A Theoretical Model and Business Solutions for Improving 5G+ Transportation Services

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ABSTRACT
Business models for improving the transportation system, which includes the services of transport facilities, predict the future of users' requirements according to the emerging technologies. All predictions raise the number of questions that support to increase business challenges such as management of 5G transportation services. Management issues cover technical challenges considered to improve the customer relationship and cost for utilizing the service mentioned in the 5G-transportation system. During the traveling or driving time, driverless vehicles face many challenges managed through the services without proper management. Security and energy management are examples of current problems. These problems involve the technical challenges of 5G, and other emerging technologies considered for developing the business model in this paper. As an appropriate method, an efficient model of 5G transportation is introduced as a business model for analyzing the challenges mentioned above. In this model, few challenges need more discussions and analysis because users' and customers' requirements are evolving with the future emerging technologies. Further, this model will encourage the users, including service providers, to make necessary decisions for enhancing the management facilities.

General Terms
In this paper, the theoretical model of the transportation service as a general term is considered. Throughout this research, transportation issues based on 5G are considered to improve the 5G solutions of transportation facilities

Keywords
Business Model; 5G based infrastructure; Automation Transportation; Transportation Modelling

1. INTRODUCTION
An autonomous transportation system introduces new features and services for improving facilities. Transportation services evolving with emerging technologies change the business processes. Although many issues focused on transportation services have efficient business solutions, few services such as security and safety considered in the driverless and autonomous vehicles do not have enough solutions for improving the technical and business management.

5G technology is a new generation technology of cellular mobile communications. It comes after 2G, 3G, 4G systems. It has many distinguishing features such as high data rate, energy saving, cost reduction, low communication latency, and massive device connections. These features can change the communication history for the next years and make a direct and positive effect on the transportation movement and spreads in general [1].

Without concerning the different transportation types, many related issues could be merged. The population and living costs have stress on the transportations and the used technologies to integrate them and produce suitable services for passengers and customers. To improve the services in the existing transportation system, service providers did not have reliable communication facilities. Although the previous generation of telecommunication supported to improve the essential services, 5G and 5G+ provide many features to enhance the business solutions, vehicular communication, and user-friendly facilities in the transportation services.

The motivation of this research is to enhance transportation services with minimum cost, which depends on the ways of using energy and features. Although energy and features of new applications are trading off, business solutions based on 5G+ systems not only increase the profits but also improve the energy efficiency (EE) for maintaining the lifetime of the new vehicles. 5G transportation industry will include wide rages of sectors that can take the benefits from a next-generation wireless network from automated cars, smart buses, and smart trains to other logistic services connected to the private and public transportations.

Since the 5G is a quite new technology in the transportation solutions for all the people and companies, studying the business model based on 5G transportation is essential. Without this study and analysis, many financial dilemmas can occur, and the organizations may lose their financial assets and then can impact on the whole transportation industry since the companies and organizations need to adjust to the requirements of different markets and to face the competitive and dynamic business environment [2]. Currently, the market for 5G technology faces security and safety issues as business competition.

Table 1. Comparison summary between 1G, 2G, 3G, 4G, and 5G

	Main Features						
Technology	**Period**	**Standards**	**Used Technology**	**Data Bandwidth**	**Advantage**	**Disadvantage**	**Applications**
1G	1970/1984	MTS AMPS	Analog cellular	2 kbps	Mobility	Security Issue	Analog Phone Calls
2G	1980/1999	TDMA CDMA PDC	GMS	64 kbps	Roaming SMS MMS	Limited Data Rates	Short messages
3G	1990/2002	CDMA 2000, UMTS	WCDMA EDGE	2 Mbps	Good Internet Experience, International Roaming	Performance mismatch the types	GPS
4G	2000/2010	CDMA	LTE Wi-MAX	1 Gbps	High speed, Global Mobility	Expensive hardware is needed	Mobile TV
5G	2010/2019	OFDM BDMA	MIMO mm Waves	> 1 Gbps	Extremely high speed, low latency	Costly, many technical and engineers are needed	Robots

Although auto industries used many business solutions for improving transportation service, mobile communication, and ICT (information communication technology) created new ways to handle the business in the transport sectors. In ICT based business development, RFID (Radio-frequency identification) can be used for improving business solutions through efficient CRM (customer relationship management). The features of RFID and IoT sensors enhance the technical issues as well as business solutions. Digital technology and communication dominate ICT based management issues in transportation services. Table 1 shows the necessary details of communication systems and their technical capacities used for vehicular communication. In the driverless vehicles, the future autonomous system plays an important role in modernizing transportation services with profitable business solutions. In this research, business solutions based on 5G+ schemes enhance the facilities and services of the transport industries. According to [3], emerging technologies such as IoT based 5G and RFID sensors create many business solutions for improving communication applications such as vehicular communication and speed monitoring.

Although many business and industrial solutions are available, This paper has considered the CRM values as one of the business solutions for improving transportation services. The following contributions have been considered in this paper.

- Studying the existing business solutions used in current transportation services for adapting new features depended on emerging technologies IoT based on 5G and beyond.
- Using 5G and 5G+ requirements and the study of current business solutions, transportation service management has been considered for improving the safety of the passengers and the security of autonomous vehicles.
- Designing a theoretical model of transportation service for improving the business solutions which provide low-cost energy management.
- Finding the theoretical comparisons of the business model for improving transportation service and managing business solutions with QoS

The rest of the paper is organized as follows. Section II focuses on the background, and related work includes transportation and the importance of business models. In section III, the modeling of 5G+ transportation services has mentioned. In addition, a generic function is introduced. A model of the proposed research and business solution of 5G transportation has provided in section IV. Section V provides analysis and discussions with some related scenarios that can evaluate the proposed model. In Section VI, overall conclusions are written based on the theoretical analysis and results.

2. LITERATURE REVIEW

In general, transportation services enhance the facilities with the types of transportation systems. Although different types of services improve business developments, new autonomous and electric vehicles expect to have new services such as intelligent. In transportation services, an intelligent system is one of the developments for enhancing business solutions. Further, smart service allows users to minimize the cost, time, etc. when they use the modern transportation system, which includes electric and autonomous vehicles. The intelligent system considered in 5G+ transportation developments manages to maintain energy-saving, storage, and harvesting, etc. In the future, 5G and 5G+, intelligent systems, and service are the critical requirements for managing autonomous vehicles.

There is a strong relationship between applied transportation services and their business model. If one of the ends of that relationship is weak, another end is weak, as well. Therefore, analyses and study carefully both sides of the relationship can provide a successful story for a necessarily model of

transportation that needs some financial returns and profits to find the primary motivation for development and innovation in the smart transportation field. In the transportation service, passengers expect to have quick and reliable facilities with minimum cost. To implement an efficient business solution, the details of the most current business models are mentioned in the (Table 2) will be useful.

In the current time, several general business models are available to assist communication organizations with the services for transportation organizations. One of the common business models is Canvas. It was proposed initially by Alexander Osterwalder in 2005, and it contains some

Table 2. Common business model comparison

Business Model	Canvas	Lean Canvas	Strategy Sketch
Author	Alex Osterwalder	Ash Maurya	Jeroen Kraaijenbrink
Target	Startups, new and current businesses	Startup businesses and new initiatives	Startups and current businesses
Focus	Customers, Investors, Entrepreneurs, Consultants, Advisors	Entrepreneurs	Entrepreneurs
Benefits	Creating a value proposition for the businesses to make it intelligent in the market	Business testing against one of customer segment	Overall strategy with focusing on new inconsistence chances of a company

components as a virtual chart such as infrastructure, customers, value proposition, and finance. The template of the Canvas business model can be used by hands-on tool or website software for more understanding, discussion, creativity, and analysis of the business model components.

According to [4-14], business solutions dealt with the current and previous transportations systems allow us to study the techniques for improving transportation services. Intelligent transportation systems [15-18] focus on enabling us to modify the business solutions considered with emerging technologies. Using intelligent approaches, modification is possible without changing the legacy of the transportation system. Business solutions not only enhance the business environment, but also the reliability of the service provided by a dedicated system, technology, and devices. The business environment depends on business solutions, which increases profits and customers.

In the transport industries, the use of IoT sensors and devices simplifies business solutions and enhance security issues. In mobile systems, wearable IoT sensors enhance the services with quick monitoring facilities, which allow service providers to improve security issues and safety conditions of the transportation services [19-23]. Sensors and IoT based devices enhance the monitoring facilities of measuring the speeds of the vehicles. They are especially useful for managing the positions, locations, time, etc. of autonomous vehicles with varying environmental conditions.

3. MODELING OF 5G+ TRANSPORT SERVICES

According to [24], the authors explored the vision of 5G with the necessary technical requirements for modeling. From the 5G technical views, emerging technologies with 5G and 5G+ allow us to create the new concepts and issues of minimizing overall cost and energy for modeling transportation services.

Energy and power management needs not only technical improvement but also efficient management because the final profit depends on the EE, reliability, maintainability, and availability (RMA). Transportation management deals with many issues they are such as handling drivers' attitudes, driving conditions, etc. According to the transportation services based on 5G and beyond, the transportation system may have new features. Fig. 1 illustrates some services. The management issues of the transportation system depend on the QoS (Quality of service) based on 5G and 5G+ which enhance the business solutions for improving transportation services.

The use of IoT sensors based on 5G and RFID in the transportation system improves security issues. Further, sensors enhance the monitoring facilities of vehicles' speed and location-based services. To improve road services, traffic light services handled through modern technologies [25-30]. Here, RFID can also be useful for modeling of transportation services with 5G and 5G+ technologies.

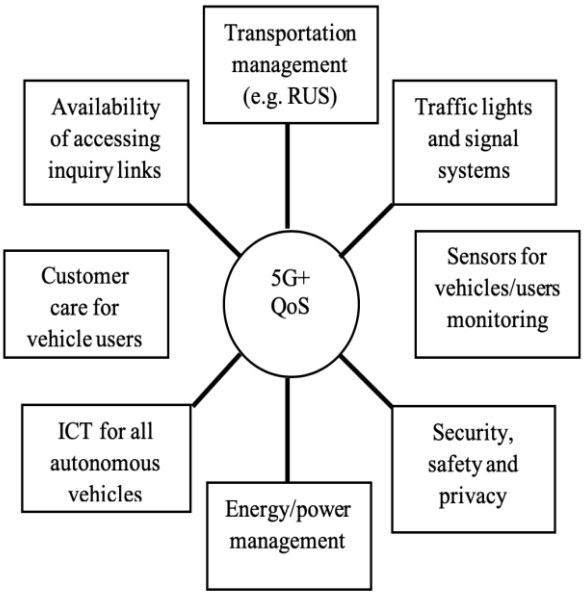

Fig 1: Examples of transportation services with 5G+ QoS

Although road service units (RSU) provide the necessary facilities to all passengers and drivers, RFID based sensors enhance the road services dynamically with emerging technologies such as RFID based on 5G, IoT based 5G+, etc. In this modeling, function (1) can take necessary inputs according to the situation for improving the road services.

$$R = f(Inputs\ to\ road\ services) \quad (1)$$

In (2), R uses 3 parameters as inputs and allows the service providers to analyze the road service. Further, R depends on availability (A), time (T), and communication (C). In this example, n, m, and r are the limits of the inputs.

$$R = \sum_{i=1}^{n} A_i + \sum_{j=1}^{m} T_j + \sum_{k=1}^{r} C_k \quad (2)$$

As an example, RSU is considered with possible inputs for calculating the QoS of transportation services. The business solutions depend on the R, which influence to emerging technologies. Using (2), service providers can calculate the QoS and analyze the 5G and 5G+ transportation services considered in this research for comparing business solutions. To improve the business olution, 5G+ based QoS will be better for modeling transportation services. Further, papers [31-39] show the IoT, which enhances the solutions as well as the security.

4. PROPOSED MODEL

This paper proposes the theoretical model which provides business solutions for improving 5G+ transportation services.

The business model can make a successful plan, and strategic management for business operations of any company or organization would use 5G technology services. Therefore, the business and finance risks can be avoided as much as the business model is accurate based on the current factors.

The importance of business solutions on the theoretical model of the transportation system may be different because some users and customers are looking for low-cost services. As in (3), low-cost services and lifetime (LT) of the best transportation services are the trade-off.

$$Cost \propto QoS(LT) \quad (3)$$

The importance of the business model developments on the transportation system depends on the potential activities for reducing overall cost and research for handling the emerging technologies and their future directions. Potential activities deal with intelligent transport management, energy-saving approaches, low-cost security issues, etc. Research for reducing the complexity should be maintained through the efficient design of the future transportation system. Here, the intelligent approach of managing driverless vehicles in the transportation system reduces the overall cost, time complexity, energy consumptions, etc.

As shown in Fig. 2, a theoretical model based on 5G+, which enhances the transportation service that users wish, has introduced. These services enhance not only the business solutions but also transportation facilities such as 5G+ based QoS.

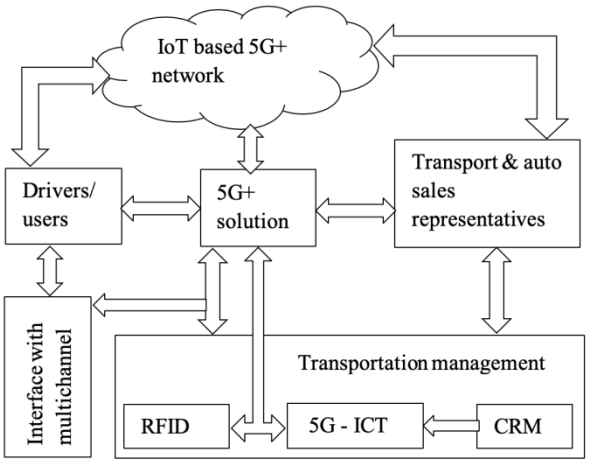

Fig 2: A theoretical model for transportation services

Minimizing the energy cost considered in potential and future transportation systems is the main motivation of all users and service providers. All business solutions depend on energy management, which improves not only the energy performance of transportation system but also business support (passenger care, ticket, etc.) to all drivers. Service providers of the energy management system use the energy-efficient technologies and protocols for maintaining the reliability and lifetime of service. Accuracy also keeps reliable vehicular communication for broadcasting the optimized signals and noise-free messages.

Transportation management influences to the satisfaction of all transportation services with necessary solutions which depend on the technical issues such as 5G+ solutions (Fig.2). Cost (c) reduction in energy consumption, QoS (q) based on RMA, satisfaction (s) of CRM during the business process, management (m) of technical and business issues and technology (t) preferences are the main points considered in the business solutions of the transportation services. This proposed theoretical model stores the updated business solutions according to situations such as demand, supply, etc. Following function (4) allows the service providers to take the decision on transportation service management with the above-mentioned business solutions (B).

$$B = f(c, q, s, m, t) \quad (4)$$

Although business solutions depend on these parameters given in (4), technological requirements of 5G and 5G+ are still dominating the business solutions comprehensively. Hence, these 5G requirements (EE, latency, capacity, dynamic spectrum, etc.) allow us to develop the model for analysing the performance of the transportation system. Strategically, this model is beneficial for developing business solutions that enhance transportation services.

Using some common business models is essential for building a particular business model for the 5G transportation model. Canvas business model is the start point for this purpose. Then, some addition and modification have done on the proposed business model. Some other business models (mention some examples) have provided some useful, necessary information to make the proposed business model more consistency, accurate, and comprehensive.

5. RESULTS AND ANALYSIS

This section provides the theoretical results of the business solutions used in the transportation service management and the technical comparisons for analyzing QoS. In this analysis, an energy-efficient and low-cost transportation system will be possible when service providers use emerging technologies.

5.1 Operational scenarios and indicative results

New transportation services and management will depend on the transportation system. If the use of autonomous transportation system becomes popular, results will be depending on the readings of the sensors between the vehicles or RSUs and vehicles. In these results, Fig. 3 shows the improvements in business solutions compared with the existing model (4th generation) and the proposed model. The following scenarios illustrate the business solutions when drivers and autonomous vehicles use basic 5G, 5G+, and IoT based ICT. In these scenarios, the three types of 5G+ transportation services for enhancing the business solution have considered.

Scenario 1 (Transportation management): In this analysis, RSU expects to have dynamic management because transport systems move with mobile messages and commands. In this

management, RSU should handle the communication dynamically and efficiently for implementing transportation management. In this scenario, business solutions depend on the decision making obtained through the 5G based IoT sensors. Here, cost reduction depends on the data management of the secure readings collected from these sensors. The cost of the transportation system can be reduced when data (audio, video, and text) management of vehicular communication provide secure services with new technology.

Although the following scenarios show the future transport services, 5G and emerging technologies enhance 5G transportation. As business solutions, 5G technology will expand business opportunities for the future transportation system. Here, scenarios can be explained through monitoring, tracking, and automation capabilities. Further, the study of the business model allows the transport service providers to facilitate the smart cities where vehicles are on a small and large scale for traveling within the residential and farming areas.

Scenario 2 (Security, safety, and privacy): Electric vehicles and autonomous systems need proper management for securing transportation services and protecting all internal devices and environments. Security, safety, and privacy are the parts of the business solutions in transportation service management as in Fig. 3 [40-52]. The performance of security issues depends on emerging technologies such as photonic technology based on 5G and beyond. Photonic sensors play an important role in maintaining the security, safety and privacy efficiently with minimum cost. Although the theoretical model focuses on emerging technologies, cost reduction is one of the business solutions for improving transportation services.

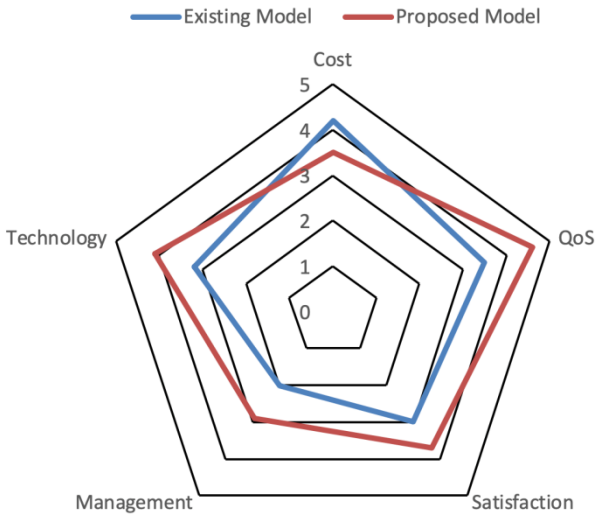

Fig 3: The business solution of transportation services management

Scenario 3 (ICT for all autonomous vehicles): All vehicles depend on efficient transportation services with low-cost ICT management. According to the future autonomous vehicles, ICT provides business solutions as well as technical issues for maintaining the QoS, EE, etc. Proposed model can be modified with the technology considered in the future transportation system and services expected during this decade or 2025 to 2030. As shown in Fig. 4, lifetime mentioned in (3) can be considered as an example for illustrating the QoS improvement in percentage.

Currently, energy-saving and consumption are the key areas in business solutions. In terms of EE, 5G and beyond provide and maintain the technical limitations for increasing the EE. Increasing EE improves not only the reliability of devices used in the transportation system but also transportation services. The communication involved with 5G and beyond will provide high-speed and accessing through efficient connectivity for improving vehicular communication. Intelligent systems also provide many benefits technically as well as intelligently for analyzing the satisfaction of the business challenges and solutions. In autonomous vehicles, the lifetime of the battery is one of the technical challenges. Here, photonic and Li-ion technologies may be useful to enhance the battery lifetime with maximum protection. Regarding the security issues, the transportation system employs the software-defined networks (SDN) with lightweight cryptographic algorithms. Handling business solutions need business model components that are useful for developing efficient transportation services with the proposed theoretical model.

5.2 Business model components

The proposed business model has some key business components (Table 3) that can cover most business and financial aspects of 5G transportation services. There are six major perspectives of the business model:

1. New Smart Transportation Elements: it contains the related parts to 5G technology such as software, hardware, and special requirements.
2. Infrastructure: it covers all the surrounded aspects to make 5G transportation services working.

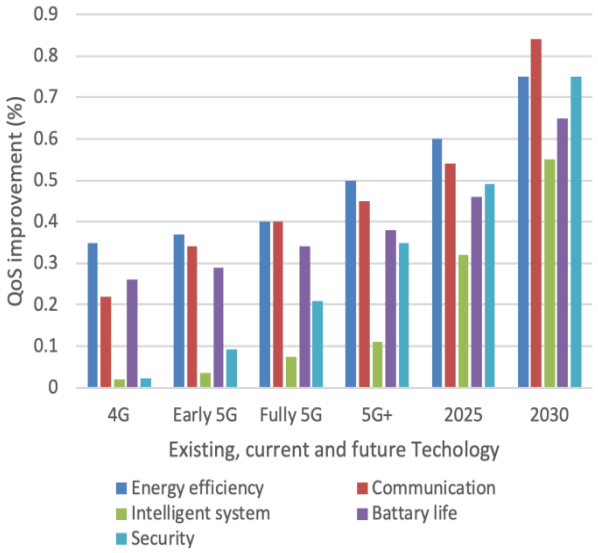

Fig 4: Analysis of proposed model

3. Provided Services: it concerns the services that 5Gtransportation will be provided when the customers would use them.
4. Customers: it focuses on the types of customers and the communication channels between them.
5. Value Propositions: it means the added values from the products and services that deliver to some customers.
6. Financials: it includes all the financial factors that impact on 5G transportation industry, such as demand and revenue.

6. CONCLUSIONS AND FUTURE WORK

The 5G and emerging technologies, such as the Internet of Things (IoT) based 5G, promise new capabilities of the 5G-transportation system. Business solutions based on 5G, which are set to impact not only transportation services but also many transportation industries that are embarking on their digital transformations of the business model. This paper introduced the modeling of 5G+ transportation services with a generic function. In fact, 5G+ and beyond will provide efficient service to the transport service providers, users, and industries through the proposed model. The results of the theoretical model allow us to verify and analyze the business solution of transportation services management. Further, the result shows the comparison of technical issues for improving QoS which is one of the business solutions. According to table 2, the proposed approach considered in this paper will open new business models and solutions across the transportation industries.

Future work is to find low-cost solutions that minimize the overall cost of the transportation service and management issues dynamically. A vast improvement will have occurred on the 5G+ 6G when service providers consider the efficient business and technical solutions depended on speed, the response time (Latency), data bandwidth, and the used technologies (Table 3).

Table 3. The business model of 5G transportation services

Main Perspectives	Key Business components	Description	Examples
New Smart Transportation Elements	Software	Easily upgradable from the legacy (if any). Connected with 5G technology.	Platforms, application, product, software, and systems
	Hardware	Physical tools to connect with 5G	Sensors, IoT networks, equipment, and Devices
	Internal activities	Most important activities to do to get the business model success	Human, logistics, consultations, demonstration, communications, R&D, media, manufacturing, process industry, safety & security
Infrastructure	5G Technology	Traffic light management, intelligent transportation system needs a business model with decision-making procedures	SDN, IoT, Big data, Multiple access, cloud
	Telecommunication Networks	Management issues which rely on networks	Core network, radio (Mobile) access network & transmission & upgrading, sensor
	Partners and Suppliers	Most useful suppliers and partners who make the business model work	Strategic alliances, joint ventures, data analysis company logistical partners, suppliers of devices (sensors, actuators, etc.), Technology provider and developer, Mobile operators, Service and application providers, Information brokers, Vehicle Manufacturers, Digital & Telecom Players, Automotive Insurers, Distributors, etc.
	Power System	Electric vehicles, charging units, solar power with photonic technologies	The Portable electric vehicle charging station, Robotic charging for self-driving and electric vehicles, Electric forecourt network, etc.
	Communication	High speed, priority, vehicular communication with evolving security technologies	Communication hardware, sensor, control system
	Processing	Signal processing in variable environmental conditions	Energy efficiency, Emission control system, Radiation of chemical reactions released from the batteries
	Industry	Transportation, vehicular, traffic light monitoring, etc.	IoT based industry, First commercial robotic charging units, secure vehicular system, low-cost solar traffic lights, Graphene for reliable vehicle parts
Provided Services	Connected Transportation	A Robust Approach for Reliable Dissemination of Critical Messages in Connected Vehicles and Vehicular Cloud Computing (VCC)	VCC is used to handle complex tasks in a connected vehicular environment, including offloading large files, minimize traffic congestion, encrypting and decrypting messages, etc.

	Self-driving / Mobility	Regulations of basic, compulsory and emergency services	Driver assistance, Mobility management, mobile operators, cloud service, Wireless chargers, energy harvesting on the move.
	Requirements	Decision making, cybersecurity detection, and prevention issues according to dynamic, real-time, and online services	Safety and autonomous driving, Scalability, Reliability, Low power, Low latency, Large coverage, Low module cost, Mobility support, roaming support, SLA support, monitoring services, Service delivery, Security.
	Policy	Users and service providers depend on the demand of the services insured through the transport management or ministry	Licenses and insurance according to the distance of the travel plan and number of users
	Strategy	Minimum cost with maximum EE & protection during traveling, transporting, etc	Business trip, pleasure trips, the occasional trip
	Government Regulation	Regulation of the transportation service with legal motivations	Speed control, secure messages, traveling and parking permits, transport management for handling all legal actions and issues
	Research and development	Low-cost energy with lithium-ion batteries for improving global warming, reliability of vehicular communication and control devices	The energy efficiency of the VANET, Cybersecurity controlled through reliable devices
	Training	Use of self-driving, handling services during the traveling and intelligent system	Emergencies such as fire, Applications, protected services, etc.
Customers	Customers Types	Aimed group of customers who will receive the service	Shareholders, government, environment, NGOs, communities, employees, Companies, Mobile users, B2B, B2C
	Customer Relationships	Relationship types with different customers	Assistance, feedback, complains, satisfaction
	Distribution channels	Communication ways with customers to deliver a service or products.	Salesforce, web sales, own stores, partner stores, wholesalers, direct, indirect, online. Internet, Mobile
Value Propositions	Value Propositions	Types of products and services that provide added value to a particular customer type	Convenience, usability, performance, customization, share
Financials	Demand	Correct security, safety & privacy features	socio-economic demands
	Market Players	Advertising possible transportation facilities, offers, promotions, issuing complements	Customer experience, technology suppliers, competitors, manufacturers. Relational based (make to stock, make to order, make to the individual)
	Revenue	Cashback from specific types of customers	Usage fee, subscription fee, leasing, licensing, brokerage fee, advertising, Return-of-Investment
	Cost Structure	All cost to operate the business model	IT cost, maintenance

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