Transformation of Mobility Industry by Advanced Digital Technologies

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Abstract. The world of mobility has always been a vanguard of scientific discovery. Artificial intelligence (AI) has already been used in motorsports, making the car more reliable and advanced. The digital transformation using AI and Machine learning in the automotive industry is fast, creating huge monetization opportunities. Autonomous cars, sophisticated self-control, safe, secure, and high-performance vehicles, and even flying cars may be the future of mobility. This research paper discusses how AI and Robotics will transform the mobility sector. It discusses the use of AI and Machine Learning (ML) in driverless cars. It also studies AI and Robotics’ convergence, creating a platform and ecosystems for human–robot partnerships, making humans free for more critical tasks. The digital technology disruption of the mobile industry is not free from challenges. The paper also discusses challenges, possible solutions, and how the transformation can benefit humanity.

Keywords: Mobility Industry, Transformation, Advanced Digital Technologies, AI, ML

1. Introduction
According to [World Economic Forum, 2016], Digital transformation gives multiple ways to create value in the market where inexpensive advanced technology has changed the dynamics and trends of organizations and society. At the same time, digital transformation is about exploring new methods and technology to enhance and modernize business operations and processes. It is about discovering and creating ways to develop new value propositions. Not only will it give the industry a new dimension to explore and digitalize their mechanized process of the manufacturing industries in the automotive sector, but it will also generate the value of the estimated worth of $3.1 trillion through societal benefits in the mobility sector by the year 2025[Accenture, 2016].

Digitization has influenced pretty much every industry during the previous decade. The remarkable pace is computerized innovations spread and infiltrate society, singular life, and organizations explicitly put develop organizations in danger. Inside the car business, digitization carries new players to the table, moves the innovative concentration from physical to IT, empowers clients to acquire their changing comprehension of versatility, and makes them an important wellspring of data. Besides, digitization influences the worth creation process and underlines the significance of multilateral cross-organization collaborations [1]. The way likewise features this that most car organizations right now do not have the fundamental skills to prevail in an inexorably programming and IT-commanded condition. The organizations BMW, Porsche, and Tesla, fill in as models for how vehicle makers manage the digitization challenge and adjust their innovation and administration portfolio as needs are. We try to advance how the ascent of computerized and arranged innovations influences the business and plans of vehicle producers’ action and give recommendations on how they ought to respond to
transform these problematic powers into business advantage. In this setting, we investigate how car OEMs can coordinate themselves into advanced plans of action and versatility ideas of things to come.

According to [2] World Economic Forum white paper on Digital Transformation of Industries January 2016, investigation shows that there's $0.67 trillion of market opportunities for car manufacturers assisted by $3.1 trillion worth of collective goods resulting in computerization of the automotive sector by 2025. The industry collaborators ought to consider this and merge to classify computerized activities by looking at three times more growth for societal benefits. These reports mainly emphasized three advanced major aspects that will drive this alter in esteem all through the industry: the smart traveler, independent vehicles, and their ecosystem. It surveys their present situation, investigates the brief and detailed effect that digitalization will have, and provides suggestions for manufacturers within the car domain. The cycle of alters starts with the associated and enabled customer who is more carefully familiar with electronic media.

As a result, this will bring advancements in all angles of the mobility industry and society. Reasonable mobility options are vital in getting out of financial debt. Individuals have long possessed and affectionately cared for their vintage automobile. The cars' expectations are the same as from the smart devices that provide us all the comforts, and nowadays it is happening through both ways of driving, i.e., assisted driving and self-driving cars have highlighted and not heard of many a long time prior. They stop themselves, self-driving mode on freeways or expressways, and with the upcoming arrival of fully automatic and smart cars, we are drawing closer to a time where there will be no driver requirements.

We'll all be travellers utilizing different mobility shapes, which will be the portion of a consistent smart continuum coating on streets where the traffic flow smoothly and hassle-free. People, particularly those who are part of this digital economy, see the vehicle not as an item to purchase; they see transportation as a service that involves a vehicle of different shape or size which take them from one place to another. Nowadays, there are genuine and considerable mobility costs [3]. A person, who drives a vehicle in Moscow, Istanbul, etc., spends a lot of time in a year in overcrowded traffic jams. [4] Universally, transportation leads to more than 2 lakh deaths due to pollution. [5] The deaths of 1.25 million people on the street [6] roughly contribute more than 25% of the carbon dioxide outflow in the atmosphere. Digitization has the scope to decrease these costs. Henceforth, the paper's objective is to comprehend the role and concepts of evolving technology and its effect on the automobile AI industry.

2. The objective of the paper
This paper studies how AI and Robotics will transform the mobility sector through AI and Robotics' convergence, making humans free for more critical tasks.

3. Literature Review

3.1 Artificial Intelligence
Artificial Intelligence [7] is the mock-up of human intelligence performed by machines, particularly advanced digital tasks. The process embodied studying (the gaining of knowledge and algorithms for using the information effectively) makes it possible for machines to learn and acquire from various experiences and simulation and reach approximate or definite conclusions by adjusting to the new inputs self-correction and perform human-like tasks. [8] AI relies deeply on deep learning by processing a large amount of data and observing a certain and comprehensive pattern in the data to perform the specific task. The most common example of AI is chess-playing computers, self-driving cars, etc.

3.2 Advance Digital Technologies
Advance digital technology [9] is a version upgrade of artificial intelligence, or it is a mix of AI and smart devices to simulate and perform real-world decisions. It is a computational system that uses a machine-learning algorithm with the combination of smart devices, which is fuelled by an enhanced
algorithmic decision-making system to hold the digital data which is collected from digital traces left from individuals online behaviors and identifying patterns and thereby discern preferences, interest as well as the behavior of the connected machine, with precision, by mitigating the risk of failure or break down of systems.

3.3 Digital Transformation of Mobility Industry

Digitization [10], or the digital transformation of the mobility industry, is the holistic approach to integrate and digitalize their business process, which comprises every sector of the industry like product design, maintenance, and servicing, automation of operations, and logistic supply chain. The global trend [11] towards a lot of environmentally friendly quality, to different drive systems and new material ideas, demands everything engineers will provide. 3D printing technology with additive ways, as an example, permits tremendous time and price savings in prototyping. The affiliation of cars, drivers, makers, suppliers, repair outlets, and transport infrastructure is setting a fast pace for perceptible innovations over the complete product life cycle. To urge new generations of good models on the road quickly, with efficiency and in most amount, end-to-end workflows and quality assurance processes are needed from the event section onward. Information volumes in testing still grow through new models and versions, alongside demands for the accuracy of the information models and check routines.

4. Research Methodology

For this research, a case study approach has been adopted. Various use cases of adoption of advanced digital technologies in the area of mobility industry have been referred, and the advantages are enumerated. For relevance to the topic, the collected literature from the internet was analyzed. The research questions that were addressed through this study are as follows:

- For advancements purposes, is Digital technology playing a significant role in the transformation of the Mobility Industry?
- Are there any specific use cases where Advanced Digital technology application has been adopted in the Mobility Industry for transformation and technological advancements?
- It draws upon various academic journals, scholarly professional articles, websites and forums, and other reputed resources primarily on the internet.

5. Industry Context

The Automobile Industry Is One of the most consumer product-driven industry but nowadays, it is facing a major shift from the consumer perspective, which is driven by the digital convergence of accelerating technologies. The industry is shifting to a mobility-driven industry.

5.1. Market Trends

The automobile ecosystem is always in a state of manipulation, which is majorly driven by two major global trends, which are disrupting the conventional market and competitive limits.

5.1.1. Urbanisation: The city population is rising rapidly [12]; currently city population is contributing and accommodating 3.7 billion people of the world population, and it is expected to grow by 66% of the world population by 2050. The city consumers are more demanding and technologically driven. They invest a greater cost on mobility. As per the study of Arthur D Little, most of the travel, which currently accounts for up to 64% of the total travel, is made within the city environment; hence the digital services and infotainment will dominate in the upcoming future.

5.1.2. Fast Expansion In Worldwide Connectivity: The current world economy is moving towards the digital economy with the rapid expansion of big data, analytics, smart sensors, Internet of Things (IoT), cloud computing, etc.[13] With the rapid increase of smart gadgets, which accounts for up to 7.2 billion or more which is quite more than the current population of the world,[14]and it is predicted by
the end of 2020, there will be 28.1 billion connected gadgets this shows how the future world will be so connected. This will bring up a major task is for the industry to accommodate, adapt and stay valid in this ecosystem of designing the product so that it can support the various life cycle of technologies which could be short or long in its long lifespan.

6. Future Horizons

As shown in Figure 1, digital transformation in the Mobility Industry is widely a mixture of three contributing factors that build the digital ecosystem of the automotive industry.

- **Smart Traveller**
- **Autonomous Driving**
- **Digital Ecosystem**

In this conceptual research paper, these three factors are analyzed, and the current challenges and their possible solutions will be discussed.

7. Digital Technology In Mobility Industry: Use Cases

7.1. Smart Traveller

The mobility industry has evolved and produces a very sophisticated computer-driven vehicle. The human and automobile are driving towards full connectivity with the help of collected data, objects, and devices. The automotive infotainment technology has rapidly advanced in the past few years as it is evolving in location-based as well as condition-based services and products as it is well aligned and customized as per the passenger and user preferences.

**Use Case 1: Jaguar Land Rover**

Jaguar Land Rover Motors has adopted intelligent self-learning vehicles which are limit interruptions and provides customized driving experiences. The model framework studies driver and traveller behavior and patterns, needs, and interest. Connecting with the user's mobile phones can provide various comfort options, leisure control decisions and offer various modification and navigation services [15]

7.1.1. Benefits Accrued: Jaguar Land Rover has improved customer experiences. It provides high stability, openness, and sharing. It simplifies the various tasks and supports quick development and deployment of various tasks, which makes human and machine interaction easier and convenient [15].
7.1.2. Future Prospects: The worldwide in-vehicle infotainment showcase was esteemed around $11 billion in 2018 and will reach around $22 billion by 2026, enlisting growth of 8.3% from 2018 to 2026. By establishment type, the reseller's exchange portion was the most noteworthy income benefactor in 2018, representing $6.30 billion, and is evaluated to touch the $11.0 billion mark by 2026, enlisting a CAGR of 6.9% during the conjecture time frame. In 2018, the Asia-Pacific district will represent a significant market share [16].

Use Case 2: Usage-Based Insurance: Marmalade. Co
Marmalade is an insurance firm in the UK that is trying out different dimensions in vehicle insurance. They deliver various custom on-demand policies which cover almost everything for young learners. The policy includes a technology called telemetric, which has been used in various motorsports racing. Telemetric is the process of deploying onboard wireless sensors which provide the driving information and pattern of the driver it is a kind of 'Black box' which helps driver to improve their driving. Based on their driving data, they provide customized insurance policies as pay-as-you-drive policies [17].

7.1.3. Benefits Accrued: This approach leads to low accident rates and also gives rewards to the consumer if no claim has been made. They also give robust incentives, pricing discounts, and various offers to good drivers, which makes it a compelling consumer proposition this encourages the customer to drive safely. It also decreases the administrative cost and declines fraudulent claims. The adoption of digital in the automotive industry makes it easier for insurers to bring cars into their network. This made a huge impact on the conventional business of authorized dealers and Original Equipment Manufacturers (OEM's); now; both are looking forward to building and strengthen relationships with the consumers by providing robust services [18].

7.1.4. Future Prospects: Usage-based insurance market was estimated at $24 billion projected to grow up to $125.7 billion by 2027, which is growing at a CAGR of 23%. Contributors such as low insurance premium price as compared to regular insurance premium price, wide acceptance of connected cars, increase in on-road vehicles, and government regulated use of telemetric are expected to drive the market of usage-based insurance [18]. The use of telemetric-based insurance not only generates revenue and saves the cost, but it will also reduce the rate of accidental crashes up to 5% by 2025, which could save the lives of 158,000 people due to better driving practices [19].

7.2. Digital Ecosystem
Digitization can seemingly drive noticeable enhancements to the worth chain through increased capabilities, decreased prices, greater collective efforts, mergers, and a lot of innovation. As OEM's are transforming business models to a B to C model, to interact and engage with consumers, partners, and with manufacturers. The smart vehicle can change businesses for a richer client experience.

Use Case 3: Disrupted Retail Service: Audi Motors
In London, Audi sells both cars and brand value through virtual showrooms. A very few cars are present in their complete physical and tangible form on display. Huge screens installed on the walls where customers can see all the features and specifications of the car of their interest. With authentic sound effects, they can zoom their car, open and close the virtual doors, look into the car's interiors. Audi also provides a smart device that is wearable based on virtual reality, which provides customers a rich understanding of personal interaction. They provide millions of totally different renderings of simulated various parts and accessories, which can be seen from all the angles by the device user [20].

7.2.1. Benefits Accrued: Relationships across the whole supply chain are being transformed by the digital revolution. Customers and OEM's are redefining the way of interaction with each other. Where, consumers were experiencing the seamless service in both physical and digital form. Customers are
using various manufacturers’ digital options such as virtual agents, online reviews, websites, call centers, etc. By these options, they can educate themselves, compare the cars, and take a virtual test drive, which helps them to build their dream car. Among authorized dealers, 81% of the retailers have their own websites through which customer can access the product and purchase the products. 75% of the authorized dealers allows online transaction through their mobile devices [21].

7.2.2 Future Prospects: By migrating from traditional channels to digital channels, the estimated operating profit will be worth $90 billion. The migration will also drive advertising to add revenues to third-party online retailers worth $28 billion [22].

Use Case 4: Connected Service and Maintenance: Michelin
Michelin offers a tire monitoring program by giving tires to the trucking fleet on lease. With the help of telematics and descriptive analysis, the program gives an on-road tire monitoring system. Gathered data is summarised and transferred to the fleet’s asset monitoring system, which provides the insight of real-time performance analysis and it can predict the data of specific tires on the specific path on trucks to the company [23].

7.2.3 Benefits Accrued: Predictive maintenance is one of the emerging trends in digitally connected service. It provides smart advanced-vehicle diagnostic system digital components and good and reliable connectivity provides proactively signal to the vehicle and some components if they need service, maintenance, or replacement. This service drastically reduces the chances of unpredicted critical failures or break down of a vehicle.

7.2.4 Future Prospect: Digitization is overhauling the complete idea of vehicle maintenance. System upgradation enhancements produce high performance in both individual mechanical systems; bother with a chassis or aerodynamics can be improved by software upgradations and system enhancements with the help of mobile computer steering elements, which results in long lasting parts and improved performance.

8. Autonomous Driving
Now the mobility industry is moving from smart vehicles to autonomous vehicles, this shifting trend will change the complete market dynamics new collaborations will take place such as OEM's will have to work with various technology leaders will become a key dynamic change in going forward since OEM’s has long integrated technology in the vehicles, but still it does not have the technological advancements of tech giants. Now for the technology companies as they are well ahead of OEM”s in terms of developing new technology. Still, they are way behind OEM's in terms of manufacturing and supply chain networks so they must come together for bridging the gap for each other. Just like NVIDIA, a company which is one of the well-recognized companies in manufacturing the computer graphic cards, is collaborated with Bosch and Daimler for developing an autonomous vehicle.

Now an autonomous vehicle is becoming a reality thanks to a lot of technologies merging together for it, such as wireless ultrasonic sensors, GPS technologies, millimeter-wave radars, cameras, connectivity from vehicle to vehicle, vehicle to infrastructure, and various advanced comprehensive models. Each coming vehicle model every year brings some technological advancements and a lot of new features but still, by this trend, it will take few years for the fully developed autonomous vehicle to run on the road.

8.1 Autonomous Driving Levels
There are six levels of autonomous driving which is a combination of human driving, assisted driving, and autonomous driving

Level 0 – Human
Automated system is present but is controlled by the human but automated system can issue some cautions or warnings.

**Level 1 - Mostly Human**
An automated system may assist in various features like lane parking; parking assistance with automated steering, Adaptive cruise control, but the driver controls the vehicle most of the time at any given point.

**Level 2 – Human + vehicle**
The automated system will take control mostly, which means performing acceleration, braking, and steering, but human will be accountable for detecting objects and events if the automated system fails to respond. The moment human intervene automated system will be deactivated automatically.

**Level 3 – Mostly Vehicle**
Automated system will control the vehicle on freeways, expressways, or in some limited surroundings and environment.

**Level 4 -Fully Vehicle**
The automated system takes the control in all environments except if sudden severe weather changes occur.

**Level 5 – Data-Driven Vehicle**
The human just needs to put the destination and initiate the automated system other than this, no human intervention are required.

8.2. *Evolution of Autonomous Vehicle and Traditional Shifts of Future*
The Figure 2 explains about the evolution of autonomous vehicle and traditional shifts of future.

![Figure 2: Evolution of Autonomous Vehicles](image)

9. **Major Digital Challenges**
   - Establishment of whole new business and app ecosystem and new skills require making them function.
   - Managing the large amount of data which is going to be generated from lots of new solutions which is required for the functioning of autonomous vehicle like metadata management, deep learning, image management, reduction and compression.
   - Enabling real time connectivity, high data speed, which is required by the new mobility business for large amount of data to upload/download?
• Data privacy and risk compliance, connected vehicles are vulnerable as valuable target for the cyber-crimes.
• The industry will need to create various solution and standard for new apps, traffic, infrastructure management and maintenance.

10. Possible Digital Solutions
Enterprises over the worth chain are co-operating in new and fascinating manners. Guidelines don't have to be viewed as hindrances but as open doors for joint effort. To seek after common advantages, regions can help influence open/private organizations. Key reasoning what's more, arranging can assist undertakings with finding better approaches to team up and find openings where somebody can lead this dynamic environment, with clients / controllers. Beyond all the universally shared advantages from cooperation, key organizations can likewise invigorate advancement. New plans of action will rise up out of sharing information and bits of knowledge, and drive administration and item advancement developing with assistance from other enterprises. Joint industry effort will turn into a necessary piece of the computerized customer experience.

The sources of information are just expanding: travel data, logistics planning, advance IT frameworks for coordinating flexibly and request, enormous information arrangements and significantly more. Heads in the present transportation industry — providers, production, automakers and mobility suppliers — are definitely mindful of the organization and coordinated efforts required to surpass the current pace of progress. In this way, the multifaceted nature of the information driven innovation framework what's more, forms must be tended to do that, associations must make a guide for the future to explore and effectively progress their organizations. Most of the data strategy stay emphasised on ingesting the data the Technology industry needs support and encouragement in order to handle and properly execute this by extract the insights from the volumes of connected, autonomous data generated vehicles in this we data can be monetized.

Create a platform-oriented organization New advanced innovation hugely extend the range, speed, comfort, and productivity of conventional infrastructural stages. This new arrangement of stages changes and topples the customary worth chain in the business. However, extra unique and disengaged frameworks — can expand complexity and obstruct the competitiveness. A platform solution approach looks comprehensively and makes solidarity through standardization and automation. New technologies can encourage and enhance the process of communication trade of data between members of the system. This way, the more an organization pulls in new participants to a more centric platform (proprietors, suppliers, producers, and buyers), the more prominent the network becomes and the more exchanges between demands and supply increases. The bigger the scale, the more worth it creates through advanced data and experiences.

The modern enterprise technique of enhancing and including service systems thru up-down and bottom-up integration will necessarily restrict the scale. Especially as workload control is applied at a foundational platform level. Managing those destiny smart fleets would require a agile architecture at the side of the functionality to control large data units being generated.

11. Conclusion
There is a already a pre-defined roadmap for the prevailing extended automobile business to guide the transition to the longer term of private mobility, however it'll need elementary and efficient business-model modification. Competitor effectively within the future mobility system needs to build compatible and new technological driven and completely different capabilities. Each sector in today’s extended automobile and mobility market has to re-evaluate their business model and have to take some key decisions on how they are going to operate and build worth whereas the five levels exist and within the long run, once autonomous and concept of shared mobility become a lot of thought.
The insiders and disrupters want one another. There is no doubt in that the extreme competition can decides and drive the business atmosphere around the private automobile sector. Yet, despite of their circumspection and differing models and views, automotive manufacturers and different new
infotainments providers, Technological giants can come along and frame a brand-new system and business models through various merger and acquisitions which gives the market a total new dimension of reciprocity and interdependence.

Significant and deep disruption can broaden such a great amount of past of mobility business, each aspect of the dynamic and trendy digital economy supports the conviction of human-managed, in-person privately owned vehicle are challenged. Each organisation during this new framework should be constrained to affirm in which segment they want to operate and decides their best approach to win. With the enormous potential and scope of change, we are able to imagine and predict the upcoming sectors and manufacturing industries to create their worth and value with the help of their differential capabilities of developing and modifying techniques and changes the elemental of ever-changing dynamics. Finally, the market which will remain persistent and relentless in its approach and seek and provide better performance in low cost will choose who prevails and who loses.

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