

# DIGITAL TRANSFORMATION FOR THE AUTOMOTIVE AFTERSALES AND FINE-TUNING THE CONCEPT OF WORKSHOP 4.0

(Master Thesis)

This dissertation is submitted in partial fulfilment of the requirements of the Master Degree in Mechanical Engineering-Politecnico di Torino

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# Declaration

I hereby certify that this material which I now submit for assessment on the programme of study leading to the award of Master Degree in Mechanical Engineering is entirely my own work and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

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# Abstract

**Keywords:** Digital Transformation, Automotive Aftersales, Automotive Industry, Industry4.0 Enabling Technologies, Italy's National Plan "Industria 4.0"

This report is the outcome of a six months internship at Mopar EMEA headquarter in Turin, between July 2018 and December 2018. During this time, I conducted my master thesis project, which enabled me to obtain my Master degree in Mechanical Engineering from the Technical university of Turin (Politecnico di Torino).

Automotive Aftersales is one of the main pillars of the Automotive Industry. It helps to keep the vehicles on the road. It represents the connection point between the carmakers and the final customers. In addition, aftersales services has become one of the main selection criteria for customers when they deciding to buy a new or used vehicle. In the last few years, the new technological development started to spread over all industries and services, which enriched the customer experience and satisfaction. So now, that experience became a customer need, as customers now expect to find the same kind of experience in all daily life activities.

In this thesis will have an overview on the Automotive Aftersales industry and the current Industry 4.0 Enabling Technologies (Ex: IoT and Artificial Intelligence) possibilities and how it is implemented to change the daily life and business models. In the second part of the thesis will focus in details on FCA (Fiat Chrysler Automobiles) Aftersales industry in Mopar by starting from the As-Is analysis and Benchmarking of the Automotive Aftersales through the main OEMs (Original Equipment Manufacturer) in the market.

A detailed analysis will show the main challenges and opportunities that can be used to enhance the customer experience and creating new value propositions for all stakeholders (Ex: final customer), at the same time improving the work productivity and efficiency of the company. Ending with the development of a proper To-Be model of a detailed Digital Transformation plan including the new process flow to transform the Automotive Aftersales Industry to Digital Automotive Aftersales Industry. That will be implemented by using the latest available Enabling Technologies. At the end will finalize the thesis by presenting the feasibility study of the new model and planning of the roll out phases by tender involvement for the implementation phase.

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# **Table of Contents**

Declaration	II
Abstract	III
Acknowledgements	IV
List of Tables	VII
List of Figures	VIII
Abbreviations	X
Chapter 1: INTRODUCTION	1
1.1 FCA company profile	1
1.2 Mopar company profile	2
1.3 Aftersales in Automotive Industry	3
1.3.1 What is the Automotive Aftersales	3
1.3.2 Challenges and opportunities	6
Chapter 2: DIGITAL TRANSFORMATION	8
2.1 Motivation	8
2.1.1 What is Digital Transformation	8
2.1.2 Why Digital Transformation	10
2.1.3 How Digital Transformation changing the world	11
2.2 Italy's National Plan "Industria 4.0"	14
2.3 Digital Transformations Biggest Challenges	18
2.3.1 Company Strategy and Organizational Structure	19
2.3.2 Employees Pushback	20
2.3.3 Limited Budget	20
2.3.4 Cyber Attacks and Data Privacy Regulations	21
2.4 Enabling Technologies	22
2.4.1 Internet of Things (IoT)	22

2.4.2	2 Artificial Intelligence	25
2.4.	3 Case Study: Autonomous Vehicles	29
2.5	Case Study: FCA Cassino Plant	31
2.6	Case Studies: Simple Digital solutions in Dealerships	34
Chapter	3: MOPAR ANALYSIS AND MAPPING	35
3.1	Model Assessment (Mopar Mapping & Concept)	35
3.1.	1 Main Workshop (AS-IS Model Analysis)	38
3.1.2	2 Mopar Express Lane (AS-IS Model Analysis)	1
3.1.	3 Main Workshop Devices	2
3.2	Challenges and opportunities	7
3.3	Benchmarking of Digital Automotive Aftersales	9
3.3.	1 Benchmarking (Reception)	11
3.3.2	2 Benchmarking (Workshop)	12
Chapter	4: MOPAR WORKSHOP 4.0	13
4.1	TO-BE Model	13
4.2	Mopar Workshop 4.0 Process flow	14
4.2.	1 New IoT Devices	17
4.3	Business Model Canvas	20
4.4	TO-BE Model Benefits	23
4.5	Purchasing Involvement & Tender	28
4.5.	1 Request for Information (RFI) & Request for Proposals (RFP)	28
4.5.2	2 Proposals Reviewing and Request for Quotation (RFQ)	29
Chapter	5: CONCLUSION	31
5.1	Benefits to the company	31
5.2	Thesis work limitations	32
5.3	Future steps the company can undertake	32

# List of Tables

TABLE 1.1: DEALERSHIP MAIN ACTIVITIES	5
TABLE 3.1: COMPARISON BETWEEN THE TRADITIONAL WORKSHOP AND MEL	2
TABLE 3.2: DEALERSHIP MAIN CHALLENGES	7
TABLE 4.1: SELECTION CRITERIA SHEET "SAMPLE"	28
TABLE 4.2: PROPOSAL EVALUATION SHEET "SAMPLE"	29

# **List of Figures**

FIGURE 1.1: AUTOMOTIVE AFTERSALES OPERATIONS	4
FIGURE 1.2: SERVICE CENTERS OWNERSHIP'S CLASSIFICATION	4
FIGURE 2.1: DIGITAL TRANSFORMATION SIMPLIFIED EXAMPLE	10
FIGURE 2.2: ESTONIA'S DIGITAL TRANSFORMATION ROADMAP	11
FIGURE 2.3: LARGEST GLOBAL COMPANIES IN 2018 VS 2008	13
FIGURE 2.4: OVERVIEW OF DIGITAL TRANSFORMATION POLICIES AND PROGRAMS	15
FIGURE 2.5: FACT BOX FOR ITALY'S INDUSTRY 4.0 POLICY INITIATIVE	16
FIGURE 2.6: EXPECTED RESULTS FOR INDUSTRY 4.0 FOR THE PERIOD FROM 2017 TO 2020	17
FIGURE 2.7: SWOT ANALYSIS FOR INDUSTRY 4.0	17
FIGURE 2.8: THE TOP FIVE DIGITAL TRANSFORMATION CHALLENGES	
Figure 2.9: IOT vs. IOE Vs. others	23
FIGURE 2.10: IOT MAIN PILLARS	24
FIGURE 2.11: ARTIFICIAL INTELLIGENCE VS. MACHINE LEARNING VS. DEEP LEARNING	25
FIGURE 2.12: TURING TEST MODEL	27
FIGURE 2.13: IOT VS. ARTIFICIAL INTELLIGENCE TREND COMPARISON PERIOD MARCH 2014- MARCH 2019	28
FIGURE 2.14: AUTONOMOUS DRIVING FIVE LEVELS EVOLUTION	
FIGURE 2.15: ALFA ROMEO QUADRIFOGLIO	31
FIGURE 2.16: ROBOTS WORKING ON A MANUFACTURING PROCESS IN CASSINO PLANT	32
FIGURE 2.17: SMARTWATCH USED IN CASSINO PLANT	32
FIGURE 2.18: HMI SCREEN USED IN CASSINO PLANT	33
FIGURE 3.1: DEALERSHIP STRUCTURE DIAGRAM	36
FIGURE 3.2: WORKSHOP MAIN PHASES FLOW CHART	37
FIGURE 3.3: CUSTOMER EXPERIENCE THROUGH THE TRADITIONAL WORKSHOP	
FIGURE 3.4: CUSTOMER EXPERIENCE THROUGH THE TRADITIONAL WORKSHOP	0
FIGURE 3.5: MAIN WORKSHOP (AS-IS MODEL)	0
FIGURE 3.6: MOPAR EXPRESS LANE ADVERTISEMENT	1
FIGURE 3.7: MOPAR EXPRESS LANE IMPLEMENTATION LAYOUTS	2
FIGURE 3.8: CUSTOMER EXPERIENCE THROUGH MOPAR EXPRESS LANE- LAYOUT A	0
FIGURE 3.9: MOPAR EXPRESS LANE LAYOUT A	1
FIGURE 3.10: WIADVISOR	2

FIGURE 3.11: WIADVISOR MAIN DASHBOARD	3
FIGURE 3.12: WIADVISOR INTEGRATED DATABASES	4
FIGURE 3.13: WITECH INTERFACE	5
FIGURE 3.14: WITECH INTERFACE	6
FIGURE 3.15: OEMs STRATEGIC OPTIONS	8
FIGURE 3.16: PROGRESS OF CONNECTIVITY IN AUTOMOTIVE SECTORS	10
FIGURE 3.17: BENCHMARKING OF AUTOMOTIVE RECEPTION "SAMPLE"	11
FIGURE 3.18: BENCHMARKING AUTOMOTIVE WORKSHOP "SAMPLE"	12
FIGURE 4.1: FIGURE 32: MOPAR WORKSHOP 4.0 MODEL	13
FIGURE 4.2: CUSTOMER EXPERIENCE THROUGH MOPAR DIGITAL SERVICE LAB" AS ONE KEY DEALER	15
FIGURE 4.3: TO-BE MODEL	16
FIGURE 4.4: VALUE PROPOSITION (MANAGEMENT - WORKERS - CUSTOMER)	20
FIGURE 4.5: BUSINESS MODEL CANVAS	22
FIGURE 4.6: MOPAR WORKSHOP KPIS	25
FIGURE 4.7: WORKSHOP KPIS CURRENT PROCESS FLOW	26
FIGURE 4.8: WORKSHOP KPIS NEW PROCESS FLOW	26

# Abbreviations

AGV	Automated Guided Vehicle
AI	Artificial Intelligence
AM	Additive Manufacturing
APAC	Asia-Pacific
AR	Augmented Reality
CX	Customer Experience
DMS	Dealer Management System
DX	Digital Transformation
ECU	Electronic Control Unit
EMEA	Europe, Middle East and Africa
FCA	Fiat Chrysler Automobiles
GDPR	General Data Protection Regulation
HMI	Human Machine Interface
ICT	Information and Communication Technology
IoT	Internet of Things
IT	Information Technology
KPI	Key Performance Indicator
LATAM	Latin American
M2M	Machine To machine
MEL	MOPAR Express Lane
MES	Manufacturing Execution System
NAFTA	North American Free Trade Agreement
OEM	Original Equipment Manufacturer
POS terminal	Point of Sale terminal
RFI	Request for Information
RFP	Request for Proposals (RFP)
RFQ	Request for Quotation (RFQ)
VIN	Vehicle Identification Number
WCM	World Class Manufacturer

# Chapter 1: INTRODUCTION

This chapter will focus on introducing the company profile for both Fiat Chrysler Automobiles (FCA) and Mopar, which represent the Automotive Aftersales division in FCA. In addition will focus on analyze the role of the Automotive Aftersales in Automotive Industry and the current challenges and opportunities in the field

## 1.1 FCA company profile



Fiat was founded in the late 1800s (July 11, was the FIAT CHRYSLER AUTOMOBILES birth of Società Anonima Fabbrica Italiana di Automobili Torino – F.I.A.T.) based in Turin, Italy. The first car built was the 4 HP. The period from 1988 to 1910 was a period filled with grand initiatives, inventive and new ideas, and FIAT rapidly became one of the world's leading industrial groups. Now it is considered as an Italian- American multinational automotive corporation and one of the top world's largest automakers. (FCA, 2018)

The Company started to expand continuously by acquiring other Automotive Brands and became a group of companies, which was called FIAT GROUP. In January 2014, Fiat Group increases its ownership in the american carmakers group Chrysler to 100%. Later in October, the two companies merge to create Fiat Chrysler Automobiles (FCA) and begin trading on the Milan Stock Exchange under the symbol "FCA" and the New York Stock Exchange under the symbol "FCAU". (FCA, 2018)

Nowadays the group manages twelve Automotive Brands (Fiat, Fiat Professional, Chrysler, Dodge, Jeep, Alfa Romeo, Lancia, Abarth, Maserati, Mopar, RAM, and SRT), also three components and production systems companies (Comau, Magneti Marelli and Teksid). In addition, retail and dealer financing, leasing and rental services in support of the group's car business are provided through subsidiaries, joint ventures and commercial arrangements with third-party financial institutions. (FCA, 2018)

Based on the last statistics from December 31, 2018, the Group presents in more than 135 markets worldwide, which are divided into four global markets (NAFTA, LATAM, APAC and EMEA), with a total workforce of 199,000 employees. Having more than 40 countries in operation by operating 102 manufacturing facilities and 46 R&D centers with an investment of  $\notin$ 3.5B on research. Having 4.8 million combined vehicle shipments (including all shipments by the Group's unconsolidated joint ventures) and a total Net Revenues of  $\notin$ 110B. (FCA, 2018).

# **1.2 Mopar company profile**

Mopar is the company that covers the whole value chain of FCA Aftersales market, Therefore it is responsible for all original equipment manufactured parts (Ex: Spare Parts, Accessories). All



services and customer care (Ex: Warranty, Maintenance) within Fiat Chrysler Automobiles brands. The name of Mopar is composed of two parts. MO comes from "motor" and PAR comes from "parts" and was founded in 1937 in USA as a line of antifreeze products manufactured by the Chrysler Motor Parts.

In 1937, six years after the Chrysler Motors Parts Corporation plant was set up, Mopar has been introduced to the market as a line of antifreeze products manufactured by the Chrysler Motor Parts. From that date, Mopar grew in both, number of plants and in number of available parts. In the '70s, Mopar also became the first to offer a dedicated parts delivery system, setting a new standard of dealer service. By 1987, Chrysler purchased the assets of American Motors and the Jeep brand came into the family, resulting in addition of Jeep parts and accessories to the expanding Mopar portfolio. (blog.mopar, 2017)

In 2008 Mopar launched its first Mopar Express Lane operation, for fast oil change and light service. It was a business model that would reshape peoples' perspective towards service visits to automotive dealerships. Quick service, no appointments required and competitive pricing. Now it has more than 1,000 Mopar Express Lane operation in the United States. (Bradley, 2016)

In recent years, Mopar has accelerated its transformation into a brand responsible for the customer journey of all FCA vehicles around the globe. Embodying that customer-centric approach and presenting a new "At Your Service" slogan. By 2016, more than 1,750 Mopar Express Lane locations were operational in more than 20 countries around the world. The brand has also shined on the biggest stages making regular appearances at international auto shows. (blog.mopar, 2017)

In numbers, Mopar is working in more than 150 markets, presenting all four global markets (NAFTA, LATAM, APAC, and EMEA), with a workforce of more than 7,000 employees and more than 34,000 technicians. In addition, managing more than 500,000 parts and accessories. (mopar, 2018)

## **1.3** Aftersales in Automotive Industry

#### **1.3.1** What is the Automotive Aftersales

Automotive Aftersales is the secondary market of the automotive industry. It helps to keep the vehicles on the road. It is the business division, which concentrates on supporting the company's industry by providing all services and processes after handing over the vehicle to the customer. It includes many activities and services starting from producing, warehouse and supply chain of spare parts, tools and accessories for all FCA brands and its models. At the same time, a focus is lied on managing sales, marketing, relations with suppliers and all stakeholders.

Also managing and supporting service centers are given in order to control the offered quality, providing original spare parts, special tools and vehicles data to facilitate the workload. At the same time offering training and support of all the stuff.

Automotive Aftersales can be defined also from the Customer Prospective as the ecosystem which starts just after purchasing a vehicle until recycling it. A focus on providing the best customer experience by availability of spare parts, accessories and maintenance services represents an important part.

Therefore, through the previous definitions it can be figured out that the service center is the connection point between the OEMs and their customers. Automotive Aftersales are the mirror of the brand itself, so it has to be managed with high care and professionalism. Winning the aftersales is not that easy, since it contains significant complexity, a large number of maintenance procedures, inventories activities, complex supply chains and customers interactions. It can be classified into offline operations (No interactions with final customer) and online operation (Interactions with the final customer) as shown in figure 1.1



Figure 1.1: Automotive Aftersales Operations (Source: Composed by author, 2019)

In the current analysis lies a focus mainly on the Service Center, which represent the connecting point between the brand and the final customer. It has a high variability in operations and managing systems. It has also a high potential in opportunities of development, which will be identified during the deep analysis of Automotive Aftersales market in chapter three.

Firstly, the analysis starts with a simple classification of the current available service centers in the market based on the ownership as shown in Figure 1.2



Figure 1.2: Service Centers Ownership's Classification (Source: Composed by author, 2019)

MOPAR as is one of the main OEMs (Original Equipment Manufacturers) in the market, so it is responsible of managing all FCA brands in the aftersales market in the current model. Usually OEMs use third party dealers to own the Service Centers while the OEMs only manage those dealers and support them with all needed spare parts, tools, technical services and latest technologies. At the same time, they supervise the offered quality to maintain its own standards (Mopar- FCA standards) to improve the customer satisfaction. As shown in Table 1.1 the main operations and processes inside the dealership service center

Table 1.1: Dealership Main Activities (Source: Composed by author, 2018)



#### **1.3.2** Challenges and opportunities

Firstly, there is a need of understanding that in the Automotive Aftersales the relationship between the Carmakers and its dealerships is controlled by complicated agreements. As Carmakers cannot force all dealers to implement the same management and tools, but in most cases, there are some basic requirements and rules have to be followed by all dealers to maintain the minimum required quality and KPIs. At the same time providing freedom for the dealers to manage some internal processes due to some factors like market traditions, dealership size and some other factors.

Usually the automotive industry is facing continuously a dynamic set of challenges based on the customer demands, the technological development and competitors in that market, whom push the market to new horizons. Therefore, each competitor has to be ready for that new level of the upcoming challenges to meet customer expectations and be able to stay in the competition. Otherwise, the competitor will not be able to maintain its position in the market for a longer period. (Deloitte, 2018).

The following part focuses on the new trends of challenges, which became opportunities at the same time for others who could make use of it (Ex: Tesla). Therefore, in the current automotive market it can be seen that some of new comers to the automotive industry (Ex: Tesla, Waymo). Those new companies mainly works on the customer attraction by offering new and special customer experience and satisfy the customer need as the customer nowadays searching for more connectivity and technology that can be facilitate his life as it is shown in the new trend of new connected and Autonomous cars.

Another big challenge in the Automotive Industry now is the high variability and complexity to manage many supply chains, production, logistics, and other activities, which need new advanced tools and systems to integrate and optimize all those operations. Regards to that challenge a new opportunity appears on, which is the advanced analytics across the manufacturing value chain by extracting as much data as possible. Using those big data to perform a deep analytical process to understand the behavior and indicate all optimization options that can be adopted.

Figure 1.3 illustrates how the advanced analytics can predict and indicate the optimization options that can be used to improve all processes and strategies to decrease costs and achieve the maximum of efficiency. (Deloitte, 2018)



Figure 1.3: Advanced analytics across the manufacturing value chain (Deloitte, 2018)

# Chapter 2: DIGITAL TRANSFORMATION

In this chapter the background and the literature of the Digital Transformation definition will be reviewed by highlighting its importance. Moreover, it will discuss the biggest challenges in Digital Transformations for the big enterprises and reviews the Italian contributions to move forward to the industry 4.0 era.

Also will discuss the main industry 4.0 enabling technologies that are used and can transform the shape of Automotive Aftersales.

### 2.1 Motivation

### 2.1.1 What is Digital Transformation

The fourth Industrial Revolution (Industry 4.0) can be expressed as the umbrella, which covers all the available technologies in the market now, mainly those technologies are Information and Communications Technology (ICT).

Actually, those set of technologies that are available now did not appear suddenly, but gradually developed and improved within time, so it contains sets of work, researches and patents. As those technologies became smarter, some scientists and innovators started to link it together and created new researches and business opportunities. Now in the market appear some new digital enterprises, which started their startup from scratch based on the latest available ICT technologies and established their business model based on that (Ex: Uber, Airbnb), which became market leaders in some markets.

On the other hand, big and old enterprises are suffering to transform and improve their business to be aligned with this new evolution, which is more difficult in that case than starting from scratch as it happens in Startups. This process for big enterprise of traditional firm is called "Digital Transformation" by switching the business operations and interactions from using traditional and limited horizons technologies in order to work with the latest super advanced and more complicated integrated technologies in their business and digitalize all operations and processes to optimize it (Ex: Supply Chain, Production and selling). Therefore, the major used technologies that drives the process of Digital Transformation will be discussed in detail in the following parts. In general, there is no inventor of Digital Transformation, as it is not just one technology but it is a set of integrated technologies.

#### Simplified Digital Transformation example:

Figure 2.1 represents a simplified example to illustrate why Digital Transformation is extremely important in the current days for all industries. So here in this example will consider any specific industry (Ex: Automotive). While all enterprises are represented as vehicles in a race competition and have to compete in an unlimited road length, which represent the future time line as the enterprise has to compete along its existence. However, at any time when the enterprise will not be able to use the available resources and boosting technologies in the competition it will find big difficulties to stay in the market, or at least will not be able to be a market leader anymore (Ex: Kodak).

During the competition, there are many boosting tools available for all competitors, which represent the available Industry 4.0 Enabling Technologies (Ex: IoT and Artificial Intelligence). Those boosting technologies will be represented as providing each vehicle extra fuel and speed to compete, but to install each tool need some time and cost.

Therefore, all vehicles need to add some boosting tools to be more competitive in the competition. However, maybe two competitors are using the same tool at the same time but with different efficiencies and optimization, therefore the competitor who use the tool with higher efficiency will be faster.

At the same time the competitor who will decide to stop using new tools or stop improving the efficiencies of the tools that he is using, he will stay with the same speed. As long as the other competitors are improving their tools and acquiring new tools will be far forward and in some point that competitor will not be able to compete anymore.



Figure 2.1: Digital Transformation Simplified example (Source: Composed by author, 2018)

### 2.1.2 Why Digital Transformation

"When wireless is perfectly applied the whole earth will be converted into a huge brain, which in fact it is, all things being particles of a real and rhythmic whole. We shall be able to communicate with one another instantly, irrespective of distance. Not only this, but through television and telephony we shall see and hear one another as perfectly as though we were face to face, despite intervening distances of thousands of miles; and the instruments through which we shall be able to do this will be amazingly simple compared with our present telephone. A man will be able to carry one in his vest pocket." (Tesla, 1926)

The main motivation of that transformation of the big and old enterprises is the competition with those new digital enterprises. At the same time with other competitors, which already started its Digital Transformation process. Those competitors are getting extra tools, which help them to increase their work performance towards a better optimization. That is why big and traditional enterprises have to find a solution at least to not lose their market share (that is one of the main reasons that some big companies tends to buy or share in new startups).

Furthermore, the market expectation and customer's demands have changed, as now customers are expecting to have at least the same kind of customer experience that they get through the new digital enterprises. For that, big and traditional enterprise have to work to satisfy the new customer's need as it became a challenging point.

Finally, can briefly say that there is no specific point or limit in Digital Transformation, which the enterprise wants to reach then can stop the improvement process. It is a continuous transformation process, as long as there appear new opportunities for development and new inventions, the enterprises have to make use of those opportunities and adapt it in their business in the best efficient way.

#### **2.1.3** How Digital Transformation changing the world

Nowadays, Digital transformation almost got involved in all life's categories (Ex: Production, transportation and healthcare). The most important thing that the Digital Transformation has changed is enriching the customer experience, as the customer expectations have become so much higher than it was from 10 years ago when the

expectations was limited and restricted based on the available technologies at that time.

Digital Transformation has a great effect on all people (Ex: governments, inhabitants and business owners), so can see how the Digital Transformation facilitates the life activities and increases revenuers for business owners whilst enriching the customer satisfaction.

A great example of a country that has almost totally transformed to a digital country is *Estonia.* The small European country became the most famous example in the 21st century for looking to the future, thanks to constructing an impressive system of e-Government since the 1997, after getting independent from the Soviet Union. The program started and continued to make headlines with a many new digital initiatives as shown in Figure 2.2 the roadmap of Digital Transformation of Estonia. (e-estonia, 2019)

![](_page_21_Figure_7.jpeg)

Figure 2.2: Estonia's Digital transformation roadmap (e-estonia, 2019)

Therefore, e- Government give access to 99% of the public services are available online 24/7, also paying taxes in Estonia just need one click as it needs only 3-5 minutes for the tax filing process.

In addition, Estonia focused in all categories as it was the first country in history to perform internet voting in a nationwide election in 2005. Also e-residents service as using digital ID for all citizens to give full access to all public e-services and there are many other services that transformed Estonia to a Digital country as the Ministry of Economic Affairs and Communications has a clear and defined strategy to follow to reach their target, which is called "Digital Agenda 2020 for Estonia". So now we can say that Digital Transformation has changed daily life activates in Estonia (Ministry of Economic Affairs and Communications, 2013).

The good point of Digital Transformation is that it gives the small startups and innovators the opportunity to start to work on innovative ideas by using some open source platforms and simulation processes to start a new business model that can compete with big enterprises. In some cases, they may be able to win that competition as it can be shown in the new startups which became a mega enterprise in few years like Airbnb, Uber.

As it is shows in Figure 2.3, a comparison of the largest global companies in 2018 vs 2008, we can see that the new ICT enterprise is growing too much and fast. As the traditional enterprises suffer to be in the largest top 10 companies, in its services mostly physical, while the new digital solution companies use mainly digital solutions based on services so it can reach a higher number of people and get higher revenues faster by using an innovative business models and exciting customer experience that leads customers to pay. (Johnston, 2018)

	2018	3			20	800	
Rank	Company	Founded	USbn	Rank	Company	Founded	USbn
1.	Apple	1976	890	1.	PetroChina	1999	728
2.	Google	1998	768	2.	Exxon	1870	492
3.	Microsoft	1975	680	3.	General Electric	1892	358
4.	Amazon	1994	592	4.	China Mobile	1997	344
5.	Facebook	2004	545	5.	ICBC (China)	1984	336
6.	Tencent (China)	1998	526	6.	Gazprom(Russia)	1989	332
7.	Berkshire	1955	496	7.	Microsoft	1975	313
8.	Alibaba (China)	1999	488	8.	Royal Dutch Shell	1907	266
9.	1&1	1886	380	9.	Sinopec (China)	2000	257
10.	JP Morgan	1871	375	10.	AT&T	1885	238

Figure 2.3: Largest Global Companies in 2018 vs 2008 (Johnston, 2018)

So now for industrial enterprises (Ex: Automotive) has become an essential tool to perform a Digital Transformation strategy and not an option anymore to compete and keep the growth in a sustainable way. That's why already most of automotive production processes became more automatized based on robots and real time planning tools for all manufacturing processes (Ex: FCA Cassino manufacturing plant). The main target now is to satisfy the highlevel customer expectations, as customers need everything to be connected and be accessed quickly. That is why most of the carmakers launched new connected cars that give extra features and special experience.

## 2.2 Italy's National Plan "Industria 4.0"

The "Industria 4.0" Italy's National Plan represents a major opportunity for all companies that are ready to take advantage of the unprecedented incentives offered by the Fourth Industrial Revolution. (Calenda, Carlo, 2017)

In February 2017, The Italian Ministry of Economic Development has launched the "Industria 4.0" National Plan (I4.0), a strategy aiming to support industrial change through a series of conjunctional measures. The measures seek to promote investments in innovation, technology and skills development while considering principles set by the fourth industrial revolution.

The Plan provides for a wide array of consistent and complementary measures promoting investment in innovation and competition. The Government intends to design a framework for effective and suitable operation. The approach of the new strategy is to help the entrepreneurs to take advantage and create  $\frac{1}{2}$  new business opportunities.

"Industria 4.0" was inspired by similar national strategies in Germany (Platform Industrie 4.0), France (Alliance Industrie du Future) and then Netherlands (Smart Industry) as it shows in Figure 2.4, taking the international and national economic environment into consideration, up-to-date series of macroeconomic data and industrial sector dynamics. (European Commission, 2017)

The main objective is to support innovative investment and empowerment of skills related to the fourth industrial revolution by setting the framework for attracting private investment technologies, in support for research, development, and innovation the and promotion of investment in venture capital and start-ups. On the other hand, the initiative seeks to contribute to the empowerment of skills by promoting I4.0 education programs, strengthening vocation training, skills development, Competence Centers, Digital Innovation Hubs and the financing of I4.0 Technology Clusters and Industrial PhDs. (European Commission, 2017)

![](_page_25_Figure_1.jpeg)

Figure 2.4: Overview of digital transformation policies and programs (European Commission, 2018)

Figure 2.5 represents a summary of Italy's industry 4.0 policy initiative. Stating the adopted strategy, funding model passing through the key barriers until it reaches to the expected impact.

Policy Lever(s)	Top-down approach, orientation towards technology as well as skills, public financing.
5 Funding Model	Funding model based on public funds earmarked for implementation of specific measures in order to create favourable conditions boosting private investment in technology, innovation, R&D.
Target audience(s)	Companies and entrepreneurs, regardless of the size, sector or location.
Concepts & Focus Areas	Take full advantage of opportunities related to the fourth industrial revolution, promoting investments in innovation, intangible assets and R&D, spreading the culture related to "Industria 4.0" and developing skills.
Key drivers	Active involvement of the policy makers and key stakeholders, variety of easily accessible fiscal instruments, a strong network of highly specialised competence centers offering tech transfer services to SMEs.
W Key barriers	So far, the implementation process is smooth, without any barriers and complications.
implementation strategy	Automatically activated fiscal measures (tax incentives) on investments, R&D expenditures and IP assets, and support to the creation of network of Digital Innovation Hubs (DIH) and Competence Centers.
Results expected	> €10 bn. private investment increase in 2017/2018, +11 bn. R&D&I private expenditure in 2017-20, 200.000 academic students and 3.000 managers qualified in I4.0, doubling the students in vocational schools on I4.0 topics
Budget	More than €18 billion for the period 2017-2020.
Uniqueness factor	Parallel focus on technology and development of skills necessary for the successful digital and technological transformation. A wide variety of fiscal incentives available for companies of any size, sector and location.
Value-added for policy-makers	Active cooperation with stakeholders; international cooperation with France and Germany on I4.0 topics.
Expected Impact	New development of I4.0 skills, uptake and diffusion of new technologies, expansion of R&D activities; increasing the competitiveness of Italian companies and industry.

Figure 2.5: Fact box for Italy's industry 4.0 policy initiative (European Commission, 2017)

So the new Italy's plan to move forward the Industry 4.0 in an official way. It creates a great environment for innovators and small startups to start their business based on the new enabling technologies and making use of the new incetives from the government. In Figure 2.6 expressed the expecting results of the implementation of the "Industria 4.0" Italy's National Plan within the period (2017-2020), based on the sudy of the Digital Transformation Monitor platform, which managed by the European Commission.

Innovative investment	<ul> <li>&gt; 10 billions € private investment increase 2017/2018</li> <li>+2.6 billion € mobilised early stage investment 2017-2020</li> </ul>
R&D	<ul> <li>+ 11 billion € research, development and innovation private expenditure (exceeding 2% of GDP) over the period 2017-2020</li> </ul>
Skills	<ul> <li>200.000 academic students and 3.000 managers qualified on I4.0 topics</li> <li>+100% students attending vocational schools on I4.0 topics</li> <li>~1.400 industrial PhDs focused on I4.0 topics (out of ~ 5.000 included in the National Research Plan)</li> </ul>
Figure 2.6: Expected Res	ults for industry 4.0 for the period from 2017 to 2020

(European Commission, 2017)

In addition, the Digital Transformation Monitor platform performed a high level SWOT analysis as it is shown in Figure 2.7, so it shows that the new national plan has good potential opportunities for the economy with creating a sustainable effective financial and regulatory framework. Otherwise, the main weakness point was that new policy that measures on skills do not bring the results as fast as innovation investment tools. So the effect of the policy and its results will be shown in the long term.

Strength	Weaknesses
<ul> <li>Strong focus on SMEs regardless size, sector and location.</li> <li>State as driving force giving significant financial backing.</li> <li>Boosting private investment.</li> </ul>	<ul> <li>Hand in hand approach, however, measures focusing on skills do not bring the results as fast as innovation investment tools</li> </ul>
Opportunities	Threats
Opportunities <ul> <li>Create a sustainable effective</li> </ul>	• Insufficient reach of
Opportunities <ul> <li>Create a sustainable effective financial and regulatory framework</li> </ul>	Threats <ul> <li>Insufficient reach of microenterprises and small</li> </ul>
Opportunities <ul> <li>Create a sustainable effective financial and regulatory framework</li> <li>Transferability and scalability not</li> </ul>	Threats <ul> <li>Insufficient reach of microenterprises and small companies.</li> </ul>
Opportunities <ul> <li>Create a sustainable effective financial and regulatory framework</li> <li>Transferability and scalability not only at national but also at</li> </ul>	Threats <ul> <li>Insufficient reach of microenterprises and small companies.</li> <li>Low interest of SMEs to invest in</li> </ul>
Opportunities <ul> <li>Create a sustainable effective financial and regulatory framework</li> <li>Transferability and scalability not only at national but also at European level</li> </ul>	Threats         • Insufficient reach of microenterprises and small companies.         • Low interest of SMEs to invest in and benefit from proposed

Figure 2.7: SWOT analysis for industry 4.0 (European Commission, 2017)

# 2.3 Digital Transformations Biggest Challenges

Based on a survey performed by Jabil (manufacturing solutions provider that delivers comprehensive design, manufacturing, supply chain and product management services for a wide array of industries) on 300 technology and business stakeholders working at manufacturing companies of all sizes around the world with levels of digitization varied greatly among these manufacturing Enterprise. (Jabil, 2017)

All participants admitted that their companies faced challenges. However, the most surprising was how similar the types of challenges were, no matter the company size. Figure 2.8 shows the top five challenges, which are always on the same list but change its order based on the size of the enterprise.

То	Top 5 Digital Transformation Challenges by Company Size		
Les	s than 100 Employees	100-1,000 Employees	
1.	Lack of Expertise to Lead Digitization	1. Employee Pushback	
	Initiatives	2. Organizational Structure Gets in the Way	
2.	Employee Pushback	3. No Overarching Strategy for Digitization	
3.	No Overarching Strategy for Digitization	4. Limited Budget	
4.	Business Partners Unable to Support	5. Lack of Expertise to Lead Digitization	
5.	Limited Budget	Initiatives	
1,0	00-5,000 Employees	More than 5,000 Employees	
<b>1,0</b> 1.	00-5,000 Employees No Overarching Strategy for Digitization	More than 5,000 Employees1. Lack of Expertise to Lead Digitization	
<b>1,0</b> 1. 2.	<b>00-5,000 Employees</b> No Overarching Strategy for Digitization Lack of Expertise to Lead Digitization	More than 5,000 Employees 1. Lack of Expertise to Lead Digitization Initiatives	
<b>1,0</b> 1. 2.	00-5,000 Employees No Overarching Strategy for Digitization Lack of Expertise to Lead Digitization Initiatives	More than 5,000 Employees1. Lack of Expertise to Lead Digitization Initiatives2. Organizational Structure Gets in the Way	
1,0 1. 2. 3.	00-5,000 Employees No Overarching Strategy for Digitization Lack of Expertise to Lead Digitization Initiatives Limited Access to the Required Technical	<ul> <li>More than 5,000 Employees</li> <li>1. Lack of Expertise to Lead Digitization Initiatives</li> <li>2. Organizational Structure Gets in the Way</li> <li>3. No Overarching Strategy for Digitization</li> </ul>	
1,0 1. 2. 3.	00-5,000 Employees No Overarching Strategy for Digitization Lack of Expertise to Lead Digitization Initiatives Limited Access to the Required Technical Expertise	<ol> <li>More than 5,000 Employees</li> <li>Lack of Expertise to Lead Digitization Initiatives</li> <li>Organizational Structure Gets in the Way</li> <li>No Overarching Strategy for Digitization</li> <li>Limited Access to the Required Technical</li> </ol>	
<b>1,0</b> 1. 2. 3. 4.	00-5,000 Employees No Overarching Strategy for Digitization Lack of Expertise to Lead Digitization Initiatives Limited Access to the Required Technical Expertise Employee Pushback	<ol> <li>More than 5,000 Employees</li> <li>Lack of Expertise to Lead Digitization Initiatives</li> <li>Organizational Structure Gets in the Way</li> <li>No Overarching Strategy for Digitization</li> <li>Limited Access to the Required Technical Expertise</li> </ol>	
<b>1,0</b> 1. 2. 3. 4. 5.	00-5,000 Employees No Overarching Strategy for Digitization Lack of Expertise to Lead Digitization Initiatives Limited Access to the Required Technical Expertise Employee Pushback Limited Budget	<ul> <li>More than 5,000 Employees</li> <li>1. Lack of Expertise to Lead Digitization Initiatives</li> <li>2. Organizational Structure Gets in the Way</li> <li>3. No Overarching Strategy for Digitization</li> <li>4. Limited Access to the Required Technical Expertise</li> <li>5. Employee Pushback</li> </ul>	

Figure 2.8: The top five Digital Transformation challenges (Jabil, 2017)

In the following section will focus on some of those challenges like employee pushback, organizational structure, Lack of overall Digitization strategy and limited budget. It will also be discussed another new challenge that enterprises faces now, which is related to the IT challenges (Cyber Attacks) and how the new European union tries to solve it by updating the General Data Protection Regulation (GDPR).

#### **2.3.1** Company Strategy and Organizational Structure

One of the main problems that faces big enterprises is that those big firms just try to implement the Digital Transformation journey on an individual business unit or just one individual department, for some internal reasons. In that case, it will not reach the maximum efficiency that could be reached if the whole business was transformed. At the same time, it will lead to some problems in the future when starting to transform another department. For example it will need to double some work which it could be done once from the beginning (Ex: system integration costs). (Jabil, 2017)

In that case, it is like developing a very powerful engine for a race vehicle, but using a heavy body structure and traditional driving control system at the same time. At the end, it will not be able to use that powerful engine in its highest efficiency to get the maximum power and speed, so it will not show the expected results. That is why the whole system has to be developed and optimized together to get the maximum efficiency and reach the target goal.

The whole enterprise should be working towards a clear wide strategy and a common goal to transform the whole enterprise, not just one department. That target can be achieved by planning and executing a detailed structured plan, that plan can be performed by a third party experienced consultancy (Ex: Accenture, Deloitte) which has a good technical and managerial experiences in digital transformation.

The transformation plan should include the execution time-line to involve all departments, and in most cases, it requires some changes in the main organizational structures, employees' daily routines, changing roles and departments. Therefore, those changes have to be considered and be expected from the beginning.

#### **2.3.2 Employees Pushback**

Naturally, humans like to stay in the comfort zone and experiencing a transformation is discomfort for majority of employees who are working for the enterprise for years and know exactly how the system and everything is working in the enterprise. It may make employees feel threatened when they see that everything is changing around them, organizational structures, daily routines, roles, departments and introducing new platforms. (Jabil, 2017)

Therefore, it is extremely important to prepare and qualify the current employees to be involved in that change by considering them as a vital part of the Digital Transformation plan. The Digital Transformation plan has to include a clear structured plan to qualify the current employees to be involved in the new challenge by organizing workshops, motivation, explaining to them the main goal and how the Digital Transformation is vital to the company for targets and competences.

At the same time providing them with training sessions helps to explain the new working environment and how they can collaborate using the new platforms. Subsequently, for hiring new employees in the future is will be much easier, as the market has already changed and the new comers are more qualifying and accepting the new transformation. Therefore, it gives more flexibility to choose the best candidate for the targeted positions.

#### 2.3.3 Limited Budget

Budget is one of the main constraints that may limit the Digital Transformation progress. As the Digital Transformation requires new and substantial sets of tools and systems, it requires high investments. While building the strategy, will need to consider the budget as a reality situation of the enterprise and how much it can handle. This will help to develop a plan that involves several phases over a suitable period with a detailed business plan for all phases to make sure that this investment is going into the right direction and make sure to not put the enterprise at risk over budgetary issues during the transformation period. (Jabil, 2017)

Therefore, to perform a complete Digital Transformation plan needs to perform a detailed business plan and financial feasibility study. As it is obvious that the Digital Transformation needs high investments in most cases but at the same time it provides a

feasible payback period. So in that case the enterprise can manage it in a better way by asking for leasing or establishing a kind of partnership to get some fund if it is required.

### 2.3.4 Cyber Attacks and Data Privacy Regulations

As long as the technology is being more developed, hackers are becoming more dangerous as they are also developing cyber-attacks, which are more sophisticated. As In 2017, the biggest breach of the year at Equifax (one of the "Big Three" largest credit agencies), where cybercriminals accessed approximately 145.5 million U.S. citizen. Therefore, it is a big challenge for IT department, trying to be prepared for potential threats, revise and updating the current security strategy at the same rate of technology evolving or one-step beyond.

In addition, another challenge for the IT department is that it has to be prepared for the new Global Data Privacy Regulation (GDPR), which became enforceable beginning on 25 of May 2018. Therefore, enterprises that deal and manage data for individuals within the European Union (EU) and the European Economic Area (EEA) must be compliant with that new regulation or will be in a serious trouble otherwise. So all customer's information has to be managed in a proper way and complying with the new regulations.

The new GDPR introduced a lot of updated and modifications on the data privacy policy but it can be summarized the main points as following:

- 1. Privacy policies have to be written in a clear, straightforward language
- 2. The user will need to give an affirmative consent before his/her data can be used by a business.
- 3. Businesses will be able to collect and process data only for a well-defined purpose. They will have to inform the user about new purposes for processing
- 4. Businesses will have to inform users without delay in case of harmful data breach
- 5. Users will have a clearly defined "right to be forgotten" (right to erasure), with clear safeguards
- The 28 data protection authorities will have harmonized powers and will be able to impose fines to businesses up to 20 million EUR or 4% of a company's worldwide turnover (European Commission, 2018)

## 2.4 Enabling Technologies

Enabling technologies are the main pillars of Industry 4.0 and the tools for the Digital Transformation. Each enabling technology uses a lot of small technologies and tools, and each of those enabling technologies is connected and integrated together with each other, so it is almost impossible to use one separate pillar alone.

For example to use IoT technologies small tools and special technologies (Ex: RFID, NFC) need to be used. In addition providing a platform to collect and store the information (Ex: Cloud solution, local Hub) at the same time to have a machine learning algorithm to manage those information and make actions. (Gubbi, Buyyab, Marusic, & Palaniswami, 2013)

Therefore, in the following part the will focus on two of the main Enabling Technologies by highlighting it and explain how those technologies are working in an integrated system.

### 2.4.1 Internet of Things (IoT)

IoT is one of the core pillars of Industry 4.0. The actual idea of connected devices had evolved at least in the 70s. Back then, the idea was often called "Embedded Internet" or "pervasive computing" and some contribution (Ex: Automated Teller Machine"ATM" in 1967, connected coke machine in1982) which was a truly game-changing technology entered the marketplace (Smith, 2015)

The term "Internet of Things" was coined by <u>Kevin Ashton</u> who is known as "the father of IoT" in 1999 during his work at Procter&Gamble. He was working in supply chain optimization, wanted to attract senior management's attention to a new exciting technology called RFID, so he called his presentation "Internet of Things" to grab the interest of some P&G executives. From that date, the term Internet of Things started to be known. (Lueth, n.d.)

In general, there are other terms that have been proposed similar to IoT but exist some small differences between the scopes between those terms, which have been developed along the years. Some of those main terms is the Internet of Everything (IoE) or "embedded internet" which aims to include all sorts of connections that can be imagined. Moreover, the

second term is M2M (Machine to machine), which mainly focuses on linking one machine to another.

In fact, the definition of Internet of things (IoT) has a wider reach as it also includes connections beyond the industrial context such as wearable devices on people. Therefore, "Internet of Things" is the most popular term in describing this new interconnected world. The scopes of those terms and how they are related to each other is shown in Figure 2.9.

![](_page_33_Figure_2.jpeg)

Figure 2.9: IoT vs. IoE Vs. others (Lueth, n.d.)

The concept of IoT started to get more popular in 2010, when information leaked that Google's Street View service had not only made 360-degree pictures but had also stored tons of data of people's Wi-Fi networks. In the same year, the Chinese government announced that Internet of Things will be the a strategic priority in their Five-Year-Plan, and later on in October 2013, IDC published a report stating that the Internet of Things would be a \$8.9 trillion market in 2020. (Lueth, n.d.)

Simply, IoT means Internet of things, while "Things" means all objects that can be connected to the internet. However, the main goal of IoT is not just to connect all devices together through internet. However, it can consider connecting it all to the internet is the first essential tool, then after connecting all devices together can communicate between each other. Nevertheless, it is required that the connected devices to have the ability to sense and emit information to a specific cloud which connects all connected devices. It can also perform the required processing processes in the cloud based on the shared data using different modes as Artificial Intelligence (AI) using some high sophisticated algorithms or can use some sort of programmable control to perform some tasks and automatize the operations.

So the system will be simple, as the smart devices are connecting together through Cloud solution where it manages receiving and processing the extracted information through some algorithms, then sending orders/actions to all the connected devices. Figure 2.10 represents the main pillars of IoT, which are the Chip Miniaturization Technology that is used to send and receive information, while the second pillar is the Cloud solution which is used to connect all devices and store data, and the third pillar is the Machine Learning algorithm which is used to perform the analysis and processing processes.

![](_page_34_Figure_2.jpeg)

*Figure 2.10: IoT main pillars* (Source: www.cloudwards.net)

In the current period not all connected devices are able to sense, send, receive and manipulate. As long as there are some devices that only sense and send information and other devices just work as manipulators, but the basic thing that should be common is that all those devices have to be connected to the same cloud.

IoT usually needs a network to connect all devices together through internet, but in some special cases it can work in the offline mode. As in some applications that take place in rural communities or does not have a reliable internet connection, so in that case it can manage IoT in offline way (without internet). Using some alternative methods, the basic one is collecting data into a logging device, then using a memory stick transporting it to another location where it can be analyzed. Other methods are using Low Power Wide Area Network (LoRaWAN) or a long-distance device connectivity network built on Unstructured Supplementary Service Data (USSD) messaging, which offers secure IoT connectivity without the Internet being involved at all. (Farnell element14, 2018)

### 2.4.2 Artificial Intelligence

Artificial Intelligence can be considered as the umbrella under which Machine Learning (ML) and Deep Learning (DL) comes, as it is expresses in Figure 2.11.

![](_page_35_Figure_3.jpeg)

Figure 2.11: Artificial Intelligence vs. Machine Learning vs. Deep Learning (Touger, 2018)

Starting from Machine Learning, which can by defined Stanford University as "Machine learning is the science of getting computers to act without being explicitly programmed". Therefore, it is a subset of AI, which uses statistical methods to enable machines to improve with experience. It enables a computer to act and take data driven decisions to carry out a certain task. These programs or algorithms are designed in a way it can learn and improve over time when being exposed to new data. (Singh, 2018)

Then can define the Deep learning as it is defined by the Machine Learning Mastery as "Deep Learning is a subfield of machine learning concerned with algorithms inspired by the structure and function of the brain called artificial neural networks"

It's a special kind of machine learning that simulate the functionality of our brain cells called neurons which lead to the concept of artificial neural network(ANN), which is
modeled using layers of artificial neurons or computational units to receive input and apply an activation function along with threshold. (Singh, 2018)

By focusing more on the Artificial Intelligence term, which consists of two words:

- Artificial, which means something that is not real or it can be considered as simulated. For example the artificial grass, which is used to substitute the real grass in some applications,
- Intelligence: Is a are very complex term and always can refer it to human intelligence or in general as a natural intelligence (NI). It includes the most important ways of intelligence like logic, understanding, self-awareness, learning, emotional knowledge, planning, creativity and of course problem solving.

Therefore, Artificial Intelligence (AI) refers to a subfield of Computer Science. It is acted by a combination of machines, computers and many software to use some kind of cognitive function based on environment observations, which used to be a learning process.

The history of Artificial Intelligence started around 100 years ago. As the first introduction of the field of the artificial intelligence was in 1920 by the Czech writer Karel Čapek who published a science fiction play named Rossumovi Univerzální Roboti (Rossum's Universal Robots). The play talked about a factory, which uses artificial people named robots that represent the living creatures, who are more similar to the term of clones. The robots in R.U.R. first worked for the humans, but then there comes a robot rebellion which leads to the extinction of the human race. (Schultebraucks, 2018)

Therefore, it was not a real artificial intelligence, but it can be considered as the first introduction of what it will be called later as Artificial Intelligence. Nevertheless, the 1<sup>st</sup> real contribution in the field of artificial intelligence done by Alan Turing, who was born on 23th of June in 1912 in London. (Schultebraucks, 2018)

Alan Turing was widely known for his encrypted code of the enigma, which was used from Nazi Germany in communication. He presented his idea in the model of the Turing machine, which today is still a popular term in Computer Science. The Turing machine is an abstract machine, which can be explained in a simple way as it can construct any algorithm's logic. Because of discoveries in neurology, information theory and cybernetics in the same time researches and with them, Alan Turing created the idea of the possibility to build an electronic brain. After the end of World War 2 with some years, Turing introduced his widely known Turing Test, which considered as the first trial to define the machines intelligent. The idea was that a machine (Ex: Computer) can be called intelligent, if a machine (A) and a person (B) communicate through natural language and where a second person (C), a so-called elevator, cannot detect which of the communicators (A or B) is the machine as shown in Figure 2.12 (Schultebraucks, 2018)



(Schultebraucks, 2018)

Now, Artificial Intelligence is everywhere present and it will become another consistent thread in the tapestry of our lives, just like the internet and electricity. It also becomes increasingly a matter of international politics.

However, in the next years breakthroughs as well as continued excitement are expected. AI looks forward to a future where the machines not only do all the physical work, as they already almost do now since the industrial revolution, but also doing the "thinking" work, strategizing, and making decisions. It will lead to a glorious utopia, where humans will be free to spend their lives doing more meaningful pursuits. (Marr, 2018)

There are new trends that AI are developed now to take part in like Speech Recognition (Ex: Siri) to develop a system that can understand and communicate with humans through their voices. Another new technology that is used now is the so-called Virtual Agents (Ex: Chatbot) which is nothing more than a computer program capable of interacting with humans. At the same time, there are a lot of developed AI systems to work almost in all life fields like Digital Twin which is a software that can bridges the gap between physical systems and the digital world. Nowadays General Electric (GE) is using an AI workforce to monitor its aircraft engines, and gas turbines and predict failures with cloud-hosted software models. (Natalia Maynez, 2019)

Figure 2.13 shows the trend on Google search engine for both IoT and Artificial Intelligence key words in the last five years form (March 2014 until March 2019), it shows that the both trends are increasing in the trend but the people keen to know more about artificial intelligence which increasing it dramatically specially in the last three years.



Figure 2.13: IoT vs. Artificial intelligence trend comparison period march 2014- march 2019 (Source: Google trends)

### 2.4.3 Case Study: Autonomous Vehicles

This is probably the biggest thing to hit the auto industry since the first car came off the assembly line," said Sen. Gary Peters, D-Michigan, at a 2017 technology conference in Washington.

As today's vehicles include a dozen number of computer modules that manage everything inside the vehicle from air-fuel ratio to climate control, and as Tesla's announcement that every car in production will have the capability for full autonomy by 2018 or in another way by handing over the control of the vehicle to the computers.

Autonomous driving is something that everyone is talking about, but actually it is still not fully utilized in the market with 100% proved trust to move in streets and in all cities. So the main trend now it to customize the environment situation to use it in some special conditions.

In general most of car makers and new incomers (Ex: Google) are working in a competition to reach the target of fully autonomous vehicle. The working progress to reach the fully autonomous car is going through following levels which Experts have defined it as the five levels in the evolution of autonomous driving, as shown in in Figure 2.1 4.

Starting from level 0, which means "No Automation", where the driver controls everything in the vehicle without any support from a driver assistance system. (BMW, 2018)

Level 1 "driver assistance": It is very common nowadays using the driver assistance systems in almost all new models to ensure additional safety and comfort. Examples of this includes the Active Cruise Control with some functions, which automatically adjusts the distance between the vehicles in front, at the same time some extra features as the Collision and Pedestrian Warning with City Brake Activation (Reese, 2016)

Level 2 "Partly Automated Driving (PAD)": Using some advanced features like cruise control and lane centering. It means that the "driver is not involved anymore in physically operating of the vehicle by having his or her hands off the steering wheel also his foot off pedal at the same time but the driver must still ready to take control of the vehicle. (Reese, 2016)

Level 3 "Highly Automated Driving": Drivers are able to completely delegate the "safety-critical functions" to the vehicle under certain traffic or environmental condition but the drivers are still necessary. It means that the driver is still present and has to intervene if it is necessary, but it is not required to monitor the situation in the same way of level 2 (Reese, 2016)

Level 4 "Fully Automated Driving": Is designed to perform all safety, critical driving functions and monitor roadway conditions. However, it is important to note that this is limited to the "operational design domain (ODD)" of the vehicle, so it does not cover every driving scenario. (Reese, 2016)

Level 5," Full Automation": It represents the car that can drive without any human interaction. This refers to a fully autonomous system that should be equal to a human driver in all driving scenarios and conditions, even in extreme environments (Reese, 2016).



Figure 2.14: Autonomous driving five levels evolution (BMW, 2018)

So now, the new requirements lead new comers to enter the automotive industry. For example, google by introducing its new autonomous vehicle brand Waymo with a partnership with some auto carmakers. Therefore, it is expected that in the following few years the automotive industry will reshape its partnerships and targets.

# 2.5 Case Study: FCA Cassino Plant

Cassino Plant started its operation in 1972 with the production of the Fiat 126 from 1972 to 1978, and then the production switched to the Fiat Ritmo. Since then, Cassino has specialized in the production of compact and mid-size models (C and D segment), such as the Fiat Tipo, Tempra, Marea, Bravo/Brava and Stilo. From 2007, the new Bravo, then the Lancia Delta and Alfa Romeo Giulietta. From 2005 to 2010, the plant also produced the Fiat Croma. (FCA)

In 1988, the plant underwent a major transformation with the introduction of automation for the most difficult and physically strenuous tasks. Since then, Cassino has consistently been at the leading edge of technological innovation. The Paint Shop, for example, is one of the most advanced in the world following the recent introduction of innovative "dry scrubbing" technology in the primer booths.

The plant has been transformed into a premium plant for the production of premium cars with the decision to allocate production of the new Alfa Romeo models (Ex: Quadrifoglio Avenue) to Cassino, beginning with the all-new Giulia. In addition, Cassino plant uses its innovative technologies, advanced processes and highly qualified people enable it to produce exceptional cars. The plant now has a total surface area of two million square meters, including a covered area of 550,000 square meters. Production capacity is around 1,000 cars per day and, over its history, the plant has produced more than 7 million cars. Figure 2.15 shows a line of finished Alfa Romeo Quadrifoglio cars out from the production line. (FCA)



Figure 2.15: Alfa Romeo Quadrifoglio (FCA)

Now the plant is considered as the best practice of FCA in Digital transformation, as it is almost full-automatized plant with nearly 1,300 robots in the body shop facility and more than 6,000 connected devices optimizing collaboration and integration between all working systems inside the plant., and having more than 15,000 best practices adopted on the production line. Figure 2.16 shows a group of robots working an Alfa Romeo car in the body shop facility. (FCA)



*Figure 2.16: Robots working on a manufacturing process in Cassino Plant (FCA)* 

At the same time, FCA introduced the latest wearable devices technologies to manage the operations and improve the communication system between working teams and facilitates the operations by having the instructions of all operations on the move by as the assembly line staff use it to manage the process operations. It is totally integrated with the FCA MES (Manufacturing Execution System) IT system that controls the entire production system using the smart watch, as shown in figure 2.17.



Figure 2.17: Smartwatch used in Cassino Plant (FCA)

The plant also uses an integrated internal management system to manage the production processes and operations inside the plants, and using the Human Machine Interface technology (HMI) touchscreen eBoards in strategic points to show production performance to have a quick and interactive way to do operations & alerts are generated with immediate response, as shown in Figure 2.18

Also the plant employs advanced ICT solutions called NPL (New Plant Landscape) to help rapid decision-making at all levels of the value chain, as it is the biggest challenge in Automotive Industry nowadays.



Figure 2.18: HMI Screen used in Cassino Plant (FCA)

Cassino plant is also considered as a "world Class Sustainable Plant" because with the application of the World Class Manufacturing methodology and the use of the most advanced automotive production systems. It is a benchmark in terms of systems, people and environmental performance, as zero industrial waste has been produced since 2000. It also produces about 3 megawatt by using solar panels. (FCA)

# 2.6 Case Studies: Simple Digital solutions in Dealerships

As most of OEMs are trying to introduce the industry 4.0 in the automotive aftersales, some new features already had been lunched or developed by the main OEMs to be launched in the next period. In the following section some case studies of introduced features by the OEMs to enhance the customer experience during the customer journey inside the dealership will be highlighted.

**Booking process:** some OEMs like BMW and Mercedes started to use their new connected car features Connected Drive and Connect Me, respectively to manage automatically the service center appointment as the new connected car features already can constantly monitoring and diagnosing the vehicle's health. (Accenture, 2018)

In the other hand there are some brands already added a booking feature to their mobile application as Audi (My Audi), Kia (remote assistant), Volvo (Volvo on call) and Volkswagen (Car-net), so it became much easier for the customers to make a booking operation (Accenture, 2018)

**Reception:** BMW already uses an automatic recognition of vehicle/ Customers to retrieve the related information through the connected systems and database in a faster way.

In addition, most of OEMs now have their write up tools, which accelerate the reception process dramatically and can open and manage job orders in a reliable way (Accenture, 2018)

**Maintenance operations:** Both Audi and Nissan started to launch a new system, which is named Audi Cam and eVISION, respectively. Used for filming the process the vehicle inspection and sharing it with the customers via email along with the quotation.

In addition, some other brands like BMW and Volkswagen started to introduce the wearables to be used by the technicians to guide and support them remotely during the service operations (Accenture, 2018)

**Handover:** Mercedes pay is a new digital payment platform (leveraging blockchain technology) to provide a secure payment to the customer and enriches the customer experience with an easy access mobility service (Accenture, 2018)

# Chapter 3: MOPAR ANALYSIS AND MAPPING

As shown in the previous literature review and analysis in Chapter two of the Automotive Aftersales industry and the current horizons and possibilities of the current ICT technologies by using the Enabling Technologies which are explained in Chapter two. Mopar as a market leader is working all the time to improve their offered services and offer the best service to their customers. Therefore, it is essential to evaluate the current offered services to the customer and how much it satisfies the customer's demand, the management systems, offered tools, and compare it with the other main OEMs players (Benchmarking). Based on that analysis it will launch the "Dealer Digital transformation" initiative, which will be the starting point for a continuous improvement of the Automotive Aftersales market in the future. It is aimed to digitalize and automate the Aftersales dealerships by using the available Enabling Technologies of Industry 4.0

In Chapter three and Chapter four the discussion will be straight forward focusing mainly on the implementation method and methodology of how the new processes and devices will operate, as all the literatures and technologies are already explained in Chapter two in detail.

# 3.1 Model Assessment (Mopar Mapping & Concept)

Automotive Dealership is one of the places where it changes quickly over time with a continuous development rate to adapt with the life style and new technologies to offer a highlevel customer service experience by introducing new services, tools, systems to manage the high variabilities that the automotive industry has now.

"The auto industry is poised for more change in the next five to ten years than as it has been seen in the past 50."

(Mary Barra, CEO, General Motors)

Firstly will start by analyzing Mopar dealership structure model as it is shown in Figure 3.1, and will explain the target and operations inside each department.



Figure 3.1: Dealership Structure Diagram (Source: Composed by author, 2019)

**Retail:** It representing the connecting point between the customer and the dealership management as it represents the interface of the brand. It contains a variety of activities starting from reception, booking and the waiting area ends with the Payment and vehicle handover. Therefore, it is one of the main phases, which has a direct effect on the customer experience. (Mopar, 2017)

**Warehouse:** The department that is considered as an offline department regarding to customer experience, but its role is very important in dealership management by holding and managing inventories to keep a high service level in the workshop and maintain the workshop operation by minimizing out of stock items for spare parts or accessories. In addition, its management to quick picking up upon receiving a new order also improves the workshop efficiency and decreases the repair delay time. (Mopar, 2017)

**The Workshop:** Representing the core business of the dealership which holds all repairing activities and deals with all interventions (Ex: mechanical, electrical, body shop, etc.). So this department is divided into zones based on the intervention category and each zone is equipped with the required tools and equipment (Ex: lifts, tools cart, etc.). (Mopar, 2017)

In addition, the presence of the workshop manager and quality control manager in the workshop is necessary to monitor all the repairing processes and performing the quality control process. The proces flow inside the workshop can be represented in Figure 3.2



Figure 3.2: Workshop Main Phases Flow Chart (Source: Composed by author, 2019)

The Workshop in the dealership usually represents the main traditional Workshop, where all repairing activities take place (Ex: Periodic Maintenance). It will be explained in details in the following section

#### **3.1.1 Main Workshop (AS-IS Model Analysis)**

It is the main traditional service offered by the dealership, which represents all dealership activities (Ex: Reception, Warehouse, Workshop and management system). Starting from receiving Customer's request for repairing process till handover the vehicle back to the customer after completing all maintenance operations.

Therefore this section will focus only on analyzing the customer experience in the dealership and the working process in the dealership after receiving a maintenance request from the customer till handover of the vehicle back to the customer, which represents all interactions and communications between all stakeholders inside the dealership.

#### **Main Workshop Process Flow**

As shown in Figure 3.3 and 3.4, the working process of the traditional workshop starts with receiving a Customer call to book an appointment through calling a call center operator, who performs the booking process by receiving the claims, personal and vehicle information. Then appointment is being arranged based on the dealership calendar using DMS and a confirmation for the appointment with the customer.

Customers should arrive to the service center on time according to the appointment. Then the Service Advisor receives all the details from the customer about the required claims and proceeds the check-in procedures using WiADVISOR. It is an FCA reception write up Tool (Electronic Tablet) which is used to check and confirm all details through an integrated online system with other different FCA databases to check Available spare parts, Warranty, and all other required information then create an electronic job card on the Dealer management System (DMS). (Mopar, 2017)

Customers in that moment (After Check- in) can ask for a courtesy car in case it is needed by following a certain internal process. At the same time, the Warehouse receives directly a Pre-Picking order of the requested items (Spare parts/Accessories) for each Job order to pick it up and waits the Technician to receive the requested items for his dedicated Job order. (Mopar, 2017)

In the other hand, the Workshop manager receives directly the electronic Job card or the printed one (based on the dealership system) and assigns each job to a technician to perform it, based on each job description, availability and expertise of each technician.

The Technician later receives a printed Job Card assigned to him from the Workshop Manager, so he can start the job-setup process by Setup the vehicle on the lift and Pick the required Spare parts/Accessories from the warehouse and then starts working on the repairing process. (Mopar, 2017)

The first repairing process in the workshop is done by using WiTECH 2.0 (FCA Diagnostics Tool) to perform a vehicle diagnose (can be performed by a dedicated technician for check-up). Then the required repair done by the dedicated technician who has beed assigned for that specific job order based on his specialization, then updates the Job card and confirms completing the required work in case that there are still missing repair processes required from another department (Ex: Body shop). So the technician will send the vehicle to that department or confirms the completed Job order and sends it to the workshop manager.

In some Dealership Technicians use a time keeping device (Ex: Marca tempo) to update the DMS of the operating time (Job start and Job End timestamp) of each Job /intervention to help to measure workshop utilization.

The Workshop Manager assigns the vehicle to the Quality Manager to perform the Quality Control process after the repairing process is finished. The Quality Control procedures are varies based on the type of claims, then the workshop manager approve the repairing process and send the vehicle back to Reception area. (Mopar, 2017)

The Service Advisor updates the customer after completing the repairing process to follow the check-out procedure by performing the payment at the casher (Payment methods may differ based on the dealership system). (Mopar, 2017)



Figure 3.4: Customer Experience through the Traditional Workshop (Source: Composed by author, 2019)

Legend Information Flow – Physical Flow –

	NOT DEFINED			
Customer	Waiting			
Call Center Booking				
Service Advisor	heck-In Payment/ Check-out			
Warehouse	Pre-Picking			
Workshop Manager				
Technician	Job Order			
Delay (Check-In / Repair Start)				

Figure 3.5: Main Workshop (AS-IS Model) (Source: Composed by author, 2019)

### 3.1.2 Mopar Express Lane (AS-IS Model Analysis)

Regards to the new life style, customer demands have changed, which requires a quicker service with transparent prices and process time, which gives the customer the possibility to control and monitor it easily. Those new demands lead most of OEMs and independent service centers to adapt a quick service facility inside their service center to attract those customers.



Figure 3.6: Mopar Express Lane advertisement (Source: Mopar advertisement materials)

So it has been introduced a new type or workshop which represents a fast service. As well as in the last few years this workshop mainly designed for quick and repetitive services, which has become more popular (Ex: Oil Change) without the need of previous booking, and it is called in Mopar as Express Lane as shown in Figure 3.5 for an advertisements of the services in a dealership

**Mopar Express Lane (MEL)** can be defined as a dedicated service lane for fast, convenient, high-quality oil changes and other light-duty maintenance, performed in 30 minutes or less in NAFTA Region and 60 minutes or less in EMEA Region and it does not need any previous Appointments. (Mopar, 2018)

MEL reduces process variability by adding some limitations like predefined list of the offered services and process time for each service. At the same time, it offers some new features to the customer (Ex: No previous booking required).

In the following section the current AS-IS model of MEL for Stand-Alone Model (**Note:** Mopar Express Lane has different models, which make it compatible with all Dealerships, therefore in this study will focus only on the stand-Alone Model) will be presented.

In EMEA region, MEL is not presented in all dealerships and it is in roll out phase to be implemented so there are three different Implementation Layouts (In dealer facilities) to make it more flexible for dealers while selecting the most suitable one for their facility. Those three layouts are explained briefly in Figure 3.6.



Figure 3.7: Mopar Express Lane Implementation Layouts (Source: FCA internal documentation)

#### **MEL Process Flow (Layout A: Stand Alone)**

For simplicity will focus on model A (standalone) only in our study. In Mopar Express Lane, it is not needed to make a previous booking but working with the strategy of first come and first serve.

Figure 3.7 and 3.8 represents the customer experience journey during Mopar Express Lane, starting from the arrival to the service center waiting the service advisor, as the working strategy is first come first serve. In case of the required maintenance service is already listed in the MEL service list and the total working time is less than 60 minutes, the customer will be oriented to Mopar Express Lane service, otherwise it will be oriented to the normal workshop.

Then the service advisor perform the check-in process and creates a Job Card perform the check-in process by using the WiADVISOR. After that, the customer will relax in the waiting room, while the service advisor will proceed with the Job Order by sending it to both the technician and the warehouse to prepare the spare parts.

At the same time, the Technician receives a printed Job Card and Pre-Picking order assigned to his lift directly after the creation of the Job Card. Then the technician will Pick and Setup-up the vehicle on the lift and Pick the required Spare parts/Accessories from the built-in warehouse in the same workshop, After the setup of the vehicle the technician starts the repairing process by using WiTECH 2.0 to perform a quick vehicle diagnose and then continues with the repairing process. After completing the repair process the technician updates the printed Job Card and sends it back to the service advisor.

Quality Control process is usually performed locally by the Technician or the service advisor as all interventions performed at the MEL are simple and not critical or it may be performed by sharing the Quality manager with the main workshop and follows the same quality control procedures as the main workshop.

During the waiting period, the customer can get updates from the service advisor in case of any other intervention operations are requested from the technician and required to be performed, and the customer can approve it.

Later on, The Service Advisor updates the customer after the completing the repairing process with the final cost to perform the payment and check out procedure at the casher (Payment methods may differ based on the dealership).



Figure 3.8: Customer Experience through MOPAR Express Lane- Layout A (Source: Composed by author, 2019)



Figure 3.9: MOPAR EXPRESS LANE Layout A (Source: Composed by author, 2019) Table 3.1 illustrates the main differences between the traditional /main workshop and the new model Mopar Express Lane (MEL) and indicating the features that the customer can get in case of using MEL.

	Traditional Workshop	MOPAR Express Lane (MEL)
Booking Required	✓	×
Available Services	All Services	Predefined specific List
Service Time Frame	Unlimited	Maximum 60 Minutes
Warehouse	Separate facility	Built-In (Small stock)
Process Variability	High	Low

Table 3.1: Comparison between the Traditional Workshop and MEL (Source: Composed by author, 2019

# 3.1.3 Main Workshop Devices

#### WiADVISOR (FCA reception write up Tool)

WiADVISOR is one of the main dealership tools nowadays as each OEM has its own write up tool, or uses a 3rd party write up tool which covers some brands at the same time. Reception write up tools have become an essential tool for Automotive Aftersales industry in general as the industry became more complicated and many brands got introduced. It helps to save more time and



Figure 3.10: WiADVISOR (Source: FCA advertisement materials)

organizes the work in the Dealer management system (DMS). So FCA developed its own reception write up tool as shown in Figure 3.9, which covers all the information about all its brands (Ex: JEEP, Fiat). (Mopar, 2014)

It is used in the first step in the reception by Inserting Vehicle Information (Ex: Plate Number/ VIN), and it shows all connected databases for that vehicle and the customer

Personal Information (Name/ Mobile/ Email) and gives the opportunity to Update it. In the next steps, it shows all available maintenance operations (Ex: Preventive maintenance, oil change) so the service advisor chooses the required intervention and adds extra intervention if it is required. After confirming all the required intervention, the WiADVISOR creates a job card automatically in the Dealer Management System (DMS), so the workshop receives it and performs the next steps inside the workshop. (Mopar, 2014)

Therefore, WiADVISOR is considered as the first step in the digital dealership concept, as it is a connected device and efficient tool to facilitate the check-in procedure, which guarantees the customer engagement and transparency, also to check and update all information in a real-time working base.

Figure 3.10 and figure 3.11 illustrate how the WiADVISOR manages to connect many integrated databases at the same time to extract and update information in a real time, which reduces much effort and time to do it manually as it was before. As the service advisor can check the warranty management system directly after inserting the vehicle information, it also confirms that the required spare parts are already available in the warehouse or not, all that in a real time. (Mopar, 2014)



Figure 3.11: WiADVISOR Main Dashboard (Source: Screenshot from the software)



Figure 3.12: WiADVISOR integrated databases (Source: Composed by author, 2019

#### WiTECH 2.0 (FCA Diagnostics Tool)

Nowadays as the new vehicles are more sophisticated especially in electrical and electronics parts, which contains a huge number of sensors and small devices so it became more difficult to diagnoses it by using old style, so it became an essential to have a smarter device to read and diagnoses those new vehicles.

As a result, almost all OEMs have their own diagnostics tool or use third party diagnostics tools, which cover some brands as it is considered as a part of the new evolution of the automotive workshop. It is also considered as a part of moving forward to the connecting workshop concept.

FCA brands developed its own diagnostics tool (WiTECH 2.0), which works by connecting a device to the vehicle computer and then can connect wirelessly to extract all vehicle data and visualize all vehicle's systems, so it can interact with that information through two different dashboard as following

- Action Items: Review all critical information that will give a good idea of the overall health of the vehicle.
- ECU Home: contains access to all the operations that can be performed within the scope of a targeted.

Based on that it can locate the parts that need to be fixed. It shows also the required repair procedures. Therefore, WiTECH 2.0 works as an efficient tool to facilitate vehicle diagnose procedure by using a real time connected database for catalogues and maintenance procedures. Nowadays some OEMs like BOSCH and BMW are trying to involve some extra features as Augmented Reality into their diagnostics tools to teach the technician how the work can be performed in a new interactive way.

Figure 3.12 shows a screenshot from the WiTECH dashboard showing all systems that can be identified and diagnosed in a simple way to have a full monitoring in one screen.



Figure 3.14: wiTECH interface (Source: Screenshot from the software)

# 3.2 Challenges and opportunities

This phase represents the starting point of shaping the final solution, starting with extracting all challenges and difficulties, which needed to be fixed, as it affects both the Customer Experience (CX) and the Dealership management system.

In this phase, will need to use some extra tools to extract some information regards to how the customer evaluates the service and what they really need from their point of view. Therefore will start with a focus group interviews with all stakeholders (Ex: Customers, Dealership Management), Customer Surveys and using Third parties reports and studies.

Therefore, by using those tools can identify the main challenges which are affecting the Dealership and Customer Experience, as shown in Table 3.2.

Management Challenges	Customer Challenges	
Engagement:	Engagement & Booking:	
Using old and less effective tools to reach the	Bureaucratic and old style booking system by	
customer (Telephone/Static Website).	phone call, also communicate channels with	
	the dealership through the Telephone/ Static	
	Website	
Workshop Monitoring:	Transparency:	
Does not have a full monitoring of all	Customer just receive an estimated Cost and	
operations in the workshop.	process time at the beginning, which may	
	differ through the working progress and	
	Customer has to approve the new cost in each	
	stage if there are any new	
Lifts Utilization:		
There is no tool to monitor and optimize all		
lifts utilization in the workshop		
automatically		

#### Table 3.2: Dealership main challenges (Source: Composed by author, 2019)

Based on the previous studies and analysis of the current Automotive Aftersales, many opportunities can be identified, not only to deal with the current challenges, but also thanks to the current Industry 4.0 Enabling Technologies can enhance the way of offering services as shown in Figure 3.13 (IBM Center for Applied Insights)



Figure 3.15: OEMs strategic options (IBM Center for Applied Insights)

Including all management and technical operations inside the service center dealership and its communication with the headquarter. Also at the same time it will enhance the Customer Experience (CX) as All Customers interactions with the dealership will be digital and monitored in a real time base.

# 3.3 Benchmarking of Digital Automotive Aftersales

It is an essential phase in developing the final solution by comparing the main features of the digital solutions available between all competitors in Automotive Aftersales dealerships nowadays (OEMs and main independent service center).

Before to start the Benchmark some points needed to be clarified regards the digitalization in Automotive Aftersales, as following:

- Until now there is no full standard digital dealership which implements transformation in all dealership processes and customer interactions.
- Digital Transformation is implemented by all OEMs and independent workshops but with different scales (Ex: Reception Write-up tools).
- Usually for the same OEM can find some technologies which are implemented in one dealership and not implemented in another dealership even in the same market (Ex: DMS), based on the size of the dealership and the mandatory obligation statues of the introduced device or solution as part of dealership agreement.

Moreover, at the same time the study is limited within EMEA region only and using only the online-published information about the main competitors. Figure 3.14 shows how each sector in automotive industry is moving from offline towards the connected sector, as it has become the main trend now in new vehicles (vehicle usage), also in production as most of manufacturing plants working to be fully automated.

AUTOMOTIVE SECTOR	OFFLINE	CONNECTED
Production		0
Sales		0
Vehicle Usage		0
After Sales (Retails)		0
After Sales (Workshop)		OPPORTUNITY

Figure 3.16: progress of connectivity in automotive sectors (Source: Composed by author, 2019

At the same time for car sales which nowadays changed too much from the classical sales way to online websites. However, here will focus mainly on the Aftersales Retails and workshop to explore the main new technologies that Mopar and its competitors are using to move towards the connected workshop concept.

### 3.3.1 Benchmarking (Reception)

In Figure 3.15 will see the main used technological tools in the automotive reception nowadays and it is noticeable that Mopar is already competing in both the reception devices by its write up tool (WiADVISOR) which already has main required features to perform the reception process and to create the Job Card automatically as shown in Figure 3.15. Generally, each OEM has its own internal system to manage its own databases (Ex: Warranty, Warehouse)



(Source: Composed by author, 2019

The only service that is considered as outstanding now is BOSCH digital workshop concept which introduced mobile application for online booking, monitoring the maintenance processes and has some extra features which give the customer a better customer experience (till now it is not officially implemented in EMEA region).

### 3.3.2 Benchmarking (Workshop)

Inside the automotive workshop, there is a big competition, as it is the main business target to reduce the cost by improving the work efficiency and at the same time, it needs to monitor everything to measure the workshop performance KPIs. So we can see in Figure 3.16 that almost all OEMs has its own diagnostics devices as Mopar has its own device (WiTECH 2.0).

At the same time, can see that BMW group has a partnership with Accenture to introduce the Augmented Reality to help the technicians inside the workshop. There are also some other brands working to improve the same solution (Mopar already has been using augmented reality in its digital store in Torino but in sales not inside the workshop).

BOSCH is working on digital workshop concept to enrich its customer experience as discussed previously. It is also developing a new IoT system which is called connected workshop as its main target is to connect all tools and devices inside the workshop and have a kind of communication between all devices and extract those information in real time.



Figure 3.18: Benchmarking Automotive Workshop "Sample" (Source: Composed by author, 2019

# Chapter 4: MOPAR WORKSHOP 4.0

According to the previous analysis in chapter three, a new model can be introduced to fix the detected problems and make use of the available opportunities. The new model will be introduced as a full-integrated solution starting from the engagement until the payment process to give the customer a special customer experience and at the same time manages the dealership in the best way and increases its workshop KPIs.

# 4.1 TO-BE Model

The new model is based on IoT solution by introducing new devices and tools, which will be used to manage the work as shown in Figure 4.1. And it will called as Mopar Workshop 4.0.

The solution will focus mainly on introducing new IoT devices which will be integrated together and with the current systems and databases through a cloud solution to have a fully integrated system. So the new model can manage, monitor and analyze all information automatically in a real-time to offer a new customer experience and at the same time it will autonomous the work inside the dealership and generate more precise workshop KPIs reports.



Figure 4.1: Figure 32: MOPAR Workshop 4.0 model (Source: Composed by author, 2019)

### 4.2 Mopar Workshop 4.0 Process flow

Mopar Workshop 4.0 has introduced a full-integrated system based on IoT technology accompanied with new devices and tools which helps in that transformation from AS-IS model to a fully digital model. As it is shown in Figure 4.2 and Figure 4.3

Therefore, the first transformed process is the booking an appointment as it was performed by a direct telephone call to book a slot in the dealership calendar, but in the new model it will substituted with an Online Platform (Mobile App. / Website) for remote booking also at the same time it reduces load on Call Center operators.

At the same time the Online Platform (Mobile App. / Website) will be used for more interactive engagement so the Customer can create a personal profile, navigate offered services details, prices and receive Communications (Ex: Recall Campaign) and this will help the Dealership to use it as a direct Communications channel with customers (Ex: Promotions).

The second transformed process is the Check-In process, which performed directly after the arrival of the customer to the service center and waiting a service advisor to help him, but in the new model, the customer can perform a self-check-in process using the new TOTEM instead. As it has a simple interface to help the customer to perform the process alone, then the customer will use the new integrated key locker to leave the keys for the technician. In case the customer needs extra information can send a request directly to the receptionist or the service advisor to ask for an extra help. So using the TOTEM will help for a quick and self-check-In at any time, it will also reduce the working load on service advisors.

The warehouse operator will receive a notification directly by using a smartwatch to review/confirm the pre-picking order instantly after customer check in (on the move) to save more time, also the warehouse operator can use it to communicate with management and the working team.

At the same time, the technician will use a Smartwatch to receive/confirm the Job Orders instantly after customer check in to save more time and that smartwatch will be integrated with the Smart Lift to recognize the vehicle plate number and update repairing status in real time without any need of manual system update. During all those operations are performed the customer can use the new Mopar mobile application features to get a full real time process status of the maintenance operations and receive notification of payment request. So the customer can use in-app online payment feature or can choose to pay using POS in the dealership and receive the keys back from the key locker, which will work in that case as a self-check-out. Later on, an automatic Feedback form will be sent to customer to evaluate the customer experience and will be inserted in the database.

So by using the new IoT devices will help to integrate all connected systems to facilitate the work environment for employees and enhancing the customer experience as offering much flexible service to the customer through online engagement, booking, self-check-in and self-check-out and having a full real time monitoring and online in-app payment using the new Mopar online application.

At the same time, the new model will help the management of the dealership to have a full control on the workshop KPIs and an accurate real-time tracking of all operations inside the workshop (Ex: Lifts utilization) and can be accessed through the online dashboard from anywhere. In addition, it will improve the warehouse process speed and it will build a new communication channel between all teams. It also gives the opportunity of using all collected information to monitor main KPIs and generate customizable reports.



Figure 4.2: Customer Experience through MOPAR DIGITAL SERVICE LAB" AS ONE KEY DEALER (Source: Composed by author, 2019)
					Legend Information Flow Physical Flow	
	[			DEFINED		
Customer	$\mathbf{\rho}$	)-+[	W	aiting		<b>-</b>
Optional						
Mobile App./ Website Booking/ E	ngagement					
ТОТЕМ	- → Self Check-II	n/ Booking		]		Payment/ Check-out
Key Locker		Leave Vehi	cle's key	]	Retrieve Vehicl	e's key
					į	
Warehouse	9	Pre-Picking				
Technician	€ 1→	Job Order	Job Setup S.Parts Vel		Repair	
					9	
Workshop Manager				!		<u></u> _
		(Che	Delay eck-In / Repair S	tart)		

Figure 4.3: TO-BE Model (Source: Composed by author, 2019)

### 4.2.1 New IoT Devices

#### **TOTEM (Self-service tool)**

As part of the digital trend, TOTEMs became a very effective solution for some special jobs specially the repetitive reception work, so it will be introduced in the new Mopar digital workshop model to work as a Self-Booking for the customer upon arrival to the service center by using a customized Human Machine Interface (HMI). It can also use the built-in POS terminal to perform the payment process later.



Therefore the TOTEM will be a customer-oriented device, which will give the customer new customer experience to perform a Self-Booking and check-in by himself and create the job card automatically and for using Built-in POS terminal for payment.

At the same time it will help the dealership management system to manage and share the Job card information in a real time through the cloud, which will be used later to analyze the workshop performance.

#### **Smart Lift (add-on device)**

It is a patent device, which developed in Mopar to help in monitoring the left utilization in a fully Automatic mode.



By attaching the smart lift device on the lift it will perform the vehicle detection and license plate number recognition using a built-in camera and update automatically in a real time the live status of the lift utilization (busy-free). Then based on the shared cloud with the TOTEM will update automatically job start/job end timestamp for each Job Order on the lift. Therefore, it will help the dealer management system to easily evaluate the workshop KPIs automatically without any uncertainty inserted manual data.

In the final model will install the smart lift on each working area (Ex: Diagnoses area) also at reception and parking Area to have a full monitoring and track of the vehicle routing inside the workshop, and can use those information to detect any potential process delay.

### **Smartwatch (Wearable Device)**

One of the main devices which became a powerful tool to facilitate and build a quick communication channels nowadays. After implementing its usage in FCA Cassino Plant it will be implemented again in Mopar new digital workshop model but it will be used in different mode to satisfy the working target.

At the same time it will be equipped with smartwatch management system to manage the storage and recharging the smartwatches, as it will be at the beginning of the shift all stakeholders (Service advisor, workshop manager, Technicians and warehouse) will use it to check-in and coupling their ID card with the Smartwatch.

Each employee will have a different interface with different features based on his job role and credential. So the warehouse receives and confirms Pre-Picking orders while Technicians can monitor the daily workload on his lift also to receive and confirm Job orders. At the same time, it will use the smartwatches as a quick on the move communication channel between the working team.

#### Dashboard

IoT is not just collecting and operating the system but also needs to represent that collected information which can be considered as Big Data in a structured way through a dashboard.

So by using a developed dashboard can help the dealership management to monitor all operations inside the workshop (Ex: Lifts status) also at the same time to generate quick reports for workshop performance or it can customize special report based on the work requirements.



#### **Mobile Application**

It will be a customer oriented device which helps in engagement between the customer and the service center, as the customer can use the mobile application to create an account by inserting the Personal Information (Name/ Mobile/ Email) and Vehicle information (Plate Number/ VIN), so he can receive promotions and service campaigns,

In addition the customer can review all offered services including cost and process time for each service and use the application for self-

booking instead of calling the call center to arrange an appointment also for monitoring all maintenance operations in a real time while the maintenance operations are performed and later can use online payment feature to pay directly through the app.

#### Key Locker

Customized key locker, which enables the customer to use it for keys exchange with the technician as it was before performed manually through the service advisor. Therefore, the key locker will enhance the digital solution by

eliminating the human interactions as the customer can perform all the operations by himself.

Simply after performing the check-in procedures through the TOTEM the customer will receive a code to activate the key locker to drop the keys in a specified slot and later on after the maintenance operations completed will receive a notification to receive the keys back from the key locker.





## 4.3 Business Model Canvas

The business model canvas is a simple physical chart representation of the business model, which is a strategic management and entrepreneurial tool. It allows to describe, design and pivot the business model. It has been developed by Alex Osterwalder and used to map exactly how the business will create revenues and works as a great tool to focus on what the business is looking to achieve. (Osterwalder, 2019)

The business model canvas is divided into nine blocks, expressed briefly in the following part, and can review a sample of Business Model Canvas which is developed during the thesis in Figure 4.5

**Value Propositions:** It represents what the new added value offered by the new system, by making a list of all the benefits that can be achieved by the new developed solution System, so for the current To-Be model can represent its value propositions and shown in Figure 4.4



Figure 4.4: Value Proposition (Management - Workers - Customer) (Source: Composed by author, 2019)

**Customer Segments:** It is one of the most important parts of the canvas. By indicating all potential customers and stakeholders whom would buy the new developed solution, or will be involved in any revenues from the new developed system.

**Channels:** Indicating how the new product will be delivered to the customers. It does not mean only delivering it physically, but also the communication channels with the customer which will be used to show up the product (Ex: Website), where the customer can review the product and decide to buy it. (Bartlett, 2016)

**Customer Relationships:** This section represents how to get the customers, how to keep them, and how they will grow. It will be affected also by the selected communication channels, which will help to improve customer relationships. (Bartlett, 2016)

**Revenue Streams:** It represents how will make money from the offered value proposition, and how much the customer will pay to get that offered values. In this model will use both direct sales model (Ex: Devices sales) and a subscription model (Ex: Dashboard subscription). (Bartlett, 2016)

**Key Resources:** The resources indicates all the available assets that can be used in the model to get reach the target and will help for successful implementation of the model. As the main key resources for Mopar are the patent of the smart lift, so it represent a very competitive resource, also have the FCA bank, so it will help in managing the financing part which represents the most important part of resources.

In addition, other resources will be used to manage the other prospective of the project from technical and marketing areas. (Bartlett, 2016)

**Key Partners:** It is a very important segment of the business model canvas to indicate all stakeholders who will help the business to grow and will handle the project with them to get the final product, so key partners can be considered as the suppliers of some parts and the FCA back who will help to manage together the financial issues (Bartlett, 2016)

**Key Activities:** It indicates the main activities that will be needed to reach the target and launch the final product, so it will include the production of some items, marketing campaigns, approvals and all other needed activities. (Bartlett, 2016)

**Cost Structure:** The cost structure is listing all what it is going to cost to start and to keep the business running, so it will be part of the financial assessment of details cost analysis of the investment and running costs also indicating any extra costs for partnerships.

Key Partners	Key Activities	Value Propositions		Customer Relationships	Customer Segments
Supplier: • Smart Lift • TOTEM • Screen • Smartwatch • Smartwatch Management System • Dashboard	<ul> <li>Devices &amp; Dashboard supplying</li> <li>Testing, Piloting</li> <li>Marketing &amp; Branding</li> <li>Business Case</li> <li>Mopar Approval</li> <li>Field Force involvement (Network)</li> <li>Customer service operations and Support</li> </ul>	<ul> <li>Management:</li> <li>Real Time Monitoring for all Works</li> <li>Remote Management and Full Tra operations</li> <li>Customized Dashboard for quick re the workshop and Workers</li> <li>Automated overtime alert to keep to process time</li> </ul>	hop Lifts ck of the main workshop eports to measure KPIs for rack of delays and optimize	<ul> <li>Trust and Loyalty</li> <li>Lock-In</li> </ul>	Customer: • MOPAR Official Dealers Users: → (Management) • Workshop Manager • Service Advisor → (Workers) • Technician • Warehouse → (Customers)
ECA Bank	Key Resources	Facilitate Work assignation and fee	edback communication ation of each Worker ion channel between all	Channels	
<ul> <li>Renting policies</li> <li>Owned dealers:</li> <li>Testing, Piloting</li> </ul>	<ul> <li>Patent</li> <li>Internal Marketing &amp; Branding department</li> <li>Service agreement with the Supplier</li> <li>FCA Bank agreement</li> </ul>	<ul> <li>Receive Incentive by Better Evaluate performance</li> <li>Management &amp; Workers:</li> <li>Improving Customer Experience</li> <li>Quick and Integrated communicaties stakeholders</li> </ul>		<ul> <li>Express Lane activation policy</li> <li>Field Force</li> <li>eCommerce B2B</li> <li>Mail</li> </ul>	
Cost Structures			Revenue Streams		
<ul> <li>Devices: Production, delivery, etc. (waiting for supplier proposal)</li> <li>Dashboard: Development and maintenance</li> <li>General &amp; administrative</li> <li>Marketing &amp; Branding</li> </ul>		<ul> <li>Device: Sales/Rent</li> <li>Dashboard: Monthly rent</li> </ul>			

Figure 4.5: Business model canvas (Source: Composed by author, 2019)

## 4.4 **TO-BE Model Benefits**

In this section will focus mainly on the new features and benefits that has been achieved by implementing the new workshop 4.0 concept. In addition, will explain how the whole process in the dealership had be transformed and how it will improve the dealership management for better KPIs and facilitating the work environment at the same time. Also at the same time we see how it enriched the customer experience for better loyalty from the customer to the brand. So it can be expressed as following

**Engagement and Booking:** It does not exist in the old model in a good interactive mode, as the customer needs to call the dealership to ask about any information and to book a maintenance appointment, so it can be considered as an old style static mode.

In the new model, it will be easier and dynamic for the customer to be engaged with the dealership services thanks to the new online platforms (Mobile Application and Website) which based on IoT solution can manage the customer information and to book a maintenance appointment in a real-time will update the dealership calendar. Therefore, it will automatize the dealership calendar and we will establish a communication channel between the dealership and the customer.

**Check-in:** in the last few years the previous model already developed by introducing some digital solutions as it showed before (Ex: WiADVISOR), but the whole process still relay on the service advisor, who uses the WiADVISOR and handle the customer.

However, the new model will be fully digitalized by using the TOTEM in the dealership reception, which gives the customer the possibility to perform self-booking and self-check-in in case of performed the booking by using one of the online platforms (Ex: Mobile application). In addition, the customer will use the key locker to leave the keys for the technician and to receive it back after the maintenance operation ends.

Service Update: It will be a new feature for the customer to have a real time monitoring on the intervention status through the new mobile application or through the website platform. It will enhance the customer experience, as the customer in the old model can only review the high-level updates through a screen in the reception area or have to ask the service advisor to get the new updates.

At the same time, it will also help the management to have a full monitoring on the all operations performed in the service center.

**Pre-Picking:** spare parts pre-picking from the warehouse will be much faster process and will be executed with less delay, as the warehouse operator will use Smartwatch to receive the new pre-picking order in a real time just after the creation of the Job Card through the TOTEM. Also will be able to confirm the pre-picking orders on the move, instead in the old model it has some delay, as the warehouse operator receive a notification on his computer or a printed pre-picking order (based on the dealership working system). Therefore, the old model leads to some delay in the total process time so the waiting time of the customer increase in general.

**Repair:** In the new model, the repairing process will be enhanced with extra features, which customized specially for Mopar. As each lift in the workshop will be equipped with a smart lift (Mopar patent device), which will recognize the vehicle's plate number and update the repairing status in a real time. Therefore, it will help the management to monitor the work performed on the lift automatically and tracking the entire vehicle path inside the workshop to update the customer and to use that information to generate more precise workshop KPIs reports.

At the same time each technician will be equipped with a smartwatch, which will help him to receive, review and confirm Job Orders quicker, also will help him to communicate with the workshop team to send and receive updates from them (Ex: warehouse's operator). **Payment/ Check-out:** with the increase of the technological development, many new payment methods are introduced and people trust it much more now, as it was at the beginning need to confess customer to use it. Therefore, the new model will give the customer multiple options to perform the payment, as the customer can use the online payment option through the mobile or the website.

After performed the payment, the key locker will be activated, so the customer can retrieve the keys as a self-service, so it will facilitate the procedures for both the customer and the dealership management.

**Follow-up:** in the current old model, to follow up with the customer it needs extra effort and time, as it is performed manually by making calls to customer to ask them about the service, or sending emails. In the new model, it will be automatically and more flexible, as the customer will receive the feedback form through Mopar mobile application on his account, so the customer can fill it any time and write all he wants to share about the service.

**Management system:** in the old model, the management system based on the Dealer Management System (DMS) software, which gives some features and integrations with the calendar and other sub system. However, the new model will use a full integrated system with included everything that affecting the performance in the workshop, and extra features to enhance the customer experience (Ex: real time monitoring of all workshop activities), so it will be more complete and reliable in the long-term development.

**Workshop Performance KPIs:** The main goal of the dealership is to improve the workshop KPIs by increasing the system quality and efficiency to achieve the maximum possible profit. Mopar workshop KPIs performance focus mainly to use three KPIs to measure the workshop performance, as shown in figure 4.6



Figure 4.6: Mopar Workshop KPIs (Source: Mopar Workshop KPIs Manual)

Therefore, to measure the workshop utilization, efficiency, or profitability requires some input data, which are the available hours (hours of actual attendance at the workshop), worked hours (clocked hours for the repair of the vehicle) and invoiced hours (Hours charged by channel "customer- warranty- internal"). In addition, it should follow a certain internal procedures as shown in figure 4.7.



Figure 4.7: Workshop KPIs current process flow (Source: Composed by author, 2019)

In the current model there are many problems as the dealer has to insert all the required data through FCA internal system (Link.e.entry), which usually includes data entry problems (Human errors), receiving the information with a delay, as the dealer has to insert the information then those information has to be verified by the field force people. So to approve or reject all inserted data for all dealers every month, which is a high work load, time consuming and not effective 100%, also in case of the dealer managing multiple brands it will be a problem to manage the available hours matches with worked hours on FCA brands only.

In the new model after introducing the new IoT devices, it will be used to get a better workshop performance KPIs by developing the process as shown in figure 4.8

NEW Process Flow	
LINK.E.E.ENTRY	REPORTING
Digital Devices insert Automatically in Link.e.entry 1.Available hours (Worker& SW Coupling sys.) 2.Worked hours (Smartwatch/SL)	A Qlik View dashboard reports the Workshop Performances at HQ, Market and Field Force level.
3.Invoiced hours (Totem/Payment sys.)	• [III. Qlik Q

Figure 4.8: Workshop KPIs new process flow (Source: Composed by author, 2019)

Therefore, the new model will develop the workshop performance KPIs as it will automatically insert the exact values of the available, worked and invoiced hours in a real time without any delay. It will reduce the cost, power and time consumed by the field force people to review and approve all inserted information for all dealers every month.

In addition, it will be easily to manage multiple brands dealership by automatically recognizing FCA plate number using the attached smart lift on each lift, assign it to the worked hours, and eliminate all other brands. In addition, it will improve the quality of collected values and getting a reliable workshop KPIs monitoring system and in a real time independently of any manual interruption.

# 4.5 Purchasing Involvement & Tender

In this section will explain briefly how the project is performed in the next phases after approving the design model from the top management. The process of choosing the best supplier will follow the following steps.

## 4.5.1 Request for Information (RFI) & Request for Proposals (RFP)

It is a combined open request that aims to investigate the marketplace technologies and capabilities to acquire more information about the proposed solution, which is useful to prepare a formal offer request. In addition, the request has to provide the supplier with the target of the project and the developed model explaining the priorities and the required deliverable from the project including the technical details that identify the object of supply. Also the evaluation criteria that will be followed to choose the best supplier, as shown a sample form of evaluation criteria in Table 4.1

Table 4.1: Selection criteria Sheet	"Sample"
(Source: Composed by author,	2019)

No.	General Information	Description	
1	Project Description		
2	How it Works		
3			
No.	Technical Requirements	Description	
1	Technology		
2	System integration		
3			
No.	Management requirement	Description	
1	Program Setup		
2	Action Plan		
3	Human resources		
No.	Evaluation Criteria	Description	Weight (%)
1	Expertise Business Aftersales		20%
2	Program Definition		25%
3	Program Setup		15%

#### 4.5.2 Proposals Reviewing and Request for Quotation (RFQ)

Interested suppliers will send a detailed proposal indicated all required information, answering the main requests which has been sent in the RFI and represented in some forms of presentation and PDFs. Company proposals may include some Supplier Presentation (Ex: Previous Experience related to the project). In addition, it should be explained how the supplier will perform this project and who will be responsible of the project indicating the Project Time management.

After receiving the proposals can interact with supplier for clarification in case it is required to understand something which is not clear in the proposal and eliminate the proposals which doesn't meet the requirements, then prepare a shortlist of the accepted technical proposals to send them a request of quotation.

Quality Criteria Weigh		Supplier 1	Supplier 2	Supplier 3
Qualitative	100%	Final Score	Final Score	Final Score
Expertise Business Aftersales	20%	Sub. Score	Sub. Score	Sub. Score
Sub. Requirement 1	5%	(0:5)	(0:5)	(0:5)
Sub. Requirement 2	3%	(0:5)	(0:5)	(0:5)
Sub. Requirement 3	4%	(0:5)	(0:5)	(0:5)
Program Definition	25%	Sub. Score	Sub. Score	Sub. Score
Sub. Requirement 1	4%	(0:5)	(0:5)	(0:5)
Sub. Requirement 2	4%	(0:5)	(0:5)	(0:5)
Sub. Requirement 3	4%	(0:5)	(0:5)	(0:5)
Program Setup	15%	Sub. Score	Sub. Score	Sub. Score
Sub. Requirement 1	6%	(0:5)	(0:5)	(0:5)
Sub. Requirement 2	4%	(0:5)	(0:5)	(0:5)
Sub. Requirement 3	5%	(0:5)	(0:5)	(0:5)
Roll-Out Action Plan	40%	Sub. Score	Sub. Score	Sub. Score
Sub. Requirement 1	8%	(0:5)	(0:5)	(0:5)
Sub. Requirement 2	8%	(0:5)	(0:5)	(0:5)
Quantitative				
Program Action Plan		Number	Number	Number
Program Roll-Out Timing		Number	Number	Number
Timeline		Number	Number	Number
Roll-Out Cost		Number	Number	Number

Table 4.2: Proposal Evaluation Sheet "Sample" (Source: Composed by author, 2019)

\* By giving rate for each Sub Requirement starting from 0 (not Provided) to 5 (Provided with extra features)

After ranking the best technical proposal, which satisfies the requirements, send a request for quotation for those suppliers asking them to send a quotation for the proposal including a detailed financial detail for each item in the proposal (Ex: Tools, Trainings).

Then after receiving the RFQ can choose the best Supplier to perform the project based on the offered cost.

# Chapter 5: CONCLUSION

## 5.1 Benefits to the company

The strong point in the thesis is that most of the analyses are performed based on real numbers derived from the real databases extracted from Mopar' dealerships and best practices in the field, at the same time the development of the final Automotive workshop 4.0 model was aligned with the latest standards and the available technologies.

Since the study was considering the development of the Automotive Aftersales sector it offered a deep analysis of the Automotive Aftersales dealership' processes, operations and performing a benchmark between the main competitors to map the current Automotive Aftersales sector.

After that, studied the main challenges that Automotive Aftersales industry face nowadays and the possible opportunities that can be used to solve those challenges by introducing the Digital Transformation horizons and its Enabling Technologies (Ex: IoT and Artificial Intelligence) to show its possibilities to improve the work environment and enrich the customer experience as one of the main goals.

The Transformation to digital enterprise is not an easy decision also it is difficult in implementation as expressed in the main challenges that big enterprise faces during the Digital Transformation face, so it proposed in the thesis how to deal with those problems such as the employees resistance to change and cyber-attacks. Also reviewed how European Commission deals with one of the big problems which is Cyber-Attack by the new Global Data Privacy Regulation (GDPR) and forcing all enterprises that deal and manage data for individuals within the European Union (EU) and the European Economic Area (EEA) must be compliant with that new regulation. As the same time, discussed how the European Countries are moving forward for a Digital Transformation era by developing new protocols and policies, and focusing more on the Italy's national plan "Industria 4.0" as a case study of those policies.

Therefore, through the thesis the company got a full overview on the market and the main trends with all challenges and opportunities that can be used to develop a better strategy for future improvements.

In the second part of the thesis presented the developed solution of the Digital Transformation plan for Mopar dealerships. Starting from As-Is analysis of the current situation passing through all needed development to reach an optimum situation for all dealership's stakeholders at the same time to enrich the customer experience to the highest possible level, ends with presenting the final solution of the To-Be model of the Digital Workshop or as it is called Mopar Workshop 4.0. Including a full business plan also indicating the procedures of involving tenders and how to evaluate their proposals based on the technical and managerial criteria.

So at the end it offers to the company a complete roadmap of the Digital Transformation plan that Mopar needed to digitalize their dealerships within EMEA region.

## 5.2 Thesis work limitations

The limitation in this thesis mainly comes from two main parts. The first limitation issue was the time frame, as it was only sufficient to cover the project till the point of tender involvement, so it was not enough to review the roll up plan and the implementation phase to state the observations during the implementation and review the real To-Be model in practice. The implementation phase is very important to confirm that the new model reaches its target and works in a proper way, also it helps to perform a real comparison between the As-Is model and To-Be model based on real numbers.

The second limitation issue in the thesis was the confidential information and data for the company, so could not state it in the thesis report for publishing it, but it does not affect the final To-Be model or the research sequence.

## 5.3 Future steps the company can undertake

The company already got the final To-Be model with all feasibility study and technical specifications till the tender involvement. Therefore, in the next period Mopar should proceed with the implementation phase in EMEA region or at least to approve the new To-Be model as a best practice for the Digital Dealership including the Industry 4.0 Workshop in Turin. In that case, it can be used as a starting point for future improvement and at the same time to have a digital laboratory to practice and test the implementation of the new technologies before implementing it.

Therefore, that Digital Laboratory will be the best environment that can be used to test any new technology or arguments to evolve the digital workshop in the future. For example can use it to test the involvement of the Automated Guided Vehicle (AGV) to transport the spare parts directly from the warehouse to the technicians and check how it will helps to reduce the wasted time and increase the efficiency. However, that argument could not be studied during the thesis due to the limited time frame and it requires a special workshop that satisfies the operating conditions for the AGV so it can be tested in the working progress.

Nowadays, the technologies are evolving in a high-speed rate, and it is not only about new inventions but it also regards how to use the current available technologies which makes the difference. Therefore, Mopar already started a big step to enter the Digital Transformation era, but it should be followed by a continuous improvement and a real time benchmark to lead the market in the future.

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