Hellenic Open University

Master in Business Administration

Postgraduate Dissertation

"The Future of the Automotive Industry: Trends and Challenges"

Grigoris Tsakakis

Supervisor: Athanasios Poulis

Athens, Greece, May 2022

"The Future of the Automotive Industry: Trends and Challenges"

Grigoris Tsakakis

Supervising Committee

Supervisor:
Athanasios Poulis
University of Patras

Co-Supervisor:
Sofia Chatzi
Athens University of Econmics and Business

Athens, Greece, May 2022

"To my family"

Abstract

Nowdays, global economy has been very complex and multilateral. It is composed by many business sectors which play a significant role in the growth of every country. One major sector is this of the automotive industry. As it is easily understood, this sector is directly associated with the production of vehicles and fullfil the basic necessity of transportation.

This paper begins by stating the importance of production in the automotive industry. The expansion of production, the integration, its gravity in national and local level and the core markets are some key matters which are discussed. Subsequently this study investigates the route of car industry in European Union. Specifically the sector in EU faces a crisis during this period due to recession and strict environmental regulations.

In addition to this, the present dissertation mentions the future challenges that the industry has to cope with. These challenges are mainly technological such as new competitors from other industries, electrified vehicles and introduction of digitalization in the automobile sector.

Finally, in the last part an extensive reference is made to the huge impact that the industry has on the environment. This impact is enormous because a vehicle burdens the environment not only during its production process but also during its life cycle. That's why a survey has been conducted with the use of primary data and statistical analysis. The survey intends to research how variables like environmental concerns, green marketing and country origin production affects a consumer's buying decision regarding a car.

Keywords

Automotive industry, Production, Technology, Electrification, Environment

"The Future of the Automotive Industry: Trends and Challenges"
(Το Μέλλον της Αυτοκινητοβιομηχανίας: Τάσεις και Προκλήσεις)

Grigoris Tsakakis
(Γρηγόρης Τσακάκης)

Περίληψη

Σήμερα, η παγκόσμια οικονομία έχει γίνει περίπλοκη και πολύπλευση. Αποτελείται από πολλούς επιχειρηματικούς τομείς που διαδραματίζουν σημαντικό ρόλο στην ανάπτυξη κάθε χώρας. Ένας σημαντικός τομέας είναι αυτός της αυτοκινητοβιομηχανίας. Όπως γίνεται εύκολα αντιληπτό, ο κλάδος αυτός συνδέεται άμεσα με την παραγωγή οχημάτων και καλύπτει την βασική ανάγκη της μεταφοράς και της μετακίνησης.

Αυτή η εργασία ξεκινά δηλώνοντας τη σημασία της παραγωγής στην αυτοκινητοβιομηχανία. Η επέκταση της παραγωγής, η ενσωμάτωση, η βαρύτητά της σε εθνικό και τοπικό επίπεδο και οι βασικές αγορές είναι μερικά καίρια θέματα που αναφέρονται. Στη συνέχεια αυτή η μελέτη διερευνά την πορεία της αυτοκινητοβιομηχανίας στην Ευρωπαϊκή Ένωση. Συγκεκριμένα ο κλάδος στην ΕΕ αντιμετωπίζει κρίση αυτή την περίοδο λόγω της ύφεσης και των αυστηρών περιβαλλοντικών κανονισμών.

Επιπλέον, η παρούσα διατριβή παρατηρεί τις μελλοντικές προκλήσεις που πρέπει να αντιμετωπίσει ο κλάδος. Αυτές οι προκλήσεις είναι κυρίως τεχνολογικές, όπως οι νέοι ανταγωνιστές από άλλες βιομηχανίες, τα ηλεκτροκίνητα οχήματα και η εισαγωγή της ψηφιοποίησης στον τομέα της αυτοκινητοβιομηχανίας.

Τέλος, στο τελευταίο μέρος γίνεται εκτενής αναφορά στην τεράστια επίδραση που έχει ο κλάδος στο περιβάλλον. Αυτός ο αντίκτυπος είναι τεράστιος επειδή ένα όχημα επιβαρύνει το περιβάλλον όχι μόνο κατά τη διαδικασία παραγωγής του αλλά και κατά τη διάρκεια του κύκλου ζωής του. Γι' αυτό το λόγο έχει διεξαχθεί και μια έρευνα με τη χρήση πρωτογενών δεδομένων και στατιστικής ανάλυσης. Η έρευνα σκοπεύει να ερευνήσει πώς μεταβλητές όπως οι περιβαλλοντικές ανησυχίες, το πράσινο μάρκετινγκ και η χώρα

παραγωγής - προέλευσης επηρεάζουν την αγοραστική απόφαση ενός καταναλωτή σχετικά με ένα αυτοκίνητο.

Λέξεις – Κλειδιά

Αυτοκινητοβιομηχανία, Παραγωγή, Τεχνολογία, Εξηλεκτρισμός, Περιβάλλον

Table of Contents

List of Figures

List of Tables

List of Abbreviations & Acronyms

FDI	Foreign Direct Investment
WTO	World Trade Organization
NAFTA	North American Free Trade Agreement
MEP	Member of European Parliament
ACEA	European Automobile Manufacturers' Association
OECD	Organisation for Economic Co-operation and Development
LCA	Life Cycle Assessment
UNECE	United Nations Economic Commission for Europe
BEV	Battery Electric Vehicle
PM	Particulate Matter
EPA	US Environmental Protection Agency
IPCC	Intergovermental Panel on Climate Change
GCC	Global Climate Coalition
NMC	Nickel – Manganese – Cobalt
LFP	Lithium FerroPhosphate
LIB	Lithium – Ion Battery
JIT	Just – In – Time
OTD	Order – To – Deliver
OEM	Original Equipment Manufacturer
ICT	Information – Communication – Technology
ECTF	European Clean Transport Facility
ICE	Internal Combustion Engine
EV	Electric Vehicle
ATVM	Advanced Technology Car Manufacturing

1. Introduction

There are a few characteristics which the automotive sector has in common with some other globalized businesses like electronics, textiles, and consumer products, as well as some that distinguish it from the rest of them.

The first thing that every one of these businesses has in agreement is that, since the late 1980s, Foreign Direct Investment (FDI), worldwide output, and cross-border commerce has all increased considerably. This is especially true in the automotive industry. Potential and actual market growth, as well as a big excess of low-cost yet skilled labor in nations such as Brazil, China, and India, have successfully attracted inflows of foreign direct investment (FDI) to serve local markets as well as export to developed nations. As the World Trade Organization (WTO) accords, trade and investment openness have been enabled and promoted, resulting in the development of this kind of global sourcing systems. In addition, growing outsourcing along with the bundling of additional value chain operations in supplier organizations are two more characteristics that have emerged. As a consequence, developed-country providers have boosted their own participation in foreign direct investment and trade, whereas developing-country providers have expanded their own capacities.

Global suppliers have emerged from the largest suppliers, all of whom are situated in developed countries, and who have the capability to sell goods and services to a diverse variety of leading organizations (Sturgeon & Lester, 2004). In particular, the automobile sector is notable for having an extraordinarily centralized firm structure, in which a limited number of large corporations wield exceptional amounts of power on smaller businesses. Production in the major markets is dominated by eleven leading corporations from 3 nations: Japan, Germany, and the United States. In the 1990s, a wave of acquisitions and mergers in addition to equity-based partnerships broadened the worldwide reach of both lead corporations and the largest suppliers, allowing them to compete more effectively. Despite the fact that lead company concentration has not reached the extreme levels seen in some industries, it has slowed attempts to construct the kinds of industry-wide business and technical procedure standards that are common in less specialized industries.

A second, distinguishing, characteristic is the substantial regional organization that it possesses. Despite the fact that the automobile sector has become more internationally linked ever, it has established significant integration tendencies in a regional scale throughout this period. Heavy industries with similar traits (high-volume and consumer-oriented), such as textiles and technology, have, on the other hand, evolved patterns of integration that are applicable on a global scale.

Third, the automobile sector is distinguished by the limited availability of totally generic parts which may be employed in a broad range of finished goods without requiring considerable modification to meet specific requirements. In contradiction to memory chips as well as microchips in the technology sector and fabric or thread in the garment business, parts together with sub-systems for individual car models are more common in the automotive industry than in the other industries. As long as there are no open, industry-wide norms, value chain flexibility is undermined, and suppliers are tied to leading enterprises, restricting the ability to achieve economies of scale in manufacturing. Distributors are frequently the only source of particular components versions that are available. Because of this, closer collaboration is required, and suppliers who serve numerous customers must raise their prices. The majority of design work is concentrated in a few geographical bunches, generally close to the offices of the leading companies. Due to the fact that the value chain is constrained, the links among leading firms and suppliers are more likely to be relational and trapped in nature. At the design level, a large degree of global connectivity has developed in the automobile sector as global corporations have attempted to leverage design attempts among products marketed in a variety of final markets. Development and design of vehicles continues to be centered in or around the headquarters of the leading companies. Apart from that, manufacturers of parts are increasingly involved in design, and several of them have created their own design centers near the headquarters of big clients in order to make collaboration easier. The fact that centrally developed vehicles are customized to local marketplaces and that parts are produced in numerous locations means that design efforts and buyer–supplier relations are often spread over multiple producing regions. Consequently, in the automobile sector, value chains at all levels have become 'nested' inside the global organizational structures and business ties of the industry’s top corporations.

2. Core tendencies

2.1 The explosion in automobile production between 1990 and 2000

Since 1975, global automobile manufacturing has more than doubled, rising from 33 million in 1975 to almost 73 million in 2007. The building of new marketplaces in India and China has contributed to the acceleration of the rate of economic expansion. In 1975, seven nations accounted for almost 80 percent of total world production; in 2005, eleven nations provided for the same percentage of total manufacturing. Worldwide vehicle production increased at an average annual rate of approximately 2 percent from 1975 to 1990 and from 1990 to 2005 to an average annual rate of approximately 3 percent. China and India, with their low rates of motorization and large populations, have seen an influx of new investment, as their markets have grown at an alarmingly rapid rate – and, consequently, their output has increased at an alarmingly rapid rate. In this view, the capacity of some nations to enhance or retain their share of the global automobile production following the arrival of India and China into the global automotive manufacturing market between 1990 and 2005 might be considered a significant achievement (Radosevic & Rozeik, 2005).

From a geographical standpoint, the global automotive sector is undergoing a period of dramatic transformation. Ever since mid-1980s, it has been transitioning from a sequence of different national businesses to a more globally integrated industry, similar to the transition seen by many other industries. Incorporated into broader regional and world-scale production, consuming, development, procurement, control and command systems is the term used to describe global integration. In addition to robust regional institutions at the operating level, these global links have been complemented by a strong worldwide presence. Market variations necessitate the need for automakers to modify the design of their car models in order to accommodate the features of particular countries (Examples: more durable suspension as well as larger gasoline tanks in developing nations, pick-up vehicles for countries like Thailand, Australia, and so forth). However, while numerous vehicles are created with worldwide markets in consideration, an expanding number of vehicles are being created with input from linked regional design centers, wherein

engineers and designers assist in customizing vehicles for regional and national marketplaces (Bechmann & Scherk, 2010).

2.2 The chronic significance of main markets

With an increase in the amount of markets in which they produce and sell automobiles over the previous decade, top automobile manufacturers have increased their global reach. Despite this, the domestic market continues to be vital for many businesses.

Major corporations in North America and Europe have maintained a strong concentration of manufacturing and supply in their respective home areas. In 1997, General Motors, Ford, Volkswagen, and Fiat sold an average of 63 percent of their automobiles in their domestic markets (63 percent, 64 percent, 59 percent, and 66 percent, respectively); by 2006, the median had dropped to 55 percent of their vehicles. Volkswagen's manufacturing concentration climbed in 2006, while the concentration of all other firms fell.

The worldwide and local allocation of vehicle sales and production for the main businesses is primarily concentrated in home areas, with only a moderate shift away from that concentration occurring over time. The exceptions include Japanese manufacturers, which have seen the greatest decrease in concentration in their own market. In 1997, Honda generated 57% of its global output in the United States, while in 2006 it produced 37% of its global output in the United States. The VW group's manufacturing concentration rose, whereas its sales specialization remained essentially the same. There has been a slow diversification of manufacturing and sales in various areas across the world for Peugeot and Citroen (PSA Group) but also Renault in both periods. The reduction in specialization in Japanese manufacturing and sales is a result of their strong market entry in Europe (mostly through Nissan) together with North America (by Nissan, Honda and Toyota) (Subramoniam et al., 2009).

2.3 Regional integration of production

Production-wise, regional integration has emerged as the dominating trend ever since mid-1980s, and this pattern has been increasing since then. Automobile manufacturers and

significant distributors of automobile components are extensively involved in a variety of regional manufacturing systems. Local components manufacturing is most common in USA, EU, as well as Asia, where it is used to supply terminal assembly facilities that construct finished automobiles for local marketplaces. Throughout regions, there is a progressive trend in investments towards locales with lower operational costs, such as the southern Mexico and the United States in North America; Spain as well as East Europe and South East Asia but also China, among other places.

In the automotive business, there is a variety of elements that influence the relevance of regional manufacturing and distribution. Most have a political as well as strategic aspect, whereas others are the result of cultural, technological, and economic considerations, among other things. Automobile products, particularly passenger automobiles, can arouse political fallout among some of the general public because of their high cost and increased visibility (Schlie & Yip, 2000). This is especially true if smuggled vehicles account for a disproportionately large share of the overall vehicle sales and when local manufacturers are challenged by imported goods. Even more significantly, the political impact of the automobile sector is increasing in many countries due to the presence of prominent local lead corporations and industry groups, large-scale employment, as well as considerably large rates of unionization. Consequently, even in countries wherein import taxes and local standards do not exist or are anticipated to drop as a result of WTO rules, assembly lines have decided to limit exports voluntarily as well as to establish local production facilities in order to avoid political reaction. Because of the North American Free Trade Agreement (NAFTA), which was signed in 1994 and provides preferable market access to the United States, car manufacturers from Japan, Germany, and Korea with facilities in North America haven't yet focused their manufacturing in Mexico and Canada, despite the fact that these nations have reduced operating expenses.

It is also advantageous for a variety of additional technical and economic reasons to maintain production near to the ultimate markets. First and foremost, automobiles as well as numerous of their major components, like seating, engines, gearboxes and body panels, are huge, weighty, and occasionally delicate, which increases the cost of transporting. Since the mid-1980s, the industry-wide adoption of "lean" manufacturing techniques, as well as an increase in the variety of products and modules, has kept part manufacturing closer to complete assembly. A key component of lean manufacturing is the delivery of

just-in-time (JIT) parts, which helps to keep low stocks and identify faults as soon as they occur. However, just-in-time parts shipments may not always necessitate the co-location of components and terminal assembly operations on the same site. Working with large continental locations with solid rail and road infrastructure and well-developed logistics abilities, such as those in North America or Western Europe, it is possible to attain lean work-in-progress stocks. Greater anomalies in transcontinental maritime shipping, along with longer lead periods, have thus far prevented truly international sourcing from being achieved. Once again, the bulky nature of many car parts prevents the use of airfreight as a shipping method. In the contrary, the small weight of electrical parts makes it possible to use lean manufacturing practices at a larger scale at a worldwide level in the electronic industry. Even though the trend toward locating vehicles and significant, heavy sub - systems nearer to terminal marketplaces can be mapped back to the very beginnings of the automotive sector (Sturgeon & Florida, 2000), as novel marketplaces have surfaced and also the sector became more worldwide integrated, the image became more complicated (Bhamu & Sangwan, 2014).

2.4 Global and regional factors

However, despite increased local integration, the automotive sector maintains a number of national and local characteristics. It is possible to see significant differences between countries (and even within countries) in terms of consumer preferences and buying power, driving conditions, labor market rules, standard demands and public policy (incentives or taxation). Clients in high-income nations are much more demanding and also expect particular aspects, even in little automobiles, explaining why they are more expensive. Client tastes are also influenced by the features of particular civilizations which are the consequence of route dependence in the marketplace.

Roads as well as fuel in developing nations are usually of lower quality than in advanced nations, necessitating the modification of automobiles to accommodate local conditions, including the strengthening of the body, suspensions, steering, as well as other components. In each market, there is a unique set of rules (environmental: water restrictions, air pollution, waste handling, environmental cleanup; sound management, fuel efficiency) that manufacturers must adhere to in order to do business there. The pricing

and performance of a product are significantly influenced by adherence with such regulations. Preference for specific automobiles can be stimulated by taxation laws, such as in Brazil's preference for small and inexpensive vehicles as well as Thailand's preference for lightweight pickup trucks (Humphrey & Memedovic, 2003).

Automobile manufacturing (and employment) is often concentrated in a small number of industrial zones within a country's surface area. For example, in certain circumstances, these clusters are focused on particular components of the business such as vehicle designing and final assembly, or on the manufacturing of parts that have a common trait such as electronic contents or labor intensity. Because of the huge investment in lengthy capital gear, skills, and strong links across value chain activities, as previously indicated, the geography of automobile clusters has a tendency to be long-lived. A contemporary study conducted by Reichhart et al. (2008) alludes to an increase in the co-location of highly specialized provider clusters, and local devoted units, near automotive assembly plants, which is consistent with previous findings. Manufacturing plants, which are often controlled by international suppliers, are housed in such parks and are committed to providing a single customer. It is common for big, sensitive, and heavy built-up modules, such as dash boards but also completed passenger seats, to be supplied to finished assembly operations on a just-in-time (JIT) basis. It is also common for parts that must be supplied to finished assembly operations in a sequential manner based on color or model variability to be supplied in a provider park model. Suppliers are given just few hours to respond to a demand for the supply of a module when such prerequisites are met (Othman et al., 2016).

A further advantage of JIT delivery is that it permits providers to retain low levels of in-process and completed inventory, which serves as a buffer for transportation and quality issues. As a result, supplier parks have emerged as a critical part of international strategies targeted at reducing the total cost of ownership for every part. The applicability, on the other hand, is not universal. In this case, it is dependent on the features of particular elements as well as the parameters of demand, which include product diversity and quantity. Constructing units in various supplier parks is both expensive and time-consuming, and it results in duplication of effort. Consequently, suppliers may rent sites from automakers and regional government bodies in order to reduce these expenses and their reliance on the automaker's supply chain. They could also use provider park centers

to store inventory that has been generated elsewhere or to make cosmetic adjustments to inventory that has been manufactured elsewhere. It is possible to make changes to the logistics operations (both inside and outside the automotive supply chain) since they are complex and expensive. As a result, they are parts of the value chain wherein adjustments can be made. Improvements in the synchronization of outbound and inbound logistics assist to the optimization of supply chains as well as the reduction of stocks and the responsiveness to customer demands. As economies develop, the emphasis of competitiveness turns from price to brand image and customization, and it is at this point that the speed and dependability of logistical operations become essential factors. One result of this growth is the increasing prevalence of supplier parks, wherein logistics corporations may successfully 'bridge the geographic distance' between customers and suppliers (Reichhart & Holweg, 2008). The logistic infrastructure for most emerging markets is inadequate, which might harm their long-term export competition as well as the car industry's ambition to lowering CO2 emissions from traffic.

3. The European car industry in crisis

The continuing slowdown in global economic growth and the bleak forecasts for growth in both the European and global economies combined with the continuing decline in consumer confidence have begun to have a particularly negative impact on European carmakers. The latter are now facing the challenge of maintaining large amounts of investment that will support the market transition to less polluting but also lower vehicle consumption by finding the acceptance of high consumer demand and the adequate support of government authorities. The effects of the financial crisis have hurt the car industry so much as the lack of capital makes it more difficult for companies in the industry to finance their day-to-day production activities and at the same time has gradually weakened consumer demand for new cars. Consumers are now particularly reluctant to negatively proceed with the purchase of a new passenger car but even if they want it, they will hardly be able to find the necessary financing from the banks to do so. The prevailing conditions may delay or even hinder the achievement of the European Union's goal of replacing the largest proportion of cars on European roads with new types of vehicles that will feature lower fuel consumption in order to reduce rates emissions of environmentally harmful pollutants. Until 2008, sales of new cars were lower than last year as a result of ever-increasing fuel prices. After 2008, the decline in sales was further intensified due to the effects of the financial crisis. European countries that have traditional powers in the industry, such as Italy, Spain and Sweden, have been hit hard by the unprecedented global economic downturn. The deteriorating industry conditions were also reflected in the sales rates of Eastern European markets, where in recent years there has been a steady increase in sales as a result of the continuous economic growth of these countries and the growth of new car owners (Lee-Makiyama, 2012).

Short-term forecasts, according to industry analysts, for the European car industry continue to be pessimistic, with no significant signs of recovery due to highly volatile market conditions, including competitive pressures and raw materials. Reducing demand in Western Europe, Japan and Americas could offset rising demand in the developing world, but emerging markets are expected to slow as well. In the light of the recession, European manufacturers have called on the European Union authorities to take various economic measures to ensure the economic viability of the European car industry and to

strengthen the consumer base for new, more fuel efficient vehicles. "Carmakers are now facing very reluctant consumers and relying on governments to respond and mobilize those levers of the economy that will free up capital and restore consumer credit. Only then will consumers be able to find the means and confidence to buy a new car," said Christian Streiff, president of the European Automobile Industry Association and CEO of the PSA Peugeot Citroën Group, at a news conference in Paris. The European car industry contributes a significant percentage to shaping the economic size of the European Union. The total revenue from the operations of the sector reaches 551 billion euros, which is 5% of the GDP of Europe of 27. In early 2011 many manufacturers announced that they would reduce their production due to the negative factors mentioned above. It is therefore natural for car suppliers to follow the same path of downsizing. The global automotive industry directly employs 2.3 million people in its divisions and indirectly employs companies close to the industry another 10 million employees. In 2009, 18.4 million vehicles were produced in Europe, 7% less than in 2008, when 19.7 million vehicles were produced. The decrease is mainly due to the particular decline that occurred in the last quarter of the year (-26%) reflecting the financial recession of this period. 86% of the total production of vehicles was related to the production of passenger cars. Production in the new EU member states amounted to 18% of total production in Europe. Production in these countries increased by 8% compared to 2007 (Jürgens & Krzywdzinski, 2009).

Quite painful for all car manufacturers with a few exceptions was May of 2008. In particular, in May 2008 and compared to the corresponding month of 2007 there was a decrease in sales by 7.8% or 1,334,081 units compared to 1,446,283 units in the corresponding month of 2007. In terms of European markets, the largest decrease was recorded in Ireland with 50.7% or 10,191 units compared to 20,689 in 2007, while the largest increase was recorded in Bulgaria with +65.3% or 3,935 units versus 2,380. Of the markets where sales exceed 100,000 units per month, Spain showed -24.3% (116,108 units), Italy -17.6% (204,607 units), Germany -6.2% (275,259 units) and the United Kingdom -3.5% (179,272 units), while France increased by 7% (184,463 units). In terms of companies and especially at the group level that of Toyota (Toyota, Lexus) showed the largest decrease of 21.6%, followed by: Daimler (Mercedes, Smart) with -13.2%, Ford (Ford, Volvo, Land Rover, Jaguar) -8.6%, VW (VW, Audi, Seat, Skoda) -8.1%, PSA (Peugeot, Citroen) -7.9%, Renault (Renault, Dacia) -5.7%, GM (Opel, Chevrolet, Saab) -

5.4%, BMW (BMW, Mini) -4.4%. In terms of companies, the largest decrease was presented by Land Rover with -39% and was followed by: Dacia -35.8%, Lexus -24.7%, Honda -21.7%, Toyota -21.5%. On the contrary, the companies recorded an increase: Jaguar +58.3%, Nissan +8.4%, Mazda +2.9% and Mini +1.6% (Grigolon et al., 2015).

In the first five months of 2008 and compared to the corresponding period of 2007 sales fell marginally by 0.7% (6,919,190 units against 9,969,408 units) with the BMW Groups +10.2%, Daimler +3.8 % and Renault with +0.8% to have an increase in sales while the other groups showed a decrease: Toyota -11.2%, GM -4.7%, Ford -3.8%, PSA -3.2%, Fiat -1.7%, VW -1%. In terms of companies, the largest increase was recorded by Smart +40.1%, Nissan with +34.2%, Mini +21.6%, Jaguar +10.7% and Mazda +10.3%. Alfa Romeo -36%, Lexus -23%, Land Rover -15.2%, Saab -13.2%, Toyota -10.7% recorded the largest decrease. The conclusions that can be drawn from the course of sales are contradictory. Given that consumers are looking for fuel-efficient cars, how does Lexus's vertical drop in sales with the widest range of hybrid cars justify Jaguar's significant increase in sales? If the main motivation is the issue of price, how is it possible for Nissan to lead the sales with the model Qasqhai, to be at the spearhead (average purchase price of 22,000 euros) while Toyota is losing significant ground with strong models in the small categories with an average purchase cost of 13,000 euros? However, Volkswagen seems to have a remarkable balance in sales as it is consistently the first European company in sales.

The effects of the financial crisis are now visible in key areas of the real economy, with the first recipient being the car industry, which is already experiencing, worldwide, the biggest crisis in its history. This was the joint conclusion of the representatives of the European Commission, the Council, and the political groups of the European Parliament, in the debate on the crisis in the European car industry, which took place in the plenary. With the exception of the MEPs of the "Greens" and the "United Left", the majority of MEPs, however, were in favor of the views of the representatives of the European Commission and the EU Council of Ministers, that there should be public, financial, support for the European car industry to cope with the effects of the crisis and in order to avoid chain problems, in the small and medium enterprises that cooperate with it and in employment. Council spokesman Jean-Pierre Zouiersaid "we must take responsibility for

dealing with the crisis in a construction industry affected by the financial crisis, which is affecting credit, which is needed to stimulate demand" (Grigolon et al., 2015).

3.1 The positive outlook for the European car industry

The representative of the EU Council of Ministers, however, claimed that "things are relatively good in the competitiveness of the European car industry", stressing that they can go even better if the European car industry is strengthened in the production of more economical and ecological cars. The view that "the European car industry is not on the brink of collapse" was expressed by the Commissioner in charge, GunderVerheugen, stressing, however, that the car industry is a "key" to the European economy. In the automotive industry, he added, there are 12 million employees in Europe for 2009, which will be a crisis year for the automotive industry, there will be layoffs, reduced production, and reduced investment in the production of greener and cheaper cars. If we want to reduce environmental pollution, he added, we must proceed with a rapid renewal of Europe's fleet, in the direction of strengthening the construction of new technology, eco-friendly cars. There must be a stable legal framework and, at the same time, we must support the demand, with tax incentives that will lead to the purchase of new technology cars (Lee-Makiyama, 2012).

3.2 Demand and classifications at Pan – European level

In December 2010 car sales in the EU decreased by 3.2% to 1 million units. In Germany sales fell by 23.4%, in France where the incentives were valid in 2010, December sales fell by only 0.7%, while domestic markets in Spain, Britain, and Italy the decline was greater. China, meanwhile, topped the car market by 33.2% in 2010. New car registrations in Europe fell 4.7% to 1.6 million, according to the European Automobile Manufacturers´ Association (ACEA). Of the largest markets, Germany and France rose 6.15% and 11.5% respectively, while Britain, Italy and Spain fell 7.9%, 28%, and 29% respectively. Although rankings rose in most countries in the first quarter in Britain they fell 8.7%, in Italy 23% and in Spain 27%. The biggest drop was in Greece where it fell 57% while the biggest rise was in Latvia where it rose 132%. Car prices fell by 2.5% in real terms in 2010 across the European Union, while in Greece they fell by 3.8%. This emerges from

the European Commission's latest report on car prices in Europe, which shows, among other things, that there is also a slight convergence in the list prices of new cars. "These long-term price trends confirm last year's decision by the Commission that there is no longer any justification for specific competition rules for the sale of new cars," said a statement issued in Brussels. In particular, in a total of 24 EU countries, a decrease in real car prices was recorded. In two other countries prices remained stable (+0.2% in Italy and Malta), while they increased in Portugal (+2.6%). However, in the case of Portugal, it should be noted that in this country a larger than average decrease in real car prices (-6.7%) was recorded last year in favor of buyers. The fall in real prices was particularly significant in Slovakia (-17.4%), Bulgaria (-13.5%), Slovenia (-11.6%) and the Czech Republic (-9.0%). In Poland, a decrease of 5.6% was recorded. In terms of large size, the decrease in real prices was more significant in the United Kingdom (-3.7%), while the price reductions were more modest in Germany, Spain and France (-1.9%). The European Commission said in a statement that "a decline in real car prices across the EU has been steady for at least a decade now", suggesting that competition between manufacturers in the new. The Commission also notes that real prices for repair and maintenance services, which have risen above the general level of inflation over the last decade, did not increase in 2010. Finally, Joaquin Almunia, Vice-President of the Commission Competition Policy, said: "It is positive that consumers in Europe benefit from competition in markets for the sale of new cars and that the prices they are called upon to pay continue to fall sharply in real terms. The fact that price differences between Member States have been further reduced is a positive sign of cross-border competition. I am also extremely pleased that, for the first time in a decade, real prices for repair and maintenance services across the EU have stopped rising, which shows that the industry has understood the new rules of the game" (Sosvilla-Rivero & Gil-Pareja, 2012).

3.3 The Greek car market in crisis and the measure of withdrawal

The crisis has hit all sectors of trade, while unemployment and the economic hardships that most of the population faces on a daily basis leave no room for demanding markets, such as the car market. According to the Association of Motor Vehicle Importers, car sales are declining sharply, with both revenue shrinking and job losses. Throughout Northern Greece, far fewer cars were released in 2010 compared to those released in 2009. Car sales

in our region have recently fallen by 63.3%. Also, only 751 cars were sold throughout Macedonia last January. A car dealership manager said that the traffic and interest of people in car markets have dropped a lot, despite the fact that prices are now lower. He characteristically stated: "People used to come in at least to ask. Even now this rarely happens. And those of the consumers, who are still interested in getting a car, turn to small cars and low cubic meters, up to 1400". Asked about the Services and whether the customers prefer the dealership's workshop, he replied: "People are very financially constrained. They find it difficult to service, and of course, they always try to save even 2 euros. They are looking for ways to make them better priced. That is why we, for our part, make offers on programs with lower prices, discounts on spare parts… Many choose the solution of external workshops, which are cheaper. But in general, they prioritize low price over quality".

The used industry is also in a big recession. After a contact we had with a manager in a second-hand shop, we were informed that the traffic there is very low, of the order of about 40% in small, and 70% and above, in large cars. Customers generally prefer cheaper solutions. In small used cars, there has been a drop in prices up to 30%, while in large ones up to 60%. Traders in the industry are waiting for a boost in the market with the withdrawal of cars. They hope this will increase their revenue somewhat. It is estimated that the withdrawal will increase traffic in the car market by 20 to 30%. According to what the government announced earlier, the withdrawal will apply to cars released before 1999, whose owners will be able to earn a reduction in the registration fee for the purchase of a new car up to 2,000 cubic meters. About 2,500,000 car owners will thus have the opportunity to change their old cars. Buyers will make a profit of 300 to 5,000 euros by applying the withdrawal measure. The withdrawal is expected to stimulate the used sector as well, since someone who has a car over 12 years old, will be able to withdraw it and buy a new one or sell his right to withdraw, taking some money and putting a little more to buy a car who will be in better condition than the one he withdrew. There is a general optimism that things might get better, with the withdrawal giving the car market a breather (Brinia & Pefanis, 2013).

3.4 The impact of the automotive industry on the environment

The automobile business has been a huge success story with a tremendous impact on society. Global car ownership has increased from from 50 million in 1950 to more than 600 million now. In 1950, just two out of every 100 individuals had a car; now, ten out of every 100 have one. In terms of the top 100 countries, the United States is in the top 70. World population and world economy growth means that the number of vehicles on the road will grow as well. Global car populations are expected to double within the next two decades, according to a variety of estimates. Because of increasing mobility, there is a greater need for commodities and a greater need for trash disposal. As long as pollution is viewed as an externality by the market, governments are commonly seen as compelled to step in. There is a wide range of policies in place in the United States, Japan, the OECD, and many other nations to minimize toxic and harmful air pollutants and also to decrease fuel usage. Emissions limits will be implemented in the OECD nations shortly. It is commonly assumed that fuel economy criteria and voluntary agreements currently in existence will be built upon by these regulations. Particulate pollution rules, fuel efficiency but also greenhouse gas requirements, and standards and subsidies for electric-drive cars will likely be the most significant environmental policy measures influencing the automobile sector in the future years (Karvonen et al., 2015).

Due to the continuous worldwide environmental degradation, the global automobile sector is today confronted with significant issues. Since CO2 emissions have been steadily rising over time, as well as the quantity of garbage created during vehicle construction and decommissioning, road transportation has been ranked as one of the greatest environmental concerns of all time. In Europe, for example, transportation accounts for more than a quarter of all greenhouse gas emissions (Bielaczyc et al., 2019). The EU's oil consumption climbed at its quickest rate since 2001 in 2017, driving up transportation emissions by 25% since 1990 (Pálvölgyi et al., 2022).

Because of the ever-increasing number of automobiles on the road, many people are worried about the impact these vehicles have on the environment. Road transport's negative impact on the environment can be mitigated by enforcing laws that aim to eliminate hazardous technology. The automobile industry is under growing pressure to cut fuel consumption and exhaust emissions during the life of a vehicle because of stricter

environmental regulations. Research has thus concentrated on minimizing energy usage and emissions of hazardous chemicals and CO2 emitted directly from automobile operation. There is a variety of ways to evaluate a car's environmental impact. Traditionally, the quantity of CO2 emitted by automobiles with internal combustion engines has been assessed using a method that relies on the kind and amount of gasoline utilized. Methods for conducting research are based on a long history of automotive industry experience and broad expertise. Because of this method, the current EURO standards were created. The ISO 14,040 and 14,044 standards (2006) offer a modern approach to the problem of the environmental effect of automobiles and have been utilized for this purpose for more than 30 years. Assessing the environmental effect means the full contractual life of an automobile, from the manufacturing of materials to the construction of a car, its operation and decommissioning.

Many studies have looked at the car's life cycle from the perspective of LCA. Some studies have examined the environmental impact of vehicle building. A life cycle assessment (LCA) of an automobile is most frequently used to examine the performance of individual parts or the entire vehicle as a whole (Suzuki et al., 2005). Other studies have looked at how easy it is to put together an automobile. The environmental impact of an automobile during its entire lifespan, broken down by process, has also been quantified (Mayyas et al., 2012). They indicate that the driving procedure has a significant influence on the quantity of energy used and the amount of pollution released. Since then, there has been a great deal of research into the environmental impact of automobile use. Among the various environmental implications of the automobile sector, air pollution by harmful compounds produced by cars, which represent a threat to human health, has received the most attention (Ballester, 2005), (Potter, 2003). The weight curb technique has been shown to be highly successful in reducing the environmental impact of automobile operating in other studies (Raugei et al., 2015). These issues will only worsen in the coming years, given the rise in the number of people needing transportation. On the worldwide scale, air emissions from the transportation sector account for around 23% of total anthropogenic CO2 emissions, according to the United Nations Economic Commission for Europe (UNECE) (Merkisz et al., 2014). By 2030, there will be 1.3 billion light-duty cars on the road, and that number is predicted to rise to 2 billion by 2050,

which will have a huge influence on gasoline and diesel consumption as well as on energy security and climate change (WBCSD, 2004).

A major factor in this shift toward a more environmentally friendly automobile sector is that sustainable development is becoming an increasingly crucial problem for the transportation industry as a whole. The environmental impact of automobile driving technology has gotten the most attention. Research has focused on fuel economy as a way to cut down on the amount of resources and energy used (Messagie et al., 2014). The usage of batteries in electric cars (BEVs) has also received significant attention, as they limit the usage of fossil fuels and thereby contribute to environmental conservation (Zackrisson et al., 2010). That's why it's so common to see comparisons of the environmental profiles of different driving systems, like the comparison of inner combustion engines with solely electric and hybrid automobiles in the literature (Xiong & Ma, 2019). The life cycle analysis of electric and hybrid cars has also been used to examine their fuel consumption and emissions (Tagliaferri et al., 2016). According to this study, electric mobility has a critical role to play in the development of sustainable road transportation. Although some comparison studies have been done based on local factors, this is not always the case. Research on certain parts of the vehicle, like the battery (Ellingsen et al., 2014), has garnered a lot of attention, but the data is scant and comes from studies that are based on previously published research. A number of studies have examined the environmental effect of car components other than the driving unit. For the whole vehicle's life cycle, such as the operation phase, the material intake was taken into account, and evaluations were conducted on this basis (Faria et al., 2013). In these studies, inventories from previous research have been utilized to estimate the vehicle's environmental effect. In addition, vehicle manufacture, particularly the production of the powertrain, has been the most often researched step. Lombardi et al. also give a comparison of the environmental characteristics of traditional and electric automobiles (2017). Although the percentage of plug-in hybrid and electric vehicle sales is increasing, the environmental and energy efficiency of the automotive fleet is still heavily influenced by vehicles with internal combustion engines. As civilization has progressed, people's awareness of environmental concerns and the urgent need to address them has grown. An excellent example of this may be seen in the automobile sector, where environmental concerns have lately grown in importance. In today's automobile business, the ecological

features of cars, as well as the safety systems utilized, are frequently seen as signs of technological development. Due to ever-increasing transportation demands, the problem of automobile use and its impact on the environment has grown increasingly critical (Harris et al., 2018). Stationary pollution sources can be controlled considerably more easily than many millions of moving automobiles.

As automobile pollution worsens, particulate matter (PM) is being regarded as the most dangerous and harmful contaminant (in OECD countries where lead emissions are already well controlled). However, it is difficult to determine the source and properties of particulate matter, and also their impact on human health, particularly those particles produced from cars. Liquid and solid droplets in the atmosphere are collectively known as PM. Particulate matter wreaks havoc on the environment and human health, as well as deteriorating building materials and obstructing vision. Fine particles are the most dangerous to humans (those less than 2.5 micrometers in diameter). Particle emissions from motor vehicles and the particles created by the conversion of gaseous emissions from motor vehicles fall under this fine particle category. The deepest regions of the lungs can be penetrated by fine particles.

According to the California Air Resources Board (ARB), which conducted several investigations, diesel exhaust is a carcinogen and has been linked to lung cancer. Particulate matter (PM) emission requirements for light-duty cars were recently strengthened by the US Environmental Protection Agency (EPA) and California. Automakers have a huge challenge with these new requirements, particularly for diesel but also immediate injection gas engines. If these new regulations are implemented, the commercialization of such engine types might be stifled, as shown in the following paragraphs. Global Warming Climate change is often considered to be the greatest threat to human civilization. Growing scientific agreement suggests the buildup of greenhouse gases emitted by fossil fuel burning, manufacturing, and agricultural but also forestry operations will have a significant impact on weather patterns if present emissions trends continue. Working Group 1 of the IPCC (Intergovernmental Panel on Climate Change) reached the following conclusion at the end of November 1995: "the weight of evidence implies that there is a discernable human effect on global climate." As a result of this global agreement, the Kyoto Protocol was ratified by nations throughout the world in December 1997.

The EU, US, and Japan all agreed to cut their greenhouse gas emissions by a combined 8% between 1990 and 2012, which is an important part of the deal. Even while these countries have not publicly agreed to these cutbacks, there is a rising feeling of concern that something needs to be done quickly. Indeed, a number of firms that had previously opposed any government climate change action are now more receptive and even helpful of the government's efforts. Ford and Daimler Chrysler, for example, resigned from a group that lobbied opposing government climate change action towards the end of 1999 and the beginning of 2000. It has become increasingly difficult for Ford to pursue its environmental initiatives with any credibility since its withdrawal from the GCC (Global Climate Coalition) in December 1999, when company spokesman Terry Bresnihan stated: "We do believe there is something to climate change; there are enough indications that something is occurring that we need to begin looking at this sincerely." Achieving the 1997 agreement on greenhouse gas emissions reductions by the goal date of 2012 will be exceedingly challenging, especially in the US, where overall emissions of greenhouse gases increased by 9.5% between 1990 and 1996. Light-duty cars account for 61% of transportation-related greenhouse gas emissions, or one-fourth of the total. Between 1990 and 1996, vehicle CO2 emissions rose by 8.8%, owing to an annual rise in vehicle miles traveled of around 2 percent and stagnant fuel economy. Any plan to minimize greenhouse gas emissions is going to rely heavily on automobiles (Gupta et al., 2019).

3.5 Rising raw material costs

In the shift to a climate-neutral mobility sector, batteries are gaining center stage because they provide a locally CO2-free alternative to fossil fuels in vehicles, and may offset the production unpredictability of renewable energy sources in the power supply. In electric cars, lithium-ion batteries (LIB), the most advanced battery technology, are prohibitively expensive. Although the cost of battery-powered devices has reduced more than fivefold in the past decade, the cost of stationary energy storage is still deemed too expensive to make battery-powered products competitive with their traditional equivalents. On the other hand, a recent analysis of battery cost forecasting studies using the approaches of technical learning, literature-based projections, bottom-up modeling, as well as expert elicitation suggests that this trend will continue in the future. Technology advancements in both battery technology and the manufacturing process are two major factors driving these

forecasts. Despite this, experts are increasingly concerned about the growing costs of crucial raw materials. As demand increases and presently committed expenditures for future mining activities are deemed inadequate, there is increased anticipation of increased demand. Studies on battery cost forecasting have neither relied on specific technology roadmaps nor taken future raw material pricing assumptions into account, making it difficult to assess the combined influence of technical advancements and tighter raw material markets on future battery costs.

There are electrodes (cathodes and anodes) inside the cell housing that house lithium ions during discharge and charge operations, an electrolyte in the electrolyte solution that allows for ionic conduction inside the cell housing, and a separator to avoid electric shorting. 20 This is because electrode materials are the most expensive of the components, and their cost share is predicted to continue to rise until 2030, so they are the focus of the technological roadmap's material innovations. Technological advancements are anticipated for both electrode active materials. There is now around 80% of the market for nickel-based layered oxide cathode materials like NMC (Nickel-Manganese-Cobalt), followed by LFP-based (LiFePO4, lithium iron phosphate) cathode materials with 10% to 20% market share. Cobalt and manganese's initial 2020 share in nickel-based products is expected to be reduced by all consulted industry analysts. For the cathode active metal, the molar percentage of Nickel among transition metals in 2020 did not surpass 60%, and it is expected to rise to at least 80% by 2030. There have been growing nickel percentages in the NMC materials since the beginning of the previous decade, with NMC111 reaching 33% nickel. For this trend to take hold, manufacturers must simultaneously increase material capacity while lowering cobalt usage, which is both expensive and divisive in terms of sustainability and supply stability, all while simultaneously improving LIB (Lithium-Ion Batteries) energy content (Schmuch et al., 2018). Higher nickel content, on the other hand, is linked to safety and performance issues (primarily capacity and voltage decay, impedance development) in batteries (thermal runaway under abuse circumstances) (Hou et al., 2021).

Anode lithiation and subsequent interactions with the electrolyte and lithiated anode increase the danger of thermal runaway due to the thermodynamic instability of nickel-rich layered oxides at high temperatures and high lithium consumption (Hou et al., 2021). Remaining lithium molecules, transition metal ion desolvation, and crack development all

contribute to the loss of performance (Li et al., 2020). In order to overcome these difficulties, researchers are working in a number of different ways, such as optimizing synthesis procedures, adding foreign-ion doping and applying surface coatings (Li et al., 2020). This analysis makes the assumption that materials will gradually progress from NMC622 in 2020 to NMC955 in 2030 based on common industry forecasts. The particular discharge capacity, average discharging potential vs. lithium, and price of the various materials are key factors in cell energy and cost (Andre et al., 2015). Specific discharge capacity increases from 180 to 215 milliamperes per kilogram (mA/kg) for the tested NMC materials, even if the discharge potential is expected to be the same. A recent article's forecasts of NMC622 market prices for 2020 are also utilized, as well as somewhat higher NMC material processing costs (per kg) with rising nickel content (Li et al., 2020).

Graphite is expected to hold the most market share in anode active materials until 2030, contrasted to silicon and lithium metal, according to industry experts. The silicon additive content (such as silicon monoxide, SiOx, x E1), which has so far been less than 5 weight % and is predicted to rise in some vehicle segments in the future, is likely to gradually alter. Prior research has outlined the state-of-the-art procedure in great detail. Automotive LIBs have had their process specialists' comment on predicted improvements in key cost-driver phases including mixing, coating, drying, stacking, forming, and aging in order to develop a technological roadmap. These steps account for around two-thirds of cell processing costs (Duffner et al., 2021).

3.6 The competitiveness of brands automotive industry

The automobile industry has seen a major shift in the competitive landscape. With the broad deployment of lean processes across geographies, what was once a clear demarcation between artisan, mass, and lean manufacturers has become muddled. One may also find strong aspects of mass manufacturing techniques (moving assembly lines, etc.) in enterprises usually regarded to be craft makers that have adopted lean manufacturing. Only a few luxury carmakers, such as Rolls Royce and Ferrari, have kept some of the old craft manufacturing methods, such as Jaguar and Bentley, whose growth into the lower sectors of the market is problematic. It's the usual practice today to employ

standardized components and work techniques as well as component sharing and pure craftsmanship is used mostly for marketing purposes rather than in day-to-day production. Carmakers are now using both mass and lean production methods, erasing the divide that characterized the manufacturing models of the past century (Jacobs, 2015). However, the method we sell and distribute automobiles has not evolved much over the previous century. In reality, Henry Ford's legacy can be found in both the way factories are operated and in the automobiles that are sold as a result of those companies' mass manufacturing. In the early 1900s, automobiles were built to order by craftsmen. Henry Ford was able to run his factories more effectively because he built his Model T from dealer stock and sold it according to prediction. He argued that increasing production at the facility would lower the cost of each unit sold, which in turn would lower the retail price. In turn, this would lead to a rise in demand, which would lead to an increase in sales. In a market where more demanding consumers demand customized automobiles with short lead times, this forecast-driven paradigm is incorrect, yet it made sense when demand outpaced supply (Holweg & Pil, 2004). Though many automakers are still relying on long-term sales estimates to drive manufacturing, they still aim to sell their vehicles from dealer stock. For the time being, the vast majority of automobiles are being constructed based on regional forecasts. Vehicles built to order have a long lead time, which makes it difficult to minimize inventory costs and sales incentives while expanding vehicle content. However, buyers in Europe are only ready to wait 2-3 weeks for an OTD (Order-To-Deliver) lead-time of 41 days with the exception of a few very patient customers, and the German market, where build-to-order has a long tradition. Manufacturers create automobiles based on sales forecasts and sell them directly from stock to avoid losing any sales to competitors with superior availability. By adjusting demand through incentives, supply is influenced by forecasted output levels.

In today's world of global excess capacity as well as fashion-conscious customers, the outcomes of this mass manufacturing logic are disastrous: car makers use increasing levels of incentives to sell off their oversupply and thereby eroding their brand image and seriously straining the residual values of their products and models. As a result, car manufacturers' (now still extremely successful) leasing operations suffer (Holweg & Pil, 2001). Indeed, automakers like GM and Ford presently make more money from their leasing and finance divisions than they do from the actual production of automobiles. It's

possible that if the present make-to-forecast practice and incentive levels maintain, this scenario will alter. From 2000 onwards, the Big Three (GM, Ford and Daimler Chrysler) have waged a war of attrition on incentives, and by 2004 a profit of $3,000 per car were on average in the US market and topped on $5,000 for some models. Europe and China have also been influenced by similar incentives in recent years as overcapacity takes its toll on these new entrants' marketplaces. Adding insult to injury, the product spectrum's volatility has risen precipitously as well. It is seen in the widening of the model range as a result of this increased dynamic variation (Holweg & Pil, 2004). Whereas in the past, manufacturers only provided a few different models, today's offerings encompass anything from superminis to SUVs to crossover vehicles to even more so-called "cross-over" cars like the Toyota RAV4 and the Honda CR-V. Because of this, the aggregate volume sold by the model has decreased dramatically as a result of car manufacturers offering more models with shorter shelf lives. In Europe and the US, the product life cycle has shrunk to 5 years. From 129,000 units in 1990 to 69,000 units in 2002, Europe's average volume sold by body style has decreased (Pil & Holweg, 2004). The manufacturers' response is the proliferation of product platforms, which allows them to save development costs without compromising the variety offered to customers by sharing significant vehicle components (such as the floor pan, engines, transmissions, suspensions, exhaust systems, etc.). Volkswagen, Skoda, Audi, and Seat all use VW's A04/PQ35 Golf IV/V platforms, which have a combined yearly manufacturing capacity of 2,000,000 cars. The amount of sharing that can be tolerated has previously been criticized because of concerns about losing the ability to differentiate one brand from another and the potential for loss of revenue.

In conclusion, the automotive market and the strategies employed by carmakers are less well defined than they were previously. As Sloan, CEO of GM, has shown, offering a wide range of options is critical to a company's long-term success; Toyota's lean manufacturing approach, on the other hand, has become standard at many assembly facilities across the world. All of these components have been copied by automakers worldwide. Lean manufacturing techniques have transformed the way we build automobiles, but the way we sell them hasn't changed much since Henry Ford's time. The forecast-driven manufacturing and sales techniques currently used by most manufacturers have resulted in large car inventories and sales incentives. More and more enterprises are beginning to realize that the new competitive fight is how to defeat this second relic of the

mass production system: forecast-driven car supply planning and production planning. Build-to-order strategies like Volvo's (Hertz et al., 2001) and Renault's (Project Nouvelle Distribution) have the goal of connecting the mass production facility to customer demand and thus fulfill what Stan Davis put forward in 1987 as an oxymoron: 'mass customization, the individual customization of a vehicle manufactured using mass production techniques' (Davis, 1987). Many academic scholars (Gilmore & Pine, 1997) built on Davis's work, and now it is being used in a variety of sectors. It is, however, far more difficult to adopt in the automobile business than in the electronics industry, where Dell has greatly profited from the potential of the build-to-order method (Holweg & Pil, 2001). A company's improved understanding of the demands of its consumers and the capacity to match production with real customer demand allows it to function without costly inventory and sales incentives. As a result of the transition away from mass manufacturing and toward a more customized approach, the economy shifts from a focus on cost-cutting to a focus on profit-maximization. The ongoing battle of attrition on incentives indicates that the concentration on maximizing production volume and minimizing unit cost is no longer effective in a sophisticated market with large overcapacity.

4. The future of the automotive industry

Approximately 71 million vehicles have been sold worldwide in 2014. It's about an increase of 3.5% over 2013 and the sixth consecutive record sales year. However, the global automobile sector still confronts several obstacles, including changes in the market, regulations, and the introduction of new rivals (Scotiabank, 2015).

4.1 Differentiation of regional markets

European automobile markets remain sluggish, while US markets have recovered from the crisis, China's market is steadily rising, the Indian market is erratic and Russian and South American market shares are diminishing (PricewaterhouseCoopers, 2015). Various worldwide product and production methods are employed by car firms in order to gain a foothold in prospective markets. For instance, Volkswagen has designed the model Lavida, while General Motors has created the Buick brand. These are attempts in order to attract clients in Chinese market (CarNewsChina, 2013) (Business Insider, 2013). Some high-end vehicle manufacturers have produced extended-wheelbase versions and regionally-tailored interior choices in order to better cater to their customers across the world. Automotive derivatives have grown tremendously as a result of global marketplaces and the demands of diverse consumers.

4.2 Strict and dynamic regulations

Original equipment manufacturers (OEMs) have until 2021 to keep their portfolio's average CO2 emissions below the EU standard of 95 g/km (European Commission, 2015). All major markets, including China, have implemented similar laws. The G7 nations pledged to an economy with a zero-carbon footprint by 2100 in Elmau, Germany, in June 2015. Despite this, automobile manufacturers are already striving hard to meet or exceed current emissions limits (Reuters, 2014). Alternative powertrain systems, like plug-in hybrid, battery-electric and fuel-cell cars, are the focus of company R&D efforts in addition to continued improvements to internal combustion engines. As new rules and customer acceptance of new technologies grow more unpredictable, current vehicle factories need to be more flexible in order to meet demand. Airflow efficiency and weight

reduction are just as crucial in the design and manufacture of automobiles as the powerplant itself, which is regulated by pollution standards. With the model i3, for example, BMW employs aluminum extensively, and numerous OEMs display complicated multi-material-bodies, such as the Mercedes-Benz C-Class or the Volvo S40. It is clear that these tactics have a substantial impact on productivity. When using CFRP (Carbon Fiber Reinforced Polymers) and multilateral bodies, OEMs need to develop new processes and materials expertise. This necessitates new approaches to body-in-white manufacturing and automation due to the different joining technology needs. This shows how manufacturing has evolved from a constraint to a facilitator and how concerns related to production must be included in the design process at the very beginning of the project.

4.3 Emerging competitors from other industries

Semi-autonomous driving features such as automated parking, lane-keeping assistance, or sensor-based reporting all rely on electronic systems that make up more than 90% of a car's existing electronics and software content (PricewaterhouseCoopers, 2015). Additionally, ICT (Information-Communication-Technology) is a significant enabler for more effective automation and operational effectiveness in manufacturing processes (Kagermann et al., 2013). Digitalization is the name given to this continuous trend toward more reliance on ICT in automobile manufacturing, which includes both product development and production. Silicon Valley or China-based ICT businesses have recently entered the automobile sector, in-vehicle infotainment where they're now cooperating with the automobile OEMs (Daimler, 2015). In addition to such systems, Google has been carrying out trials on its first self-driving car and speculations have been circulating about an Apple automobile (Macworld, 2015).

Nevertheless, the ICT giants' plans to join the automotive market, which has a narrower profit margin than consumer electronics, are open to dispute. If ICTs are to be a significant component of any future premium car's value, it might lead to fierce rivalry and new alliances among traditional automotive suppliers and carmakers with ICT businesses, regardless of the final business model chosen. When it comes to increasing complexity and diversity in manufacturing, ICT techniques have emerged to one of the strongest facilitators. "Industrie 4.0," also known as the "Industrial Internet," has become a popular

term in the manufacturing industry throughout the world. With the use of the latest production technology, Bosch expects to see 30 percent efficiency gains (Peters et al., 2014). It is possible that these influences might have a significant impact on automotive sector value chains in general, which will be examined in this article. On the one hand, the established auto industry needs innovation in nearly every area, such as engines, materials, and manufacturing, but at the same time, ICT firms have emerged as competitors and are calling into question the significance of these technological fields and the importance of creating one's own value.

4.4 Significance of production depth and outsourcing

Making or purchasing items and components is referred to as a "make-or-buy choice," and it is vitally necessary for a corporation as a whole to make these kinds of decisions (Jauch & Wilson, 1979). In a broader sense, it refers to a company's strategic choice of the depth of its output. It is defined by the Organization for Economic Co-operation and Development as "an index that indicates the percentage of national production that is developed in the country" (OECD, 2010). A firm's (or a product's) production depth is defined here as the value-added content that a company itself creates. "Vertical integration" refers to the process of bringing previously outsourced components of a company's value creation (or services) back in-house (or insourcing).
Several industry instances have proven that outsourcing may be particularly beneficial in the following areas:

- gaining from the suppliers' economies of scale, to outsource certain tasks (such as catering services or the fabrication of items of lower priority),
- profiting from suppliers' economies of scope in order to speed up the development process (Porter, 1996),
- reducing internal intricacy and focusing on market/brand and quality-relevant functionalities with limited resources,
- meeting standards (regulated by local authorities),
- safeguarding against variations in the value of the monetary unit (by using suppliers in the corresponding regions),

A great deal of study has been done to better understand the long-term effects of outsourcing on a company's success since the 1980s (Canils & Roeleveld, 2009). The papers in Scopus were analyzed to gain a sense of the focus areas. Articles with abstracts including the phrases "outsourcing," "manufacturing," or "production," were tallied for this analysis. Stuckey and White (1993) cautioned corporations against vertical integration unless it was "absolutely required to produce or defend value," while Lacity et al. found that empirical data on outsourcing were contradictory (Stuckey & White, 1993) (Lacity et al., 2010). Over a given degree of outsourcing, several researchers have shown negative correlations between outsourcing and measures such as revenue or market share (Kotabe et al., 2012). Other studies have shown that outsourcing does cut operating expenditures; (Jiang et al., 2007). With real-world examples from the optoelectronics sector, Fuchs and Kirchain (2010) illustrated how salaries, yields, downtimes, and other characteristics are affected by a factory's location. They found that the innovative industry, as well as others employing immature processes, makes it difficult to keep design and manufacturing operations separate geographically. Using data from a variety of sectors, Steven et al. discovered that outsourcing had a detrimental influence on performance, particularly in the quality.

4.5 Scenarios for the future of automotive industry

The consequences of "digitalization" on the automobile sector and its value chain are described using key competencies and current business model methods from the ICT (Information – Communication – Technology) and automotive industries. The concentration is on high-end carmakers (Gausemeier et al., 1998).

Automotive OEMs' value generation strategy is at the heart of this remark, compared to the strategy of the ICT giants. Consequently, while identifying influencers, the present facilitators of ICT companies in today's specific capabilities of car OEMs are noticed primarily. The goal is to reap the benefits of (personalized) advertising made possible by acquired consumer data, while for the other, the goal is to get a comprehensive understanding of the system in order to improve usability, safety, and quality. "Quality" is used to define an automobile that is both dependable and well-balanced in terms of its features. It is thought that the OEMs' own value generation is reducing as a result of increased cost pressure alone. To avoid complexity, some organizations prefer to

outsource, while others want to manage it inside, hoping to reap the benefits of platform methods more quickly. It is generally considered that electric mobility reduces production depth (Bunzendahl & Schneider, 2021). A customer's willingness to give up their personal information is viewed as a key factor in the success of ICT firms' automobile strategy. For their part, established automotive OEMs are expected to have plans that are influenced by consumers' expectations for the driveability and (passive) crash safety of future cars (Gunasekaran et al., 2015). The impact of ICT in manufacturing, such as the Industrial Internet, on the strategy of automotive OEMs and ICT businesses, cannot be overstated. It is explored how ICT might increase manufacturing efficiency all the way up to the point when manufacturing knowledge may no longer be a determining element in success - in extreme words, production may become a commodity. Companies providing ICT solutions to the automobile sector are viewed as independent and disconnected from the ICT firms in the B2C sector (business to customer) that may potentially join the automotive market.

5. Variables affecting the purchase vehicle intention

In a sense, cars have a notion of freedom, easy movement and convenience. From another aspect, car means style and status. On the other hand, they have a big impact on the planet. As a result, the following areas come up for consideration.

5.1 Environmental concerns

Environmental and consumer concerns are two critical issues that have gained widespread attention in recent times. Environmental concerns refer to the matters that affect the natural world, such as climate change, pollution, and deforestation, while consumer concerns refer to issues that affect people's consumption patterns, such as fair trade, animal welfare, and ethical sourcing.

Environmental concerns have been an issue of global importance for decades. The effects of climate change are becoming increasingly evident, from rising sea levels to extreme weather events. According to the Intergovernmental Panel on Climate Change (IPCC), the world is on track to exceed the 1.5°C warming threshold by 2040 if current trends continue (IPCC, 2018). This warming trend is largely caused by the burning of fossil fuels, which emit greenhouse gases (GHGs) into the atmosphere. Additionally, deforestation, which is often driven by commercial agriculture and logging, reduces the ability of forests to absorb GHGs.

The impact of climate change extends beyond environmental concerns; it also has social and economic implications. Climate change disproportionately affects the poorest and most vulnerable populations, particularly in developing countries (Barnett & Adger, 2007). These impacts can result in food and water insecurity, displacement, and conflict. In terms of the economy, climate change can have both direct and indirect costs, such as damage to infrastructure, reduced agricultural productivity, and increased healthcare costs (IPCC, 2018).

Consumer concerns are also an increasingly important issue. Consumers are increasingly interested in where their products come from, how they are made, and who made them. Ethical sourcing has become an important issue for consumers, particularly regarding labor practices and animal welfare. For example, in the garment industry, concerns over labor practices have led to the development of certifications, such as Fairtrade and the

Global Organic Textile Standard (GOTS) (Chand, 2018). These certifications ensure that workers are paid fairly, and that environmental and social standards are met.

Animal welfare is another consumer concern that has gained traction in recent years. The treatment of animals in the food industry has become a focus for consumers, particularly regarding factory farming. Consumers are increasingly concerned with the welfare of animals and the use of antibiotics and hormones in animal feed (Bratanova, Loughnan, & Bastian, 2011). This has led to the development of certifications, such as Certified Humane and Animal Welfare Approved, which ensure that animals are raised in a humane and ethical manner.

There is a clear interrelatedness between environmental and consumer concerns. The production of goods and services can have a significant impact on the environment, and this impact can have social and economic consequences. For example, the production of palm oil, which is used in many consumer goods, has been linked to deforestation and habitat destruction, particularly in Indonesia and Malaysia (Hussein, Suryanto, & Septian, 2021). This has led to the displacement of indigenous communities and the loss of biodiversity.

Additionally, the production and consumption of goods contribute to GHG emissions, which are a major contributor to climate change. This means that consumers have a significant role to play in addressing environmental concerns. By making more sustainable choices, such as reducing their meat consumption and choosing products made from sustainable materials, consumers can help reduce their carbon footprint and promote environmentally friendly practices.

Consumers have a critical role to play in addressing environmental and consumer concerns. By choosing to purchase goods and services from companies that have ethical and sustainable practices, consumers can send a message to companies that these issues are important. This can help drive change in the industry as companies respond to consumer demand.

One example of this is the rise of plant-based meat alternatives. As consumers have become more aware of the environmental impact of meat production, they have looked for alternative protein sources. This has led to the development of plant-based meat alternatives, which are more sustainable and have a lower carbon footprint than traditional meat (Huang & Du, 2021). The success of companies such as Beyond Meat and Impossible Foods is a testament to the power of consumer demand in driving change.

Consumers can also take action to reduce their own impact on the environment. For example, reducing meat consumption, using public transportation, or cycling instead of driving, and reducing energy consumption in the home are all actions that can make a significant difference. Additionally, consumers can support sustainable and ethical initiatives, such as renewable energy projects, conservation organizations, and fair-trade certification programs.

Environmental and consumer concerns are two critical issues that are interrelated and require urgent attention. Climate change, pollution, and deforestation are all environmental concerns that have social and economic implications. Consumer concerns such as ethical sourcing and animal welfare are also important issues that have gained increasing attention in recent years. Consumers have a critical role to play in addressing these concerns by making more sustainable choices, supporting sustainable initiatives, and driving change in the industry through their purchasing power.

Production and Destruction

Before even launching a car on the road, its production demands a lot of energy. Materials like steel, rubber, glass, plastics and many other must be created and these for one unit only. If we take into consideration the volume of the global production, we realize the giant footprint.

Similarly, just because a vehicle has completed its purpose does not mean it is no longer environmentally damaging. Plastics and potentially toxic battery acids, for example, might end up in the environment. Thankfully, junkyard pileups are becoming a thing of the past. Three-quarters of today's average automobile may be recycled.

Costs of production, recycling, and disposal are difficult to predict, and the bulk of consumers have little influence over them. It is proved that most of an automobile's environmental effect, approximately 80% to 90%, is due to fuel consumption and emissions enchancing air pollution and global warming according to environmentalists. The severity of an accident is mostly at the hands of the driver.

Fuel Costs

Oil products raise environmental concerns even before fill in a vehicle’s fuel tank. Extracting petroleum from the earth is a process that can damage local ecosystems. The fuel transportation by vessels also demands a lot of energy and there is always danger of

ecological disaster such as an oil spill. It is easily understood why fuel efficiency is so important and why electric vehicles can contribute to reduction of environmental impact, since they don't burn fossi fuel.

Air Quality

Over a third of the nation's air pollution is caused by automobiles, making them the largest source of pollution. The carbon dioxide emissions released by vehicles are especially harmful because humans inhale the polluted air directly into their lungs. Consequently, automobile emissions may pose a greater risk to human health than toxins generated by industrial smokestacks in the sky.

Infrastructure

Another consequent impact of cars is the construction of new roads and the maintenance or expansion of the existing ones. Road building has a big impact on ecosystems and the emissions resulting from this procedure are difficult to be quantified.

The European Commission has set a high priority on environmental protection and air quality improvement. EU rules and standards in the automotive industry aim to reduce CO2, NO2, and particulate matter emissions. The Commission is also working to reduce noise and eliminate fluorinated greenhouse gases from mobile air-conditioning systems.

Emissions

In European Union, road transportation is a major source of gas emissions, producing 15% of the total CO2 emissions. These emissions come from the following vehicle categories:

- heavy-duty vehicles (trucks and coaches)
- light-duty vehicles (cars and vans)
- machinery that is not intended for use on the road (excavators, bulldozers, front loaders)

Light and heavy-duty vehicles have already been subjected to legally binding emission limits. Future laws will include environmental criteria for farm and forestry machinery, as well as two-wheeled vehicles.

Mobile air-conditioning systems (MACs)

The European Directive on MACs set a phased prohibition on fluorinated greenhouse gases used in mobile air-conditioning systems (MACs) to minimize emissions. This law will assist the Commission in achieving its climate action goals.

Automakers have tried for many years to lessen the environmental impact of their products and manufacturing processes. It is essential to strike a balance between economic growth, environmental protection, and social responsibility.

In the past 15 years, the automotive industry has made substantial strides in lowering the environmental effect of its products over their entire life cycle. Since 1999, manufacturing process enhancements have led to a 19 percent decrease in energy consumption, a 35 percent decrease in water consumption, and a 91 percent decrease in the amount of trash entering landfills. Additionally, CO2 emissions from new automobiles have decreased, and are today 31% lower than they were 15 years ago.

When considering the influence of automobiles on the environment, the choice to purchase a vehicle may be challenging. Automobile production, utilization, and recycling all have an influence. Due to clean automotive technology and increased consumer and manufacturer awareness, car owners and industry experts have alternatives for addressing the issue.

Manufacturing processes

Plastics account for 10% of a car's weight and 50% of its volume, resulting in passenger vehicles that are roughly 450 pounds lighter than they were forty years ago.

The disposal of unwanted autos is highly regulated in industrialized countries, providing the industry with a large supply of sorted, useable old raw materials. Polypropylene, polyurethane, and polyvinyl chloride make up 32 percent, 17 percent, and 16 percent of a vehicle's polymers, respectively (two thirds in total). As a result, only these three plastics provide enormous recycling potential.

As much as we'd like electric vehicles to be fully environmentally beneficial, battery manufacture is still far from being 100% sustainable. When purchasing a new electric vehicle, close attention should be paid to the manufacturer's battery replacement options and whether they refurbish batteries.

If you want to use a gasoline-powered vehicle, keep in mind that driving an old automobile rather than buying a new one does not always imply a smaller carbon footprint. Older automobiles have a larger carbon footprint than newer cars, according to the MIT research "On the Road in 2020: A Life-Cycle Analysis of Emerging Automobile Technologies", published in 2000.

This indicates that after three and a half years, the environmental impact of manufacturing a new automobile is offset in comparison with running an old one. This is due to the fact that during a vehicle's lifetime, fuel use accounts for 75% of its carbon impact, whereas production only accounts for 6%.

Using a car

The 1973 oil crisis and subsequent increases in gasoline prices prompted automakers to create lighter and hence more energy-efficient vehicles. Electric and hybrid automobiles are speeding the trend of engines becoming more efficient than ever before.

Driving an electric car or employing more fuel-efficient driving tactics, such as keeping a moderate pace, might improve fuel economy. Remember to maintain your vehicle decluttered, since excess weight might result in increased fuel use. Also, remember to turn the air conditioner off while it is not in use.

Although biofuels and blended fuels are appealing, they are not carbon-neutral. Our gasoline contains a significant proportion of palm oil, which accounted for half of world palm oil usage in 2017 - 4 million tons annually. Since palm oil is subsidized in biofuels by the EU, many individuals consume it unknowingly. Palm oil, whether on our plates or in our cars, necessitates deforestation and poses a threat to natural ecosystems by producing three times as much greenhouse gas as fossil fuels.

Recycling

Fortunately, metal is a valuable commodity that is frequently recycled (about 97 percent). The collection and sale of spare parts is a thriving business in both industrialized and developing countries. It is unnecessary to manufacture each spare part that is reused, and it is also extremely cost-effective.

Similarly, despite the fact that electric batteries are still rather expensive to make, their refurbishment presents a tremendous potential for automakers to reduce the cost of electric car maintenance and so increase their market share.

As in the past, we may help the environment by doing modest things now. While some of them require more funding, others are completely consistent with our budgetary goals. Hence, environmental concerns may have a positive impact on purchase intention (first hypothesis /H1).

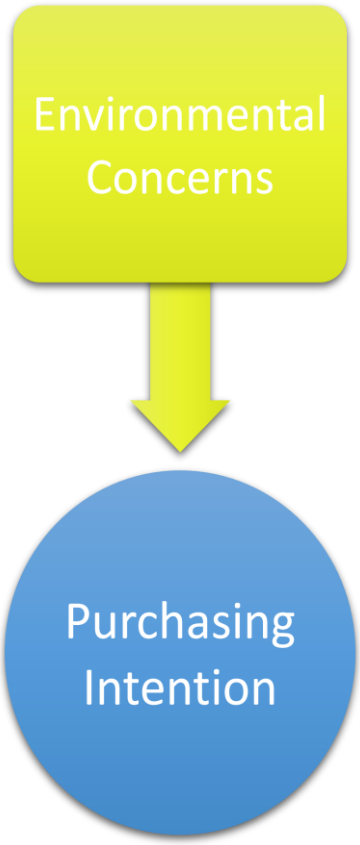

Figure 1. Effect of "Environmental Concerns" on Purchasing Intention

5.2 Green consumption values

Green consumer values refer to the beliefs, attitudes, and behaviors that consumers adopt to support environmentally sustainable practices. These values reflect a growing concern for the environment and a desire to reduce the impact of human activities on the planet. Environmental concern and awareness are the most fundamental dimensions of green

consumer values. Consumers who are environmentally aware recognize the impact of their actions on the environment and are motivated to reduce their environmental footprint. Several studies have shown that environmental concern is a strong predictor of pro-environmental behaviors (Tudoran et al., 2018). The more consumers are concerned about the environment, the more likely they are to adopt sustainable consumption practices.

Ethical and social responsibility are other key dimensions of green consumer values. Ethical consumers are concerned about the social and environmental impact of the products and services they consume. They look for companies that prioritize sustainable and ethical practices, such as fair trade, organic, and vegan certifications. Social responsibility refers to the extent to which consumers are willing to take action to promote environmental and social causes, such as supporting renewable energy or conservation organizations.

The health and wellness dimension of green consumer values relates to the belief that sustainable and organic products are healthier and safer for human consumption. Consumers who value health and wellness are more likely to choose organic, natural, and locally sourced products because they perceive them as healthier and more nutritious than conventional products (Grønhøj et al., 2011).

Environmental knowledge and education are critical dimensions of green consumer values. Consumers who are knowledgeable about the environment and sustainability are more likely to adopt sustainable consumption practices. For instance, consumers who are aware of the environmental impact of single-use plastics are more likely to choose reusable products, such as metal straws and cloth bags, instead of disposable ones (Lee et al., 2020). Environmental education programs can play a significant role in increasing consumer awareness and knowledge about sustainability.

Price and quality are also important dimensions of green consumer values. Consumers who value sustainability may be willing to pay more for eco-friendly products if they perceive them to be of higher quality. However, price is still a significant barrier to the adoption of sustainable consumption practices, particularly for consumers with lower incomes (Schanes et al., 2018). Companies that can offer sustainable products at a competitive price have a better chance of attracting green consumers.

Green consumer values represent a growing concern for the environment and a desire to reduce the impact of human activities on the planet. Environmental concern and awareness, ethical and social responsibility, health and wellness, environmental knowledge and education, and price and quality are all critical dimensions of green consumer values. Consumers who adopt these values are more likely to adopt sustainable consumption practices and support environmentally responsible companies.

One of the challenges for companies seeking to attract green consumers is to communicate their sustainability practices effectively. Green consumers are often skeptical of companies' green claims and may require additional information and transparency to make informed choices (Wagner et al., 2017). Therefore, companies need to provide clear and verifiable information about their sustainability practices to build trust with green consumers.

Additionally, governments can play a role in promoting sustainable consumption practices through policies that incentivize companies to adopt sustainable practices and promote environmentally friendly products. For example, governments can offer tax incentives to companies that invest in renewable energy or reduce their carbon footprint. Green consumer values represent a growing trend in consumer behavior, reflecting a concern for the environment and a desire to reduce the impact of human activities on the planet. Environmental concern and awareness, ethical and social responsibility, health and wellness, environmental knowledge and education, and price and quality are all critical dimensions of green consumer values. Companies and governments can play a significant role in promoting sustainable consumption practices and supporting environmentally responsible choices.

In recent years, "green" tends to be a hot trend in the corporate world. To send an image of a sustainable company to the market, businesses brand their products with eco-friendly characteristics and labels. These acts are characterized by the expression "green marketing tactics."

Automobile manufacturers anticipate that hybrid technology and electrification will advance the industry in an environmentally friendly and sustainable path. Transportation encumbers significantly global greenhouse gas emissions and is one of the most obvious source of air pollution. As a result, manufacturers are investing heavily in the development

of more fuel-efficient and eco-friendly goods, as well as in the promotion of green advantages.

The decarbonization of the sector is a national and regional authority priority. Europe established the European Clean Transport Facility (ECTF), a grant for activities with low or no carbon emissions. British government has announced plans to enhance the infrastructure for electric car charging and offer incentives to consumers who purchase electric or hybrid vehicles.

The Advanced Technology Car Manufacturing (ATCM) initiative of the United States has provided money for the evolution of environmentally friendly technology such as electric car batteries. Since 1990s, the Japanese government has promoted electric vehicles through tax incentives and R&D spending. Chinese government is attempting to realize its goal of becoming one the largest constructors of electric vehicles by giving consumer subsidies and substantial R&D funding.

This green – trend presents several new opportunities for enterprises. Consumers typically view environmentally conscious innovation as a distinguishing factor (Kassarjian, 1971). Automakers have noticed this trend and striving to capitalize on it. However, can the green marketing tactics of automobile firms adequately address client preferences and behaviors? Consequently, one of the goals of this study is to examine customer behavior patterns in the vehicle industry as a result of green marketing and determine the effectiveness of green marketing by automobile manufacturers in promoting and growing customer knowledge of environmental issues.

Green Marketing and Consumer Behavior

The foundation of green marketing is a larger notion of "value for customers" that incorporates environmental and social responsibility. In order to maintain their corporate sustainability, companies have to adjust their strategy in the new business envirnonment. (Polonsky, 1995). Furthermore, a great deal of research has examined if and how eco-friendly marketing influences consumer behavior, resulting in a broad and diverse field of study (Hur, Kim, & Park, 2013).

The first factor to evaluate is the impact on customers' spending propensity. Since tackling environmental challenges requires additional resources, companies expect consumers to pay a bigger premium for environmentally friendly items (Galarraga & Markandya, 2004).

However, important challenges persist, necessitating a further examination of the connection between green marketing and consumer behavior (Chamorro et al., 2009). According to researchers, customers' stated aspirations to purchase ecologically friendly products and their actual consumption patterns are at conflict (Peattie & Crane, 2005). As scientists attempt to determine why the so-called attitude-behavior gap arises, it has generated considerable scientific interest. Environmentally concerned shoppers' skepticism was initially discovered as a significant factor affecting their purchasing habits. The term "green consumer" was used by Zinkhan and Carlson (1995) to describe someone who is "somewhat suspicious of marketing efforts and prone to reject promotional messages." Shrum, McCarty, and Lowrey (1995) discovered an association between green consumption and advertising skepticism, their findings were lauded in the green marketing literature and a number of scholars continue to cite them today (Bickart & Ruth, 2013).

Despite the popularity of the skepticism, some academics espoused the concept of the skeptical green consumer without conducting enough study into the causes of suspicion of green advertisements (Matthes & Wonneberger, 2014). According to Matthes et al., general ad skepticism must be distinguished from green ad suspicion, and green consumers' attitudes must be distinguished from those of nongreen consumers (2014). According to their study, green customers view green advertisements as more informative and have more faith in them than nongreen customers.

On the other side, customer-verifiable advertising promises are more likely to elicit skepticism or suspicion in marketing conduct (Bickart & Ruth, 2013). It may be a case of "green washing" practices, which are used to improve a company's image by misleading advertising or to conceal environmental or social malpractices. Therefore, rather than widespread distrust among green clients, the causes of the attitude-behavior gap are associated with other obstacles (Gagnon, Michael, Elser & Gyory, 2013). According to Webb, Mohr, and Harris (2008), social benefit appeal encourages green consumption since consumers are willing to pay more or sacrifice a portion of their private benefit when purchasing ecological friendly products. Private goals, such as saving money, are the sole method to inspire prosocial action, according to Peattie (2001), and they are often deemed successful even when the environmental advantages are limited. According to Green and Peloza, "the decision-making environment has a major effect on consumers' responses to advertising that encourages ecologically responsible purchase behavior" (2014, p. 134).

They provide the moderating function of impression management, which states that people want to make a favorable impression on others and hence project a positive picture of themselves. Consumers' buying decisions are influenced by social benefits, especially when they are held publicly accountable for their actions. Griskevicius, Van den Bergh, and Tybur (2010) supported this assertion by demonstrating that demand for hybrid automobiles increases as they become more visible to the public. They believe that altruism is a symbolic action indicative of a social disposition. This position is highly wanted since it is associated with reputation and prestige and can emerge an individual's role within a group. Consequently, consumers strive to demonstrate their prosociality and desire to offer resources, time, and money for the public benefit without sacrificing their lifestyle, even if it comes at a steep cost. In 2007, according to a market study done by The New York Times, 57% of Prius owners bought the vehicle because "it makes a statement about me," while 36% claimed energy savings as the key reason. "By buying a Toyota Prius, individuals may indicate that they are prosocial as opposed to pro-self." The Prius owner decides to benefit the environment for public, even if it means abstaining the luxury of a vehicle with greater amenities or performance (Griskevicius et al., 2010).

As previously mentioned, the automotive industry is developing hybrid technologies and electrification to follow an environmentally friendly and sustainable path. In this very competitive industry, investments in greener products are rising significantly. Ford Motor Company, for instance, has put aside $14 billion for fuel-efficiency enhancements ($5 billion from the US Department of Energy and $9 billion in bridge loans), with the aim of increasing fuel economy by 36% across the board by 2015. Audi has also invested around €65 million in a new factory for electric power trains as of today.

Once the relationship between car manufacturers' investment plans, green marketing strategy, and consumer behavior are comprehended, it is crucial to be aware of consumers' opinions and observe their responses to this trend (Braimah & Tweneboah-Koduah, 2011). Using the aforementioned literature and empirical evidence, this study evaluates the true gap between green automobiles and customers, given that "going green" has become an industry standard. The primary premise of the study is that green marketing strategies employed by automakers impact consumer purchase decisions.

According to Bickart and Ruth, brand recognition is crucial in shaping consumers' perceptions of green advertisements (2012). When individuals are concerned about the

environment, they discover that an on-package eco-seal shown in an advertisement is advantageous to established companies but detrimental to new ones.

Unconcerned about the environment, consumers favor the old brand over the new. Evidently, brand image influences consumers' trust (or skepticism) in advertising that touts a product's green performance. Consequently, it is essential to consider how brand positioning influences consumer perceptions, particularly in the automotive sector, where the brand image conveys the quality and attributes of the automobile. For example, a brand commonly connected with the concept of safety may also be deemed ecologically friendly. The second argument therefore focuses on the connection between brand positioning and perceived environmental performance.

Based on the aforementioned, it can be supposed that green consumption values have a positive impact on purchase intention (second hypothesis /H2).

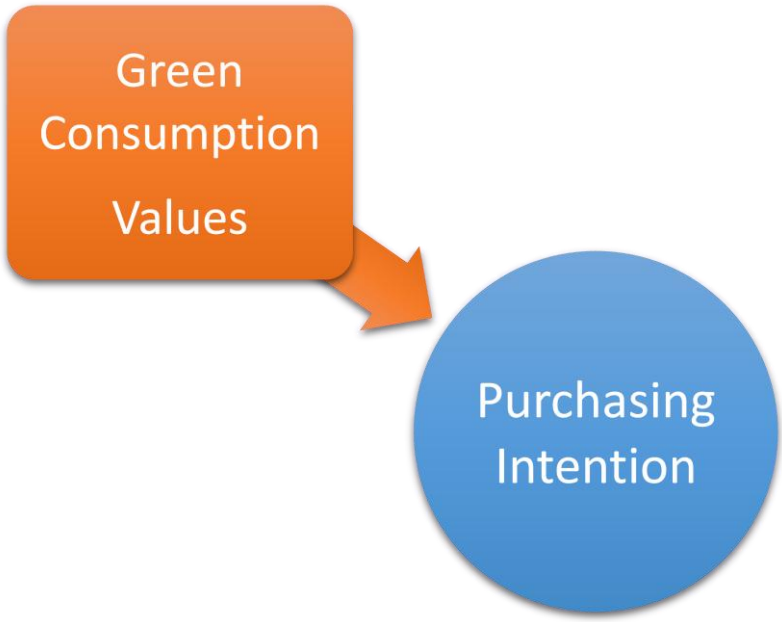

Figure 2. Effect of “Green Consumption Values” on Purchasing Intention

5.3 Country origin production

The country of origin is a crucial factor that affects consumers' decision-making when purchasing cars. The country of origin is often associated with various attributes that may influence consumers' attitudes and perceptions about the product. In this analysis, we will explore the importance of the country of origin in car purchasing decisions and the factors that affect consumers' perceptions of car brands.

The country of origin of a car brand can influence consumers' perceptions of quality, reliability, design, and prestige. Consumers may associate certain countries with specific attributes, such as Japanese cars being reliable, German cars being high-quality and well-engineered, or Italian cars being stylish and luxurious (Papadopoulos & Heslop, 2002). These associations are often based on stereotypes and cultural beliefs, which can affect consumers' attitudes and purchasing decisions.

Several studies have shown that the country of origin can significantly influence consumers' perceptions of car brands. For example, a study by Dawes and Brown (2003) found that consumers in the UK associated German cars with high quality, reliability, and performance, while Japanese cars were associated with reliability and economy. Another study by Durmusoglu and Ozmizrak, (2017) found that Turkish consumers had a preference for German and Japanese car brands, which they perceived as high-quality and reliable.

Several factors can influence consumers' perceptions of car brands and their country of origin. These factors include brand reputation, personal experience, advertising, and cultural beliefs.Brand reputation is a critical factor that affects consumers' perceptions of car brands. Consumers are more likely to associate positive attributes with car brands that have a good reputation, such as BMW, Mercedes-Benz, or Toyota. A good reputation can be established through quality, reliability, and durability, and can be reinforced through advertising and word-of-mouth recommendations.

Personal experience is another important factor that affects consumers' perceptions of car brands. Consumers who have had positive experiences with a particular car brand are more likely to perceive it positively and recommend it to others. In contrast, negative experiences can lead to negative perceptions and a reluctance to purchase that brand in the future.

Advertising is a powerful tool that can influence consumers' perceptions of car brands. Effective advertising can help create positive associations between the brand and the country of origin, as well as emphasize the brand's unique selling points, such as quality, reliability, or design. On the other hand, negative advertising or public relations issues, such as product recalls or scandals, can damage the brand's reputation and affect consumers' perceptions.

Cultural beliefs and stereotypes can also affect consumers' perceptions of car brands and their country of origin. For example, German cars are often associated with engineering and precision, while Italian cars are associated with style and luxury. These associations are often based on cultural beliefs and stereotypes that have developed over time.

The country of origin is an essential factor that affects consumers' perceptions of car brands and can significantly influence their purchasing decisions. Consumers may associate certain countries with specific attributes, such as quality, reliability, design, or prestige. Brand reputation, personal experience, advertising, and cultural beliefs are some of the factors that affect consumers' perceptions of car brands. Understanding these factors and their impact on consumer behavior can help car manufacturers develop effective marketing strategies that resonate with consumers and promote their products.

Numerous corporations are engaged in the design, development, production, marketing, and sale of automobiles. It consists one of the most lucrative sectors. For instance it contributes 16% in French economy and 40% in Slovakia. In addition to this, the specific industry is the largest investor in research and development.

It is worth mentioning that in the 1860s many firms contributed to the pioneering passage from the horseless carriage to the motor vehicle, launching the beginning of automobile industry. In 1929, the United States produced the vast majority of the 32 million cars in use across the globe. After World War II, USA manufactured over 75% of the world's automobiles. In 1980, Japan surpassed the United States, but in 1994, the United States recaptured the top spot. In 2006 Japan exceeded again the United States in production, a position held until 2009, when China got ahead of Japan with 13.8 million units.

In the early years, the production was based on manual assembly by humans. Afterwards, the technique changed and engineers working on a stable automobile were replaced by a premature production system in which the automobile moved through many stations of

more skilled specialists. In the 1960s, robotic technology was integrated into the production line, and today, the vast majority of automobiles are produced mostly by automated machinery.

Safety

In general, safety means the condition of being safe from undergoing or causing hurt, injury, or loss. Safety in the automobile business refers to the protection that is provided by a vehicle to users, operators, and manufacturers.

The vehicle business places great emphasis on safety, explaining why it is strictly regulated. To be certified for sale, cars must meet a set of domestic and international regulations. ISO 26262 is widely acknowledged as one of the most essential building blocks for ensuring vehicle functional safety.

During the construction of a motor vehicle, the manufacturer has the ability to pause and reverse the production line in the case of a safety issue, product defect, or defective technique. This action is known as a product recall. Every industry has product recalls, which may be caused by manufacturing issues or a lack of raw materials.

At various stages of the value chain, product and operation testing and inspections ensure end-user safety and conformity with automotive industry standards.

Economy

In 2007, around 800 million automobiles and light trucks were in circulation, demanding more than 980 billion liters of fuel, gasoline and diesel, per year. In industrialized economies, motor vehicles are the main form of travel and transportation. The Boston Consulting Group's Detroit office predicted that by 2014, the four BRIC nations (Brazil, Russia, India and China) would account for one-third of global demand. In the meantime, the vehicle sector in developed nations has been stationary. This trend is anticipated to continue, especially because younger generations (in highly urbanized nations) prefer alternative modes of transportation to automobile ownership.

In 2010, developing regions accounted for 51 percent of worldwide sales of vehicles, according to a research by J.D. Power, and this trend is anticipated to accelerate. Recent research (2012), on the contrary, demonstrated that the vehicle industry in the BRIC nations was slowing. In 2000, sales of motor vehicles in the United States hit an all-time

high of 17,8 million units. By 2035, all new automobiles sold in Europe must be zero-emission vehicles.

The governments of 24 developed nations in collaboration with a group of major automakers, including GM, Ford, Volvo, Jaguar Land Rover and Mercedes-Benz, have agreed to "go together toward all new car and van sales being zero emission globally by 2040, and in leading markets by 2035." Germany, France, Japan, and South Korea have all rejected to commit, as have the core brands of Volkswagen, Toyota, Peugeot, Honda, Nissan and Hyundai.

After ten years of constant expansion, the global auto industry decreased by more than 5 percent in 2019. In the same year, more than 92 million vehicles were manufactured worldwide, including 67 million passenger cars and 25 million light-commercial vehicles.

Beginning in March of that year, the global economic crisis triggered a decline in automobile production that lasted well into 2020. From January to September of 2020, worldwide automobile production decreased by 22.9 percent compared to the same period in 2019. As it concerns the production countries, China is the world's largest producer of automobiles, with majority of them sold domestically. Following China, the top six vehicle makers are the United States, Japan, Germany, India, and Mexico.

China

China is the largest automaker and the largest factory in the world. Approximately 28 percent of all vehicles and trucks were completed in the United States in 2019, or approximately 26 million automobiles and trucks. Over 83 percent of China's production consisted of private passenger automobiles, while the remaining 4.3 million vehicles were commercial vehicles. SAIC Motor Corporation Ltd is the largest automobile manufacturer in China, having sold 6,2 million automobiles in 2019.

United States of America

Despite producing just 11 million cars and trucks this year, the United States is the world's second-largest automaker, accounting for 12% of the global market. Despite manufacturing fewer passenger automobiles than Japan and Germany, the US produced more than twice as many commercial vehicles, including five times more than Japan.

In the United States, General Motors Company sold the most cars, accounting for 17.4 percent of the market. Ford Motor Company and Toyota Motor Corporation each had 14.5 percent and 13.9 percent of the U.S. vehicle market share, respectively.

Japan

In 2019, Japan manufactured 9.7 million vehicles, representing nearly 10% of all automobiles produced globally.

In 2017, Japan also exported 4.71 million vehicles, including automobiles, trucks, and coaches. In 2018, the country shipped 4,82 million vehicles, up 2.3 percent from the year before. With 4.82 million autos exported in 2019, the country's exports were stable.

In 2020, Japanese automakers produced 5.7 million vehicles, down 22.8 percent from the 7.4 million vehicles produced during 2019.

Germany

Volkswagen, BMW and Daimler produced around 4.7 million vehicles in 2019. This number represented a reduction of 9.4 percent from 2018 and 17.44 percent from 2017. According to the VDA, a German auto industry lobbying group, the fall is mostly attributable to a decline in demand from international markets.

In the first eight months of 2020, Germany produced almost 2 million passenger automobiles, a 36 percent decrease compared to the same time in 2019. Fewer working days and facility closures were attributed to the decline in production, which was attributed to the global economic crisis.

India

Despite its anonymity in the United States and Europe, India manufactures automobiles for its population counting around 1.3 billion. In 2019, India produced 4.5 million automobiles, 12.2% fewer than in 2018. Approximately 80% of all vehicles manufactured were passenger automobiles, while the remaining 20% were business vehicles. India's automakers produced around 2.16 million automobiles in 2020, a 38.4% decrease from the 3.5 million vehicles produced in 2019.

Mexico

Mexico has surpassed South Korea to grab the sixth position on our list of nations with the most autos produced. In 2019, Mexico manufactured 3,9 million vehicles, with 1.38 million automobiles and 2.6 million trucks. This is a 2.8 percent decline over the previous 2 years. In 2020, Mexico, like the other nations on our list, had a decrease in automotive production. In 2020, Mexico's manufacturers produced roughly 2.2 million vehicles, down 29.4 percent from the 3.0 million vehicles produced in 2019.

As a result, country origin production seems to have a positive impact on purchase intention (third hypothesis /H3).

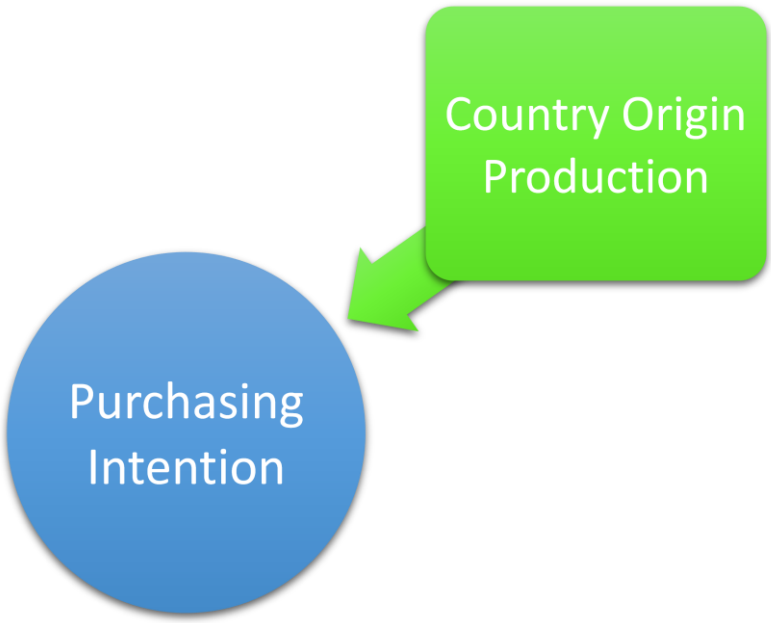

Figure 3. Effect of "Country Origin Production" on Purchasing Intention

5.4 Purchasing intention

Buying intention analysis is a critical process for companies that aim to understand the factors that influence consumers' purchasing decisions. By analyzing buying intention, companies can identify the drivers of purchase behavior and develop effective marketing strategies that resonate with their target audience. In this analysis, we will explore the

concept of buying intention and the factors that affect it, with the support of academic references.

Buying intention refers to consumers' intention to purchase a particular product or service. It is an important predictor of consumer behavior, as it reflects consumers' motivation, attitudes, and beliefs about a product or service (Chinomona & Maziriri, 2018). Buying intention is influenced by various factors, including personal and situational variables, product characteristics, and marketing stimuli.

Personal and situational variables, such as age, gender, income, and lifestyle, can significantly affect consumers' buying intention. For example, younger consumers may be more likely to purchase products that are trendy and fashionable, while older consumers may prioritize quality and reliability (Wang & Kim, 2017). Income and lifestyle can also influence consumers' purchasing decisions, as consumers with higher incomes and more luxurious lifestyles may be more willing to purchase expensive products.

Product characteristics, such as quality, price, and brand reputation, can also affect consumers' buying intention. Consumers are more likely to purchase products that are perceived as high quality, affordable, and reliable, and that have a good reputation. In contrast, products that are perceived as low quality, overpriced, or unreliable may deter consumers from purchasing them (Chinomona & Maziriri, 2018).

Marketing stimuli, such as advertising, promotions, and social media, can also influence consumers' buying intention. Effective marketing strategies that emphasize the unique selling points of a product, such as quality, price, or design, can help create a positive attitude towards the product and increase the likelihood of purchase (Huang & Sarigöllü, 2014). Promotions, such as discounts or free gifts, can also encourage consumers to purchase a product by creating a sense of urgency or perceived value. Buying intention is a critical concept that reflects consumers' motivation, attitudes, and beliefs about a product or service. Personal and situational variables, product characteristics, and marketing stimuli are some of the factors that influence buying intention. By understanding these factors and their impact on consumer behavior, companies can develop effective marketing strategies that resonate with their target audience and increase their chances of success.

In the remanufacturing of new-energy automotive components, contemporary technology enables remanufactured goods to match or surpass the performance and quality of the original ones. Remanufactured autos are becoming an increasingly important aspect of the future of the business, and remanufacturing car parts has become a cost-cutting and resource-saving approach for many automakers. China's Ministry of Industry and Information Technology initiated a study in 2017 to develop a phase-out plan for the production and sale of conventional vehicles. In reality, several other nations have already established comparable schedules for the elimination of cars fueled by fossil fuels. In the United Kingdom, diesel and gasoline-powered cars will be phased out by 2040, whilst the Netherlands and Norway will do so by 2025. Given these unambiguous promises of displacing conventional fuel-powered cars, new-energy vehicles will be the future of the automotive industry. On the global market, remanufacturing new-energy vehicle components is not yet widespread. Remanufactured new-energy automobile components are a strategic alternative because they make the most efficient use of resources and materials while contributing to the long-term sustainability of the economy and the environment. In our analysis, we will use the Chinese market as an illustration.

Remanufacturing discarded objects is a feasible business model in the field of waste recycling, as well as a crucial means of protecting the environment and conserving resources. Xerox, for instance, recycles the toner and ink cartridges used in its printers and copiers, whereas Kodak's approach includes recycling and reusing postconsumer materials. In reality, both businesses have gained monetarily from their recycling efforts. China's customers are unusual in that they continue to misunderstand and reject refurbished products. Remanufactured commodities, for instance, are viewed as defective, reconditioned, and inferior; as a result, their market acceptance in China is low. Several experts and academics, as well as numerous empirical research studies, have examined the present challenges in remanufactured product marketing. However, the majority of these research are concerned with product, pricing, and sales methods. In China, Liu et al. explored how product knowledge effects the willingness of Chinese consumers to purchase remanufactured goods and assessed customer awareness and buying behavior of remanufactured products. They examined the segmentation of the remanufactured goods market. However, few research has examined customer purchase intentions for remanufactured automobile components. Purchase intention is a consumer's attitude

toward a certain buying activity and their readiness to pay for it. In essence, this reflects the purchase habits of customers.

The COVID-19 epidemic spread over the globe with intensity and speed. Every business, including the car industry, has been impacted. Despite projections that light passenger car sales would decline by 25 to 30 percent in the United States and 20 to 25 percent internationally this year, the auto industry might be in for some good news. According to Ipsos' COVID-19 Impact on Auto Global Study, some pre-COVID-19 vehicle intenders are more interested in getting a vehicle once the crisis has passed, therefore the decline may not be as drastic. And something about the outbreak piques their interest right away: their personal protection or safety.

Following the epidemic, everyone's incentive for getting a car was the same. Consumers in the United States, China, the Eurozone, and Brazil have all expressed a desire to feel safer and more protected.

Top reasons to maintain/increase purchase interest

Safety has always been a consideration in vehicle purchase decisions, but this is a definite trend toward social isolation as opposed to sharing congested public transit. This essential consumer knowledge should be addressed in current and future car marketing communications.

Despite impending economic unpredictability, the Ipsos survey indicated that Americans are still hopeful. Pre-COVID-19 US potential vehicle customers said they are more likely to purchase a vehicle after the COVID-19 outbreak is done, compared to less than 20% who reported that it is less possible for them to purchase a vehicle once the COVID-19 outbreak is finished. Customers in China are also positive, with more than half indicating they are thinking about acquiring a vehicle. This optimism excludes Brazil and the five nations of the Eurozone (UK, France, Germany, Italy and Spain). Consumers in such a place are more reluctant and less inclined to make a purchase.

Purchase vehicle intention impact after COVID-19 outbreak

According to the Ipsos poll, financial worries are the primary reason why customers in the United States, China, Brazil, and the EURO5 nations have lost interest in overseas

purchasing. Various automobile manufacturer incentives, such as zero-percent financing, deferred payments, and security against job loss, can help to alleviate this fear.

The vehicle sector should also develop and grow virtual and digital shopping possibilities as a big transformation. If customers are unable to visit the dealership, the business must give a realistic test drive at their location. The vehicle industry has experimented with virtual purchasing experiences, but the COVID-19 issue has made virtual reality the norm.

John Kiser, senior vice president of Automotive & Mobility at Ipsos, declared: "I believe the COVID-19 outbreak will upend the status quo in terms of car purchases; I expect more digital sales, a considerable rise in online/virtual purchasing, and less dealership test drives as a result of the outbreak. Automotive manufacturers who want to gain a competitive advantage in attracting new customers will be able to quickly develop a comprehensive virtual shopping procedure."

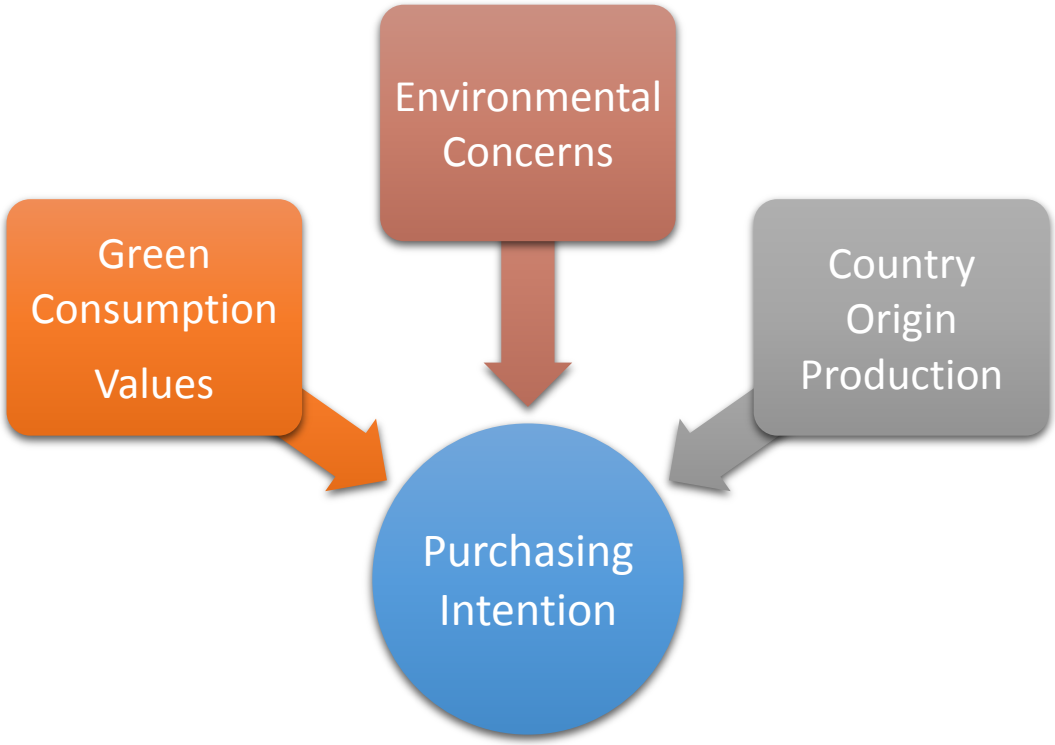

Figure 4. Conceptual Framework of the present study

6. Methodology

6.1 Research method, tool and questions

Research method

Social science is concerned with the combined efforts of explaining and understanding social reality. The difficult part is reaching consensus on the right ways of tracing social reality. Although it may seem relatively simple, social reality does not consist of "scattered, individual reactions" mixed together while an independent observer can come to an objective conclusion.

Rather than individuals behaving as chemicals that will mix in the same way regardless of the observer's gaze, social phenomena are complex concepts/associations of meaning making (interpretive philosophy of research). Indeed, meaning itself not only influences the relationships exchanged, but also the individual meanings, which may influence subsequent exchanges, communications, and variations of meanings.

The existence of patterns in human behavior (positivism) is not an absurdity, but a reality. Although human behavior cannot (possibly) be completely modeled, statistical principles seem to tend to explain some general directions (based on mean, outliers, etc.). The quantitative direction, was adopted in this paper as:

- the initial assumption, was that there is a rich, theoretical framework that explains to a satisfactory degree the social reality

- The aim of the study was to verify specific research hypotheses in the context of Greek consumers

Research tool

The research tool was structured on the basis of a critical reading of a series of relevant articles. After a fruitful discussion with the supervisor, the final result was arrived at.

<u>The dependent variables were as follows:</u>

- the intention to purchase a car in the future

- the intention to buy an electric car in the future

The independent variables were conceptually divided into the following dimensions:

- environmental concern

- green consumer values

- country of origin

Purpose and objectives

The theoretical purpose of this paper was to study the concept/phenomenon of the new car market (conventional and electric).

Research questions

H1: does the concept of environmental concern have a significant impact on the new purchase of:

a. a conventional car?
b. an electric car?

H2: does the concept of being green have a significant impact on the new market of:

a. a conventional car?
b. an electric car?

H3: does the concept of country of origin have a significant impact on the new buy of:

a. a conventional car?
b. an electric car?

6.2 Sampling and statistical techniques

The sampling technique used is that of convenience, as in most theses, as random sampling requires developed resources (in terms of time, money, resources, design capacity, etc.). On the downside of this technique, is the potential reduced reliability of the findings and the reduction in the ability to generalize the findings to the population. Positives include a high response rate (valuable information may not be lost), the achievement of ease /speed and the possibility of including in the sample, individuals considered to be knowledgeable about the phenomenon under study.

As regards the description of the research process, the following can be highlighted: once a suitable research tool was structured, it was distributed electronically to consumers (convenience sample, consisting of the participants who finally responded, 97 in total). After the primary data were collected (in excel format), they were transferred to the SPSS 22 statistical tool.

First a descriptive analysis was performed followed by a factor analysis. After appropriate adjustments, multiple regression models were performed to test the significance of the relationships between the groups of variables under study and finally appropriate tests were also performed in relation to the identification of differences between the means of different categories derived from the demographic variables (gender, age, education, etc.).

6.3 Questionnaire development

Environmental Concerns Scale

I am very concerned about the environment < Hamzah & Tanwir (2021)

I believe that the efforts on behalf of Firms & Governments in relation to the environmental protection are not enough/adequate < Dunlap & Scarce (1991)

I believe that the industries are not investing as much as they should in developing green products

I believe that although many actions are done by Firms & Governments at the level of marketing and communication/promotion there are still a lot to be made in order to claim that it exists an holistic / global environmental protection plan

I believe that the appropriate level of cooperation between Firms, Governments and Citizens has not been achieved, in order to solve the environmental problem

The car industry is investing in the development of more efficient and environmentally friendly goods < Pujari & Wright (1996)

The automotive industry is leading the industry forward on an environmentally friendly and sustainable path, based on hybrid technologies and electric propulsion < Friedrich & Robertson (2014)

The majority of a car's environmental impact is related to fuel consumption and air pollution and greenhouse gas emissions, which contribute to global warming < Gagliardi, La Rossa, Filice & Ambrogio (2021)

The end of life of a car has an impact on the environment due to the plastics and harmful acids of the battery < Li, Huang, Liu, Ju (2021)

Cars consume a lot of energy and car production has a huge environmental impact < Nunes & Bennet (2010)

Green Consumption Values Scale

It is important to me that the products I use do not harm the environment < Haws, Winterich & Naylor (2014)

I consider the potential environmental impact of my actions when making many of my decisions < Haws, Winterich & Naylor (2014)

My purchase habits are affected by my concern for our environment < Haws, Winterich & Naylor (2014)

I am concerned about wasting the resources of our planet < Haws, Winterich & Naylor (2014)

I would describe myself as environmentally responsible < Haws, Winterich & Naylor (2014)

I am willing to be inconvenienced in order to take actions that are more environmentally friendly < Haws, Winterich & Naylor (2014)

Country origin production Scale

The country of origin is important in relation to the purchase of a car < Tung, Hieu, Phuc (2015)

I may not buy a car because I do not have sympathy and appreciation for the country of origin (for example for political or environmental reasons) < Wang & Yang (2008) & Chinen, Sun & Ito (2014)

I may not buy a car because the image of the country in my mind, does not match my self image < Li, Wang & Yang (2011)

I believe that some countries make safer cars than others < Chinen, Sun & Ito (2014)

I believe that some countries make more technologically advanced cars than others < Train & Winston (2007)

I think a car from America is very good and gives me confidence < Train & Winston (2007)

I think, a car from Japan, is very good and gives me confidence < Train & Winston (2007)

I think, a car from Germany, is very good and gives me confidence < Train & Winston (2007)

Buying Intention of an Internal Combustion Engine (ICE) car Scale

I plan on purchasing a car in the near future < Tung, Hieu, Phuc (2015)

The probability that I will purchase a car in the near future is very high < Tung, Hieu, Phuc (2015)

My willingness to purchase a car in the near future is very high < Tung, Hieu, Phuc (2015)

Intention to Purchase a Fully Electric Car Scale

I plan on purchasing an electric car in the near future <Shalender & Sharma (EVPI Scale) (2020)

The probability that I will purchase an electric car in the near future is very high <Shalender & Sharma (EVPI Scale) (2020)

My willingness to purchase an electric car in the near future is very high <Shalender & Sharma (EVPI Scale) (2020)

7. Analysis

7.1 Demographic data

The following is a presentation of the demographic data. First, the percentages by gender will be shown (percentages by men and women).

Levels	Male	Female
Percentages	67%	33%

Table 1. Percentages of gender levels

Therefore 67% of the participants were male and 33% female. In the table below, the percentages by age category of the sample will be shown.

Levels	18-30	31-40	41-50	51+
Percentages	18.6%	28.9%	37.1%	15.5%

Table 2. Percentages of age levels

The percentages by educational category are shown below. 6.2% of the sample are high school graduates, 14.4% are graduates of an IEK, 36.3% are graduates of an AEI/TEI, and 43.3% have a master's or doctoral degree.

Levels	High-School graduate	IEK graduate	AEI-TEI graduate	Masters /PHD
Percentages	6.2%	14.4%	36.3%	43.3%

Table 3. Percentages of educational levels

As it concerns income, 3.1% have an income of 0-500 euros, 32% 501-1000 euros, 42.3% 1001-1500 euros and 22.7% 1501+ euros.

Levels	0-500	501-1000	1001-1500	1501+
Percentages	3.1%	32%	42.3%	22.7%

Table 4. Percentages of income levels

7.2 Descriptive analysis

At the first level, the independent variables will be presented, followed by the dependent variables. For each variable, the mean (the opinion of the majority of the sample) and standard deviation (how the outliers cluster around the central trend/mean of the observations) will be shown.

Independent variables

Variable	Mean	Std. Deviation
I am very concerned about the environment	4.43	0.660
I believe that the efforts on behalf of Firms & Governments in relation to the environmental protection are not enough/adequate	4.23	0.729
I believe that the industries are not investing as much as they should in developing green products	4.11	.828
I believe that although many actions are done by	4.25	0.708

Firms & Governments at the level of marketing and communication/promotion there are still a lot to be made in order to claim that it exists an holistic / global environmental protection plan		
I believe that the appropriate level of cooperation between Firms, Governments and Citizens has not been achieved, in order to solve the environmental problem	4.41	0.732
The car industry is investing in the development of more efficient and environmentally friendly goods	4.11	0.734
The automotive industry is leading the industry forward on an environmentally friendly and sustainable path, based on hybrid technologies and electric propulsion	4.08	0.712
The majority of a car's environmental impact is		

related to fuel consumption and air pollution and greenhouse gas emissions, which contribute to global warming	4.58	0.574
The end of life of a car has an impact on the environment due to the plastics and harmful acids of the battery	4.59	0.673
Cars consume a lot of energy and car production has a huge environmental impact	4.65	0.630
It is important to me that the products I use do not harm the environment	4.36	0.680
I consider the potential environmental impact of my actions when making many of my decisions	4.19	0.697
My purchase habits are affected by my concern for our environment	3.79	0.803
I am concerned about wasting the resources of our planet	4.55	0,672
I would describe myself as environmentally responsible	4.26	0.726
I am willing to be	3.41	0.976

inconvenienced in order to take actions that are more environmentally friendly		
The country of origin is important in relation to the purchase of a car	4.07	0.881
I may not buy a car because I do not have sympathy and appreciation for the country of origin (for example for political or environmental reasons	2.10	1.237
I may not buy a car because the image of the country in my mind, does not match my self-image	2.48	1.378
I believe that some countries make safer cars than others	4.11	0.840
I believe that some countries make more technologically advanced cars than others	4.26	0.807

Table 5. Presentation of independent variables (mean /standard deviation)

The scores are quite high, and the variables with the highest score are the «*The majority of a car's environmental impact is related to fuel consumption and air pollution and greenhouse gas emissions, which contribute to global warming, The end of life of a car has an impact on the environment due to the plastics and harmful acids of the battery, Cars consume a lot of energy and car production has a huge environmental impact».*

Dependent variables

Variable	Mean	S. deviation
I plan on purchasing a car in the near future	3.49	1.165
The probability that I will purchase a car in the near future is very high	3.65	1.155
My willingness to purchase a car in the near future is very high	3.74	1.261
I plan on purchasing an electric car in the near future	2.80	0.943
The probability that I will purchase an electric car in the near future is very high	2.75	0.958
My willingness to purchase an electric car in the near future is very high	3.34	1.314

Table 6. Presentation of research tool variables (mean /standard deviation)

The scores here are lower, while the variables with the highest scores are *«The probability that I will purchase a car in the near future is very high, my willingness to purchase a car in the near future is very high»*.

7.3 Factor analysis

Above, there is a presentation of the results of the application of factor analysis, which is an important statistical technique. Exploratory factor analysis has the following positive aspects. The validity of the questionnaire and questions is assessed in a meaningful way,

not based on the accepted validity of other surveys that may have been conducted in other reference contexts (countries, etc.), but on the specific data. This is extremely important as quantitative analysis is based on two evaluative pillars, validity and reliability. Reliability is much easier to find, as opposed to validity (validity is about questions ending up at the centre of the conceptual target), while reliability is about questions ending up at the same point (internal consistency). Validity is more difficult to infer, or the fact that reliability is observed does not necessarily imply validity.

Something else, very important, is that factor analysis, can open up new "research horizons". Through the identification of common, unobserved factors, and the clustering of variables, there can be more targeted conclusions and perspectives. Factor analysis can discover latent common factors, which explain the strong relationship between a set of variables. This can, in itself, contribute to further understanding, complex concepts, clustering and providing more targeted conclusions and suggestions (even the clustering of variables itself, can sometimes lead to the generation of useful conclusions).

Below are the results of conducting a factor analysis, on the variables of the research tool related to the concept.

Items	Component 1	Component 2	Component 3
I am very concerned about the environment	**.549**	.197	.190
I believe that the efforts on behalf of Firms & Governments in relation to the environmental protection are not enough/adequate	**.896**	.201	.111
I believe that the industries are not investing as much as they should in developing green products	**.818**	.330	.005

I believe that although many actions are done by Firms & Governments at the level of marketing and communication/promotion there are still a lot to be made in order to claim that it exists a holistic / global environmental protection plan	**.869**	.088	.241
I believe that the appropriate level of cooperation between Firms, Governments and Citizens has not been achieved, to solve the environmental problem	**.805**	.137	.254
The car industry is investing in the development of more efficient and environmentally friendly goods	.228	.130	**.915**
The automotive industry is leading the industry forward on an environmentally friendly and sustainable path, based on hybrid technologies and electric propulsion	.210	.243	**.885**
The majority of a car's	.218	**.789**	.244

environmental impact is related to fuel consumption and air pollution and greenhouse gas emissions, which contribute to global warming			
The end of life of a car has an impact on the environment due to the plastics and harmful acids of the battery	.220	**.867**	.098
Cars consume a lot of energy and car production has a huge environmental impact	.172	**.823**	.116

Table 7. Rotated Component Matrix (Environmental concerns)

Total Variance Explained

Initial Eigen values			Extraction Sums of Squared Loadings		
Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
4,925	49,251	49,251	4,925	49,251	49,251
1,453	14,534	63,785	1,453	14,534	63,785
1,235	12,351	76,135	1,235	12,351	76,135

Table 8. Total Variance Explained (Environmental concerns)

The existence of 3 factors was evident which is shown in the Table 8 where the associations of the variables with the 3 factors are presented. A loading value above 0.4 means that a variable tends to have a stronger association with one of the 3 factors. In

addition, the second table shows the overall percentage of internal variability within the scale, explained by the finding of the 2 factors (76.14%).
The CMO took a value of 0.769, therefore, there is satisfactory validity with respect to the above procedure. The CMO takes values from 0-1, and 0.6 is considered the minimum, satisfactory value.

The first factor can be called environmental concern and consists of the items «*I am very concerned about the environment, I believe that the efforts on behalf of Firms & Governments in relation to the environmental protection are not enough/adequate, I believe that the industries are not investing as much as they should in developing green products, I believe that although many actions are done by Firms & Governments at the level of marketing and communication/promotion there are still a lot to be made in order to claim that it exists an holistic / global environmental protection plan, I believe that the appropriate level of cooperation between Firms, Governments and Citizens has not been achieved, to solve the environmental problem*» (Cronbachs alpha was 0.887).

The second factor encompasses the items «*The majority of a car's environmental impact is related to fuel consumption and air pollution and greenhouse gas emissions, which contribute to global warming, The end of life of a car has an impact on the environment due to the plastics and harmful acids of the battery, Cars consume a lot of energy and car production has a huge environmental impact*". This factor can be called concerns in relation to cars, while the price of Cronbachs alpha was 0.833.

The third factor can be called opinion on the automotive industry, consisting of the following items «*The car industry is investing in the development of more efficient and environmentally friendly goods, The automotive industry is leading the industry forward on an environmentally friendly and sustainable path, based on hybrid technologies and electric propulsion*» (Cronbachs alpha 0.889).

Green consumer values

The results of the factor analysis are presented below.

Total Variance Explained

Initial Eigen values	Extraction Sums of Squared Loadings

Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
4,026	67,093	67,093	4,026	67,093	67,093

Table 9: Total Variance Explained (Green consumer values)

Below is the table showing the loadings (the strength of the relationship) of the variables with the common, unobserved factor.

Item	Component
It is important to me that the products I use do not harm the environment	.895
I consider the potential environmental impact of my actions when making many of my decisions	.869
My purchase habits are affected by my concern for our environment	.856
I am concerned about wasting the resources of our planet	.820
I would describe myself as environmentally responsible	.881
I am willing to be inconvenienced in order to take actions that are more environmentally friendly	.537

Table 10. Component Matrix (Green consumer values)

There is therefore a factor that satisfactorily and validly explains the overall variability within the scale (CMO 0.869 and reliability coefficient 0.882).

Country of origin

In this concept 2 factors were identified that satisfactorily explain the variability within the scale (CMO = 0.654 - satisfactory degree of validity). The results are presented below.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,687	53,738	53,738	2,687	53,738	53,738
2	1,470	29,395	83,132	1,470	29,395	83,132

Table 11. Total Variance Explained (Country of origin)

Items	**Component 1**	**Component 2**
The country of origin is important in relation to the purchase of a car	**.796**	-.200
I may not buy a car because I do not have sympathy and appreciation for the country of origin (for example for political or environmental reasons	-.074	**.940**
I may not buy a car because the image of the country in my mind, does not match my self-image	-.175	**.921**
I believe that some countries make safer cars than others	**.929**	-.058
I believe that some countries make more technologically advanced cars than others	**.917**	-.097

Table 12. Rotated Component Matrix (Country of origin)

Therefore, 2 factors were identified in terms of the relevant consumer perceptions: The first can be called general country of origin perception and contains the variables *«The country of origin is important in relation to the purchase of a car, I believe that some countries make safer cars than others, I believe that some countries make more technologically advanced cars than others»* (Cronbachs alpha-0.865).

The second factor can be called individual alignment with the country of origin and consists of the following elements «*I may not buy a car because I do not have sympathy and appreciation for the country of origin (for example for political or environmental reasons, I may not buy a car because the image of the country in my mind, does not match my self-image»)* (Cronbachsalpha-0.864).

Buying intentions of an Internal Combustion Engine (ICE) car

The latter concept consists of the intention to buy a car in the near future. The CMO was 0.756 (Cronbach's alpha-0.970) and the results are given below.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,837	94,558	94,558	2,837	94,558	94,558

Table 13. Total Variance Explained (Buying ICE car)

Below is the table showing the loadings of variables on the common, unobserved factor.

Items	Component
I plan on purchasing a car in the near future	.975
The probability that I will purchase a car in the near future is very high	.983
My willingness to purchase a car in the near future is very high	.960

Table 14. Component Matrix (Buying ICE car)

Buying intentions of an electric car

The latter concept consists of the intention to buy an electric car in the near future. The CMO was 0.741 (Cronbachs alpha-0.932) and the results are listed below.

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,718	90,601	90,601	2,718	90,601	90,601

Table 15. Total Variance Explained (Buying electric car)

Below is the Table showing the loadings of the variables on the common, unobserved factor.

Items	Component
I plan on purchasing an electric car in the near future	.969
The probability that I will purchase an electric car in the near future is very high	.960
My willingness to purchase an electric car in the near future is very high	.926

Table 16. Component Matrix (Buying electric car)

7.4 Multiple regression model concerning dependent variables

In the first Multiple Regression model the dependent variable was the intention to buy a conventional car in the future. The analysis did not yield any result, which means that the independent variables did not seem to significantly influence the dependent variable.

Model Regression	B (Coefficients)	R Square (Model Summary)	Adjusted R Square (Model Summary)	F (ANOVA)	Sig. (ANOVA)
Dependent variable-intention to buy a conventional car					
Environmental concern	-.093 (Sig. .733)	.073	.011	1.184	.322
General country of origin perception	-.304 (Sig. .253)	.073	.011	1.184	.322
Green consumer values	-.127 (Sig. .257)	.073	.011	1.184	.322

Table 17. Regression Model (Buying ICE car)

Therefore, the factors environmental concern, green values, and importance in the country of origin of the cars did not seem to have a significant effect on the intention to buy a conventional car in the future.

Environmental concerns and values may not have a direct effect on the future purchase intention of a conventional car (whereas below they appear to have a significant effect on the purchase intention of an electric car). Therefore, in the context of the future purchase of a conventional car, other (unseen) variables seem to be more importantin the Greek reference context.

In the next model, the effect of these on the future purchase intention of an electric car was investigated. A stepwise regression was conducted, presenting the following results.

Model Regression	**B (Coefficients)**	**R Square (Model Summary)**	**Adjusted R Square (Model Summary)**	**F (ANOVA)**	**Sig. (ANOVA)**
Dependent variable- intention to buy an electric car					
Environmental concern	.286 (Sig. 208)	.174	.119	3.163	.007
General country of origin perception	.221 (Sig. .130)	.174	.119	3.163	.007
Green consumer values	**.573 (Sig. .010)**	.174	.119	3.163	.007

Table 18. Regression Model (Buying electric car)

R Square can be considered relatively satisfactory, as it explained 17% of the total variability of the dependent variable, based on the research model of the paper. The Adjusted R Square demonstrates the generalizability of the population (it should not be significantly smaller than the R-Square), the F value refers to the control value, where the statistical significance of the final model is assessed (Sig. should be less than 0.05). Finally, b refers to the expected change in the dependent variable if this independent variable changes by 1 unit and the others remain constant.

In this case, the essential conclusion is the following: the intention of future purchase of an electric car depends on the existence of green, consumer values. Other variables (such as environmental concerns and country of origin) did not seem to have a significant effect on the intention to purchase an electric car.

8. Conclusions

This thesis dealt with the consumer behavior in relation to the automotive industry. The purpose of this essay was to study the automotive industry by analyzing the phenomenon of buying a new car (conventional and electric). The research questions are as follows:

H1: does the concept of environmental concern have a significant effect on the new purchase of:

a. a conventional car?
b. an electric car?

H2: does the notion of taking into account green consumption values have a significant effect on the new purchase of:

a. a conventional car?
b. an electric car?

H3: does the concept of country of origin have a significant impact on the new purchase of:

a. a conventional car?
b. an electric car?

The statistical analysis revealed the following:

Research question		**Answer (based on statistical significance)**
H1.a.	does the concept of environmental concern have a significant effect on the new purchase of a conventional car?	No
H1.b.	does the concept of environmental concern have a significant effect on the new purchase of an electric car?	No
H2.a.	does the notion of taking into account green consumption values have a significant effect on the new purchase of a conventional car?	No

H2.b.	does the notion of taking into account green consumption values have a significant effect on the new purchase of an electric car?	Yes
H3.a.	does the concept of country of origin have a significant impact on the new purchase of a conventional car?	No
H3.b.	does the concept of country of origin have a significant impact on the new purchase of an electric car?	No

Table 19. Answers overview to research questions

- Initially there was a significant conceptual delineation of the concepts under study, in the sense that both validity and reliability were observed. The concepts under study appeared to have been measured correctly in the given context. On the other hand, there seemed to be no significant predictive properties.
- The concepts of environmental concern, green values and country of origin did not seem to be significant in relation to the purchase of a new conventional car and, therefore, the buying decision of such type of car did not seem to depend on these concepts.
- In the same context, the purchase of an electric car seemed to depend on green consumer values. This means that consumers who stated that they are likely to own an electric car also tend to state that it is important that the product they choose does not have a negative impact on the environment, etc.
- From this research, it appeared that green values are not as important in relation to the intention to recover a car. They may be important in terms of choosing an electric car model but not as influential in relation to the future acquisition of a conventional car.
- Other variables may be much more important, as a car may mean a great deal to the average consumer. Such influential factors could be the economic situation, the brand image, the self image, etc. Although it may appear to be non-politically correct (it would be more appropriate to emphasize that green values have a significant impact on consumers' purchase intentions in relation to cars), this did not seem to be supported. It is possible that green values are overestimated in relation to the basic consumer choice of a car.

- What is suggested to car manufacturers is to thoroughly study consumer attitudes and feelings and not to rest on modern trends. In the present study, it was shown that green aspirations (concern for the environment, etc.) do not play such an important role when it comes to the future purchase of a car.
- Finally, in the present thesis, several mismatches were found, in regard to many studies presented in the theoretical framework. The concepts of environmental concerns and country of origin did not seem to have a significant effect on the future intention to acquire a conventional or electric car. Especially with regard to the intention to acquire a conventional car, environmental concerns would be expected to have a negative, significant effect.
- The most important variable in this survey, appeared to be green values. This may be understandable, as values are "powerful instruments" in shaping purchasing decisions (perhaps more so than concerns and perceptions). Nevertheless, it can be stressed that the results are based on the Greek context (involving Greek consumers), and at the same time the sample was a convenience one. Therefore it is not recommended to generalize the findings to the population under study.

References

Andre, D., Kim, S. J., Lamp, P., Lux, S. F., Maglia, F., Paschos, O., & Stiaszny, B. (2015). Future generations of cathode materials: an automotive industry perspective. Journal of Materials Chemistry A, 3(13), 6709-6732.

Ballester, F. (2005). Air pollution and health. Environmental health impacts of transport and mobility, 53-77.

Barnett, J., & Adger, W. N. (2007). Climate change, human security and violent conflict. *Political geography*, 26(6), 639-655.

Bechmann, R., & Scherk, M. (2010). Globalization in the automotive industry–impact and trends. In Globalization 2.0 (pp. 177-192). Springer, Berlin, Heidelberg.

Bhamu, J., & Sangwan, K. S. (2014). Lean manufacturing: literature review and research issues. International Journal of Operations & Production Management.

Bielaczyc, P., Klimkiewicz, D., Woodburn, J., & Szczotka, A. (2019). Exhaust emission testing methods-BOSMAL's legislative and development emission testing laboratories. Combustion Engines, 58.

Bickart, B., & Ruth, J., (2013). Green Eco-Seals and Advertising Persuasion, 51-67.

Bratanova, B., Loughnan, S., & Bastian, B. (2011). The effect of categorization as food on the perceived moral standing of animals. *Appetite*, 57(1), 193-196.

Braimah, M., Tweneboah-Koduah, E. (2011) "An Exploratory Study of the Impact of Green Brand Awareness on Consumer Purchase Decisions in Ghana" Vol. 5, Iss. 7, pp. 11-18

Brinia, V., & Pefanis, K. (2013). The business training in the automotive industry in Greece: the example of Opel. Industrial and Commercial Training.

Bunzendahl, S., & Schneider, O. (2021). DIRECT IMPACTS OF INDUSTRY 4.0 TO PURCHASING 4.0 AND QUALITY 4.0. In 17 th Annual International Bata Conference for Ph. D. Students and Young Researchers (p. 117).

Business Insider (2013), http://www.businessinsider.com/why-chinese-buyers-love-buick-2013-4?IR=T

Caniëls, M. C., & Roeleveld, A. (2009). Power and dependence perspectives on outsourcing decisions. European Management Journal, 27(6), 402-417.

CarNewsChina (2013), http://www.carnewschina.com/tag/volkswagen-lavida/page/2/

Chamorro, A., Rubio, S., & Miranda, F. (2009). Characteristics of research on green marketing, 223-239.

Chand, M. (2018). Fairtrade and Global Organic Textile Standard. *In Sustainability in the Textile and Apparel Industrie*s (pp. 105-115). Springer, Singapore.

Chinomona, R., & Maziriri, E. T. (2018). The effects of product attributes on consumer buying intention: A case of fast-food brands in Zimbabwe. *Journal of Marketing and Consumer Research*, 49, 35-46.

Chinen, K., Sun, Y. & Ito, Y. (2014). The Effects of Country of Origin on Consumer Willingness to Purchase General Motor Automobiles in the United States. International *Journal of Marketing Studies*, 6(6),1-14.

Daimler AG (2015), http://media.daimler.com/dcmedia/0-921-658901-1-1678242-1-0-1-0-0-1-0-0-0-1-0-0-0-0-0.html?TS=1435327318437

Dawes, J., & Brown, G. (2003). Country of origin and consumer choice in the European car market. *Journal of Consumer Marketing*, 20(4), 350-365.

Durmusoglu, S. S., & Ozmizrak, S. (2017). *Country of origin effect in automobile market.*

Dunlap, R. & Scarce, R. (1991). Poll Trends: Environmental Problems and Protection. *The Public Opinion Quarterly*, *55*(4), 651-672.

Ducker Worldwide LLC (2014). 2015 North American Light Vehicle Aluminum ContentStudy: Executive Summary, http:// www.alcoa.com/car_truck/en/pdf/2014_Ducker_Executive_Summary.pdf

Duffner, F., Mauler, L., Wentker, M., Leker, J., & Winter, M. (2021). Large-scale automotive battery cell manufacturing: Analyzing strategic and operational effects on manufacturing costs. International Journal of Production Economics, 232, 107982.

Ellingsen, L. A. W., Majeau Bettez, G., Singh, B., Srivastava, A. K., Valøen, L. O., & Strømman, A. H. (2014). Life cycle assessment of a lithium-ion battery vehicle pack. Journal of Industrial Ecology, 18(1), 113-124.

Entrepreneurial Insights (2014), http://www.entrepreneurialinsights.com/google-business-model

European Commission (2015), http://ec.europa.eu/clima/policies/transport/vehicles/cars/index_en.htm

Faria, R., Marques, P., Moura, P., Freire, F., Delgado, J., & De Almeida, A. T. (2013). Impact of the electricity mix and use profile in the life-cycle assessment of electric vehicles. Renewable and Sustainable Energy Reviews, 24, 271-287.

Friedrich, C. & Robertson, P. (2014). Hybrid-electric propulsion for automotive and aviation applications. *Aeronaut J*., DOI 10.1007/s13272-014-0144-x

Fuchs, E., & Kirchain, R. (2010). Design for location? The impact of manufacturing offshore on technology competitiveness in the optoelectronics industry. Management science, 56(12), 2323-2349.

Gagliardi, F., La Rossa, A.D., Filice, L. & Ambrogio, G. (2021). Environmental impactof material selection in a car body component – The side door intrusion beam. *Journal of Cleaner Production*, 318, 1-9.

Gagnon, M., Michael, J., Elser, N., Gyory, C. (2013). Seeing Green in Several Ways: The Interplay of Entrepreneurial, Sustainable and Market Orientations on Executive Scanning and Small Business Performances, Journal of Marketing Development and Competitiveness, Vol. 7, Iss. 3, 9 – 28.

Galarraga, I., & Markandya, A. (2004). Economic techniques to estimate the demand for sustainable products: a case study for fair trade and organic coffee in the United Kingdom.

Gausemeier, J., Fink, A., & Schlake, O. (1998). Scenario management: An approach to develop future potentials. Technological Forecasting and Social Change, 59(2), 111-130.

Gilmore, J. H., & Pine, B. J. (1997). The four faces of mass customization. Harvard business review, 75(1), 91-102.

Greenwood, M., Wentker, M., & Leker, J. (2021). A bottom-up performance and cost assessment of lithium-ion battery pouch cells utilizing nickel-rich cathode active materials and silicon-graphite composite anodes. Journal of Power Sources Advances, 9, 100055.

Green, T. & Peloza, J. (2014). Finding the Right Shade of Green: The Effect of Advertising Appeal Type on Environmentally Friendly Consumption, 128-141.

Grigolon, L., Leheyda, N., & Verboven, F. (2015). Public support to the European car industry: the impact of the financial crisis. Journal of Industry, Competition and Trade, 15(3), 283-321.

Griskevicius, V., Tybur, J. M., & Van den Bergh, B. (2010). Going green to be seen: Status, reputation, and conspicuous conservation. *Journal of Personality and Social Psychology*, *98*(3), 392-404.

Grønhøj, A., Thøgersen, J., & Ölander, F. (2011). The relationship between consumer attitudes and the purchase of organic food. *Journal of Consumer Marketing*, 28(2), 132-140.

Gunasekaran, A., Irani, Z., Choy, K. L., Filippi, L., & Papadopoulos, T. (2015). Performance measures and metrics in outsourcing decisions: A review for research and applications. International Journal of Production Economics, 161, 153-166.

Gupta, S., Soni, U., & Kumar, G. (2019). Green supplier selection using multi-criterion decision making under fuzzy environment: A case study in automotive industry. Computers & Industrial Engineering, 136, 663-680.

Harris, A., Soban, D., Smyth, B. M., & Best, R. (2018). Assessing life cycle impacts and the risk and uncertainty of alternative bus technologies. Renewable and Sustainable Energy Reviews, 97, 569-579.

Hamzah, M.I. & Tamir, N. (2021). Do pro-environmental factors lead to purchase intention of hybrid vehicles? The moderating effects of environmental knowledge. *Journal of Cleaner Production*, 279, 1-14.

Haws, K. L., Winterich, K. P., & Naylor, R. W. (2014). Seeing the world through GREEN-tinted glasses: green consumption values and responses to environmentally friendly products. *Journal of Consumer Psychology*, 24(3), 336–354.

Hertz, S., Johansson, J. K., & de Jager, F. (2001). Customer-oriented cost cutting: process management at Volvo. Supply Chain Management: An International Journal.

Hou, J., Feng, X., Wang, L., Liu, X., Ohma, A., Lu, L., ... & Ouyang, M. (2021). Unlocking the self-supported thermal runaway of high-energy lithium-ion batteries. Energy Storage Materials, 39, 395-402.

Huang, R., & Sarigöllü, E. (2014). *How brand awareness relates to market outcome, brand equity, and the marketing mix.* In Fashion Branding and Consumer Behaviors (pp. 113-132). Springer, Singapore.

Huang, Y., & Du, S. (2021). Sustainable development of the plant-based meat industry: Current status and future trends. *Journal of Cleaner Production*, 295, 126262.

Humphrey, J., & Memedovic, O. (2003). The global automotive industry value chain: What prospects for upgrading by developing countries. UNIDO Sectorial Studies Series Working Paper.

Hussein, A. F., Suryanto, P., & Septian, S. A. (2021). *Sustainability in the Palm Oil Industry*. In Sustainable Development and Tropical Agri-chains (pp. 149-168). Springer, Singapore.

ISO. (2006). Environmental management - Life cycle assessment - Principals and framework. International Standard ISO 14040.

International Organization for Standardization. (2006). Environmental management: life cycle assessment; requirements and guidelines (Vol. 14044). Geneva, Switzerland: ISO.

IPCC. (2018). Global Warming of 1.5°C. IPCC Special Report. Retrieved from https://www.ipcc.ch/sr15/

Jacobs, A. J. (2015). The new domestic automakers in the United States and Canada: History, impacts, and prospects. Lexington Books.

Jauch, L. R., & Wilson, H. K. (1979). A strategic perspective for make or buy decisions. Long Range Planning, 12(6), 56-61.

Jiang, B., Belohlav, J. A., & Young, S. T. (2007). Outsourcing impact on manufacturing firms' value: Evidence from Japan. Journal of operations management, 25(4), 885-900.

Jürgens, U., & Krzywdzinski, M. (2009). Work models in the Central Eastern European car industry: towards the high road?. Industrial Relations Journal, 40(6), 471-490.

Kagermann, H., Helbig, J., Hellinger, A., & Wahlster, W. (2013). Recommendations for implementing the strategic initiative INDUSTRIE 4.0: Securing the future of German manufacturing industry; final report of the Industrie 4.0 Working Group. Forschungsunion.

Karvonen, M., Klemola, K., Ranaei, S., & Kässi, T. (2015). Predicting the technological paths in automotive industry and the environmental impacts of electrification of automotive industry in selected OECD countries. In 2015 Portland International Conference on Management of Engineering and Technology (PICMET) (pp. 1247-1259). IEEE.

Kassarjian, Harold H. (1971), Personality and Consumer Behavior: A Review," Journal of Marketing Research, 8 (November), 409418.

Kotabe, M., Mol, M. J., Murray, J. Y., & Parente, R. (2012). Outsourcing and its implications for market success: negative curvilinearity, firm resources, and competition. Journal of the Academy of Marketing Science, 40(2), 329-346.

Kwade, A., Haselrieder, W., Leithoff, R., Modlinger, A., Dietrich, F., & Droeder, K. (2018). Current status and challenges for automotive battery production technologies. Nature Energy, 3(4), 290-300.

Lacity, M. C., Khan, S., Yan, A., & Willcocks, L. P. (2010). A review of the IT outsourcing empirical literature and future research directions. Journal of Information technology, 25(4), 395-433.

Lee, Y. K., Kim, Y., & Kim, Y. (2020). The Effect of Environmental Knowledge and Awareness of Plastic Waste on Plastic Reduction Behavioral Intention in Korea. *Sustainability*, 12(9), 3869.

Lee-Makiyama, H. (2012). FTAs and the crisis in the European car industry. ECIPE Policy Brief, 2.

Li, Y.; Huang, S.; Liu, Y.; Ju, Y. (2021). Recycling Potential of Plastic Resources from End-of-Life Passenger Vehicles in China. *Int. J. Environ. Res.PublicHealth*, 18, 10285.

Li, Y., Wang, X. & Yang, Z. (2011). The Effects of Corporate-Brand Credibility, Perceived Corporate-Brand Origin, and Self-Image Congruence on Purchase Intention: Evidence from China's Auto Industry. *Journal of Global Marketing*, 24, 58–68.

Li, W., Erickson, E. M., & Manthiram, A. (2020). High-nickel layered oxide cathodes for lithium-based automotive batteries. Nature Energy, 5(1), 26-34.

Lombardi, L., Tribioli, L., Cozzolino, R., & Bella, G. (2017). Comparative environmental assessment of conventional, electric, hybrid, and fuel cell powertrains based on LCA. The International Journal of Life Cycle Assessment, 22(12), 1989-2006.

Macworld (2015). http://www.macworld.co.uk/news/apple/willapple-make-icar-rumour-roundup-3425394/

Matthes, J., & Wonneberger, A., (2014). The Skeptical Green Consumer Revisited: Testing the Relationship Between Green Consumerism and Skepticism Toward Advertising, Journal of Advertising, 43:2, 115-127.

Mayyas, A., & Qattawi, A, & Omar, M. & Shan, D. (2012). "Design for sustainability in automotive industry: A comprehensive review," Renewable and Sustainable Energy Reviews, Elsevier, vol. 16(4), pages 1845-1862.

Merkisz, J., Pielecha, J., & Radzimirski, S. (2014). New trends in emission control in the European Union. Switzerland: Springer International Publishing.

Messagie, M., Boureima, F. S., Coosemans, T., Macharis, C., & Mierlo, J. V. (2014). A range-based vehicle life cycle assessment incorporating variability in the environmental assessment of different vehicle technologies and fuels. Energies, 7(3), 1467-1482.

NBC News (2015), http://www.nbcnews.com/tech/innovation/googles-self-driving-car-prototypes-hit-public-roads-first-timen381941

New Scientist, http://www.newscientist.com/roadtothefuture/Casestudy

Nunes, B. & Bennett, D. (2010). Green operations initiatives in the automotive industry anenvironmental reports analysis and benchmarking study. *Benchmarking: An International Journal*, 17(3), 396-420.

OECD (2010). Measuring Globalisation: OECD Economic Globalisation Indicators 2010, OECD Publishing, p. 208

Othman, A. A., Sundram, V. K., Sayuti, N. M., & Bahrin, A. S. (2016). The relationship between supply chain integration, just-in-time and logistics performance: A supplier's perspective on the automotive industry in Malaysia. International journal of supply chain management, 5(1), 44-51.

Pálvölgyi, T., Princz-Jakovics, T., Valkó, L., Kósi, K., & Háry, A. (2022). Qualitative Analysis of Carbon Emissions and Offsetting Opportunities of Zalaegerszeg Automotive Proving Ground. PeriodicaPolytechnica Transportation Engineering, 50(2), 128-135.

Papadopoulos, N., Heslop, L. Country equity and country branding: Problems and prospects. J Brand Manag 9, 294–314 (2002).

Peattie, K., & Crane, A., (2005). Green marketing: legend, myth, farce or prophesy? Qualitative Market Research, Vol. 8. No. 4, 357-370.

Peters, S., Lanza, G., Jun, N., Xiaoning, J., Pei Yun, Y., & Colledani, M. (2014). Automotive manufacturing technologies–an international viewpoint.

Pil, F. K., & Holweg, M. (2004). Linking product variety to order-fulfillment strategies. Interfaces, 34(5), 394-403.

Polonsky, M. (1995). Incorporating the Natural Environment in Corporate Strategy: A Stakeholder Approach. Journal of Business Strategies, 12(2), 151–168.

Porter, M. E. (1996). What is strategy?

Potter, S. (2003). Transport energy and emissions: urban public transport. In Handbook of Transport and the Environment. Emerald Group Publishing Limited.

PricewaterhouseCoopers AG (PwC) (2015), http://www.strategyand.pwc.com/perspectives/2015-auto-trends

Pujari, D. & Wright, G. (1996). Developing environmentally conscious product strategies: a qualitative study of selected companies in Germany and Britain. *Marketing Intelligence & Planning*, 14(1), 19 – 28.

Radosevic, S., & Rozeik, A. (2005). Foreign direct investment and restructuring in the automotive industry in Central and East Europe.

Raugei, M., Morrey, D., Hutchinson, A., & Winfield, P. (2015). A coherent life cycle assessment of a range of lightweighting strategies for compact vehicles. Journal of Cleaner Production, 108, 1168-1176.

Reichhart, A., & Holweg, M. (2008). Co-located supplier clusters: forms, functions and theoretical perspectives. International Journal of Operations & Production Management.

Reuters (2014),http://www.reuters.com/article/2014/10/02/autoshow-paris-carbon-idUSL6N0RX5S520141002

Schanes, K., Dobernig, K., Gözet, B., & Hanley, N. (2018). Food waste matters—a systematic review of household food waste practices and their policy implications. *Journal of Cleaner Production*, 182, 978-991.

Schlie, E., & Yip, G. (2000). Regional follows global: Strategy mixes in the world automotive industry. European management journal, 18(4), 343-354.

Schmuch, R., Wagner, R., Hörpel, G., Placke, T., & Winter, M. (2018). Performance and cost of materials for lithium-based rechargeable automotive batteries. Nature Energy, 3(4), 267-278.

Scotiabank (2015),http://www.gbm.scotiabank.com/English/bns_econ/bns_auto.pdf

Shalender, K. & Sharma, N. (2020). Using extended theory of planned behavior (TPB) to predict adoption intention of electric vehicles in India. *Environment, Development and Sustainability*,23(1), 665-681.

Shrum, L.J., McCarty, J., & Lowrey, T. (1995). Buyer Characteristics of the Green Consumer and Their Implications for Advertising Strategy, Journal of Advertising, 24:2, 71-82.

Sosvilla-Rivero, S., & Gil-Pareja, S. (2012). Convergence in car prices among European countries. Applied Economics, 44(25), 3247-3254.

Stuckey, J. (1993). When and when not to vertically integrate. Sloan management review, 34(3),

Sturgeon, T. & Florida, R. (2000). Globalization and jobs int the automotive industry. *Regional integration and low-cost production strategies*, 78-84

Sturgeon, T. & Lester, R. (2004). The new global supply base: New challenges for local suppliers in East Asia, Chapter 2, 35-87

Subramoniam, R., Huisingh, D., & Chinnam, R. B. (2009). Remanufacturing for the automotive aftermarket-strategic factors: literature review and future research needs. Journal of Cleaner Production, 17(13), 1163-1174.

Suzuki, T., Odai, T., Hukui, R., & Takahashi, J. (2005, April). LCA of passenger vehicles lightened by recyclable carbon fiber reinforced plastics. In Proceedings of the international conference on life cycle assessment (pp. 1-3).

Tagliaferri, C., Evangelisti, S., Acconcia, F., Domenech, T., Ekins, P., Barletta, D., & Lettieri, P. (2016). Life cycle assessment of future electric and hybrid vehicles: A cradle-to-grave systems engineering approach. Chemical Engineering Research and Design, 112, 298-309.

Train, K. & Winston, C. (2007). Vehicle choice behavior and the declining market share of U.S. automakers. *International Economic Review,* 48(4), 1469-1496.

Tudoran, A. A., Schröder, H., & Möser, S. (2018). Environmental concerns and pro-environmental behavior: The role of intrinsic and extrinsic motivations. *Journal of Environmental Psychology*, 56, 96-105

Tung, L., Hieu, L. & Phuc, N. (2015). *Factors affecting consumers purchase decision: a case study in car market in Ho Chi Minh city*. Conference Paper.

Wagner, T., Lutz, R. J., & Weitz, B. A. (2017). Corporate hypocrisy: Overcoming the threat of inconsistent corporate social responsibility perceptions. *Journal of Marketing*, 81(1), 79-98.

World Business Council for Sustainable Development (WBCSD) (2004). Mobility 2030: Meeting the Challenges to Sustainability. World Business Council for Sustainable Development; Conches: Geneva, Switzerland.

Wang, Y., & Kim, Y. K. (2017). Understanding the effect of age on consumer attitudes and purchase intention toward green hotels. *Sustainability*, 9(9), 1556.

Wang, X. & Yang, Z. (2008). Does country-of-origin matter in the relationship between brand personality and purchase intention in emerging economies? Evidence from China's auto industry. *International Marketing Review*, 25(4),458-474.

Webb, DJ., Mohr, LA., & Harris, KE. (2008). A re-examination of socially responsible consumption and its measurement - Journal of business research, Elsevier.

Xiong, S., Ji, J., & Ma, X. (2019). Comparative life cycle energy and GHG emission analysis for BEVs and PHEVs: A case study in China. Energies, 12(5), 834.

Zackrisson, M., Avellán, L., & Orlenius, J. (2010). Life cycle assessment of lithium-ion batteries for plug-in hybrid electric vehicles–Critical issues. Journal of Cleaner Production, 18(15), 1519-1529.

Zinkhan, G. & Carlson, L. (1995). Green Advertising and the Reluctant Consumer, Journal of Advertising, 24:2, 1-6.

Author's Statement:

I hereby expressly declare that, according to the article 8 of Law 1559/1986, this dissertation is solely the product of my personal work, does not infringe any intellectual property, personality and personal data rights of third parties, does not contain works/contributions from third parties for which the permission of the authors/beneficiaries is required, is not the product of partial or total plagiarism, and that the sources used are limited to the literature references alone and meet the rules of scientific citations.