions. They can strengthen their procurement power by forming large purchasing alliances, this retaining their most important competitive advantage (cost leadership). They can profit from rising price awareness among customers who are increasingly better informed about quality and value for money, consequently able to select the best offer for every type of repair and service.

Opportunities for authorized repair shops

In the coming years, OEMs and their authorized repair shops will actively use cost and price strategies to assert themselves in the highly competitive market. Customer perceive authorized repair shop as being considerably more expensive than independent repair shops. The development of strategies that enable attractive prices for customers while simultaneously avoiding the erosion of margins may be one of the biggest challenges of the services business for OEMs.

Also, they have their service networks belonging to large companies: in competing with small, flexible, and agile service providers, they will face a different set of challenges when it comes to aligning their business models, price strategies, and services offered to the needs of the market.

Trends in a competitive environment

The development of the competitive landscape will allow independent services providers to expand their market share, though slightly. Thanks to their cost advantages, they are in the best position to address the customer's increasing price awareness. This applies primarily to larger independent services chains. Small independent repair shops will be increasingly challenged by know-how and investment barriers so that we see a further decrease in outlet numbers until 2020.

Also, longer maintenance intervals and generally higher quality will have a negative effect on customer loyalty to authorized repair shops. And non-traditional market players such as insurers, fleet operators, and leasing firms will partner primarily with independent service providers in order to reduce their own costs. (Viewpoint et al., 2011)

3. DESCRIPTION OF SPARE PARTS PROJECT

3.1. SpareParts Service

In the following paragraphs, the objective and the context in which the idea of developing this project was developed will be described in detail. The structure of the project will also be presented, reporting some significant data about its progress and illustrating the mechanism used to monitor performance. To conclude, an overview of the portal operation on which the initiative is based will be shown.

In the previous chapter the new European Regulation 1400/02 was introduced, designed to liberalize the automotive aftermarket and, consequently, to make obvious benefits to European consumers. The provision also covered the way for a wider use of new distribution techniques, such as online commerce and multi-brand sales. Owners of cars have been granted the right to freely choose both those who entrust the repair/maintenance and the type of spare parts to use. It is based on these points that the "Spare parts" project is born, because of an agreement between the major manufacturers to increase competitiveness in the Automotive spare parts sector.

The multi-brand program has stimulated a certain feeling among the insiders. In fact, there are not frequent cases in which large manufacturers are able to agree on such important aspects (such as aftersales and spare parts) by developing joint projects. In this case has been created a portal through which the workshops can order the original spare parts, of 13 participating brands, through the Dealers of the official networks. The founding concessionaries hope that the alliance will spread to the largest possible number of brands: the shared hope is that the agreement will become global and succeed in involving all them.

As mentioned in the previous paragraph, the SpareParts project was born as a partnership enriched by a horizontal agreement between the participating car manufacturers (which play the role of customers in this respect) and by a strategic alliance with ACN Consulting. The last has the information and organizational skills

necessary to set up a project of this magnitude, also acting as a mediator in decision-making processes.

Horizontal agreements are very delicate forms of collaboration because they usually concern competing companies. In this case, however, even considering industrial companies competing, the actual competition mainly concerns the sale of motor vehicles; in the spare parts market, it is not perceived the competition between car manufacturers, as it is strongly influenced by what happens upstream in the sales segment.

However, it is not uncommon to see how, for the end customer, the choice to purchase the car is driven by criteria including the costs of ownership. These mainly depend on the cost of spare parts, repairs, and maintenance, all critical success factors of the aftersales market. Despite this, the concessionaires have understood that the fight in the spare parts sector must not be internal to the official distribution networks but directed towards independent parts distributors.

The attention of the concessionaries has therefore shifted to the real customers of the spare parts market: the car repairers. When a car arrives in the workshop, the mechanic or the coachbuilder, during the diagnosis and repair phase does not choose, obviously, the spare part to be assembled among those offered by the different manufacturers, but among the components of the price list supplied by the specific one manufacturer and the details offered by the independent market. Therefore, even though they are competitors in the motor vehicle sales market, the concessionaires can be considered partners in the spare parts market, since the sale of the pieces is, approximately, directly proportional to the cars sold. In addition to streamlining the cost structure, collaboration intercompany allows also to exploit relevant economies of scale, allowing companies to make optimal use of the resources available and to incorporate through the learning of the people involved in the project, new elements of know-how useful for expanding their internal expertise.

The idea behind the "Spare Parts" project is to create an online supermarket that allows us to create a single point of re-supply for repairers (one-stop-shop). The goal, however, maintained, with the passage from 7 to 13 brands, is that of encouraging the

access of as many manufacturers as possible to extend the offer as much as possible. For example, it is not unusual to come across specialized repairers in the reopening of particular brands: if they previously had a vehicle of another brand to be repaired in the workshop, hardly they could have repaired with original spare parts, but would have turned to the universal spare parts market or, at least, to the spare parts market (sale of original spare parts, but through an incorrect distribution scheme). With the *SpareParts* initiative, they could have used a tool to purchase original spare parts from a supporter Dealer.

3.2. Context

From the definition on the ACN Consulting website, *SpareParts* is an initiative developed by some car manufacturers, in collaboration with the Dealer Network retailer, to provide after-sales services to independents repairers. The reality of *SpareParts*, as can be guessed from the definition, is rather structured and complex, due to the large number of SMEs (repairers and dealers) and large companies (different car brands, ACN Consulting, temporary agencies) involved in the project. *SpareParts* is therefore an innovative solution in the after-sales world, which aims to create a new type of relationship between independent repairers and dealers with the stated objective of increasing the sale of original spare parts. ACN Consulting is the company assigned by the car manufacturers to the management of the Internet portal, a new distribution channel between repairers and dealers for the process regarding orders for original spare parts.

It therefore, deals with its maintenance and the planning and execution of activities in the field, to enlarge the perimeter of the project to all the selected areas in agreement with the car manufacturers. To give an idea of the importance of this project, it is useful to consider the fact that the participating concessionaries, adding the market shares of their own brands, cover just over 50% of the circulating vehicle fleet, as it supports the credibility of the project.

The idea of the *SpareParts* portal was created in 2001 by five major manufacturing groups. The latter, in fact, worried by the drop in their market shares regarding original

spare parts and in anticipation of the entry into force of the Regolamento Monti, they have seen in the online portal an innovative tool able to generate a competitive advantage.

For a couple of years, a team made up of members of ACN Consulting Technology Solutions, a company of the ACN Consulting group, made up of information technology specialists, has developed an internet portal which is a user-friendly, because the target end users were not definitely used to working with the computer or an internet browser.

Using Web Services in Java technology, it was possible to integrate the business logic for the management of the spare parts of the various groups that were part of the consortium, building a more efficient and low-cost spare parts logistics management system. The most difficult challenge, as far as the technical part is concerned, was to combine the tools for identifying the spare parts of cars in different concessionaries with the processes for managing the workflow of the orders and checking availability at the warehouse.

In fact, the servers on which the catalogs have been prepared individually by each concessionary; moreover, each catalog, to interface with the site, needs certain programs to be launched. After setting up the site, in 2004 a pilot project was launched in the Rome area, involving ten dealers and a hundred repairers. After the roll-out phase, the performance assessment phase was opened, thanks to the monitoring operations carried out during the pilot phase. The results that emerged were prominent, for that reason the partners decided to continue investing in the project, which contained interesting ambitions and perspectives. According to the data certified by the dealers and repairers belonging to the pilot, there were:

- The average increase in Concessionaire turnover equal to 35% (increase in quantities sold).
- Increasing in the Concessionaire client portfolio close to 20% (come from served repairers who previously used the spare parts dealers)
- Time-saving in the procedure of sending-receiving-checking availability order equal to 51%

- Reduction of orderly errors in 82% of the cases (thanks to the possibility of having updated electronic catalogs is much less likely to commit order errors).

Naturally, this data is still important, but need an appropriate contextualization. It is good to keep in the relative number and heterogeneity of the sample, the enormous enthusiasm in concomitance with the launch of a new initiative and the enormous effort made by all the participants. The next step was to widen the project perimeter to the whole Lazio region and in 2005 at the beginning of the diffusion phase of the project, the Concessionaires decided to focus on Lombardy and Veneto.

In 2006 Tuscany and Emilia took over (only with the provinces of Parma, Bologna, Modena, Reggio Emilia) and, between September 2006 and January 2007, the group of partners expanded thanks to the inclusion in the project of two more groups, for a total of six new brands. 2007 was the year in which the Concessionaires had decided to proceed with the phase of consolidation of the project, extending the basin of work also to Piedmont and Romagna.

Between 2008 and 2009 the extension of the supported provinces continued until the complete coverage of the Italian territory at the end of 2011. In 2013 the project continued at the Italian level with the Sales Force supported by 6 promoters on 7 provinces of strategic importance. In 2014, 31% of the provinces are covered by all 13 brands on a perimeter basis, while the number of provinces covered by at least one of the managed automakers has increased to 60%. Figure 17 summarizes the different steps of the project diffusion:

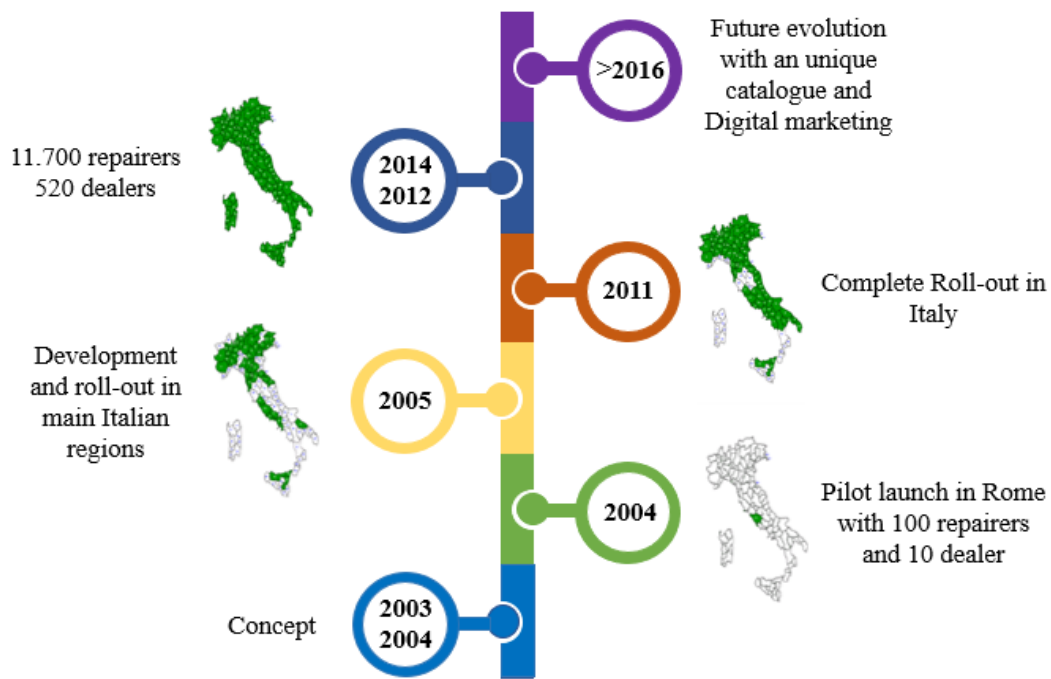


Figure 17. Expansion of the SpareParts portal

The dissemination of the project in a new area

In this paragraph, the methodology adopted by ACN Consulting will be explained in the management of the *SpareParts* project about Salesforce activities and the latter's relations with the main players of the Automotive market: dealers and repairers.

The phase of diffusion of the project consists in an accurate and long programming consisting of several steps of approaching the final objective: the complete mastery of the system and the catalogs by the warehouse workers and repairers.

These steps are defined in the project headquarters and apply indistinctly on all the new areas, first involving the dealers and, a later the workshops/body shops.

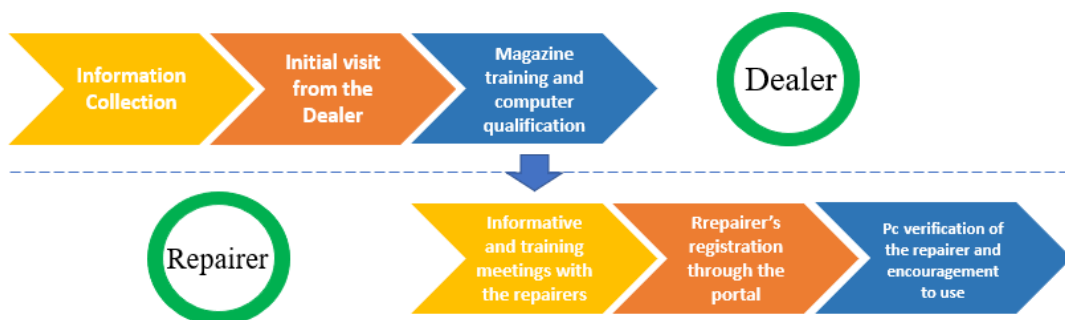


Figure 18. Training and recruiting Process

The training and recruiting process reported (Figure 18) is divided into the following main activities:

1. **Collection of accessions:** it is the real starting point because at this stage we collect the participation of the dealers. A list of participants in the Coordinator Area is also sent, which can organize the initial phase of its work.
2. **Initial visit:** It is the first meeting between the Sales Force ACN Consulting and the project managers of the dealers. Here we define the future training appointments, both for the warehouse and for the repairers.
3. **Training Warehouse:** Before involving the repairers, one or more training sessions are organized with the warehouse workers on the use of the system from their point of view (order processing activity and communication to the workshops of availability on the details ordered). In this way, the dealer and the spare parts warehouse are prearranged for immediate evasion of orders sent by repairers.
4. **Informative and formative meetings with the repairers:** the repairers are invited by the dealer to one or more training events to know the initiative and to learn the functionalities of the site and the navigation of the catalogs.
5. **Repairer's registration:** After following the training courses, repairers can register at the *SpareParts* portal to take advantage of the services of the initiative. A user and a password are then supplied to the repairer to access the *SpareParts* portal in a personalized way.
6. **Computer verification and encouragement to use:** The activation process takes place at this stage. The registered repairer is contacted by the Support Centre, which after verifying the adequacy of its IT structures, carries out a small telephone training of recovery regarding the navigation of the catalogs and confirms the activation process of the repairer, who is finally allowed to send orders.

3.3. Key Data

Before concluding the paragraph is good to highlight some data to emphasize the rapid growth of the project even in recent times. It is one of the largest and most publicized projects within the Automotive segment of ACN Consulting for different reasons, including number of ACN consulting employees involved, time duration, amount of resources invested, and geographic interested areas. It is possible to better understand the scope of the project by observing these numbers:

- Although it started in 2004 it is still in progress, with expansion programmed also to foreign.
- It affects all Italian regions and enjoys the support of two promoters on specific provinces with high potential.
- Between consultants and IT experts, there are approximately thirty ACN Consulting members.
- In Total, ACN consulting and non-ACN consulting staff are committed to about fifty people distributed between project management, Sales Force, call center and computer support.

After the successful pilot test, the project was progressively extended to several brands and several regions, bringing the number of repairers involved in the initiative from 100 to about 6000 at the end of 2007 and the number of dealers from 10 to 450. Nowadays, the project has expanded to reach a total coverage of the territory with more than 10.148 repairers and 515 dealers enrolled.

The following Figure 19 wants to show the trend of the value of the ordered for repairers registered to *SpareParts* in the period that starts before 2018. In the first month of the year 2018, the trend was positive, the orders were increased, but this positive trend was not maintained until May, where again an increment with respect the precedent year is observed. In June the tendency is negative, these results possibly were generated by the low offers of promotions during this semester.

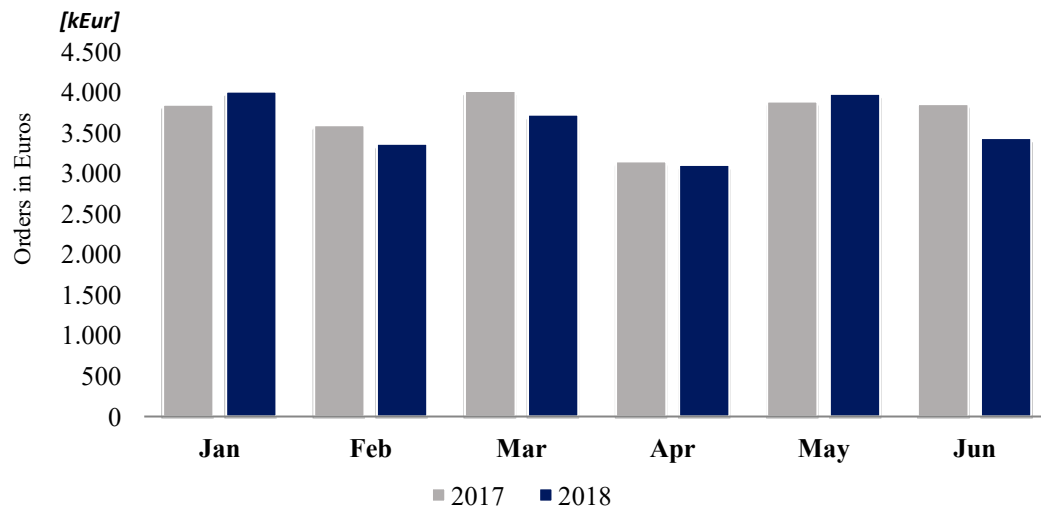


Figure 19. Orders in the SpareParts portal from January to June 2017 vs 2018

In the following **Figure 20** it is possible to observe the trend of the overall order, divided between the orders made by the repairers which are part of the official concessionaire network (authorized) and independent repairers:

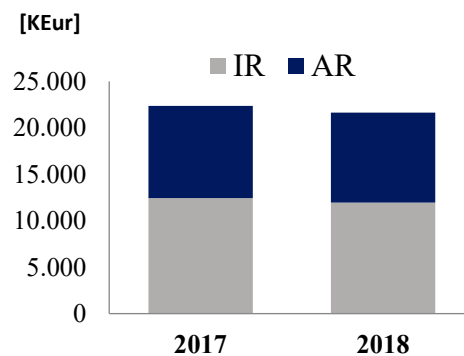


Figure 20. Sorted divided by Channel

As can be observed from the figure, in terms of relative stability of the number of repairers ordering, the progress of the total ordered passing to the portal is a focus to high instability, mainly due to the very difficult conditions of the current market.

However, it is worth noting that, in overall, the effects of the crisis are being mediated by obtaining on several months levels of performance absolutely in contrast with respect to what is possible to observe in the markets. It is also important to observe the

decreasing in the authorized ordered, this reinforces the probably negative impact of the low sales discounts offered by the concessionaires.

These results probably indicate the actual state of the project in terms of order amount performance, more than a negative trend presented, this information is taken as important input to search the facts which affect the amount in orders and the impact of the actions taken by the concessionaires.

3.4. Organization

After presenting the context in which the project developed it is necessary to describe how the organization structured. This section can be divided into two fundamental macro-areas:

- Hierarchical and relational organization of the project, through which are clarified the hierarchical positions and the responsibilities of all the figures (ACN consulting and non-ACN consulting) participating in the project, as well as the relations between them and the Decision-making levels.
- The main roles of the project's diffusion in the study area.

Performance monitoring system, where the various global and local project performance indicators (KPI, Key Performance Index) are presented, together with the methods of use and usage of this data.

3.5. Hierarchy

Before describing in detail, the internal organization, it is prudent to consider how different realities are involved within the project, which must be integrated in the way to guarantee satisfactory results and to realize advantages at every hierarchical level. The project involves the entire automotive aftermarket sector and supports automakers in achieving the ambitious targets settled. The main agents in *SpareParts* project are:

- ACN Consulting, Automotive segment
- ACN Consulting Technology Solutions (ATS)

- Manufacturers
- Not ACN Consulting employees (Sales Force e Call Center)
- Concessionaires
- Independent and authorized workshops, body shops; Not-ACN associations but internal to the Automotive Aftermarket.

It is important to clarify the fact that for each of these organizations there are several hierarchical levels involved, so each professional will communicate mainly with members of the same level according to the following scheme (Figure 21):

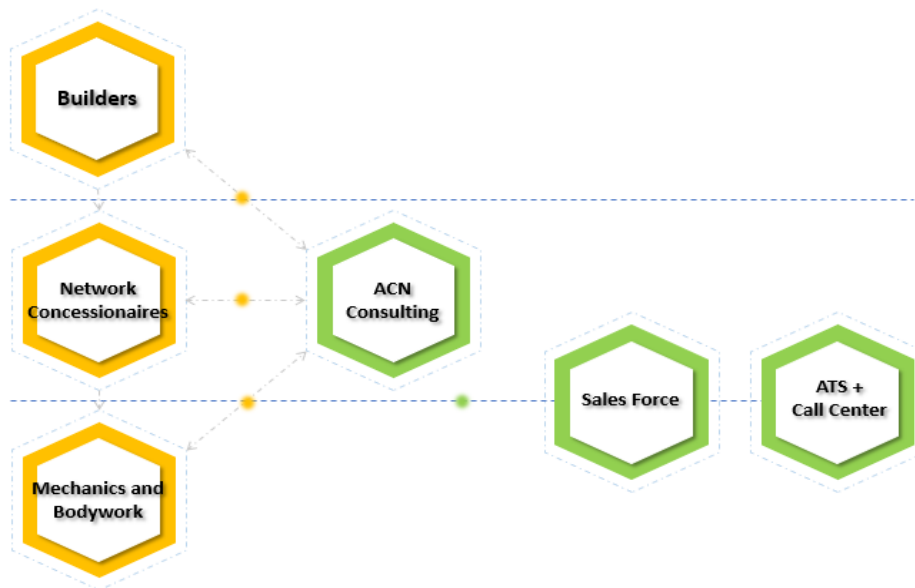


Figure 21. Between hierarchical levels

As mentioned above, the project is born at the level of the parent company for each automotive group, for which they are the members of the top management of the concessionaires, aftermarket division, to make strategic decisions of the medium-long period of the project. The task's division between these organizations is well defined. The financial investment is supported by all the manufacturers in partnership, together with ACN Consulting, which believes in the importance and profitability of *SpareParts* project.

ACN Consulting has been commissioned to develop the Internet portal around which revolves the chaotic Salesforce activity, which is composed by an ACN Consulting employees, concessionaires zone manager, and promoter. The task of the Sales Force

overseas promoting the use of the portal by interconnecting with the potential users of the service: dealers and repair activities.

The portal was created by a team of professionals in the IT field, taken from ACN Consulting Technology Solutions. This staff still follows the project, both to manage its operation and to implement any modifications and functionalities designed for improving its use. The IT team of *SpareParts* in the organizational level, a sort of transverse staff within which the hierarchies are based on the positions that each member occupies within ACN Consulting. All the modifications to the portal are agreed with the project leaders, based on the reports that have come from dealers and workshops, but also directly from the concessionaires or from the *SpareParts* team.

In this sense, a file is settled to collect all the improvement proposals that reach the IT team through the different channels available (Support Center, area Coordinator, Zone Manager). For each report, in addition, is indicated by the IT team: difficulty, priority of the change to be implemented, the status of the change and the expected date of release in certification (beta version) and subsequently in production (Final version).

Once this brief parenthesis is completed, the description of the general organization of the project is returned. At the head of *SpareParts* are the top managers of the manufacturers and a senior executive of ACN Consulting, part of the Automotive segment. At this level, the strategic decisions of the project are taken, dictated the organization's guidelines and approved the financial and human resources to be included. For example, the definition of the areas to be activated in the project and its timing of diffusion is delineated by the leaders of *SpareParts*, based on careful commercial, strategic and corporate evaluations.

As soon as the decisions are made feasible, the control of the project is completely entrusted to ACN Consulting which, based on the agreements made with the concessionaires begins to define the strategy with which to implement the inputs coming from the same NSC.

The results achieved can be monitored by project managers for NSC at any time. In addition, at regular intervals (usually 3 months), ACN Consulting's Index of meetings (NSC, National Sales Company meeting) with NSC's to take the point of the situation and plan future activities.

These meetings are made up of a common session in which the overall project results and an individual session are analyzed, during which ACN Consulting individually meets the manufacturers to outline the maximum strategies related to those brands. In the common session, the following topics are usually investigated:

- Visualization and analysis of the overall results in terms of recruiting and volumes (orders, ordered, accesses to catalogs, repairers ordering)
- Analysis of the KSF (critical success factors) of the project; Developing from the situation of the new areas involved.
- Programming and reporting of upcoming events to be involved with *SpareParts* (Fairs, events, newspapers)
- Updating reporting systems
- Calendar of upcoming NSC meetings.

The main objective of this discussion is the presentation of the project from the point of view of ACN consulting, so it is necessary to proceed by examining the figures and positions of which ACN Consulting is responsible. The Manager relates directly to the Senior Executive, a real coordinator of the project. To him are entrusted all the responsibilities of global management of resources addressed to *SpareParts*, coordination activities dissemination activities and extension of the project and tracking of the guidelines that the members responsible for the various areas must follow. The Manager compares with the consultants involved in the project, who follow more closely the activities and oversee the work of the Sales Force ACN Consulting. Among their tasks is to agree with the promoters the actions to be undertaken on the territory.

Further down the level, is precisely the sales force, structured according to the following structure (Figure 22):

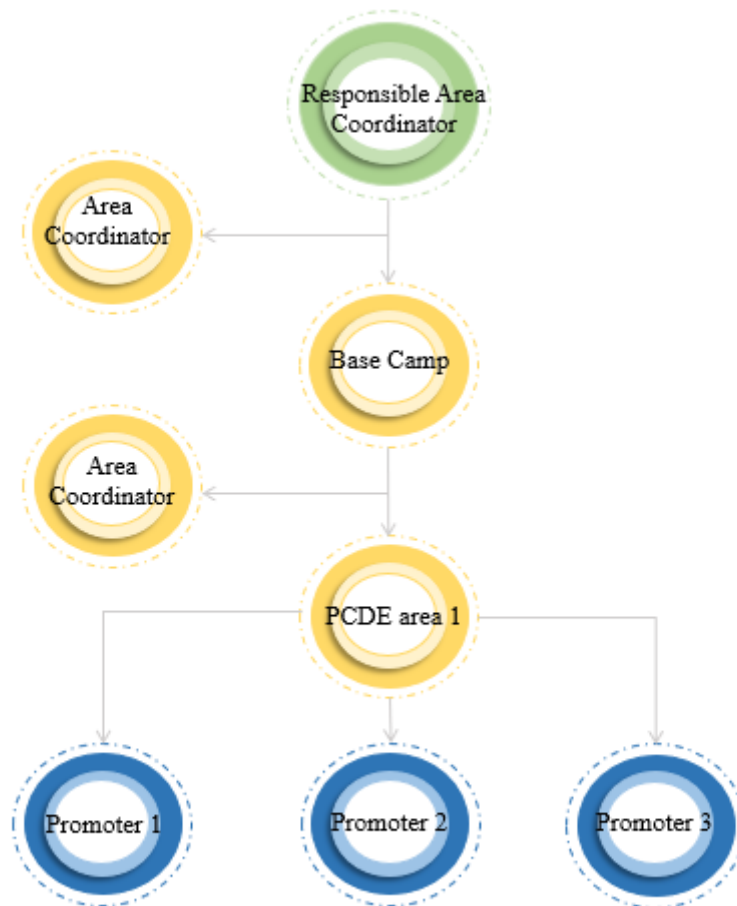


Figure 22. Sales Force Hierarchical Matrix

Each area (corresponding to more than one region) is entrusted to a Coordinator area, which has the task of relating to the dealer in the area and outlining the program of recruiting and training activities on it. In addition, it provides support for any problem of the project in that area and is responsible for the objectives assigned to him at the beginning of his assignment (ex.: Number of repairers registered to *SpareParts*). The area coordinator is also responsible for managing the initial phase of the project in a new area. Later, it can also enrich its tasks, for example by managing the process of integrating MSDS from the warehouses with the site.

After the initial phase, the area coordinator remains in support of dealers and repairers if it is needed: then, there is no definite period relative to this position, but it varies depending on the usefulness of that role. There are, for example, dealers who decide to join later or who choose to organize further training courses on the use of the site and the catalogs for their customers. Finally, new brands may come into the initiative

and it is necessary to manage the dissemination process specifically for adapted brands. The area coordinator consequently has the task of carrying the repairers and dealers to a good use of the portal and to a continuous learning process regarding the way of ordering. In *SpareParts* is also the role of the global manager of the area coordinator, which serves as a reference point for all other members of the Sales Force and reports directly to the project manager.

As soon as the numerical and monetary volume of the orders starts to become consistent, another role comes into play: The Base Camp. This figure is responsible for the project's performance for the area assigned to him, usually an entire region. The Base Camp is therefore, the real leader of the project for the reference area and interfaces directly with the Senior Executive in outlining the long-term strategies of *SpareParts*.

Therefore, he leads the post-recruiting activities to achieve the monetary and economic performance established in setting goals. It represents the real interface between ACN Consulting and the project on the field.

Its task is to trace, in agreement with the dealers, the activities and the strategies to follow in order to ensure that the project results are satisfactory for the houses and for the concessionaires themselves; anyone who assumes this role must monitor the data and results of the reference area daily in all respects (dealer, trademarks, province performance, and the repairer's activities) to intervene punctually in case of irregular and under-performing situations.

The Base Camp is the coordinator of the project in a specific area and is edged by other roles included in the project (not ACN Consulting) to maximize the results of *SpareParts*. In fact, when the area is considered ready from the point of view of recruiting and training, the promoters come into play, who have the task of being a technical support and a commercial reference for the repairers.

The promoters are coordinated by a chief promoter, called PCDE (promoter Coordinator and Dealer enabler), who often joins the Base Camp in his activities (even if he hierarchically reports to him) and acts as an interface between dealers and

repairers, through its promoters. The PCDE is not an ACN Consulting employee but is among the large group of people participating in *SpareParts*, including the promoters, which are grouped in the category Sales Agents. In a nutshell, they have been selected by ACN consulting based on collaboration a leading agency in the management of human resources and recruited in the project to support the figures ACN consulting, as pure commercial.

At the hierarchical level, the PCDE respond to a single project manager, (PCDE Coordinator) jointly with the Base Camp of reference. The promoters work, however, exclusively on the field at the repair activities for:

- Solving any problem inherent in *SpareParts* at the repairers (navigation of catalogs, management of application programs useful for a correct visualization of the site and catalogs, optimal use of the site)
- Facilitate commercial communication between repairer and dealers.
- Present marketing initiatives and dealer promotions (where are required by the dealer), without having contractual power.
- Presenting marketing initiatives and promotions initiated by the *SpareParts* team (prize competitions, competitions, gadgets).

Therefore, the promoters support the purchase of spare parts through the portal and are the presenter for the demands and needs of the repairer regarding the initiative. Each promoter is assigned to a specific area (usually one or two provinces) and, through a planned visits plan, are present at regular intervals at the repairer, as well as always available by telephone or by e-mail for any information. The insertion of the promoters serves to provide a service of excellence to the repairers, to assist him in the use of the site and consolidate the bond of loyalty with the dealers of reference.

The methodology implemented is based on the already known model one customer-one face, adapted to the situation: in this way the customer intertwined a single relationship with a well-defined role in *SpareParts*, which can lean for any problem and with which it can establish a business relationship and personal imprint on trust.

Each promoter is assigned objectives, defined mainly according to the potential of the area in which they operate. The goal-setting path starts from the initial definition of the project's overall turnover objectives; the expected turnover is then divided between the various regions following the indications provided by the houses. Achieving this objective is the responsibility of the PCDE.

In turn, the PCDE assigns to each promoter a well-defined turnover goal, so that the sum of the local objectives, if achieved, leads to the attainment of the regional target. The definition of the objectives of the promoters is carried out considering several variables including the number of repairers, the previous invoicing and the potential of the repairers of the relative customer portfolio.

As mentioned previously, the figures of the team *SpareParts* must interface with ambassadors and managers of other entities interested in the good performance of the project: houses and dealers. The relations with the dealers are established, first, by the Area Coordinator, who works with them to plan the training activities of the repairers regarding the use of the site and the catalogs; in fact, these courses are kept in the premises made available by dealers.

The reference figures for the project are the owner or sales manager of the dealers for the general organization of the activities, and the warehouse manager for the scheduling of the training events. As soon as the recruiting phase is completed, the Basecamp enters the field. He operates at a strategic level with the dealer so that the network of customer workshops is in the best condition to operate.

The relations between ACN Consulting and the manufacturers, as has been schematized at the beginning of the paragraph, follow a hierarchical logic, where each agent of one of the two realities interfaces, in most cases, with referents to the same level of other partner companies.

For each house, the titles assigned to these managers are different, but the tasks attributed to them tend to coincide. They are responsible for the results of the dealers, in terms of post-sales turnover, identifying spare parts sales objectives and suggesting to the dealers themselves the strategies to reach them. In the *SpareParts* framework,

they act as facilitators of the initiative since they do not have a real responsibility on the project objectives. Their valuable help, however, contributes to helping the penetration within the official network of the NSC, aware of the fact that any novelty, even if economically very tempting, will be initially read with great distrust.

The figure of the Area Manager always follows the same dealers and knows in detail the situations of each, so it can, if convinced of the usefulness of the project, offer a great help to *SpareParts* to enter without resistance and uncertainty in Business of these realities.

Obviously, as also happens within ACN Consulting, the field forces of the NSC are coordinated by a managerial role to which they refer. This case, however, the intercompany relationships will be handled by the consultants or the Project Manager. This figure exercises the real internal leadership to the builders for the project *SpareParts* and dictates the guidelines of the actions taken by the manager's area, regarding the project and especially for the activities of their close competence.

3.6. Monitoring

After having illustrated the structure of the project in terms of hierarchy, roles, responsibility, and relationships, it is necessary to continue dealing with the theme of the performance monitoring system used within *SpareParts*.

The monitoring system collects all the information useful to the measurement, representation, and selection of the different project performances, both in qualitative and quantitative terms. The system is designed to ensure that each hierarchical level has the information it needs in a short time, in the right aggregation and visualization. Each actor in the project is assessed on well-defined and structured performances, monitored through several reports generated in a semi-automatic way by the *SpareParts* information System.

Most of the data is accessible at all levels and in different aggregative modes, but each degree of the hierarchical scale and each project participant's reality is given a different

priority in displaying the results. The indicators (KPI, Key Performance Indicators) that will be presented in this paragraph have been designed and implemented to achieve the following objectives:

- Identify the criticality of the project.
- Identify the criticality of the processes.
- Systematize the identification and resolution of problems and dysfunctions.
- Measure the result of the improvement activities.
- Visualize in an analytical way the progress of the project in terms of area, brand, and dealer.
- Monitoring the effectiveness and efficiency of the activities and resources that operate on the project.
- Evaluate the performance of the project in a parametric and comparative way (comparing the data in a subjective and temporal way).

For an indicator to be useful to achieve these objectives and immediate to be read and analyzed, it must be assessed positively under different points of view, describing the robustness of the indicators:

- **Understandability:** Ease of interpretation of the indicator.
- **Processing cost:** simplicity and rapidity in obtaining the information necessary to provide an exact value to a given indicator.
- **Significance:** Signaling indicator importance. A KPI is meaningful when it is particularly useful for the clear discovery of the project's key performance.
- **Frequency:** Occurrence of detection required to keep the indicator significant, based also on its variability in time and the importance of detecting such variations.
- **Structuring:** Degree of objectivity of measurement.

These parameters are usually assigned a value of 1 (less desirable) to 5 (more desirable) able to synthesize the goodness or not of the indicator for the desired characteristic. To evaluate the objective validity of a KPI it is necessary to group all these values in a single data, averaging the values assigned to each parameter, the

weight of each parameter depends, of course, on the project you want to measure. This procedure is very useful when selecting, evaluating, and analyzing KPIs.

At the global level of the project, the most important KPI from which the refinancing and the improvement of *SpareParts* depend is the monthly turnover generated by the sale of the spare parts, calculated as the sum of the ordered transited in the portal, for the marks participants. This turnover must not be the result of the movement of a certain part of the orders from the old mode (fax, telephone, bank) to this new channel, but must also enclose a certain factor of incrementality.

The main objective of the manufacturers is to increase their sales of original spare parts, by subtracting market shares from the competition (sale of spare parts conforming to the original), which has become increasingly strong after the entry into force at the level European Regolamento Monti. The incremental increase above must be more pronounced especially for the large market share represented by independent repairers. Therefore, the indicators which can be considered the most important are:

- **Monthly turnover** related to ordered volumes transited through the portal (in millions of euros)
- **Percentage of increase in dealer's sales** with respect the periods preceding the entry into a SpareParts portal which can be quantifiable by:
 - Ordered from customers purchased through *SpareParts*
 - Incremental ordering registered on existing dealer's customers.
 - Percentage of increase in sales related to the independent market.

These are the indicators most requested by the top management of the houses to analyze the results of the project synthetically. These are therefore carried out all the reasoning about the adoption of new strategic lines or of consolidation of the results. To decide how to structure visible reports to cases ACN Consulting uses the several meetings of the NSC, thus involving the beneficiaries of those reports. As far as reporting is concerned, it is essentially divided into two categories:

External reports: those documents intended for those who benefit from the service offered by the initiative (manufacturers and dealers). They allow to monitor the

performance of the project according to different points of view and to different levels of competence:

- **Journal Report:** tracks the progress of the service's dissemination and recruitment activities.
- **Concessionaire performance reports:** it shows the data relating to each dealer participating in *SpareParts* in terms of the status of its customers, of ordered and accesses to the electronic catalogs, etc.
- **Order reports:** This document allows to view aggregate information for brands in terms of the order, access to catalogs, etc.

Internal reports: those documents not accessible to all participants in the *SpareParts* project but distributed to ACN consulting staff and non-ACN consulting personnel in the field force.

However, for these latest reports, we must proceed with a dual breakdown. They are made by following two main discriminants:

- **Refresh rate:** daily, weekly and monthly.
- **Area of expertise:** Global, area, sub-zone.

Depending on the two allocations, the reports will contain different levels of aggregation and detail and, above all, information sensitive and useful to their activities. The purpose of this breakdown is dual:

- **Simplification:** reports must be legible, and for this reason, a quantity of unnecessary data and information threatens to complicate and weigh up procedures without providing added value. The promoters, like the PCDE, need a quick tool for the consultation of the data of its customers that are part of the respective area of reference.
- **Confidentiality and processing of sensitive data:** Certain information must not be disclosed at all levels, to avoid a disturbance of sensitive data or the proliferation of harmful behavior to the initiative's success.

3.7. Operation of the Portal

After describing the organization and the monitoring system on which the project is based, it is always wise to go deeper into the methodology of *SpareParts* outlining the steps that lead the repairer from a selection of the parts desired until the arrival of the latter in the workshop:

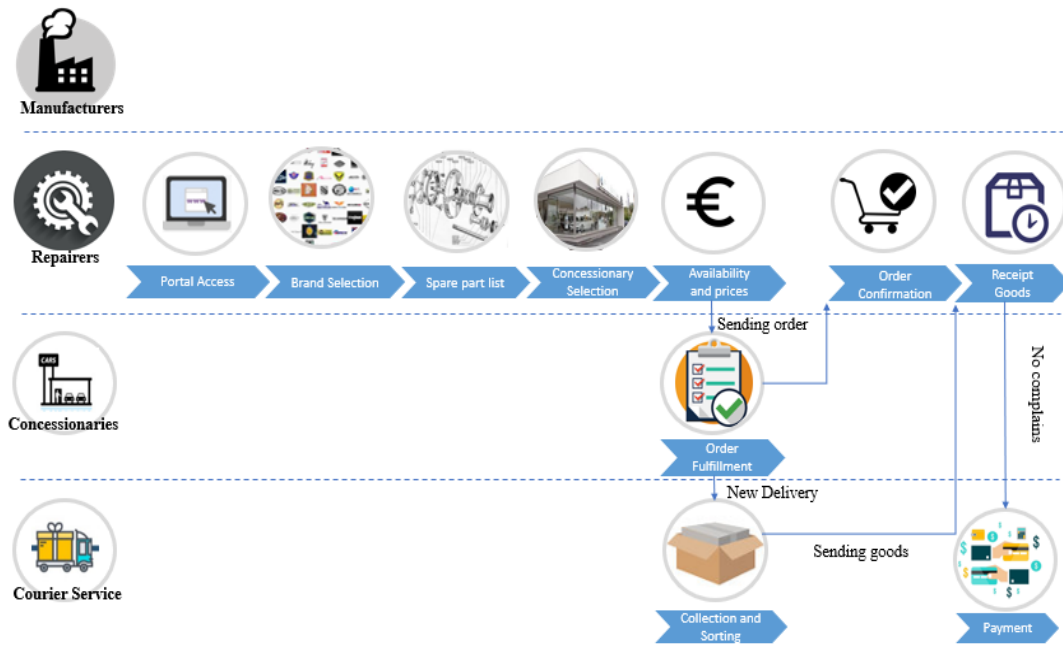


Figure 23 Process of sending-receiving-order fulfillment

To better understand the explanation is useful to keep an eye on the diagram above (Figure 23), which summarizes in a clear procedure to follow to complete the joint process of sending-receive-order fulfillment. It is necessary to clarify that the portal replaces the usual way of working regarding the dispatch, the reception of the order and the communication from the dealer to the repairer of the availability or the reordering of the components.

They are not managed in the billing, for which the dealer continues to be responsible, in the order fulfillment process, even if ACN Consulting has provided, for completeness of service, to conclude contracts with the local transporters about the deliveries.

In the following paragraph, the first chain of the schema will be deepened, from the access to the Internet site to the phase before the order fulfillment, since the second part is carried out with the same existing procedures.

3.8. Registration

The first step that the repairer must make to do a registration in the portal, consists in the user's creation; in this way, you can get custom access to the site through the credentials provided by the system. To create a user, it is necessary to complete the registration procedure, by which the new person is requested their personal data. In the process of creating the account, it is mandatory to enter also a registration key. This is a reference code provided to the repairer by the concessionaire, to make clear how the service, despite being an initiative of the manufacturers, is directly supplied by the dealers.

After completing the registration procedure, the user becomes part of registered users to *SpareParts*, thus having a personal user. Once you have logged in, you must select the dealers which you intend to establish commercial links. The selection is made by the brand, because it is not said that a dealer of an NSC trade all the brands and it is not assumed that a repairer chooses to buy the spare parts from two brands belonging to the same group, from the same dealers. It can be selected two dealers for each brand:

- **Preferential dealer:** it consists of the company to which all orders are automatically diverted from the system and with which the repairer has entered the main link.
- **Secondary dealer:** It is a kind of reserve to which the workflow, if any, will send orders not satisfied by the preferred dealer, thus maintaining the high level of service.

Once the reference dealers are selected, a request for authorization for access to the relevant catalog is sent to each of them; as soon as the dealers in question, through its users, accept the request of the repairer, he will have the opportunity to navigate in the catalog for the brands to which he is now bound.

At this point, the repairer will only have to wait for a call from the Support Center *SpareParts*, which will guide him step by step in the due settings on the computer to optimize the browsing experience of the catalog. At the same time, the repairer can ask the telephone support for a training on the use of the catalog and portal, to be devoid of doubts and start to order. Synthetically, the procedure that leads the user to the possibility of ordering can be summed up in the following diagram (Figure 24).



Figure 24. Registration process

We now proceed with the list and the description of the phases that lead to the sending of the order and to the reception of the same by the dealer. The process of access to the catalog is really very simple. After completing access to his personal page, the repairer will immediately show the logos of all the trademarks managed by the *SpareParts* project but will be able to click, and consequently open the catalog, only those for which he has made a connection with the dealer.

The access to the catalogs also allows you to visualize the list prices of the components and, with these, make an official quotation. This entails a serious risk: the repairer could use the instrument only to see the prices or to search for the components, then order by other channels (telephone) or, worse, by other distribution networks (generic spare parts and therefore not Originals).

Despite the financial effort is considerable, the NSC grant the service of consultation of the catalogs free of charge, advancing only one request to the beneficiaries of the service: use it correctly, ordering the original spare parts through it. For this reason, a mechanism based on the credits associated with each catalog has been introduced since January 2013.

The operation is simple and certainly favorable to repairers: every user has fifty credits for each catalog, loses one for each access, but can recover two for each order line that sends through *SpareParts*. In this way, if the catalog is incorrectly used the credits end and the catalog crashes.

The spare parts list: Entered in the catalog, the repairer creates his virtual trolley which, after completing the catalog navigation, the system automatically transfers to the Universal trolley *SpareParts*.

This system allows to greatly simplify the sending of the order because it makes converge all the trolleys of the catalogs in a single trolley through a wizard that the user is obliged to follow.

This procedure is quite easy and can be expected from three to four different steps, depending on whether the management system of the dealer's warehouse is integrated with the portal.

3.9. Orders Management



At this stage, the user first selects the dealer to whom he wants to place the order, then perform the last step before sending: the request for information on the availability of the codes ordered in stock.

The logistic agreements between dealer and repairer are outside the *SpareParts* project, which is why the delivery methodology is established in a unique way between the transporter and the repairer. The portal does not manage the commercial/logistical conditions but allows the two parties to exchange useful and accurate information without having to use the phone.

In the process of finalizing the order, the repairer can communicate, always online, with the warehouse keeper of the dealers what are his wishes in case the material is not available in stock. It is advisable, however, to distinguish two specific cases that the repairer may meet depending on the dealer whom he is in contact. As is known, each warehouse is managed through a management system programmed specifically for use and commonly referred to as DMS (Data Management system). Through the DMS, the warehouse automates all its processes, from order to billing, articles archive to the emission of bubbles to direct links with the house.

To hurry up the process of ordering and checking the availability of components, the *SpareParts* team allows the integration of the DMS from the warehouse with the site, by agreement with the software NSC producing the management modules and with the dealers who decide to make this leap of quality. In this way the repairer can virtually enter the dealer warehouse and view the stocks present, to know in real time whether the piece they need is available or to be ordered. It is possible to deduce that users may encounter integrated and non-integrated dealers; the reason why the order's finalization mode is different. The following diagram (Table 2) shows the substantial differences between the two modes. If the dealer is integrated, the repairer immediately sees if the material is available and can then plan his work immediately, knowing that the pieces will arrive with the next delivery.

Table 2. Order management

Concessionary Type	Recognition	Confirmation	Type of part received
Integrated	4 arrows 	Immediately On the site when placing the order	Column «exceptions» The part is available, and I receive it. The is not available and I will receive it.
Non-integrated	3 arrows 	Within 30 minutes 1. Fax, SMS, automatic emails. 2. On the site in the section (the historical orders) 3. Call from the concessionary (if there is something wrong)	Column «Order Status» Confirmed: I receive all the parts. Reorder: I receive only the parts available. “Exception”: I do not receive any spare parts.

Therefore, when the DMS is integrated, the flow that leads the repairer to the finalization of the order is formed by four steps, because it is possible to visualize, before issuing the order, the availability of the desired codes in the dealer's warehouse.

If the dealers are not integrated, the communication about the availability of the components arrives within half an hour after sending the order on the site *SpareParts* in the appropriate section and, if expressly requested by the repairer, also by fax, e-mail or SMS.

When the material is not available, usually, the warehouse operator asks the customer whether to order the piece or not, communicating the day of arrival of the material in the warehouse and the consequent delivery at the repairer. This procedure can also be

done through the site, always in the process of finalizing the order, and is equal in both cases (integration and not). The repairer has four options to choose to tell the warehouse what they should do if the material is not available:

- Order normal
- Urgent order
- Do not order
- Phones

Having done this, the repair operator sends the order and waits for the response of the spare parts warehouse. Meanwhile, the warehouse operator sees the order on his dedicated page and begins to interrogate his DMS to determine the presence of the materials in stock. Depending on the request that was made by the repairer and the availability of the codes, the warehouse operator labeled the order in three different states, thanks to which the repair operator understands when the pieces will arrive. The communication that arrives at the repairer can be labeled with these states:

- **Confirmed:** all codes are available and will arrive with the next delivery.
- **Re-ordering:** among all the order lines, there is at least one code not available at home, but that the repairer has asked to order in urgent or normal mode, while the available codes will be shipped with the next delivery.
- **Exception:** among all the order lines, there is at least one code that is not available, but the repairer has explicitly requested not to order, so that order line will remain unanswered, while the available codes will start with the next delivery.

This latter case allows introducing the usefulness of the choice of the secondary dealer made by the repairer at the beginning of its adventure in *SpareParts*. The only case in which the repairer can move to the reserve dealers is precisely that of the exceptional order, which the dealer has closed without fully satisfying the customer's requests because it is precisely the repairer who asks not to order what is not available. Thus, if the repairer wants, the system allows you to resume the order lines containing unshaped codes from the first dealer and divert them to the secondary dealer.

4. INTERNSHIP ACTIVITIES

During the internship I worked on different activities related to the data analysis process of the project's performance, these activities were developed with the objective of support the daily activities of the ACN analytics' team. I participated in the creation of a dashboard through *Qlik sense view*⁴, where a prototype was presented to the customer to evaluate its implementation in the controlling of KPI's performance in a specific process. Another Dashboard was created to evaluate the Dealer and Repairer performance from a determined brand, having as a result of the evaluation to insert the new tool in the performance monitoring process.

Additionally, I supported the analytics' team in the data analysis process, taking responsibility for the generation of reports for the daily decision making and the performance evaluation of the project. These reports were done with the orientation and suggestions of the team, the analysis included the monitoring of the best and worst performers (Dealers and Repairers) based on the FIL (Fatturato Incrementale Lordi) which is a measure of growth resulting from the increment in turnover comparing the current time period (define in month or years) with the preceding period in the same interval of time; another important factor is the number of orders obtained by the portal *Spareparts* and the support actions executed by the support team.

An important activity was the query validations, this activity consisted of the execution of defined queries to find possible mistakes in the data extraction, the operational mode was the execution of the complex queries and then, the data verification with more simple queries, this process allowed the identification and correction of queries used for the monitoring of the performance and the upgrade of KPI's.

Moreover, each week was evaluated the worst performer from the "Copia Commissione" which is an additional service offered by the team that consists in the service of supporting the order process of the customer (repairer) through a Sales Agent, which uses this tool (Copia Commissione) to request the order, here, it is

⁴ **Qlik sense view** is a software used for data analysis and visualization.

important to monitor the worst performers with the purpose to follow up situation of the customer with possible problems to creation of the orders.

Furthermore, I oversaw the production weekly and monthly warranty claim assessment monitoring report which include the data processing from an external company and the process to obtain consolidated report in a single file, taking the responsibility to evaluate the results and adjust the process to obtain reliable data, at the end it was possible to obtain a complete guide to execute the steps for the execution of the report.

Finally, the inclusion of new repairers in the project entails the evaluation of the best possible prospects to be followed, through the service called “Sales Force”, where diverse characteristics of the repairers are considered such as the average turnover, capacity, and FIL. I was in charge of the potential repairer evaluation to be included in the base of repairers.

4.1. Identification of improvement opportunities

A question resulted from this process was the identification of the variables that affect the turnover, because the turnover increasing is a priority for the analytics team. The objective in the process dealers selection is identified which in the last year had the higher increasing of turnover, at the same time it was important to analyze the turnover trend, and the interval in which it moves, because the high-rise repairers have already developed their businesses and their growth potential is not so high, for this reason, they are not considered within the selection process.

To obtain a reliable evaluation of the dealers with the greatest growth potential, it was possible to evaluate different factors that affect the turnover by proposing a Multiple Linear Regression model, this would allow identifying the independent variables that affect the independent variable under study.

The following paragraphs show the proposed model, the main variables analyzed and the different tests to check the validity of the model, as well as the results and the conclusions.

4.2. Proposal: Model to identify the variables that affect turnover

This report shows the results in the analysis of the variables involved in the conceptual design and in the daily activities developed in the analysis team. This study has been applied in the operations department of the ACN consultancy, where the analysis of the data is a fundamental competence. The information collected from the SQL server was analyzed and some relationships between the variables proposed in the conceptual model were identified, some recommendations were made on the actions implemented for the result of the daily activities carried out by the ACN consultant team.

This document is structured as follows. First, a conceptual model is proposed in which, by means of hypotheses, the relationships between the variables selected for the study are shown. Second, an inventory of the information collected for the analysis is shown, thirdly, the methodology and the application of statistical tests to obtain the multiple linear regression model are exposed. In the end, the results obtained were analyzed and the possible improvements to the process of selection of dealers for their subsequent follow-up are proposed.

4.3. Conceptual Model Definition

As a first step a conceptual model was defined, this will help to highlight important connections in the automotive market, this is used as a first step to develop a more complex model adding levels of influence and positive or negative impacts of the independent variables.

In the present model, the objective is to know the causes that explain the growth or decrease of the turnover, using the data obtained from the portal of *SpareParts* from 2017 and from the turnover databases of the different concessionaires.

Based on the analysis of the market and the project, the following conceptual model was used to explain the causal relationship between the independent variables and the dependent variable. Next, each one of the variables included in the model was

explained and then the proposed model is shown graphically. The following paragraphs describe each one of the selected variables:

Dependent Variable:

- **Turnover:** it represents the number of sales in euros from each dealer during the year under study (2017). The year-round sales of the two main car brands in the project were taken.

Independent Variables:

- **Region:** For the construction of the model three regions were chosen, these present the largest number of dealers and repairers in Italy. Lombardia, Lazio, and Piemonte were selected as the three most important regions for the project.
- **Bonded Dealer:** is the number of repairers linked to a given dealer, “linked” means that between the dealer and repairer there is a commercial relationship in which the repairer acquires parts from the related dealer. The relation of the dealer to repairer is from one to many as well as the relation of a repairer to the dealer.
- **Workforce:** it refers to the number of employees that each repairer must perform their daily activities.
- **Purchase Order:** Represents the decision to order from the repairer through the portal, the total quantity of orders comes from the orders through the portal, the orders via email, and via telephone.
- **Purchasing Frequency:** is the number of purchase orders made by the repairer during the year. It is calculated as the count of the orders made during the year 2017.
- **Number of promotions:** it refers to the number of promotions used by the repairer during the year 2017. Promotions with the promoter published, in each promotion, specifies the name of the product, the discount amount and the duration of the promotion.

- **Competitiveness:** is a measure of product rotation, within this classification products are defined depending on the product family as follows: high competitive, medium competitive and captive.
- **Operative years:** is the number of year since the repairer registration.

Once the variables to be used were described the conceptual model was defined (See Figure 25), which aims to explain the relationships between turnover and the available variables that have been selected.

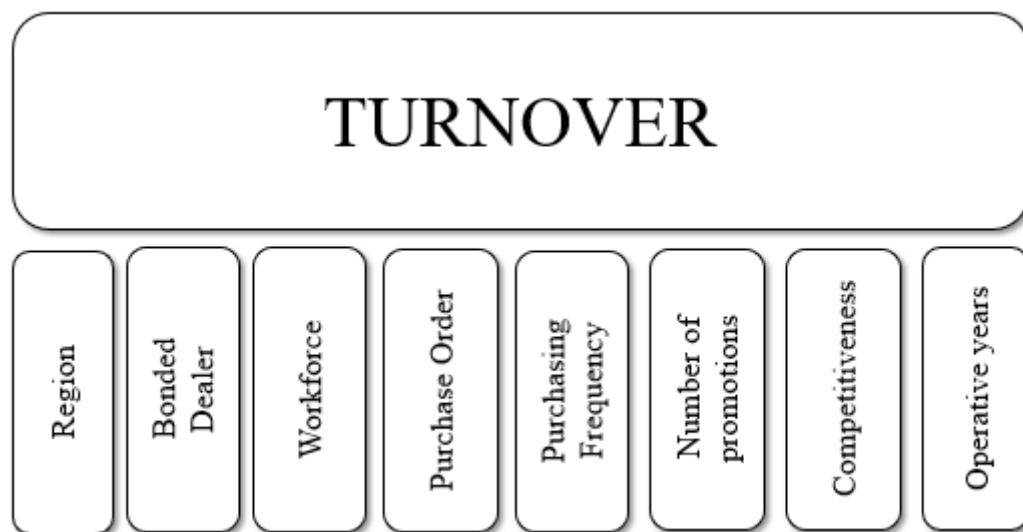


Figure 25. Model for predicting turnover increasing of the repairer in the project

These variables were defined based on the fact that the amount of turnover carried out by the repairer is made by the dealer's **Region**, the location was selected as a variable that affects the turnover, in this case, is because of these regions have the highest concentration of repairers and the market is more dynamic, that is why the turnover should be higher.

About the number of **Bonded dealer**, it is assumed that if the repairer is linked to several distributors, their turnover is low because they could select the best offers from the different distributors.

In this case, the **Workforce** is assumed to have an influence on the turnover since the repairer must maintain a level of income that guarantees the support of the employees he owns.

The **Purchase Order** is defined as the decision to purchase orders that are made from the portal *SpareParts*. It is assumed that the repairers who make orders to buy through the portal have a greater amount of turnover. It should be noted that the increase in orders through the portal is also due to the promotions offered, which attracts a greater number of repairers.

The **Purchase Frequency** is understood as the number of transactions performed by the repairer, without considering the level of purchase, this to understand if repairers that perform more transactions in the same time interval generate more turnover. This means that the repairer who purchases the products more frequently is contributing to the increase in sales and could be an approach to follow the repairer's experience during the acquisition of the products from the dealers.

The **Number of Promotions** is established in the sense that the greater the number of promotions published by the distributor, the greater the amount of purchases by the workshops due to promotions that encourage purchases.

Competitiveness is established to define the type of products that most repairers acquire, it is the family of the product and it explains if the type of products influences turnover, which is why it is assumed that highly competitive products generate more turnover because they are the more bought.

Another variable considered was **Operative years**, this variable represents the number of year since the registration. It is assumed in this case that the higher the time since the registration to the portal the higher the turnover.

4.4. Methodology

Analyzing the available data, it is important to start with an exploratory analysis, this allows to acquire a basic understanding of the existing relations between the variables. For the accomplishment of the exploratory data analysis the following steps were followed (Salvador Figueras & Gargallo, 2018) :

- The data was prepared in a structured way to make easier its analysis with the available statistical tools, the codification of the different categories was carried out to facilitate its interpretation.
- Graphic evaluation of the nature of the individual variables and a numerical descriptive analysis that allows quantifying some graphic aspects of the data.
- Graphical analysis of the relationships between the variables and a descriptive numerical analysis that quantifies the degree of interrelation between them. Additionally, some basic assumptions such as normality, linearity, and homoscedasticity were evaluated.
- Possible outliers were identified and the potential impact they could exercise in the subsequent statistical analysis was evaluated.

Once the exploratory data analysis was carried out, a **Multiple Linear Regression** model was proposed, with the support of a statistical process, the relationship coefficients were found, which gave an idea of the influence of the independent variables selected in the dependent variable as a predictive variable.

In the next paragraphs will be explained the steps followed to analyze the Multiple Linear Regression, the first step refers to the goodness of the model, i.e. if the set of independent variables (causes) explain the dependent variable (result).

R squared: Is how much the independent variables explain the dependent variable, it indicates the percentage of the dependent variable variance explained by the set of independent variables. The greater the R-square the more explanatory and the better the causal model (Rojo, 2007).

Beta coefficient (β): Indicates the intensity and direction of the relationship between that independent variable and the dependent variable (Statistics Solutions , 2018).

- The farther away from 0 the stronger the ratio.

- The sign indicates the direction (a positive sign indicates that by increasing the values of the independent variable, the dependent variable increase; and the opposite for a negative sign)

Upon the information was collected the standardization of the information and the cleaning is needing to accurate the results. Because is knowing that the set of data is composed by a categorical variable like region, province, and competitiveness, it was defined a fictitious variable to explain the influence from the predictors in the variable under study. The classification of the fictitious variables was defined later.

4.5. Sample Description

To guarantee the representativeness of the sample in all the levels, it was applied a stratified random sampling. With the objective of determining the sample size for each repairer in the regions, it was used the data from three regions in Italy, such as Lazio, Piemonte and, Lombardia. For the calculation of the sample sizes equation 1 was used (Peréz, 2005):

$$n = \frac{\frac{z^2 p (1-p)}{e^2}}{1 + \left(\frac{z^2 p (1-p)}{e^2 N} \right)} \quad \text{Equation 1}$$

Where N is the total size of repairers, e is the error range (percentage expressed in decimals), z is the statistical test value and p is the level of confidence. For the actual simple was fixing a 95% level of confidence and 5% of error.

Characteristics of the sample

In total 2221 data was extracted from the database, eliminating the incomplete records or whose are not meeting the characteristics of the study, 1076 useful data were finally obtained. The distribution of the final sample by region can be seen in Table 3.

Table 3. Sample by region

Region	Total Repairers	Sample	Data Collected	Percentage
Lazio	621	238	205	19%
Lombardia	1075	284	582	54%
Piemonte	525	223	289	27%
Total	2221	745	1076	100%

As the Figure 26 shows the year with a higher number of registrations in the portal *SpareParts* was in the period from 2005 to 2007, possibly due to the initial phase of the project and the effort to capture customers. It must be clarified that their registrations are from the selected regions, also, the figure shows that in the last years the registrations were decreasing this could to reflect the maturity of the project.

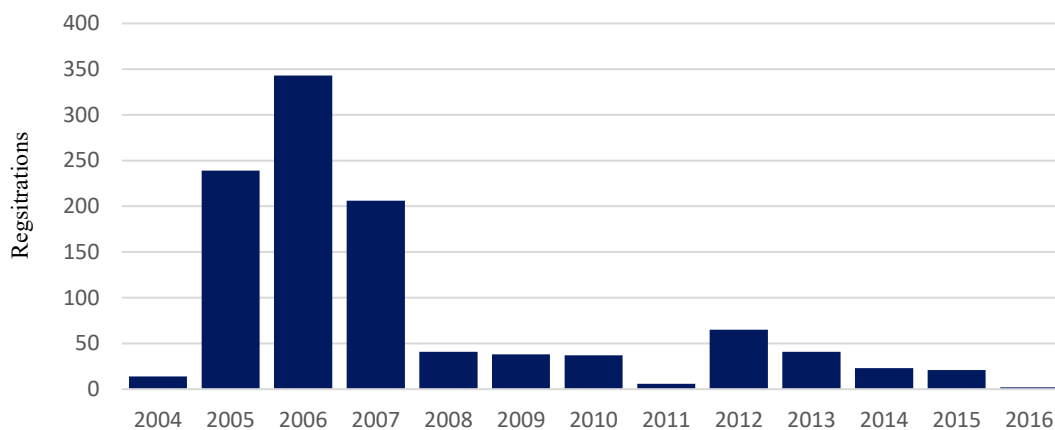
**Figure 26. Registrations through the time from the data selected**

Figure 27 shows the month was the repairers were registered, it is observed that in March, October and, November a high quantity of registrations was presented. This information could be useful to estimate the period were the higher quantity of registrations are taking place.

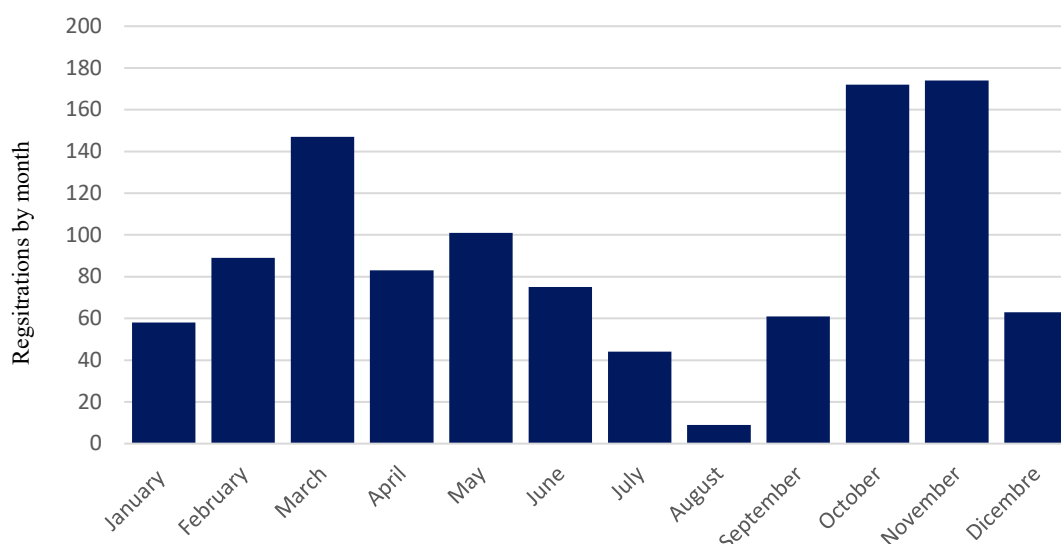


Figure 27. Registrations of repairers by month

Table 4 shows the repairer's regions considered in the sample, there was specified each province. These regions were selected according to the higher concentration of repairers in Italy.

Table 4. Regions considered in the study

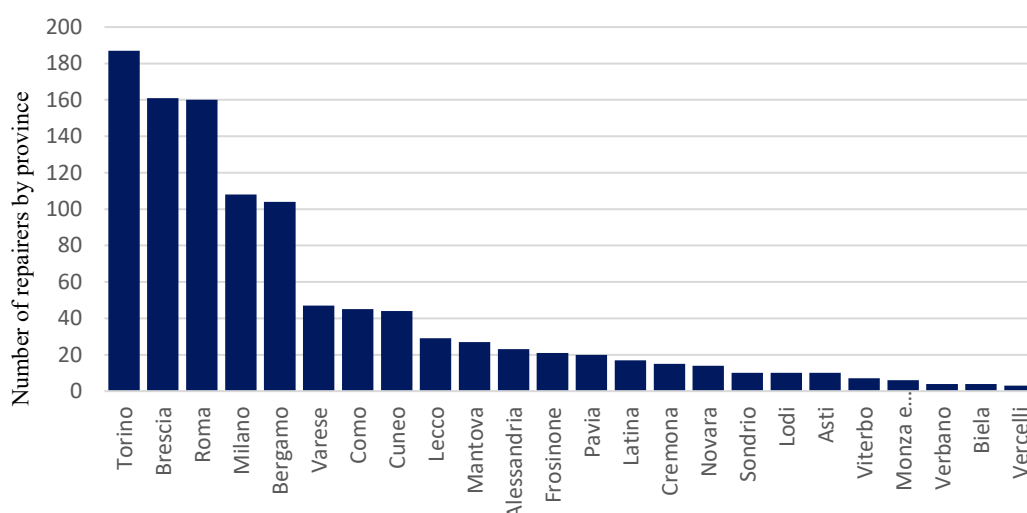
Region	Province	Region	Province
Lombardia	BG – Bergamo	Lazio	FR - Frosinone
	BS – Brescia		LT - Latina
	CO – Como		RI - Rieti
	CR – Cremona		RM - Roma
	LC – Lecco		VT - Viterbo
	LO – Lodi	Piemonte	AL - Alessandria
	MN – Mantova		AT - Asti
	MI - Milano		BI - Biella
	MB - Monza e Brianza		CN - Cuneo
	PV – Pavia		NO - Novara
	SO – Sondrio		TO - Torino
	VA – Varese		VB - Verbano
			VC - Vercelli

From 1076 repairers, 54% are from Lombardia, the 19% are from Lazio and 27% from Piemonte, Table 5 shows the concentration of repairer within the sample categorized by region, is observed that the highest value of repairers is from Lombardia.

Table 5. Repairers selected by region

Region	Repairers	Percentage
Lombardia	582	54%
Lazio	205	19%
Piemonte	289	27%
Total	1076	100%

Table 5 shows the number of repairers by province, it is observed the province with more active repairer according to the sample is Torino with more than 180 and its following by Brescia, Roma, Milano, and Bergamo.

**Figure 28. Number of Repairers by province in the regions selected**

The data analyzed above is useful to understand the characteristics of the sample and the distribution of repairers through the regions selected, and it was valuable to know the time when the registrations were doing with more frequency to understand the behavior of the repairers through the time. In the next chapters will be present in a deep way the variables selected for the analysis, in fact, an exploratory analysis was doing to evaluate the behavior of the variables and the relations between them.

4.6. Exploratory Data Analysis

Unidimensional statistical analysis

The next paragraphs will explain the problem in a graphic and numerical statistical analysis of the variables, to obtain an initial idea from the information contained in the data set as well as detect the existence of possible errors in coding them.

In Figure 29 is presented the graphic of regions corresponding to this variable, is observed the great part of the repairers (54%) are from Lombardian.

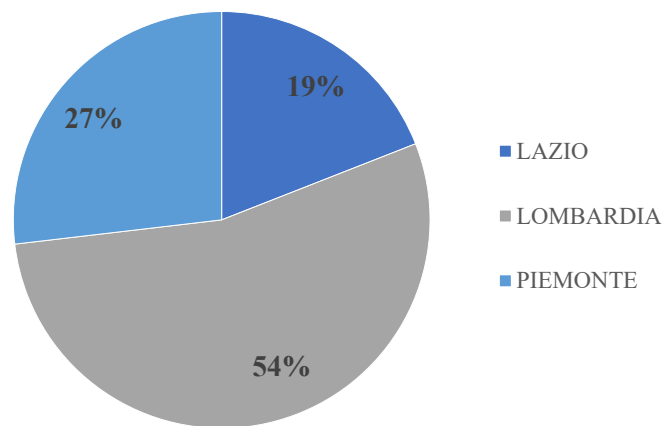


Figure 29. Region under study diagram

Another important variable is the **Bonded Dealer**, this a discrete quantitative variable that shows the number of dealers linked with the repairer. In Table 6 is presented the frequency distribution of the bonded dealers from Lombardia, Lazio, and Piemonte in the year 2017 according to the database.

Table 6. Frequency of Bonded Dealers

Dealer Bonded	Bonded Dealers	Percentage	Accumulated Percentage
5	257	24%	24%
9	147	14%	38%
10	117	11%	48%
8	103	10%	58%
4	98	9%	67%
7	92	9%	76%
6	85	8%	84%
3	71	7%	90%
2	61	6%	96%
1	45	4%	100%
Total	1076	100%	

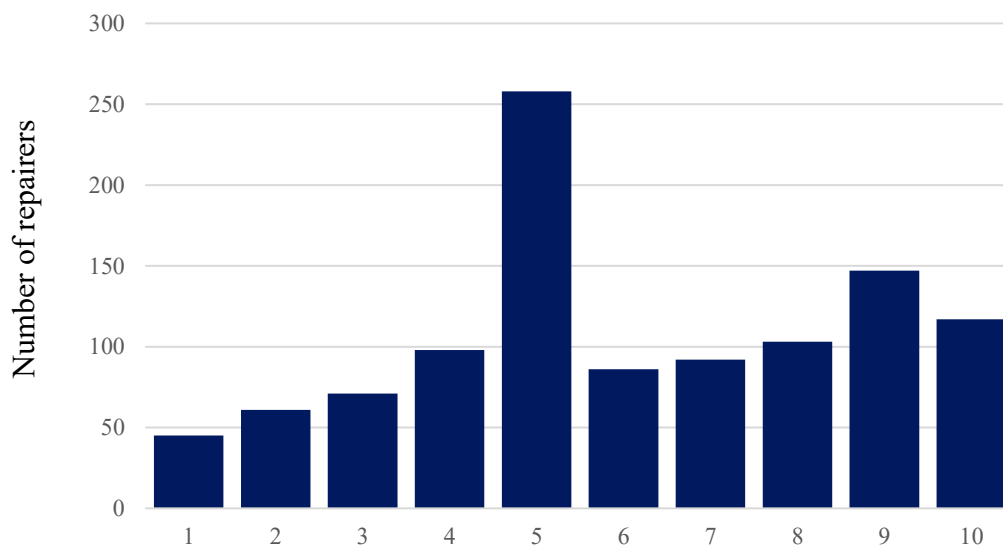
The average number of the bonded dealer is 6.07, with 5 being the most frequent and 6 the median value. In 50% percent of the cases, the number of bonded dealers ranges from 4 to 8 (see Table 7).

Table 7. Descriptive statistics of the variable
dealer bonded

N	1076
Average	6,07
Median	6,00
Mode	5,00
Deviation	2,57
Asymmetry	-0,085
Kurtosis	2,037
Minimum	1
Maximum	10
Percentiles:	
25	4
50	6
75	8

According to the Asymmetry and kurtosis the variable, Bonded Dealer has a distribution with negative asymmetry (displaced to the left) and due to the kurtosis doing reference to the Fisher's measure the variable Bonded Dealer has a Platikuric distribution (Salvador & Gargallo, 2003).

The Figure 30 shows the quantity of dealer bonded by repairer, is detected that a great part of part the repairer are bonded with 5 dealers, this means that these repairers are purchasing from 5 different dealers.



In Table 9 is showing the frequency distribution of the repairer's workforce from the different regions: Lombardia, Lazio and, Piemonte in the year 2017.

Table 8. Descriptive statistics of the variable Workforce

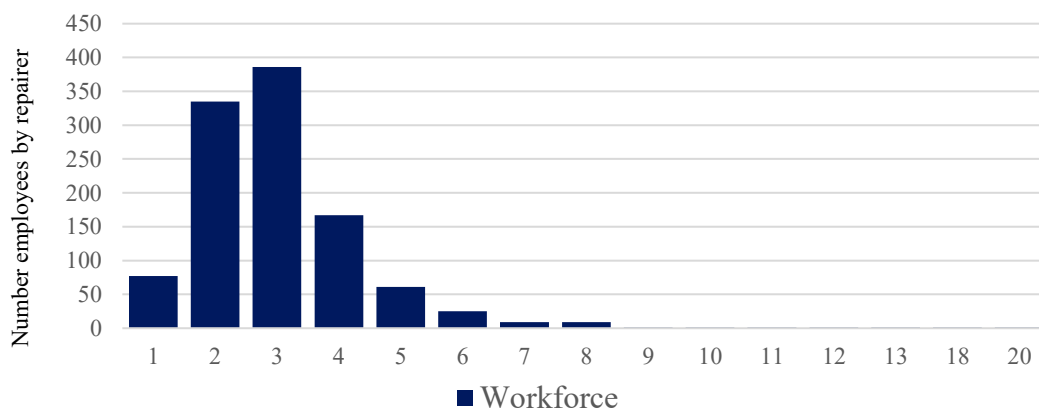
N	1076
Average	3,03
Median	3,00
Mode	3,00
deviation	1,52
Asymmetry	3,427
Kurtosis	29,384
Minimum	1
Maximum	20
Percentiles:	
25	2
50	3
75	4

Table 9. Frequency of workforce

Workforce	Frequency	Percentage	Accumulated Percentage
3	386	36%	36%
2	335	31%	67%
4	167	16%	83%
1	77	7%	90%
5	61	6%	95%
6	25	2%	98%
7	9	1%	99%
8	9	1%	99%
9	1	0%	99%
10	1	0%	100%
11	1	0%	100%
12	1	0%	100%
13	1	0%	100%
18	1	0%	100%
20	1	0%	100%
Total	1076	100%	

In Table 8 are shown the statistical results of the workforce in the regions Lombardia, Lazio and, Piemonte. The average of the workforce is 3,03 and its median is 3. This difference is reflected by the asymmetry value.

Figure 31 shows the number of employees by repairer, is observed in the sample that a huge amount of repairer has between 1 and 5 employees, on average the repairers have 3 employees.

**Figure 31. Workforce number of each repairer**

The following graphs (Figure 32) show the number of repairers belonging to the sample whose have made orders through the portal. This information is represented by a categorical variable that counts the number of repairers with and without orders made in the year 2017, belonging to the regions of Lombardia, Lazio and, Piemonte.

Table 10. Frequency orders status

Order status	Frequency	Percentage
Orders	368	34%
No Orders	708	66%
Total	1076	100%

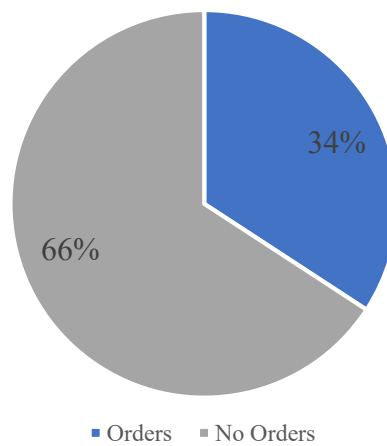


Figure 32. Representation of the order status

It is observed that in these regions the number of repairers that do not order is high with a value of 66% while the repairers that do order represent 34%. Figure 33 shows the intervals of frequency purchases, it is observed that the 69% of the repairers present less than 66 purchases in a year, in average 62 times purchases for a month in the year 2017; only the 5% were doing purchases more than 716 times during 2017.

Likewise, the Figure 33 shows the frequency level of the purchases, it is observed that the clear majority of repairer made less than 66 purchases in the year 2017.

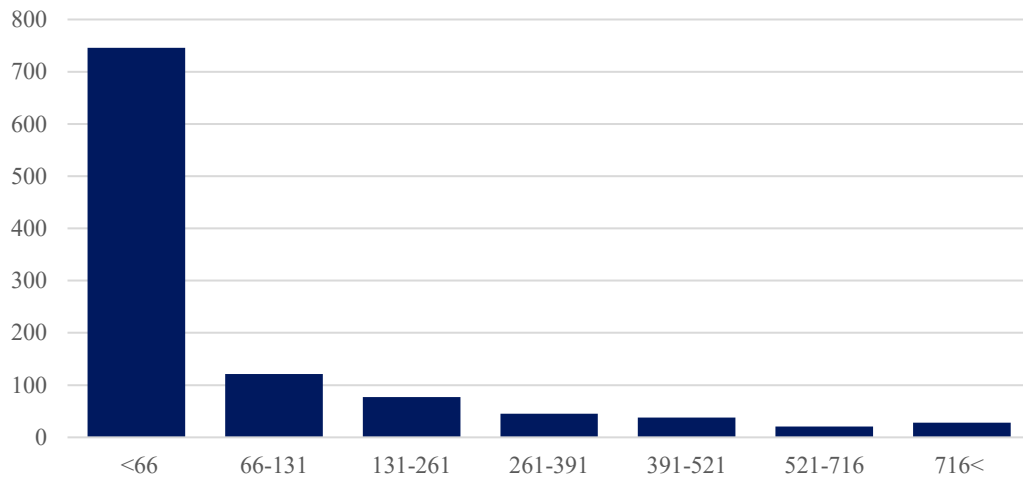


Figure 33. Frequency of Purchasing

Figure 34 shows the frequency of the promotions by repairer, it is observed that the repairers in the sample have a high concentration between 12 and 44 promotions used. The promotions are published by the dealer with the objective of sell more components.

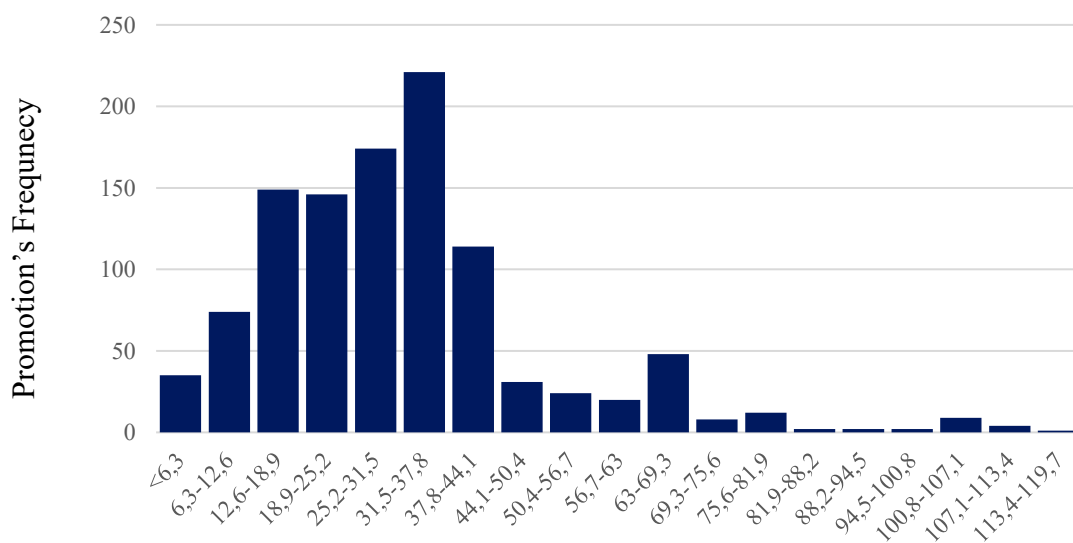


Figure 34. Frequency of promotions used by repairer in 2017

According to the statistical measures show in Table 11, the average value of purchase frequency is 105,63 purchases and its median is 31. This shows the high variability of the values, the asymmetry indicates the displacement of the curve to the left, and the kurtosis shows a Leptokurtic distribution.

Table 11. Descriptive statistics of the variable Purchase Frequency

N	1076
Average	105,63
Median	31,00
Mode	1,00
deviation	190,67
Asymmetry	3,221
Kurtosis	15,496
Minimum	1
Maximum	1552
Percentiles:	
25	12
50	31
75	86

Table 12 shows the representation of the competitiveness of products purchased by each repairer, is observed that the 94% of the repairers considered in the sample are purchasing products in the category captive that represent the product which is designed specifically for use with other product, many captive products are necessary to the functioning of the core product. The 5% of the repairers on the sample are buying a highly competitive product which is a good that can be sold in profitable quantities based on its price, quality and service combination preferred by buyers over that offered by competing products.

Table 12. Competitiveness classification

Competitiveness	Repairers	Percentage
Captive	1008	94%
High Competitive	51	5%
Medium Competitive	17	2%
Total	1076	100%

Figure 35 shows the quantity of years since the repairer registration, it is observed that 73,23% of the repairers are registered for more than 10 years. This indicates the loyalty of the repairers with the service.

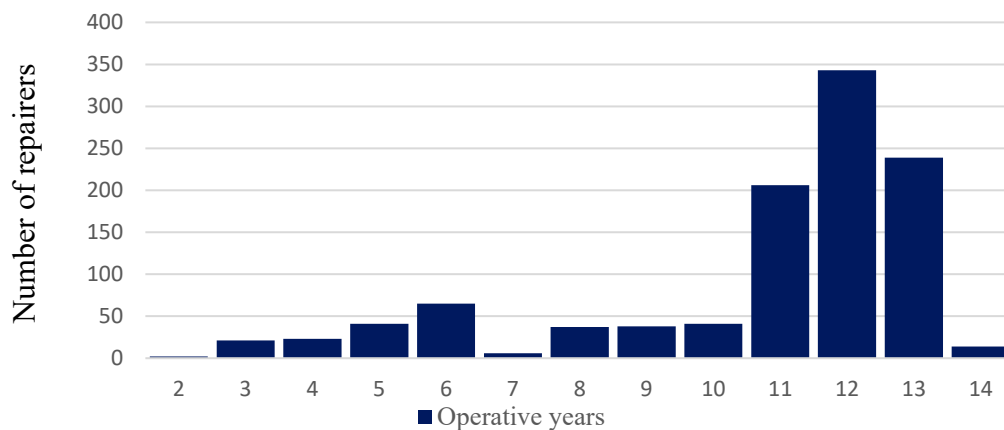


Figure 35. Operative years since the initial registration

The variable operative years shows an average of 10,71 with median 12, according to the asymmetry coefficient the curve is asymmetrically negative, so the values tend to gather more in the right part of the mean. In relation to the kurtosis the value is higher than 0, so the variable follows a Leptokurtic distribution.

Table 13. Descriptive statistics of the variable Purchase Frequency

N	1076
Mean	10,71
Median	12,00
Mode	12,00
deviation	2,68
Asymmetry	-1,439
Kurtosis	4,012
Minimum	2
Maximum	14
Percentiles:	
25	10
50	12
75	12

Once the individual analysis of the variables has been carried out, it is necessary to perform a correlation analysis among the selected variables to find possible relationships that do not add value to the model. In the next paragraphs are showing the results of the correlations analysis with the variables selected to be excluded from the model.

The intensity of the relations with a correlation analysis

It will be presented a correlation analysis to evaluate the intensity of the relations among variables. This is a statistical method used to study the strength of a relationship between two, numerically measured, continuous variables. This type of analysis is useful to establish if there are possible connections between variables.

If the correlation is found between two variables it means that when there is a systematic change in one variable, there is also a systematic change in the other, the variables alter together over a certain period. If there is correlation found, depending upon the numerical values measured, this can be either positive or negative:

- Positive correlation exists if one of the variable increase simultaneously with the other, i.e. the high numerical values of the one variable relate to the high numerical values of the other.
- Negative correlation exists if one variable decreases when the other increases, i.e. the high numerical values of one variable relate to the low numerical variables of the other.

Pearson's product-moment coefficient is the measurement of correlation and ranges (depending on the correlation) between +1 and -1. The value +1 indicates the strongest positive correlation possible, and -1 indicates the strongest negative correlation possible.

Therefore, the closer the coefficient to either of these numbers the stronger the correlation of the data it represents. On this scale 0 indicates no correlation, hence values closer to zero highlights weaker/poorer correlation than those closer to +1/-1.

If there is a correlation between two numerical sets of data, positive or negative, the coefficient worked out can allow you to predict future trends between the two variables. However, you must remember that you cannot be 100% sure that your prediction will be correct because correlation does not determine cause or effect (djsresearch, 2018).

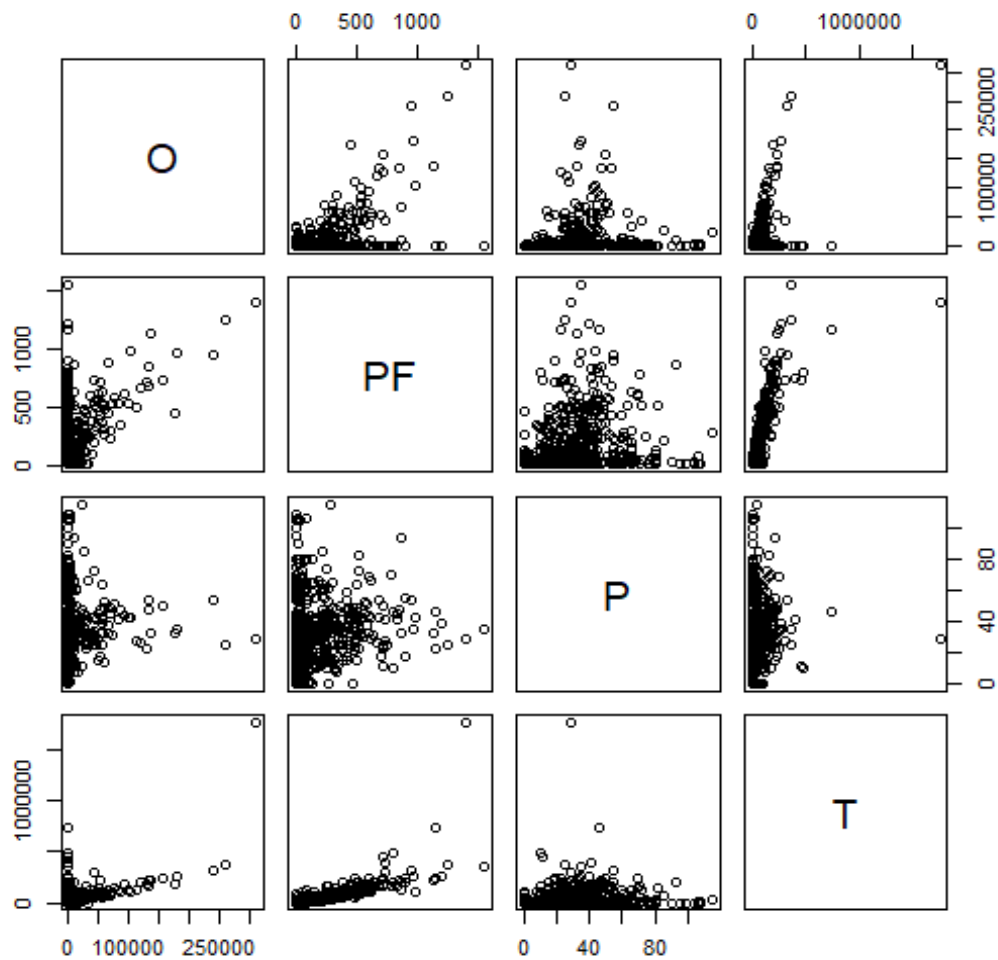


Figure 36. Correlation analysis

Figure 36 shows the relation between the dependent continuous variables with each one of the independent variables. Additionally, shows the relation between the predictors.

From the analysis is observed that higher correlation between the variables O-Orders and PF-Purchase Frequency (0.58). From these results the decision does not take in consideration the variable one of the above variables mentioned, the decision is to eliminate the variable **Orders** due to its high relation with **Purchase Frequency**, both are correlated with the dependent variable. It would be more interesting to include **Purchasing frequency** in the model.

To evaluate the collinearity, it is suggested to calculate the correlation coefficient between each pair of predictors that will be included in the model. In this case, it was used the equation 2, the Pearson coefficient $r(x, y)$ as:

$$r(x, y) = \frac{cov(x, y)}{sd(x)sd(y)}$$

Equation 2

If two variables are independent of each other, its covariance is zero. The linear correlation varies between 1 and -1. A value close to one indicates that while one variable increases the other two in a linear proportion. A value close to -1 indicates an inverse relation (one grows the other increase). If the correlation is close to zero you have linear independence. (Bravo Marquez, 2018)

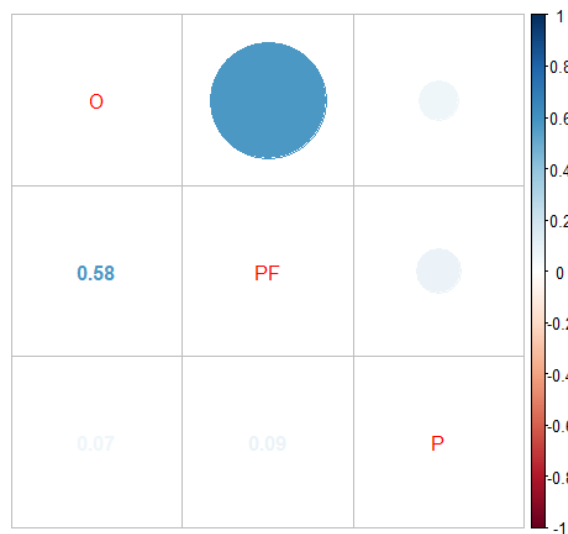


Figure 37. Correlation Coefficient

The analysis shows a high correlation between the variables **Purchase Order (O)** and **Purchasing Frequency (PF)**. If the correlation is high and therefore the variables provide redundant information, it is advisable to analyze whether the model improves or does not worsen by excluding any of these predictors.

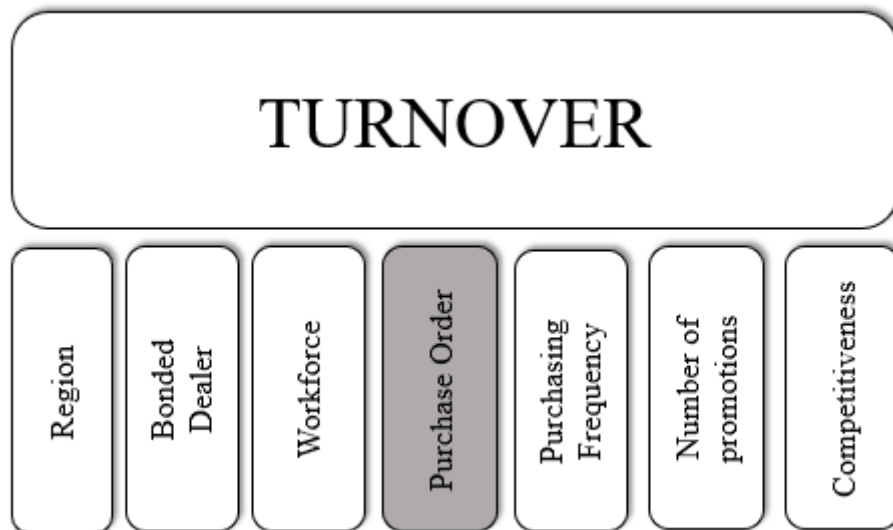


Figure 38. Elimination of variables from the model proposed

From the correlation analysis is advisable to eliminate Purchase Order from the model due to the high correlation with Purchase Frequency.

Normality analysis

Many statistical methods are based on the hypothesis of normality for the variables under study. It is observed in the next figures that any variable fits the normality assumption, graphically and through the Normal Q-Q plot is possible to identify that the data does not fit the Normal Q-Q plot this means the normality for the variables under study is not present. From the analysis of normality, it was found that any variable follows a normal distribution for that reason in the next paragraphs will apply a Cox Box transformation adjusting the variables to a normal distribution and comply with the assumptions of normality to define a valid model.

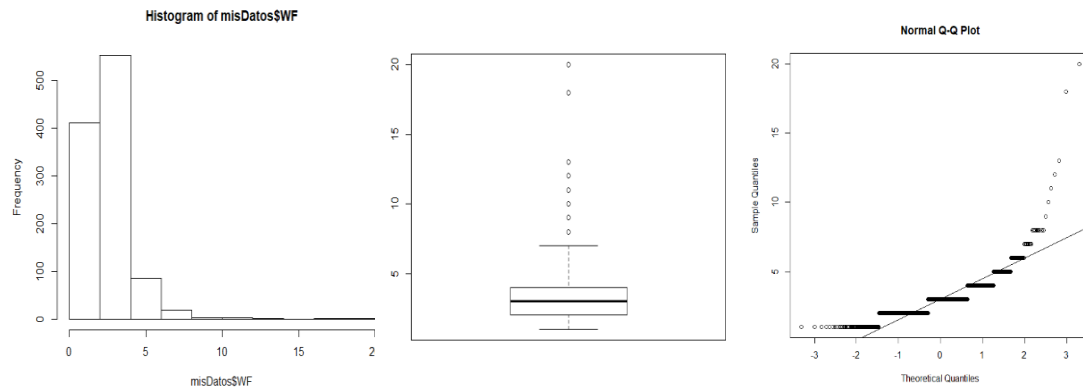


Figure 39. Normality test variable Workforce

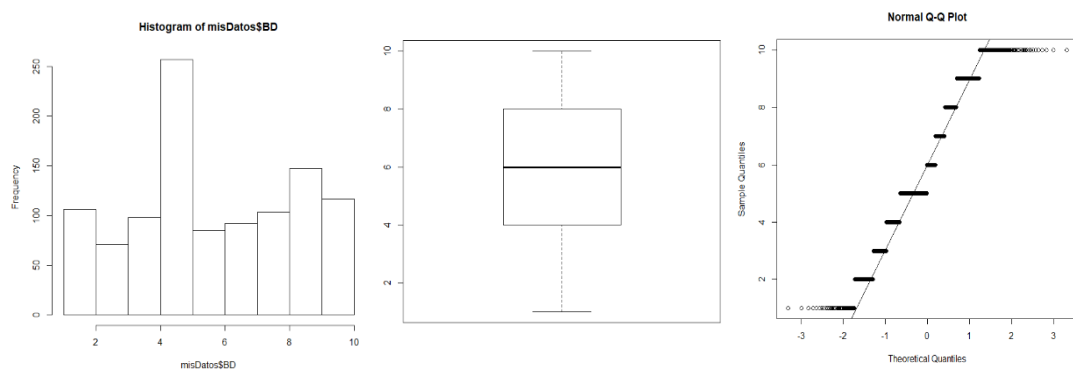


Figure 40. Normality test variable Bonded Dealer

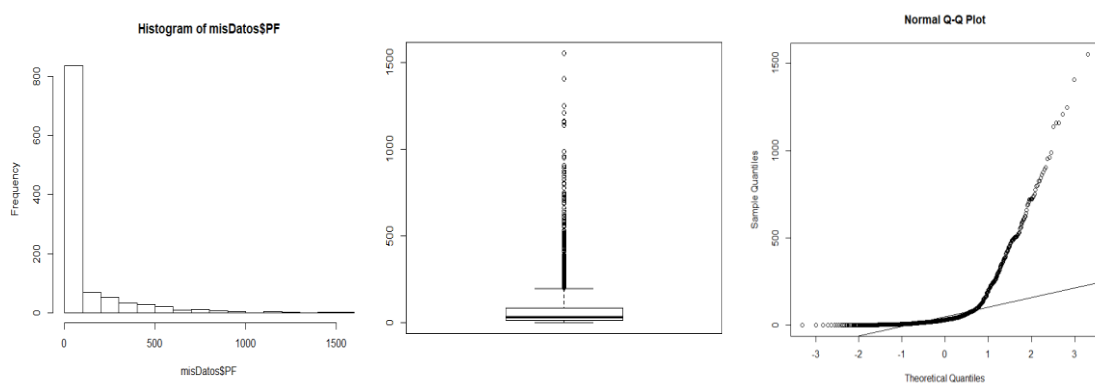


Figure 41. Normality test Purchase Frequency

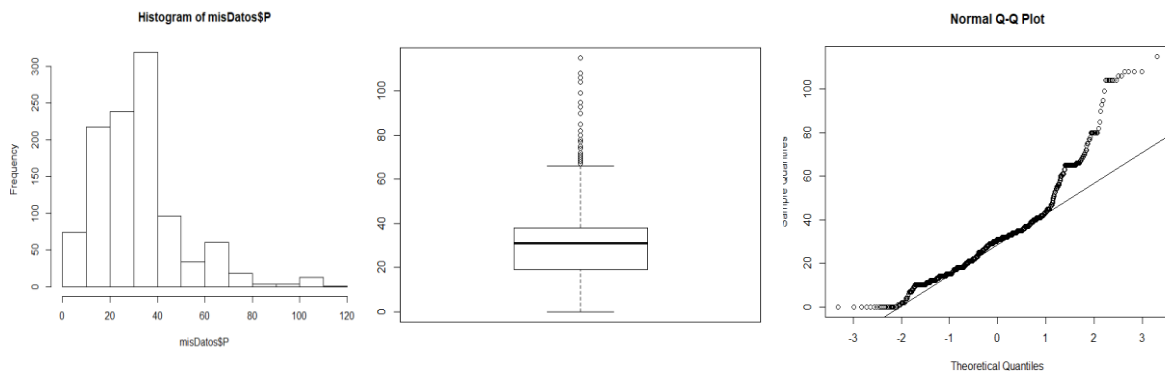


Figure 42. Normality test Number of Promotions

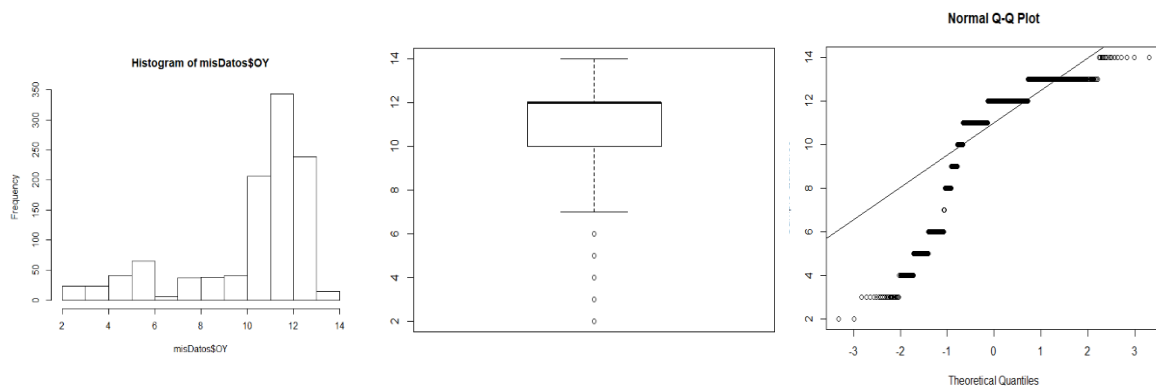


Figure 43. Normality Operative years

A visual inspection of the distribution was used for assessing normality, however, this approach is generally unreliable and does not guarantee a normal distribution (Altman & Bland, 1995). It is useful to present visually the data because at the first sight it is possible to judge the normal distribution. It is included the frequency distribution (histogram), boxplot and Normal Q-Q plot for checking normality (SAGE, 2009).

In the graphics above it is shows the frequency distribution that plots the data frequency, according to graphics from the data evaluated is observed visually that the distribution is not shaped a normal distribution.

Another useful graphic is the boxplot that shows the median as a horizontal line inside the box and the interquartile range (between 25 to 75 percentiles) as the length of the box (Peat & Barton, Medical Statistics: A guide to data analysis and critical appraisal, 2005); the whiskers (line extending from the top and bottom of the box) represent the minimum and maximum values when they are within 1.5 times the interquartile range from either end of the box (Peat & Barton, 2005). Scores greater than 1.5 times the interquartile range are out of the boxplot and are considered as outliers, and those

greater than 3 times the interquartile range are extreme outliers. A boxplot that is symmetric with the median line at approximately the center of the box and with symmetric whiskers that are slightly longer than the subsections of the center box suggests that the data may have come from a normal distribution (Elliot & Woodward, 2007). In this case, according to the boxplots above, from the information related to the median and whiskers is deduced that the data does not follow a normal distribution.

The Normal Q-Q plot plots the quantiles (values that split a dataset into equal portions) of the data set instead of every individual score in the data, if the data are normally distributed, the result would be a straight diagonal line (SAGE, 2009).

An additional normality test was applied, it was selected the Shapiro-Wilk test based on the correlation between the data and the corresponding normal scores (Peat & Barton, 2005) and provides better power than the K-S test even after the Lilliefors correction (Steinskog, 2007). Power is the most frequent measure of the value of a test for normality—the ability to detect whether a sample comes from a non-normal distribution (Thode, 2002). Some researchers recommend the Shapiro-Wilk test as the best choice for testing the normality of data (Ghasemi & Zahediasl, 2012). Applying this test was possible to confirm the non-normality of the data evaluated.

Outliers Analysis

Outliers are extreme values that deviate from other observations in data, they may indicate a variability in measurement, experimental errors or a novelty. An outlier is an observation that diverges from an overall pattern on a sample (Santoyo, 2018), the outliers are the data which are very different from the trend expressed by the other values in the data set, it is important to identify the possible outliers of the data set.

The first step in calculating the outliers in a data set is to find the median value of the data set. This process is much simplified if the data set values in order from least to greatest. Therefore, before continuing, order the values of the data set in this way. Then calculate the median of the data set: The median is the data over which half of the data is located and below which is the other half of the data; basically, it is the value in the middle of the data set. If the data set contains an odd number of data, it is easy to find it (the median will be the data with the same number of values above and below it)

(Devore, 2005). However, if there is an even number of data, then there is no single midpoint, the two midpoints must be averaged to find the median.

Calculation of the first Quartile: this value is the data below which is 25% (or quarter) of the values, this mean, is the data in the middle of the data set which is below the median. If there is an even number of values below the median, it must average the two values in the middle.

Calculation of the third Quartile: To this value is assigned the variable Q3, is the data which is the 25% of the values, is the same method to find Q1 with the difference that in this case is considered the data above the median.

Interquartile range: After the definition of the Q1 and Q2 it necessary to calculate the distance between these two variables. The value obtained to the interquartile range is key to determine the limits for outliers of the data set.

Internal limits: the outliers are identified evaluating if are present or not inside the internal limits and external limits. One value that is outside of the internal limits of the data set is called level outlier extreme. To find the internal limits of the data set first should be multiplied the interquartile range by 1.5. Then, add the result to Q3 and give it to Q1. The two values that it will be obtained are the internal limits of the data set, the same is doing to obtain the external limits of the data set. In the following table is shown the result of the process above:

Table 14. Analysis of outliers

Variable	Median	Q1	Q3	Interquartile Range	Internal Limits		External Limits	
Workforce	3	2	4	2	-1	7	-7	13
No. Bonded Dealer	6	4	8	4	-2	14	-14	26
Purchasing Frequency	31	12	86	74	-99	197	-321	419
No. Promotions	31	19	38	19	-10	67	-67	124
Operative years	12	10	12	2	7	15	1	21

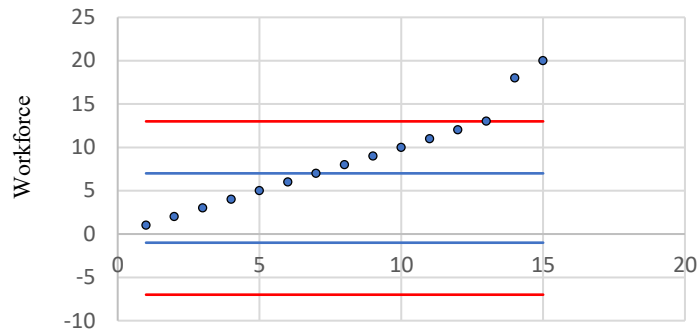


Figure 44. Outliers workforce

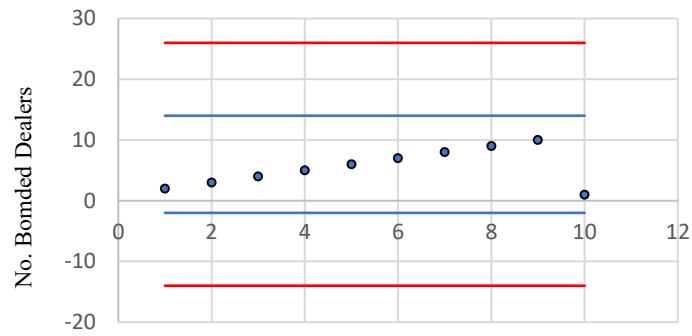


Figure 45. Outliers bonded dealers

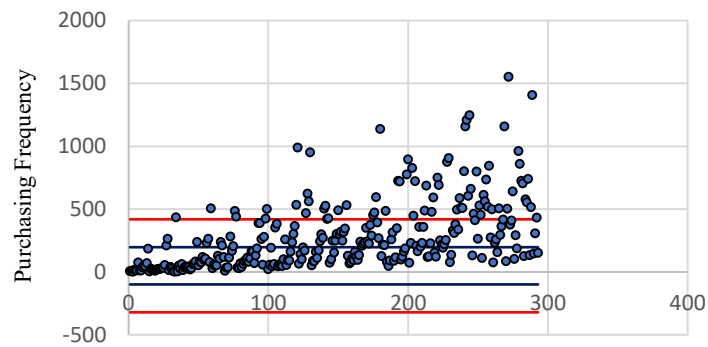


Figure 46. Outliers Purchasing Frequency

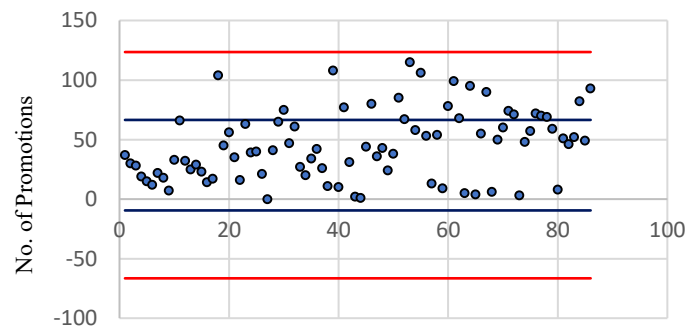


Figure 47. Outliers Number of promotions

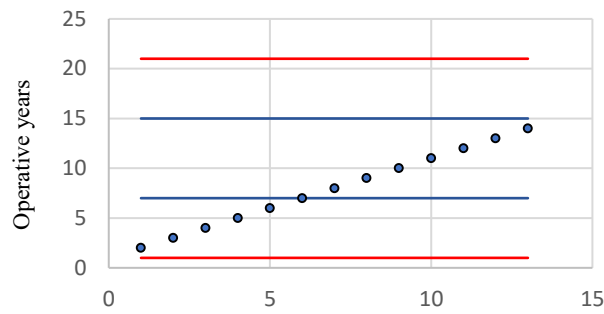


Figure 47. Outliers Operative years

Any data that is outside the outer limits is considered an extreme outlier, a qualitative evaluation is used to determine whether it should discard the outliers. Using the describing method, it is possible to determine if certain data are mild outlier's values, extreme outliers. However, identify a data as an outlier only categorizes it as a candidate that can be ignored from the data set, but not as a data that should be ignored. The reason why an outlier differs from the rest of the values in the data set is crucial in determining whether to ignore the outlier (Charu, 2016). In general, outliers whose origin can be attributed to an error of some kind, such as an error in the measurement, in the record, or in the experimental design, are ignored. On the other hand, outliers that cannot be attributed to an error and that reveal new information or trends that had not been predicted are generally not ignored.

Another condition to consider is whether the outlier significantly affects the average of the data set by deviating it or making it deceptive. This is particularly important as a plan to draw conclusions from the average of the data set.

The importance of counting outliers

While some outliers should be ignored from the data sets because they are the result of an error and/or mistake the results making them incorrect or misleading, some outliers should be counted. If, for example, it seems that an outlier was obtained in a valid way (that is, not because of an error) and/or gives it new knowledge of the phenomenon that is be measuring, it should not be ruled out. Scientific experiments are particularly susceptible situations when dealing with outliers. Ignoring an outlier by mistake may mean discarding information that indicates a trend or new discoveries. In the end, were eliminating the variables out from the external limits.

Box-Cox Transformation

When analyzing data measured by a continuous quantitative variable, the statistical tests of estimation and contrast frequently used are based on supposing that a random sample of a probability distribution of normal or Gauss type has been obtained. The assumption of normality frequently primes to tests that are simple, mathematically controllable, and prevailing associated with tests that do not make the normality assumption. Regrettably, several real data sets are not nearly normal. Nevertheless, a suitable transformation of a data set can regularly produce a data set that does follow approximately a normal distribution. This increases the applicability and utility of statistical techniques based on the normality assumption.

The Box-Cox transformation is a particularly valuable family of transformations. It is defined as:

$$T(Y) = (Y_{\lambda} - 1)/\lambda$$

Equation 3

where Y is the response variable and λ is the transformation parameter. For $\lambda = 0$, the natural log of the data is taken instead of using the above formula (Box & Cox, 1964).

Assumed a specific transformation such as the Box-Cox transformation defined overhead, it is helpful to define a measure of the normality of the resultant transformation. One measure is to compute the correlation coefficient of a normal probability plot. The correlation is computed between the vertical and horizontal axis variables of the probability plot and is a convenient measure of the linearity of the probability plot (the more linear the probability plot, the better a normal distribution fits the data). The Box-Cox normality plot is a plot of these correlation coefficients for various values of the λ parameter. The value of λ corresponding to the maximum correlation on the plot is then the optimal choice for λ . (Engineering statistics handbook, 2018)

Table 15. Box-Cox Transformation parameters

Variable	Lambda (λ) estimate	Lower CL	Upper CL
Workforce	0,08	-0,04	0,20
No. Bonded Dealer	0,082	0,71	0,94
Purchasing Frequency	0	-0,3	0,4
No. Promotions	0,51	0,43	0,58
Operative years	3,3	3,16	3,67

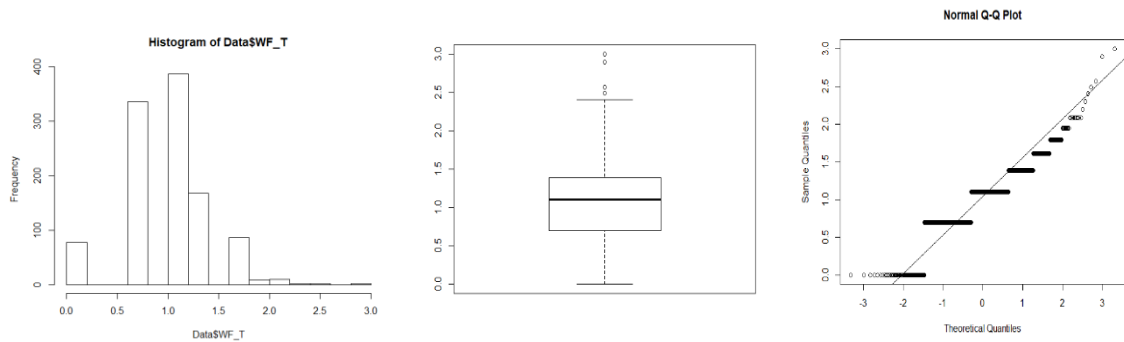


Figure 48. Transformation of variables: Workforce

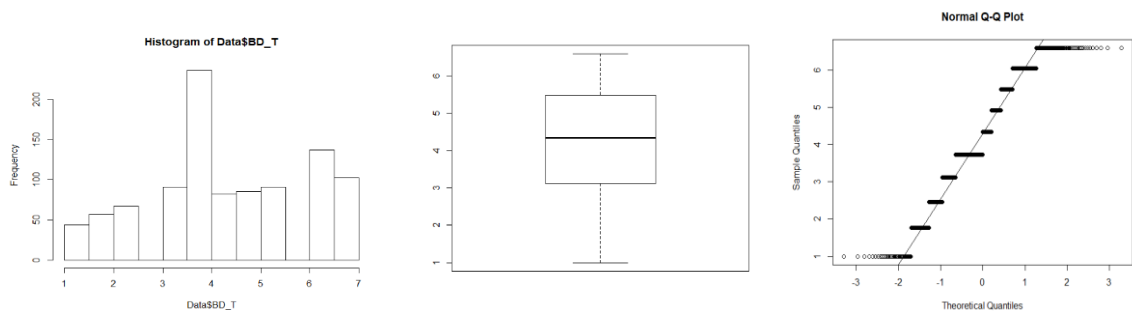


Figure 49. Transformation of variables: Bonded Dealers

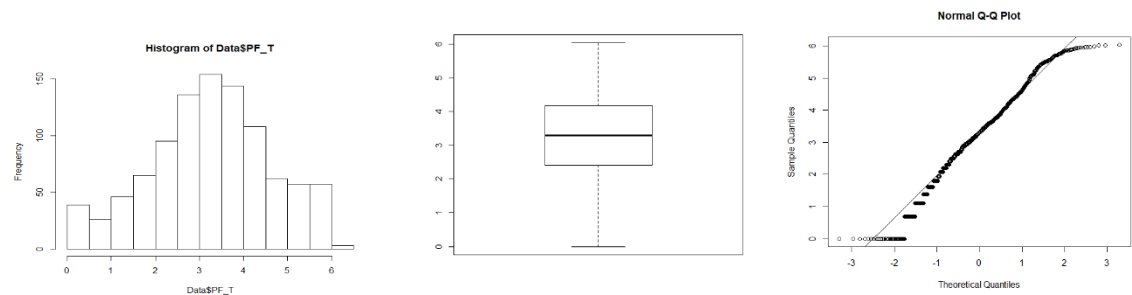


Figure 50. Transformation of variables: Purchasing frequency

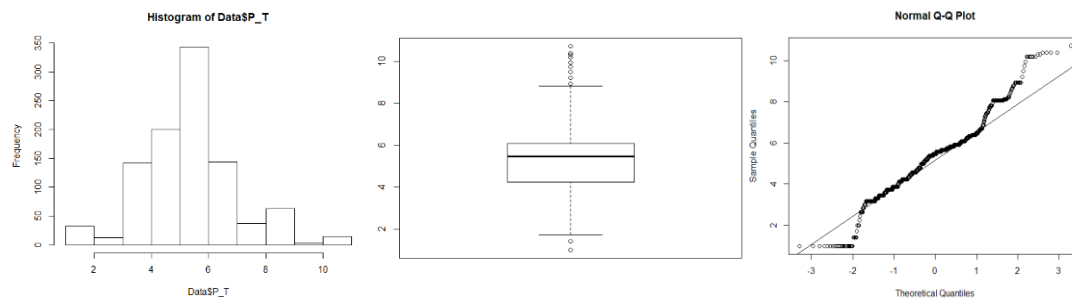


Figure 51. Transformation of variables: Number of promotions

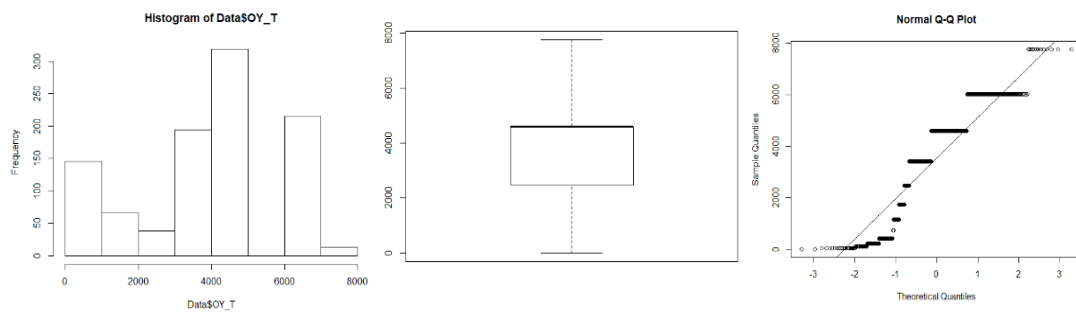


Figure 52. Transformation of variables: Operative years

From the Cox Box transformation, it is possible to deduce an improvement in the adjustment to normal distribution from the Normal Q-Q plots and the frequency diagrams, especially for the variables Workforce, Purchase Frequency, and Operative Years.

Once the transformation of variables was doing the data is prepared to continue with the regression, in the next paragraphs will be developed the model, with the data obtained from the exploratory data analysis and Cox Box transformations. To guarantee an accurate model, the steps followed above are important, because the data must comply with the assumptions doing for the regression model.

Then, it will be presented the structure of the Multiple Linear Regression model, the assumptions doing, and the steps implemented to obtain the fulfillment of the objectives of the model, it will be presented the model proposed, the selection of variables that really affects the turnover and the statistical validation through an ANOVA and residual.

4.7. Model definition

In the model is assumed that more than one variable has influence or is correlated with the value of a third variable. In this model is expected that the events have a functional form as:

$$Y_j = \beta_0 + \beta_1 x_{1j} + \beta_2 x_{2j} + \dots + \beta_i x_{ij} + u_j$$

Equation 4

Where Y_j the endogenous variable, x_{ij} the exogenous variables, u_j the residual and β_0 the estimated coefficients of the marginal effect between each x and y (multreg, 2018).

To define the model was necessary to establish the correct definition of variables, such as the categorical variables like region, competitiveness and, orders.

The categorical variable region was divided into three important regions: Lombardia, Lazio and, Piemonte, for this reason, was necessary to create a factor variable, its structure is shown below:

$$R_2 = 1 \text{ if } Region = Lazio; R_2 = 0 \text{ if not}$$

$$R_3 = 1 \text{ if } Region = Piemonte; R_3 = 0 \text{ if not}$$

When both factors R_2 and R_3 are equals to zero, the intercept takes the value of Lombardia

Another important variable was the Competitiveness, it was defined as follows:

$$C_2 = 1 \text{ if } Competitiveness = High \text{ Competitive}; C_2 = 0 \text{ if not}$$

$$C_3 = 1 \text{ if } Competitiveness = Medium \text{ Competitive}; C_3 = 0 \text{ if not}$$

When both factors C_2 and C_3 are equals to zero, the intercept takes the value of Captive

The objective is to identify the difference relative to the turnover between the three groups of regions and the competitiveness, the variable of reference selected to the factor region is Lombardia.

4.8. Analysis and results

In a Simple linear regression model, a single response is measurement Y is related to a single predictor and X for each observation. The assumption is this model is that the conditional mean function is linear: $E(Y|X) = \alpha + \beta X$.

For the multiple linear regression more than one predictor variable will be available, this follows the next function:

$$E(Y|X) = \beta_0 + \beta_1 X_1 + \dots + \beta_n X_n$$

Where β_0 is the intercept and β_n are the coefficients. (multreg, 2018)

When it comes to contrasting our null hypothesis, several factors will determine the statistical test that we will use and refer to the number, type and, distribution of the variables and the way in which the subjects of the study were chosen. So that the results of the regression are:

Dependent Variable:

- Turnover

Independent Variables

- Region
- Workforce
- Purchase frequency
- Competitiveness

Number of observations: 992

As a method for the selection of the variables was used the backward method, its begin by including all the variables in the regression model and progressively eliminating regressors from lower to higher specific contribution until it is significant enough to not be eliminated. In Figure 53 is showing the variables that were significant for the model after the backward selection.

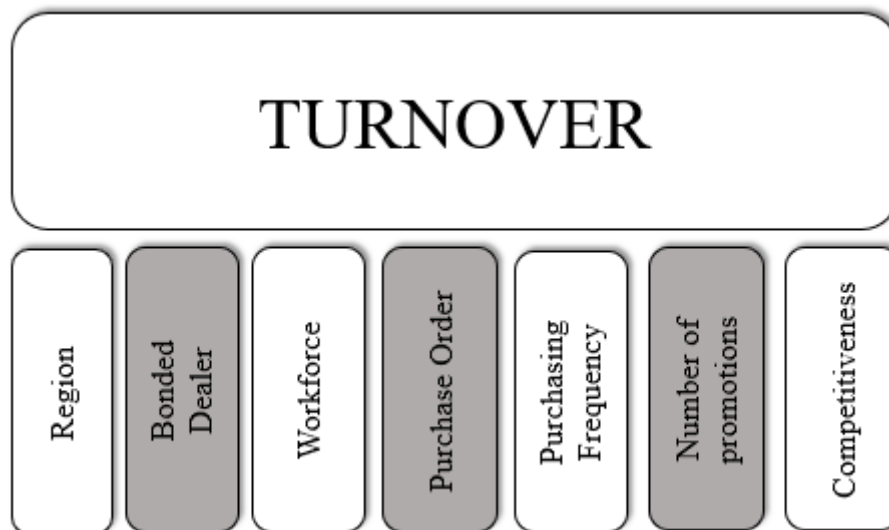


Figure 53. Variables selected from the model proposed

After the application of backward procedure to eliminate the non-significant variables it was obtained as a result the next Multiple Linear Regression Model:

```
Call:
lm(formula = misDatos$T ~ misDatos$R + misDatos$C + misDatos$WF +
    misDatos$PF, data = misDatos)

Residuals:
    Min       1Q   Median       3Q      Max
-0.186179 -0.014800  0.002003  0.017335  0.108343

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.6020981  0.0033262 181.017 < 2e-16 ***
misDatos$R2 -0.0028151  0.0027317  -1.031  0.303004
misDatos$R3  0.0044575  0.0023165   1.924  0.054613 .
misDatos$C2  0.0253762  0.0046211   5.491  5.08e-08 ***
misDatos$C3  0.0279107  0.0076043   3.670  0.000255 ***
misDatos$WF -0.0113636  0.0023956  -4.744  2.41e-06 ***
misDatos$PF -0.0280297  0.0007375 -38.008 < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.03079 on 985 degrees of freedom
(84 observations deleted due to missingness)
Multiple R-squared:  0.6498,    Adjusted R-squared:  0.6477
F-statistic: 304.6 on 6 and 985 DF,  p-value: < 2.2e-16
```

Figure 54. Model Estimators

The equation 5 represents the Multiple Linear Regression Model:

$$\hat{T} = \hat{\beta}_0 - \hat{\delta}_0 R_2 + \hat{\delta}_1 R_3 + \hat{\gamma}_0 C_2 + \hat{\gamma}_1 C_3 - \hat{\beta}_1 WF - \hat{\beta}_2 PF + e$$

Equation 5

In this model was included the variables, Region, Competitiveness, Workforce and Purchase Frequency. As usual β_0 is the expected value of Turnover when the regressors are equal to 0.

$$T = 0,602 - 0,0028 R_2 + 0,0044 R_3 + 0,0253 C_2 + 0,0291 C_3 - 0,0113 WF - 0,0280 PF$$

Equation 6

The model shows that if the repairer is from Piemonte has a positive influence in the variable turnover, in the same way, the repairers that are classified as a High Competitive and Medium Competitive are too a positive effect in the turnover.

Instead, the variables Workforce and Purchase Frequency have a negative influence. An increase in the Workforce or on the Purchase frequency the less the Turnover. This model explains the variance of the variable turnover with a $R^2 = 64.98\%$

Based on this function, we can determine the expected turnover for any repairer as long we know its Workforce, Purchase Frequency, its region of provenance and category of components that acquires (High competitive or Medium competitive).

4.9. Model Validation

Since the P-value in the ANOVA table is less than 0.05, there is a statistically significant relationship between the variables at the 95.0% confidence level. The R-Squared statistic indicates that the model as fitted explains 64.98% of the variability in Turnover. The adjusted R-squared statistic, which is more suitable for comparing models with different numbers of independent variables is 64.77%.

```
Analysis of Variance Table

Response: misDatos$T
      Df Sum Sq Mean Sq F value    Pr(>F)
misDatos$R    2  0.07210  0.03605   38.038 < 2.2e-16 ***
misDatos$C    2  0.10153  0.05077   53.566 < 2.2e-16 ***
misDatos$WF    1  0.18934  0.18934  199.777 < 2.2e-16 ***
misDatos$PF    1  1.36909  1.36909 1444.585 < 2.2e-16 ***
Residuals   985  0.93352  0.00095
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Figure 55. ANOVA Analysis

Residual Analysis

For this model to be reliable it must be performed a Residual Analysis, this allows to evaluate if the assumptions of the regression model are met:

- If the relations between the variables is linear.
- If there is normality in the errors.
- If there are outliers in the distribution of the errors.
- If there is a constant variance (homoscedasticity)
- If there is independence in the errors.

To end with the analysis of the assumptions underlying the multiple linear regression model, the assumption of the normal distribution of the residuals should be considered. For this purpose, the standardized residuals versus the adjusted values should be plotted, this will determine the assumption of random errors and homoscedasticity is fulfilled.

Assumption 1: The residuals follows a normal distribution.

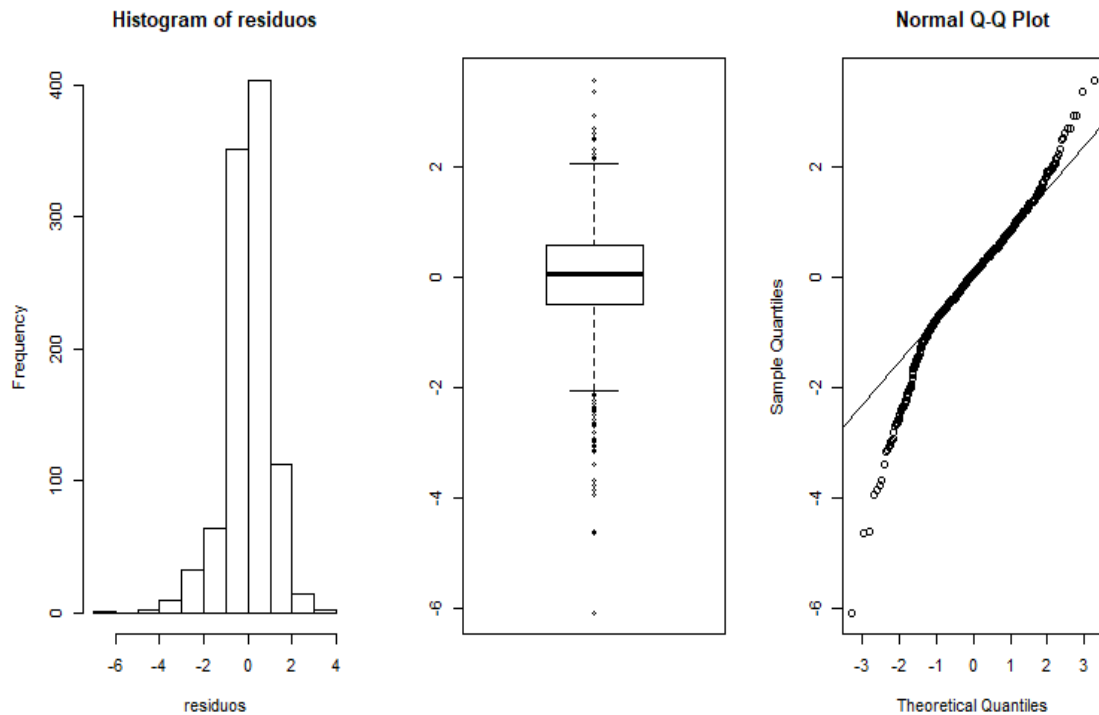


Figure 56. Residual analysis

The histogram in Figure 56 permits to validate graphically the assumption of normality; an aspect that is necessary to take into account for the interpretation of the results in the statistical inference. In this case, we see that the distribution is bell-shaped but presents a shift to the left.

Another graphic that allows visualize and evaluate if one variable has a normal distribution, is the Q-Q plot graphic, which graph the accumulated values of the variable versus the accumulated probability of the normal distribution. In this sense, each value is contrasted with the expected value that the result follows a normal distribution.

In the case of this study are analyzing the observed residuals and plotted through the Q-Q plot graphic. If the errors have a normal distribution, they will form a straight diagonal line, which is evidenced in Figure 56, therefore the errors have a normal distribution.

Assumption 2: The residuals variance is constant

In Figure 57 it can be observed the dispersion of the points distributed evenly distributed around of zero, is a signal that both the assumptions of linearity (the relation between the dependent and the independent's variables are linear) and homoscedasticity (the variance of the residuals are constants) is fulfilled.

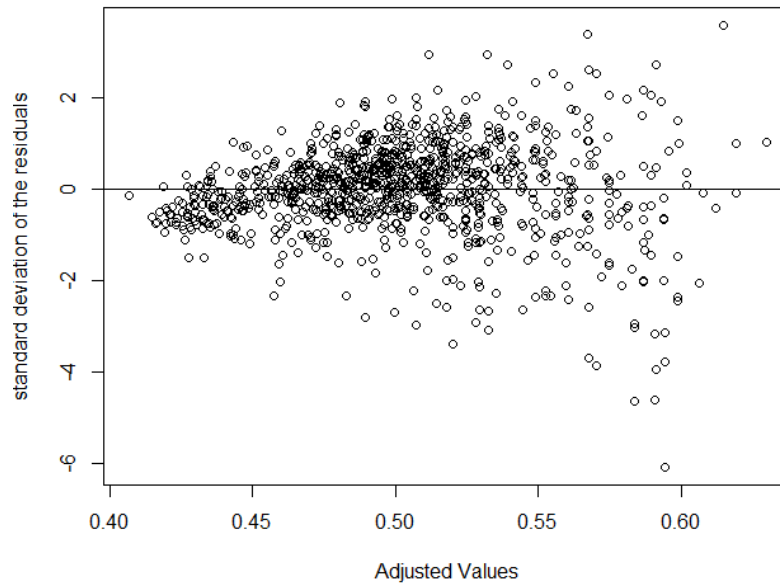


Figure 57. Variance of the residuals

In the graphic above the residuals seem random. It is a good indication that the regression model fits well.

Assumption 3: Residual Independence

To verify that the errors are independent between observations, the Durbin-Watson test was applied. This test can vary between 0 to 4, where a value close to 2 means that the residuals are not correlated, on the other hand, a value greater than 2 indicates a positive correlation between underlying errors, while a value less than 2 represents a negative correlation between errors.


```

Durbin-Watson test

data: modelo4
DW = 1.9376, p-value = 0.1573
alternative hypothesis: true autocorrelation is greater than 0

```

Figure 58. Durbin-Watson test

Reviewing the information displayed in Figure 58, it is observed that the value of the Durbin Watson statistic is close to 2, information confirmed with the P-value of 0,1578.

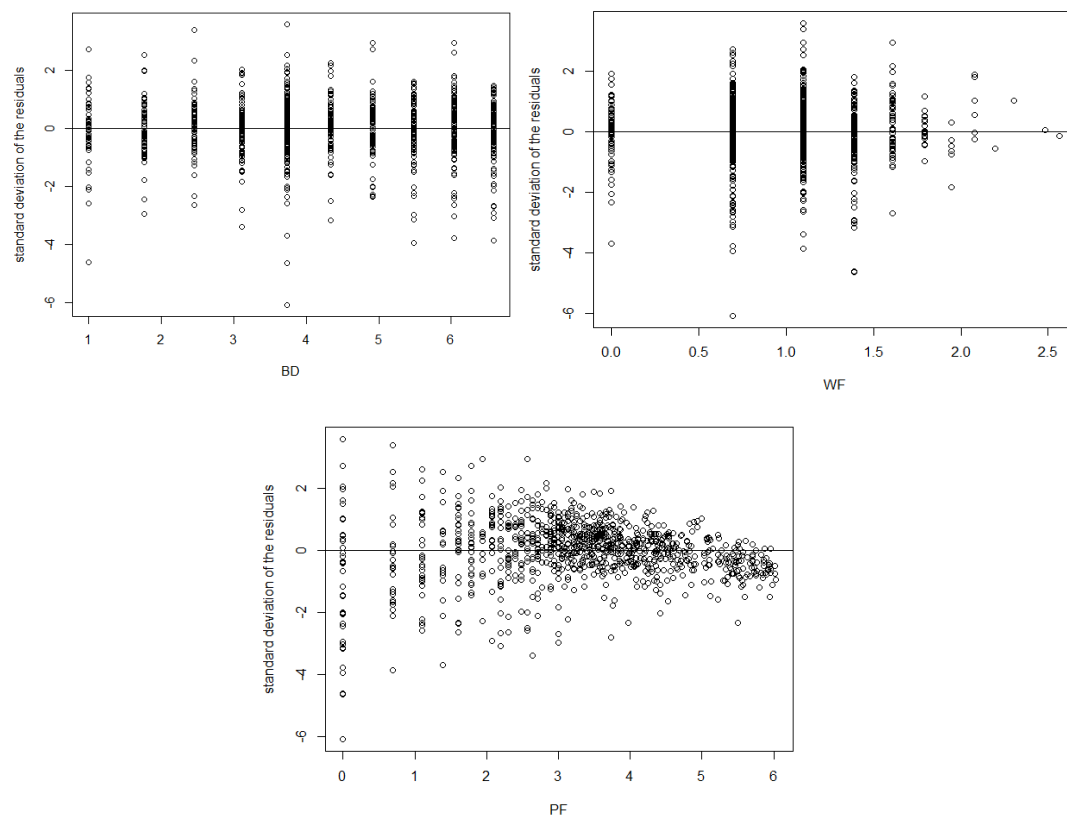


Figure 59. Residual Independence

Once it has been reviewed that all the assumptions inherent in the multiple linear regression model have been met, it can be concluded that the model predicted for the sample may be generalizable for the population.

5. CONCLUSIONS

The SpareParts initiative is an example of the need to create alliances between several companies in the same sector, to meet the challenges that over time the industry presents; with the partnership between the main suppliers and different brands of components all members can achieve economies of scale and offer products and services with the best quality.

The success of the project is the solid structure that allows the connection between all links in the chain, the project has highly qualified people and trained to achieve optimal results, this solid structure ensures the achievement of objectives and an efficient workflow that ensures optimal execution of processes.

Another important part of the project is the monitoring of the processes, where the main indicators that play an important role towards the achievement of the objectives are defined, these help the project leaders make timely decisions. The selection of indicators must be carefully evaluated to add value to the project and to measure the results of the decisions made daily.

In the same line of indicators, the analysis of data is key to react to changes in the market, recognizing with their help the patterns that provide useful information for decision making, for this reason it is crucial to have adequate tools and well-defined processes to ensure data quality.

The statistical process applied in the present work could be replicated to identify the relationships between different variables identified in the auto parts business, there are many tools such as regression models. Including statistical analysis in data analysis processes would increase the effectiveness of decisions made from the data.

In this study, Multiple Linear Regression was useful to identify the relationships between the main variables used to measure project performance. The results of the model show that the variables Frequency of Purchase and Workforce negatively affect the turnover, this means that the increase of both variables has consequently the decrease of the turnover. These results go in the opposite direction to what the logic dictates because it could be thought that more Frequency of Purchase generates greater turnover, but in this case the amount of money for each order was not considered in

the variable, it can happen that the repairer is making many orders but of little monetary value.

Also the variable labor was analyzed, it is common to think that when in a company the labor increases must at the same time generate more income with its activity to sustain all its employees, in this case it is said that the repairer has the potential to buy more spare parts, because it tends to do more work, due to its interest in generating more income and being able to sustain its workforce, it is said that it has the potential to have a higher income. Interestingly, the model shows the opposite, according to the model the more employees the fewer orders translated into income for the parts companies. This is an indication that the model is not completely reliable, for this reason it is crucial to analyze the model combining experience with theory to identify misinformation.

This model is an example of the application of statistical tools to obtain interesting analysis of the available information according to the activity that is carried out, it is advisable to find a balance between what says the experience and what says the data. It is assumed that the inconsistencies in this model is due to its poor representativeness of the variability of the data, which is reflected in its R^2 of 64.98%. In theory, is model does not fit reality because it considers few variables within the spectrum of possibilities of the activity, the turnover can be influenced by many more variables such as, for example, investment in marketing of suppliers, customer satisfaction with the product, productivity of repairers, etc.

Improving the proposed model, it could be used to find repairers with high potential in terms of increased turnover in the purchase of spare parts and be included in the process of selecting repairers.

A standardized process of creation and storage of codes is important to retain the knowledge acquired and achieve more efficient analysis of information, in the day to day companies generate new knowledge that if not processed correctly can be lost and generate reprocesses that hinder the fluidity of processes.

One of the limitations of this study was the lack of consideration of external variables, due to the limited information available at the time of the analysis; it would be interesting to include information about the competition, additional information about repairers and their online purchasing behavior, the exposure of repairers to advertising

campaigns, satisfaction with the product purchased, among other variables that could add value to the model. This would allow a deeper analysis and identify how customers behave and in the long term it would be possible to predict their behavior according to defined parameters.

This internship was very useful for me to know the automotive market and acquire skills in data analysis, recognizing the importance of the data handling, the capacity of processing a large quantity of data in an efficient and accurate way to guarantee that the decision-making process of the company is doing based on reliable data.

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