A study of data-driven decision making in the insurance industry

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ABSTRACT

In this study it will be explained the potential that big data has in the insurance industry. It will be started by some history to better understand the evolution of the business. This will help understand how the industry can evolve in the future. Once the topic has been presented, it will be explained how big data is used nowadays in the insurance industry. At this point it will be presented a particular application that will be the main focus for the rest for the study: usage-based insurance. It is a new insurance product where the price is not set like until now, but thanks to data sent by every user to the company. As it will be seen, it is forecasted that their use will grow exponentially in almost everywhere. Once presented the topic, it will be explained all the actors present in the system, which vary from the traditional one. Finished the detailed explanation of the system, we will move to make different analysis to find what is the current situation of this new product and the potential that it has. This study has the particular characteristic of packing a detailed but schematic explanation of the concept followed by different analysis and a theory of future evolution. To finish, the results of this particular product are generalized to the rest of the industry.

Index

List of tables

Abbreviations list

CAGR: Compound Annual Growth Rate

EIPOPA: European Insurance and Occupational Pensions Authority

LAMEA: Latino America, Middle East, and Africa

OBD: On-Board Diagnostics

PAYD: Pay-As-You-Drive

PHYD: Pay-How-You-Drive

RDBMS: Relational Database Management Systems

SWOT: Strengths, Weaknesses, Opportunities, and Threats

UBI: Usage-based insurance

1. Introduction

The world's most valuable resource is no longer oil, but data (The Economist 2017). Big data has made their way in many different industries due to the great potential in improving different aspects. The concept of 'Big Data' became popular already a few years ago, but the applications and uses of it are still growing. In this document, it will be studied how the apparition of this widely used technology has affected the business of insurance companies. It will be focused on one particular application that shows and explains very well the current situation and the potential of big data.

In the past, the insurance industry has relied traditionally on datasets that were obtained using old ways to recollect information. This was translated into sometimes dubious forecasts to set prices, to detect fraud or to attract new customers. The irruption of big data has proved to be a game changing tool for decision making. As most of the businesses, it is being evolved to a product tailored to the customer more and more. This way both customer and insurer tend to obtain better results.

In the beginning of the document an introduction to the world of the insurances will be done, then the different aspects of the business will be studied with special focus on the evolution of the data use on each aspect, and to finish, a particular topic will be discussed and studied.

1.1 Object of the study

The object of this study is to determine how big data has influenced and will influence the insurance industry. This will be achieved by studying in detail one modern application of big data in the insurance business.

1.2 Scope of the study

In order to accomplish the mentioned goal, it will be first reviewed the story of the insurance industry and how rates where set. After this, a superficial analysis will be carried to determine how big data is applied in the insurance industry. Once done this, it will be focused on the application of usage-based insurance and different analysis will be carried out in order to full understand and forecast the future of big data in the insurance industry.

1.3 Justification of the study

The interest of this study relies in the fact that big data is getting very important in many different businesses. The insurance industry is no an exception and the applications of

big data in this field are vast and very interesting. By performing this study, it will become easier to understand the future of big data in the industry.

1.4 Methodology followed

The methodology followed for the elaboration of this study has been a mix between an application of the learnings taken from different papers, reports, books, and information found of internet and the learnings taken from the master's in engineering management.

One of the first ideas for this end-of-studies project was to find some databases and analyze them in order to extract some conclusions, particularly related to the concept of usage-based insurance that latter will be explained. The difficulty and unavailability of this data has moved the objective of this project to a more theoretical study of viability and evolution of the data bases-insurance relation.

So, to be more precise, before starting the study a deep learning of the topic has been made to latter apply all the knowledge to write a document with the particularity of touching almost all aspects of usage-based insurance. To make this study more personal, it has been latter added some analysis performed with the knowledge taken from different subjects with the objective of defining the present and future outcome of usage-based insurance and latter trying to apply the conclusion to the whole insurance industry.

2.1 The insurance industry history

Introduction

The insurance industry has played a vital role in modern society and culture, yet it is a field that is not widely understood. In 2012, a staggering $4613 billion was spent on insurance worldwide, demonstrating just how integral it has become to modern life. The industry has a long history dating back to the 18th century and has been successful due to its reliance on principles of solidarity, business acumen, and calculated risk-taking. Trade and migration have played a crucial role in establishing a global network of insurance coverage.

However, the insurance industry has not been immune to challenges. Natural disasters, such as the 1906 San Francisco Earthquake and Hurricane Betsy in 1965, have caused enormous losses for some companies. Economic crises have also had a significant impact on the industry, with monetary issues such as fluctuating exchange rates and interest rates causing difficulties. The attack on the World Trade Center in 2001 was another major challenge for the industry.

Despite these challenges, the insurance industry has demonstrated remarkable resilience. Even in recent times, the industry has been less affected by crises compared to other industries. This is likely due to a long tradition of careful risk management and reserve planning, which have taught insurers to act with caution. Overall, the insurance industry has proven to be an almost unbeatable business idea and has played a crucial role in the development of industrialization, welfare, innovation, economic growth, and modernization.

A bit of story

The connection between risk, innovation, and growth is now widely accepted, but this understanding is relatively recent. In the past, risk was often viewed through the lens of fate and accepted rather than actively mitigated. Protecting against misfortunes was seen as challenging divine providence. For many centuries, religious practices such as prayers, pilgrimages, and donations were the primary means of managing risk, rather than insurance premiums. As late as the 19th century, insuring against death was met with controversy among religious leaders. However, there were socially acceptable ways to alleviate losses, such as sharing risks within communities and businesses. Risk mitigation based on solidarity was common among guilds, trade associations, and village communities. For example, many seafaring nations would distribute cargo among multiple ships to hedge against storms and pirates, and fraternal organizations provided ex-post forms of solidarity.

While this method of risk management had its limits, it faced many challenges as a business model. Ship owners sailing the same route often faced cumulative losses, as did certain communities, such as mine workers. A single disaster could easily exceed the capacity of a burial club to aid. Additionally, early forms of mutual insurance, in which premiums were paid in advance, lacked the sophistication of modern insurance enterprises. Operating costs had to be financed through member contributions, and few such societies had the means to invest capital professionally. In order to become a modern, successful industry, insurance had to find ways to effectively spread risk and manage finances. Another important factor also played a significant role in the development of the industry.

When did we moved from conjecture to calculation?

In 1654, Chevalier de Méré, a French nobleman, was intrigued by the uncertainties of gambling and sought to determine the probability of rolling a six in a particular sequence. Mathematicians Blaise Pascal and Pierre de Fermat used an ancient pyramid of numbers to prove that mathematical probability could be calculated, which sparked a revolution in the development of probability theories. Mathematicians across Europe worked together to apply these theories to calculate life expectancy, despite this being in direct conflict with Church doctrine. Ironically, it was the Church's own mortality tables that provided some of the data used in these early probability calculations.

Mortality tables were often created by clerics seeking to understand the role and plans of a divine creator and to demonstrate the regularities and divine order behind the seemingly random nature of mortality.

The life insurance industry was slow to adopt these new scientific principles. Many forms of annuities, which resembled gambling more than assurance, were prevalent. Tontine schemes, named after their creator Lorenzo Tonti, were particularly popular in Italy and France. These allowed subscribers to buy a share in a kind of life annuity based on the mortality of a designated nominee. With nominees grouped by age range, the interest was shared and paid to subscribers annually. When a nominee died, the associated subscriber's share in the annuity became void, and the remaining subscribers within the age range received an increased share of the interest. Many tontines were fraudulent or underfunded and eventually evolved into simple life annuities.

It was not until the 18th century that the life insurance industry was established on a more solid foundation. James Dodson, an English mathematician, was denied insurance due to his advanced age, which motivated him to search for a mathematical solution to create a more equitable method of calculating premiums based on life expectancy. This principle was adopted by the English Equitable Life Assurance Society in 1766. Building on this foundation, Richard Price, a Welshman, developed a cost and accounting model for the Equitable Life in 1774, calculating the profitability of life insurance based on current and expected mortality, allowing for a more precise assessment of the company's operations. From this point on, life insurance ceased to be reliant on speculation.

The birth of modern insurance

During the Age of Reason, or Enlightenment, in the 17th and 18th centuries, actuarial science was accepted as a rational way to improve business practices. Insurance, particularly life insurance, aligned with the search for laws, the statistical recording of natural events, and the calculation of future developments. This innovation was based on the belief that the world and its potential future states could be predicted and calculated. Insurance was the perfect laboratory for enlightened business ideas. The process of collecting various types of institutional and personal information and using underwriting to transform it into quantifiable costs was crucial. It provided a vital balance to the disruptive forces of the changing division of labor, urbanization, and trade economics. Insurance also helped money become the means of communication within the economy and contributed to more and more problems being expressed in terms of costs and time.

Not all cultures immediately embraced this way of thinking. In Southern Europe, it took a catastrophic event to change the perception of risk and views on destiny. The Great Lisbon Earthquake in 1755 challenged the traditional interpretation of divine omnipotence. Almost the entire city was destroyed, including churches and municipal

buildings, but, much to the concern of many survivors, the red-light district was left intact. This led many to question how a benevolent God could allow this and why an all-powerful God did not prevent it. This disaster led some to believe that it was mankind's duty to take control of their own destiny. Rational thinkers were increasingly seen as being on the right side of the argument, and although the earthquake did not immediately boost the concept of insurance in the South, it gave rise to modern seismology.

In England, it was the Great Fire of London in 1666 that changed public opinion. Hardly any of the 70,000 destroyed homes were insured. Nicholas Barbon, a Londoner, made a fortune rebuilding the city and then turned to insuring houses. His primary motive was business, pure and simple. His rational approach and experience as a banker and mortgage provider led him to realize that his insurance company needed to be built on a different financial foundation. In 1681, he created the first known joint stock insurance company. Shareholding became essential for modern insurance as it allowed the separation of operating capital from risk capital and provided funds to expand business into new areas and beyond the domestic market.

However, the immediate success of these joint stock corporations was overshadowed by speculation and subsequent ruin, as occurred in the South Sea Bubble in 1720. The rational business ideas of the Enlightenment also tempted many investors to misuse the sound concepts of insurance to bet on unlikely risks, such as the outcome of wars, the danger of dying from excessive gin consumption, or the date of birth of heirs to empires. The government subsequently banned some forms of insurance. A ban on reinsurance had already been put in place in 1746. Despite these setbacks, the development of insurance seemed inevitable. Economist Adam Smith praised it as a rational invention and even a moral obligation, stating that failing to insure oneself was a "thoughtless rashness and presumptuous contempt of the risk."

The industrial revolution and the growth of the British Empire necessitated insurance solutions. Towards the end of the 18th century, the first truly modern and global insurance company, the Phoenix, was founded by an association of sugar refinery owners in London. Shortly after its foundation, it began insuring risks in distant countries and was the first insurer to establish offices abroad. From Britain, property and life insurance began spreading around the world, based on modern science, new forms of capitalization, and the ability to spread risks globally. This proved to be an almost unbeatable business model, and the insurance industry continued to expand and evolve.

Global expansion of insurance

After the wars in Europe and the Anglo-American conflict ended in 1815, insurance was able to expand beyond Europe and the US, which had adopted the British model early on. As trade grew and emigration increased, the British system was gradually adopted in most white settler colonies in the Americas, Australia, New Zealand, and South Africa.

It was a privilege for European settlers and traders to insure themselves and their businesses, while local communities rarely adopted the concept, preferring to stick with their traditional methods of protection. Non-European societies preferred forms of family and village solidarity and trust in God, and Europeans initially showed no interest in insuring others. In India, for example, insurance was limited to British subjects as locals were thought to be untrustworthy and a higher risk for life insurance due to their perceived lower living standards. Ironically, the worst risks for life insurers turned out to be young British officers who were often exposed to severe health problems in tropical colonies and had a higher tendency to die prematurely. However, India became important as a launching pad for the spread of insurance into the Far East. The East India Company dominated insurance on the Subcontinent, but underwriting risks from a London office was almost impossible due to the long exchange of letters with India. As a result, higher risk premiums were demanded, leading agency houses in Kolkata to set up their own insurance and expand the business into Asia.

In the early 1800s, Singapore began to grow as a major trading hub in Southeast Asia due to the efforts of Thomas Stamford Raffles. This led to the city becoming a gateway for insurance companies looking to expand into the Dutch East Indies. In the late 1880s, a Singapore-based trading company that had served as an agency for Liverpool's Royal Insurance since 1860 set up the first rubber plantations on the Malay Peninsula. This type of combined business approach, where entrepreneurs or agencies provided insurance to their own and others' businesses, was common at the time among large Asian corporations. In Latin America, insurance was introduced on a large scale by European immigrants. The British companies focused on trade-related risks, while immigrants introduced insurance to a larger population. These companies were often based on mutuality, with more modern operations than traditional friendly societies. The widespread adoption of personal insurance was mainly a result of the mass migration from Europe that occurred in the 19th and early 20th centuries. In an effort to protect local insurers from foreign companies, many Latin American countries passed legal reforms to address concerns about British domination. As a result, these countries saw a diverse range of local insurers vying for business and catering to the different needs of clients with Italian, Spanish, English, or German backgrounds, often signaling their target demographic in company names such as Anglo-Argentina, Franco-Argentina, or Germano-Argentina. In Africa, especially in Sub-Saharan Africa, South Africa emerged as a leader in the insurance industry. Dutch and British immigrants founded combined fire and life insurance companies as early as the 1830s. In the early 20th century, the South African government took a unique approach by choosing not to implement a social insurance system and instead leaving old age provision to life insurers. At the time, many other countries had adopted social insurance schemes based on the German model created by Chancellor Otto von Bismarck to placate the growing working class.

The growth of trade, industrialization, urbanization, and transportation in the 19th century created a huge demand for insurance. By the turn of the 20th century, the

industry had spread across the globe, but it also reached its limits. In South Africa, after World War I, the government created jobs with tied-in pensions and medical coverage to deal with the influx of workers to cities. This led South Africa to become a leading expert in life insurance market innovations, and it attained the highest proportion of life insurance in the world. However, the non-life or short-term market was still largely dominated by foreign, mainly English companies.

Modern insurance

In the late 19th century, national insurance programs began to be introduced to provide protection against sickness and old age. Germany implemented welfare programs in Prussia and Saxony in the 1840s, and in the 1880s, Chancellor Otto von Bismarck introduced old age pensions, accident insurance, and medical care that formed the basis for Germany's welfare state. These programs were supported by German industry because they aimed to win the support of the working class for the Empire and reduce the number of immigrants going to America, where wages were higher but there were no welfare programs. In 1911, the British government, led by H. H. Asquith and David Lloyd George, introduced the National Insurance Act, which gave the working classes in Britain their first contributory system of insurance against illness and unemployment. All workers who earned less than £160 per year were required to pay 4 pence per week to the scheme, the employer paid 3 pence, and general taxation paid 2 pence. This allowed workers to take sick leave and receive 10 shillings per week for the first 13 weeks and 5 shillings per week for the next 13 weeks. The Act also provided free treatment for tuberculosis and access to panel doctors for the sick. Maternity benefits were also included in the National Insurance Act. Unemployment benefits were time-limited and based on actuarial principles, and were funded by fixed amounts from workers, employers, and taxpayers. However, these benefits were only available in certain industries and did not provide support for dependents. By 1913, 2.3 million people were insured under the scheme for unemployment benefits and almost 15 million were insured for sickness benefits.

This system was greatly expanded after World War II under the influence of the Beveridge Report to create the first modern welfare state. In the United States, the Social Security Act of 1935 established insurance programs at the national level for the first time. The VA Home Loan program, which began after World War II, greatly expanded the idea that affordable housing for veterans was a benefit of military service. Mortgages underwritten by the federal government during this time included insurance clauses to protect banks and lending institutions from avoidable losses. The GI life insurance policy program, also introduced in the 1940s, was designed to ease the burden of military losses on civilians and survivors.

The insurance nowadays

The insurance industry is composed of firms that provide risk management through insurance contracts. Insurance works by having one party, the insurer, promise to cover a potentially damaging or costly event in the future. In return, the insured or policyholder pays a smaller fee, known as a premium, to the insurer. Historically, the insurance sector has been viewed as a stable, albeit slow-growing, investment option, although this perception has weakened somewhat in recent decades compared to other financial industries.

There are various types of insurance companies, including those that specialize in accident and health coverage, property and casualty protection, and financial guarantees. The most common types of personal insurance policies include auto, health, homeowners, and life insurance. In the United States, it is required by law to have car insurance. Accident and health insurers, such as UnitedHealth Group, Anthem, Aetna, and AFLAC, offer coverage for individuals who have experienced injuries or illnesses.

Life insurance companies provide policies that pay out a lump sum death benefit to the beneficiaries of the insured individual upon their death. These policies may be offered as term life, which is less expensive but expires after a set period, or permanent life insurance, such as whole life or universal life, which is more expensive but lasts for the entirety of the insured individual's life and includes a cash value component. Life insurers may also sell long-term disability policies that offer income replacement in the event that the insured becomes sick or disabled. Some well-known life insurance companies include Northwestern Mutual, Guardian, Prudential, and William Penn.

Property and casualty insurance companies offer coverage for non-physical damages or injuries, such as lawsuits, damage to personal assets, and car accidents. Major property and casualty insurers include State Farm, Nationwide, and Allstate.

Businesses may require specialized insurance policies to cover specific types of risks that they face. For example, a restaurant that uses a deep fryer may need coverage for injuries or damages that result from cooking, while an auto dealership may need coverage for damage or injuries that occur during test drives.

There are also insurance policies available for specific, specialized needs, such as kidnap and ransom (K&R) coverage, medical malpractice protection, and professional liability insurance, also known as errors and omissions coverage.

To reduce risk, some insurance companies engage in reinsurance, which is insurance that they purchase to protect themselves from large financial losses due to high levels of exposure. Reinsurance plays an important role in helping insurance companies remain financially stable and avoid default due to payouts, and it is often required by regulators for companies of a certain size or type.

For example, an insurance company may sell a large amount of hurricane insurance based on models that show a low likelihood of a hurricane hitting a particular region.

However, if a hurricane were to unexpectedly occur in that area, the insurance company could suffer significant losses. Without reinsurance, which helps to transfer some of that risk to another party, the insurance company could potentially go out of business.

2.2 History of big data

The term 'Big Data' has been around starting in the earlies 1990s. Although it is not very clear where it was started to use the term, it is believed by most people that John R. Mashey, who was working at Silicon Graphics, made this term popular.

Despite the public thinking of the recent apparition of this concept, Big Data is not really a concept that is completely new or only of the last two decades. If we look behind, there has been always the interest on using data analysis and analytics techniques to take the best decision and support the process. As an example, the ancient Egyptians around 300 BC already tried to capture all existing 'data' in the library of Alexandria. Moreover, the Roman Empire used to carefully analyze statistics of their military to determine the optimal distribution for their armies.

However, the main difference in the last two decades is the speed and volume with which data is generated: the increase has been huge, beyond measures of human comprehension. In 2013 the total amount of data in the world was 4.4 and in 2020 raised steeply to 44 zettabytes. That is more data than humans can even study. In fact, nowadays it is generated more data than the one that we can process, even with the help of the new technologies. The need to process these increasingly larger (and unstructured) data sets is how traditional data analysis transformed into 'Big Data' in the last decade.

In order to make a schematic table of the evolution of big data, it is going to be divided into the different phases. Every phase had its particular capabilities and characteristics. The three phases listed below can help understanding the evolution that has led Big Data to the actual situation.

To illustrate this development over time, the evolution of Big Data can roughly be sub-divided into three main phases. Each phase has its own characteristics and capabilities. In order to understand the context of Big Data today, it is important to understand how each phase contributed to the contemporary status/development of Big Data.

Big Data phase 1.0

Data analysis, data analytics and Big Data was originated starting as merely database management. It relied heavily on the actions of storing, extracting, and optimization techniques that are common in data that is stored in Relational Database Management Systems (RDBMS).

Database management and data warehousing are considered the be the core components of Big Data Phase 1. It provided the foundation of modern data analysis as it is known today, using well-known techniques such as database queries, online analytical processing, and standard reporting tools.

Big Data phase 2.0

In the earlies 2000s, the Internet opened a new world offering unique data collections and data analysis opportunities. Thanks to the expansion of online stores and web traffic, companies such as Amazon, Yahoo or eBay started to analyze customer behavior by analyzing click-rates, IP-specific location data and search logs.

From a data analysis, data analytics, and Big Data point of view, HTTP-based web traffic introduced a massive increase in semi-structured and unstructured data. Besides the standard structured data types, organizations now needed to find innovative approaches and storage solutions to deal with these new data types in order to analyze them effectively. The arrival and growth of social media data greatly aggravated the need for tools, technologies and analytics techniques that were able to extract meaningful information out of this unstructured data.

Big Data phase 3.0

Although web-based unstructured content is still the main focus for many organizations in data analysis, data analytics, and big data, the current possibilities to retrieve valuable information are emerging out of mobile devices.

Mobile devices not only give the possibility to analyze behavioral data (such as clicks and search queries), but also give the possibility to store and analyze location-based data (GPS-data). With the advancement of these mobile devices, it is possible to track movement, analyze physical behavior and even health-related data (number of steps you take per day). This data provides a whole new range of opportunities, from transportation to city design and health care.

Simultaneously, the rise of sensor-based internet-enabled devices is increasing the data generation like never before. Famously coined as the ‘Internet of Things’ (IoT), millions of TVs, thermostats, wearables and even refrigerators are now generating zettabytes of data every day. And the race to extract meaningful and valuable information out of these new data sources has only just begun.

A summary of the three phases in Big Data is listed in the figure below:

BIG DATA PHASE 1	BIG DATA PHASE 2	BIG DATA PHASE 3
Period: 1970-2000	Period: 2000-2010	Period: 2010-present
DBMS-based, structured content: • RDBMS & data warehousing • Extract Transfer Load • Online Analytical Processing • Dashboards & scorecards • Data mining & statistical analysis	Web-based, unstructured content • Information retrieval and extraction • Opinion mining • Question answering • Web analytics and web intelligence • Social media analytics • Social network analysis • Spatial-temporal analysis	Mobile and sensor-based content • Location-aware analysis • Person-centered analysis • Context-relevant analysis • Mobile visualization • Human-Computer-Interaction

Source: Big Data Framework organization

Table 1: Different phases of big data

3. Big data applications in the insurance business

Having explained the history of the insurance business and big data, it is now going to be explained without entering into details in how many different both concepts can work together to achieve better results. Only one of these points will be the one concerning this project, but it is thought to be interesting and useful to know all the possibilities the combination of both worlds can bring. The insurance industry uses big data for the following purposes:

- Customer Acquisition
- Customer Retention
- Risk Assessment
- Fraud Prevention and Detection
- Cost Reductions
- Personalized Service and Pricing
- Effects on internal processes

In the following points it is going to be explained one by one.

Customer Acquisition

The main activity of an insurance company and the source of revenue is to offer the products to their customers. Customers are needed to generate revenue. By using big

data, the process of acquisition can be made efficient and make things a lot simpler. As many other companies in different sectors do, using users data created in social media and the internet can help the business focusing and targeting the right users instead of losing time and other resources in adds to not interested people.

By using the data available from the users, insurance companies can create targeted marketing campaigns that will increase the rate efficiency of acquisition of new customers. In practice, big data gives much more precise information than any survey and questionnaire.

Customer Retention

No business likes to lose its customer base. One of the main numbers of a business to measure their commercial success is the customer retention rate. The higher it is the better. The insurance industry is no exception. So, to improve that number it utilizes big data to find ways to retain its customers, who may part their ways with the company.

If an insurance company using big data tracks their customer activity it can predict the early signs of customer dissatisfaction. Working on the insights provided, Companies can quickly react by working on the reasons of customer dissatisfaction to improve their services and try to find a solution of that particular customer, so it does not decide to change company. The usual methods insurers take are the offering of price discounts or even change the pricing model for the client.

Risk Assessment

Traditionally insurance companies have always assessed the customer's risk using the customer information to set prices. The most common way to proceed is to segment customers into different risk classes based on the data provided by the user. But this procedure compared with the same but using big data turns out to be very inaccurate.

Big data technology helps increasing the efficiency of the entire process of risk assessment. Before arriving at a final decision, an insurance company can utilize big data and use predictive modeling to forecast possible issues, based on client's data, and furthermore put them into a suitable risk class.

Fraud Prevention and Detection

Fraud is one of the biggest problems in the insurance business. According to Coalition Against Insurance Fraud, United States insurance companies lose every year more than $80 billion due to fraud. In the end, these fraudulent acts result in higher premiums for every customer.

Big data can be used very efficiently to act against these frauds. By creating predictive models, insurers can check the data of a customer against other fraudulent profiles in the past and find the cases that should be investigate before moving on.

Cost Reductions

Cost-cutting is one of the many benefits of leveraging technology. The most you automize a process using machines the most efficient will it get, leading to cost reductions.

Big data technology can be used to make manual processes automatic, so they get more efficient. This way, for example, instead of handling certain claims manually you can let data do the job for you and reducing the costs. This will not only create bigger margins for the company but also open the door to offer lower premiums to their clients and increase competitiveness in the market.

Personalized Service and Pricing

A new tendency in every business is the personalization for the customer. The need for a personalized experience is every day more demanded. The analysis of data can help companies to offer services that are closer and effectively meet the needs of the customers.

As an example, a way to personalize life insurance using on big data is considering the medical history of a new possible client along with the habits received by activity trackers that the user can wear. Another use of data could be to decide in which pricing model should be inserted that prospect so it can fit into the budget of the client while maintaining profitability for the company.

Effects on internal processes

Using big data for internal processes can carry many vantages. As confirmed by a study by McKinsey it is found that automation saves a total of a 43% of the time of insurance employees. The implementation of big data algorithms can really help to increase the efficiency of the processes that usually require deep brainstorming. Big data technology allows insurers to work quickly on a customer's profile. They can check their history, form a pricing model, automate claims processing, decide on a suitable risk class, and overall deliver the best services.

3.1 Personalized service and pricing

Now that it has been explained all the basics and the different ways in which Big Data it is applied in the insurance industry it is time to move on to a particular feature in which this document will be focused from now on: the usage-based insurance. This term has been adopted to express a tendency that is strongly growing in the industry and represents a particular way of pricing the service of the company towards the customer in a very personalized way thanks to data.

The reasons behind focusing on this topic are the following:

- This pricing modality has just taken off, and it is expected to dominate the market in the next decade. This makes it very interesting to study so it can be learned and predict how it could evolve. As every innovation, it could also just not deliver the expected results and being left, and that brings me to the next point.
- Since the usage-based insurance concept has just been launched, a business case/viability study can be very useful, and it can be very helpful in the current state of evolution.
- This new insurance product demands for a particular use of technology, involves different actors and has some unresolved issues such as the privacy of the user, risking violating some directives that latter will be discussed. All these open questions make this topic a very suitable one to be worked.

Usage based insurance can be applied to many different services in an insurance company, but in order to be able to deeply study the topic, it will be focused on the car insurance service.

4. Usage-based insurance

The usage-based insurance concept it is a new trend present in the insurance industry. It is a data-driven service that appeared after the huge increase in data availability from many users, mainly in the automotive sector thanks to the new technologies applied in cars and the development of the smartphone sensors. The influence of usage-based insurance strikes directly on the price to pay to the insurer, the so-called premiums. Before the appearance of this concept, premiums were always calculated from different variables of the user like age or gender and paid once a year, which is still the most common procedure.

What usage-based insurance aims to change is the calculation of this premiums thanks to the usage of the data received from the customer (miles, car acceleration, speed….), allowing the company to offer a much more personalized product and a more accurate pricing. This way a company can charge more the most ‘aggressive’ drivers and reduce the price for the most responsible ones. A further impact on more conscious driving in the society could be obtained if this trend manages to be the dominant one.

To give a bit of information, traditional premiums set the price of an insurance depending in different aspects of the driver and the car. Below can be seen an example:

Motor insurance rating factors categories	Examples of rating factor included in this category	Influence on final premium (approximation)*	Type of information provided
Driver details	Age of driver, mileage, car usage	High	Perceived as having a direct causal link
Vehicle details	Horsepower, car model, car value	High	
Claims and experience	Bonus malus, year of obtaining the driving license	High	
Cover	Type of cover, deductibles	High	
Driver behaviour	Driving score, acceleration, telematics data	High	
Loyalty	Multi-subscription, renewal, tenure with company	Low	Perceived as having an indirect link to risk behaviours – more likely elasticity
Location	Postal code, region, area of residence	High	
Affluence	Credit score, kind of home ownership, occupation	Low	
Distribution	Sales or distribution channel	Low	
Non-risk (not captured)	E-mail address,** customer marketing opt-out preference, quote manipulation	Low	
Other	Miscellaneous	Low	Not clear, excluded

* Depends on concrete rating factor and firm. Therefore the aggregated value for the group is only an approximation taking into account the most repeated value of all the rating factors within that group (firms were asked to categorise each rating factor between High = is one of the 50% most influential rating factors they you use and low = is one of the 50% less influential factors that they use)

** Only one firm reported the use of this rating factor, reportedly to steer communications to paperless channels. However, it should also be noted that personal e-mail addresses might provide a lot of personal information about the consumer, since they often include the name, surname and age of the consumer, and further personal information can be derived therein. The media has recently reported examples of price discriminatory practices because of the use of email address as a rating factor.

Source: Swiss-Re 2021 report

Table 2: Types of rating factors used in motor insurance

The technical aspect of this trend relies on Information Technology (IT), which provides facilities for collecting the instantaneous driving data which comes through on-board diagnostics (OBD), which will be latter explained. Once this data is gathered, it is calculated different driving indicators.

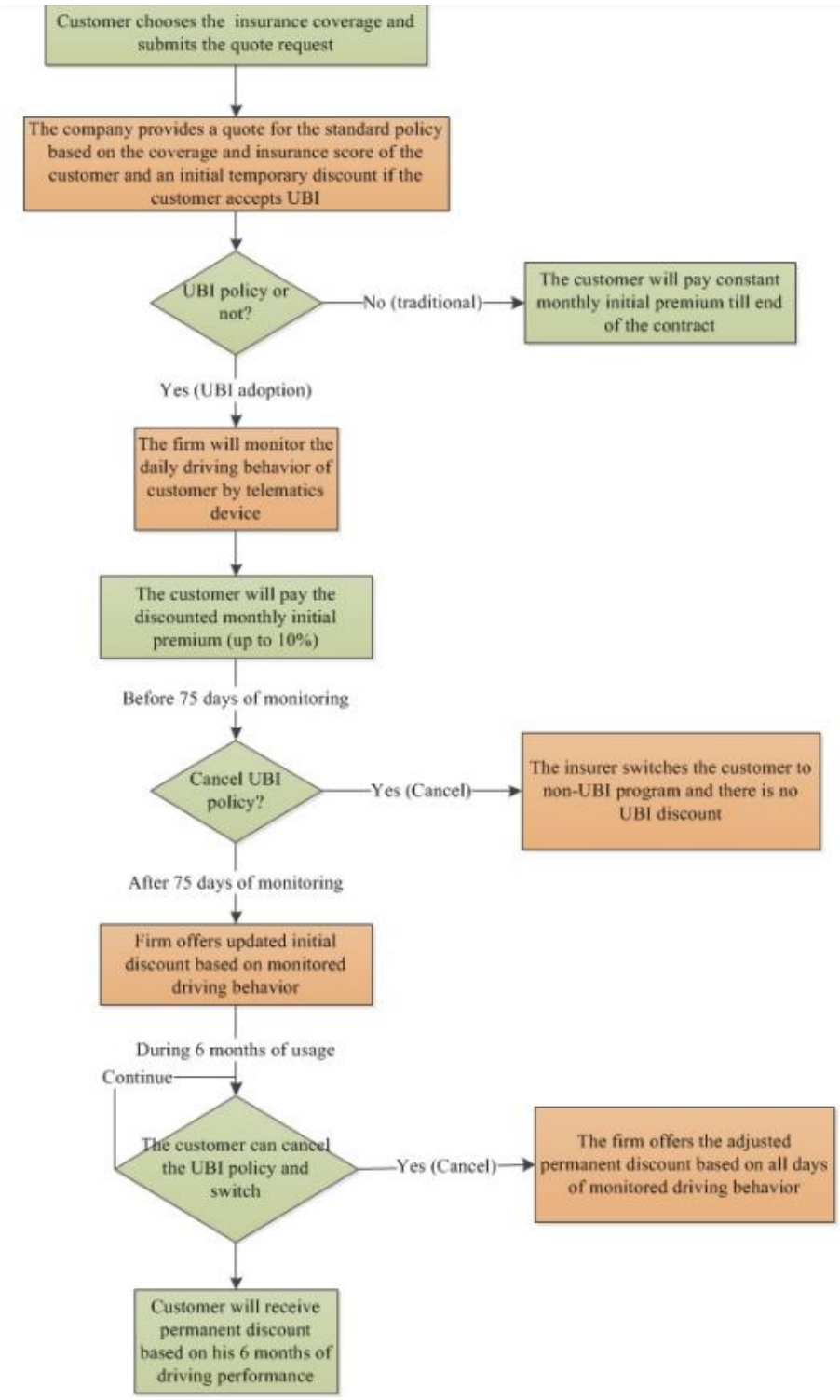
From a business perspective, usage-based insurance is changing the incumbent business model of vehicle and medical insurance.

One of the difficulties that is facing this new trend is that this optional service is not always welcome by the customers. The main barriers reported have been the reluctance of customers to trust data when defining the price to pay. For other users, one of the fears is that by using this modality price might increase.

4.1 How usage-based insurance works?

Usage-based insurance, from now on UBI, is a generic concept applied mainly to two different packages, product models, to call it in some way, always driven by data: Pay-How-You-Drive (PHYD) and Pay-As-You-Drive (PAYD).

Before entering into details, below can be found the typical procedure when contracting UBI products:



Source: European Insurance and Occupational Pensions Authority

Table 3: Steps to follow when contracting an insurance policy

Having seen the usual procedure, let us now explain two of the most demanded products of UBI insurances.

Pay-As-You-Drive Model (PAYD)

As the name suggests, the Pay-As-You-Drive model is based on the usage of the car. It is the UBI product that relies less on data, since usually only kilometers and a few more variables with low weight are taken from the car data. The more kilometers that are driven, the higher premium the insurance charges. Apart from this, like traditional insurance it uses other parameters to define the premiums such as type of car and location.

This modality has seen an exponential growth after the Covid-19 pandemic. After a year of a very low car usage users have started asking themselves if it makes sense to pay for a service that they are not using. This kind of product is the perfect solution for these users. It has opened a market niche for many startup insurances companies, consequently damaging the margin of the big insurance companies, but still not being a thread to them.

An example of insurance product within this model is the Pay-Per-Mile insurance. As generally in the PAYD models, distance driven is the main parameter. The policy divides the protection in two parts: on one side the user pays a fixed amount to cover stationary risks when the car is parked and on the other side risks such as collision with another car, animals, body injuries are covered and priced on mileage basis.

One of the main benefits of this modality is that the customer is in control over the benefits and get a personalized service.

Pay-How-You-Drive Model (PHYD)

This model is the most interesting in relation with this thesis, since it has an exhaustive use of data and is the less evolved one due to the complexity of developing a mathematic model where variables are inserted, and a price is returned. It is also the one where database takes a higher importance. On the other side, is a model that can really help improve driving safety. The concept of this model relies on a price calculation based on the driver's safety score. But the first logic question that comes to the mind is: how come a company can find this safety score? A lot of work has been put into this topic and it will be studied in the following pages. The variables that are usually considered are acceleration, cornering, speeding, braking, and lane changing.

By using this model some behaviors are penalized and others are rewarded. In order to attract more customers, it is adopted a strategy of starting the drive at a high base price and by driving in a good responsible way this price is reduced, and if not, it is maintained, so the customers do not get bothered by the system.

In any case, this model varies quite a lot depending on the companies and the countries, but in all cases the principles are the same. In some cases, the rewards come as free gifts, in others as a direct discount in the premiums as we said, etc.

The positive point of this modality is that incentives a risk-free driving so all the actors are interested in it. On the other hand, there are other problems as data privacy or the difficulty to find the right model.

Having seen the two most common modalities, in the next point it is going to be explained how the system works, this is, what are the data flows, the components and the requirements to run these modalities.

4.2 The usage-based insurance system

The main actor of the system is the user, that has agreed with his insurance provider a UBI methodology in order to set the price for the premium. So, it could be said that the first step of our system would be the agreement between the customer and the insurance company in order to apply this particular methodology.

Once the agreement is set, usually the insurance company provides the customer with a tool in order to monitor the user's data. The most common tool is an OBD device to be connected in the OBD port (usually under the steering wheel, mandatory nowadays for all class of vehicles) or a Black Box. But in some cases, there is not even need for that: the insurance company can also provide an app to download and be used while driving or in the case of the most advanced vehicles data could be automatically send to the insurance company without any need to install anything. In the next pages it is going to be explained all these mentioned possibilities. In summary, thanks to all these tools the data is send automatically to the insurance company at the end of every trip.

Once the insurance company has received all the data, it is time to evaluate and set a cost for the trip. It is in this step were comes into play the Information Technologies. The insurance companies have a cloud where all this information is saved and computes the premiums for each user. In the case of PAYD methodology, calculation is usually an easy task. In the case of PHYD, all the data must be processed and introduced in a complicated model, which returns the premiums to the insurer. This model has been developed by engineers, technicians and AI using data, and as every unfinished model, it keeps evolving and finding the most accurate variables values.

After all this computation, the insurance communicates the cost of the trip to the user. This step is generally automized and managed through the insurer's customer app. Only very particular cases need to be checked and verified by the insurer manually.

In the following table it can be found a comparison between the main characteristics and differences between the traditional insurance product and an insurance product following the usage-based insurance modality:

	Traditional insurance	Usage-based insurance
Offered by any company	Yes	Still in expansion
Risk analysis	Based on risk segmentation	Based on data received when driving
Premium price	Fixed	Variable, lower than traditional insurance
Need for set-up	No	Yes, there is need for a device to send data to the insurer
Price review frequency	Annually	Depending on the insurer, can be monthly, trimestral…

Source: prepared by author

Table 4: Comparison table between traditional and UBI insurance

4.3 UBI trend and numbers: forecast

In this point it is going to try to transmit some of the previous ideas, particularly those regarding the promising future of UBI, through different numbers and statistics.

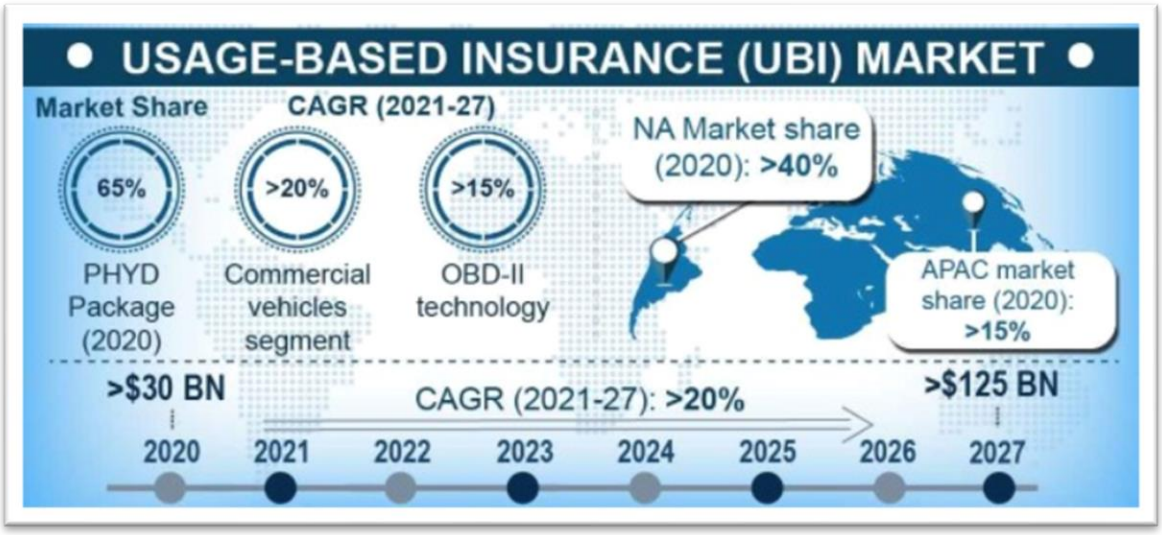
The starting point which is still somehow in our paths is the fact that the pandemic Covid-19 has made to most of us rethink many pre-Covid obvious things. And one of them is the traditional auto insurance policies. Particularly, In the case of auto insurance the biggest reasons are work-from home modality and the decrease in the use of the car for short unnecessary trips.

Products and services are in constant evolution and insurance products aren't immune to these changes. Other factors that will push Usage-based insurance are connectivity of cars, a growing conscienceless of safe driving and new trends between the young generation, which will be the future customer base of insurance policies.

Entering into detail to the numbers, and starting by looking at the past, in 2019 the global market size of UBI was valued at 28,7 billion of dollars (source: *Allied Market research*). Another interesting point is that in the USA the number of users of UBI that involves use of telematics technology with the aim of taking data to set premiums have doubled since 2016. Also, the percentage of insurance companies offering these products in 2020 was of a 16 percent.

In terms of product users, after conducting a survey in March 2022 to insurance product holders it was found that the 40 percent of respondents were offered an UBI option from their insurance company, up from 32 percent in November 2021. The percentage of users who accepted the deal also was up from a 49% to a 65% (Source: Forbes). With another survey that again Forbes did, results were showing higher satisfaction than regular insurance users.

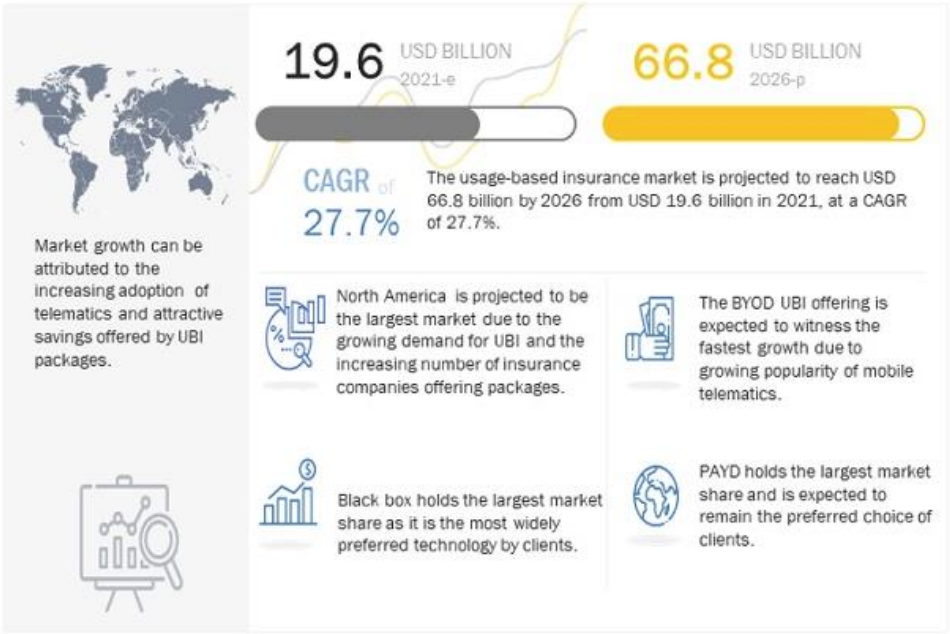
Moving back to business numbers, the market share in USA (UBI are more advanced there than other parts of the world like Europe) in 2020 was already a 65%. It is expected that the global business value which in 2020 was around 30 billion will increase to around 125 billion by 2027. All this information coming from Allied Marked research can be found in the following table, with some extra details.



Source: European Insurance and Occupational Pensions Authority, 2020

Table 5: Usage-based insurance market forecast

To add some more numbers, in the following table we can find other interesting numbers. As anticipated USA seems to be the most advanced market and CAGR is expected to be of 27,7 percent between 2021 and 2026.



e-estimated, p-projected

Source: Secondary Research, Expert Interviews, Company Presentations, and MarketsandMarkets Analysis

Table 6: Opportunities in the Usage-Based Insurance Market

4.4 The UBI expansion around the world

When talking about Usage-Based insurance products it can be found a difference in the development of the concept in the different areas of the world. Without entering into details, it is going to be explained what the situation in around the world grouping it by the following regions: North America, Asia Pacific, LAMEA (Latino America, Middle East and Africa) and Europe.

North America

North America is the region where most advanced it's the market of UBI. Not only in terms of product evolution but also in terms of share in the usage- based insurance market, thanks to two insurance companies: Allstate Corporation and Allianz. Two of the main reasons that boosted the UBI market in the USA are the extended and accepted concept of flexible driving, a very efficient roadside assistance and vehicle theft recovery.

In particular, one of the particularities of the North America region is that the main insurers are immersed in a battle for increasing their geographical presence by launching a hard campaign of product development in terms of features, price and quality. Also, another characteristic that has helped North America in leading the UBI development

has been the high number of players that are in the market, leading to a fast industrial and commercial growth.

The main country in the North America region leading the dominance in the UBI insurance has been Canada. This country is the most advanced in the region and has experimented a strong growth of UBI policies these last years.

To conclude, the main reason for North America to be the strongest area regarding is the fierce competition between the insurance companies, which leads to evolution. But it is not the main reason, also the wide expansion of technological startups has helped evolve the market. An example of this is the partnership forged in March 2018 between Hyundai Motors and Verisk Analytics Inc, one of the key players in American data analytics. This is an example of a partnership that helped Hyundai Motor America to offer usage-based insurance to its customers. As one can expect, having a manufacturer offering an UBI insurance policy after the purchase of a new car helped to boost the market.

Europe

After North America, Europe is the area with the highest number of UBI policies and spread. In fact, according to a recent report by 'Research and Markets', Europe total number of UBI based insurance policies reached 10.3 million in 2018. Similarly to the North American Area, there has been a trend that is helping to boost the UBI market. This is the rising number of InsurTechs dedicated to only insurance products. Thanks to these companies, usually young and in a rapid growth, it is happening a transformation of the business models and searching for new ideas regarding data gathering and sharing. As an additional information, these companies usually tend to focus in using improved means of connectivity and data communication across OEMs, TSPs, and insurance providers.

In the population side, according to Capgemini consumer interest has risen by a 45% between 2020 and 2021, mainly due to the pandemic. So, one of the main factors of the growth in the European market is the interest from the market. In the following graphic it can be seen the level of awareness of UBI products in Europe:

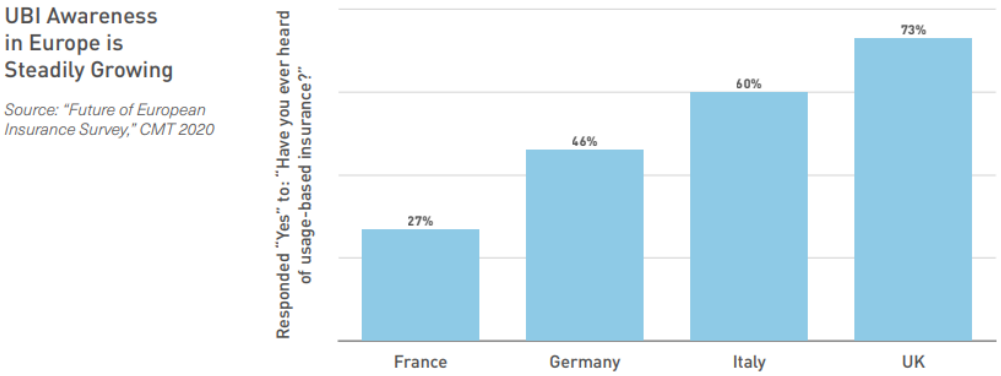


Table 7: UBI awareness in Europe

If we go into detail country by country, it can be affirmed that Italy dominates the connected insurance market in Europe, followed by the United Kingdom and Germany. This last have experienced a rapid expansion in the post pandemic era. Unlike the west, in Europe the insurance business is driven mostly by regional companies. Another positive point is the great number of partnerships between insurers and telematics providers, which has accelerated and will keep accelerating automotive UBI insurance growth during the next years. In the following graph it can be seen the proportion of insurance policies by country, with to added countries from North America to compare the volumes. As previously said, Italy is particularly ahead of the rest of the European countries by a big margin.

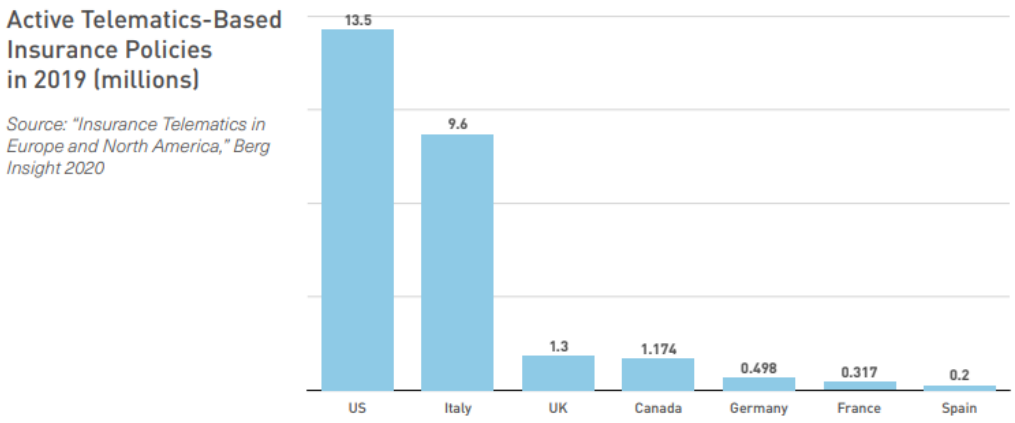


Table 8: Number of active UBI policies in 2019

To finish, it is interesting to add how the pandemic affected the adoption of UBI insurance in Europe. According to the "Future of European Insurance Survey" conducted by CMT in 2020, the appetite for usage-based insurance increased rapidly during the first months of the pandemic. In Italy, the segment most attracted to UBI before the first wave of lockdowns was Millennials paying €500-700 in premiums (81%). However, by September, the age group most actively embracing telematics was Gen X (71%). In the UK, drivers paying more than £1,000 in premiums were overwhelmingly in favor of telematics, regardless of their age group. After the first wave of lockdowns, 80% of Gen Z and 68% of Millennials surveyed were ready for telematics. In Germany, the most attractive segment was Gen Z drivers paying €500-700 (83%), but Millennials paying over €700 (65%) or under €300 (67%) were not far behind. Following the first wave of lockdowns, the main age group to express readiness for telematics was Millennials, with 69% of that age group ready to switch and 5% having already made the switch. In France, the most interested age group was Gen Z drivers paying below €700 (73%) and Millennials paying over €700 (60%). However, a September survey showed that Gen X was also a strong target segment, with 64% of them likely or very likely to switch to telematics. Gen Z followed at 63%. To support this numbers and due to the fact that it is interesting how the pandemic affected the perception of customers, a table is added to visualize more graphically the situation of Europe after a few months of the pandemic.

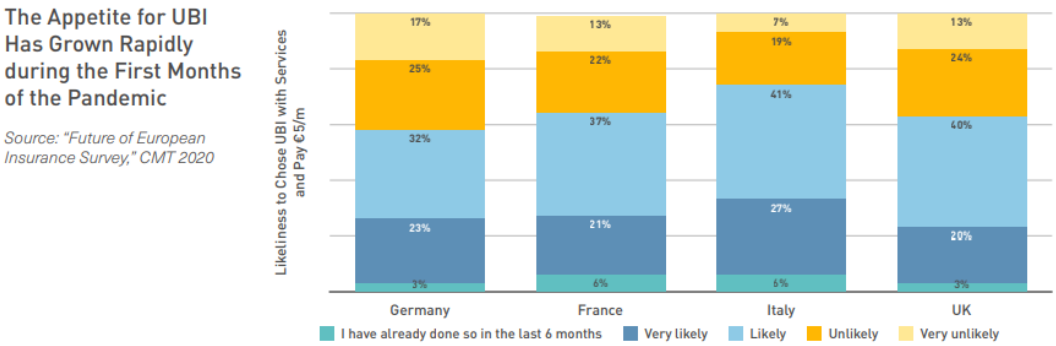


Table 9: Likeliness to choose UBI in Europe after the first months of pandemic

Asia Pacific

Asia Pacific region is the next in line when talking about UBI insurance implementation. While it is still not as expanded as in North America or Europe, the key point of this region is the potential that it has. The increase in economic strength of countries such as China or India is expected to rise even further the potential of this area and the linked market growth.

Added to the previous point, there is another positive catalyst which is government implication. Countries like India, Japan or Singapore is in favor of UBI insurance and are promoting different UBI initiatives in order to impose the adoption of usage-based

insurance products. So, it can be said that there is some government influence to modify the market in favor of UBI insurance.

LAMEA

LAMEA region is the less expanded of the list of the different regions, but similarly to Asia Pacific, the main point of this region consists in the potential that it has. While Asia Pacific was the top investment country for the UBI insurance, LAMEA follows it but with some limitations mainly due to not been so evolved.

The key regions leading the potential of this region are the growth in Latin America and Central America.

To conclude this point, it is shown below a graph displaying the reaction of different drivers in different countries in front of the proposal to sign in for Usage-Based Insurance in 2019. It can be seen that already at that year, openness from drivers all around the world was already high.

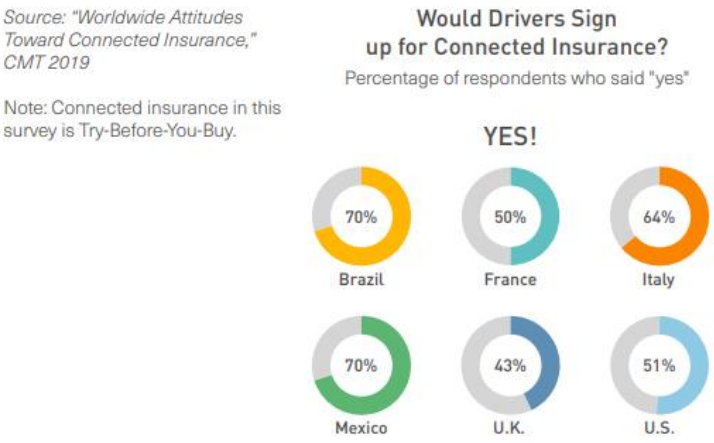


Table 10: Openness to UBI in 2019

5. Ecosystem analysis

Before entering into different viability and economic analysis it is going to be explained the different players in the UBI ecosystem, so it is easier later to build the analysis. The UBI ecosystem it is formed by the insurance companies, automakers, the telematic solution providers, the smartphone providers, the telecom service and finally the OBD manufacturers.

Insurance companies

Insurance companies are the main interested in evolving and developing new services, and the future is clearly going to be Usage-based insurance. So the roll that insurance companies play in the UBI ecosystem is the one to connect this reality to the final users, its customers. In order to success, it has to manage different aspects.

From one side, insurance companies have to do investigation and innovate in the field while partnering with all the players that the technology requires. For example, they need to adapt to the new on-board systems that automakers are installing in their latest vehicles, develop suitable applications for smartphones that are user friendly and efficient or partner and negotiate with OBD manufacturer companies in order to provide them to the customers and to link their devices to the insurance cloud; a place where the telematic solution providers need to set for the companies.

From the other side, companies need to design and offer attractive products so they attract enough customers and fill their expectations, bringing to them flexible solutions that will bring an appreciated saving when driving and an increase in the safety of the public roads.

So as obvious, insurance companies have the important roll to manage and sell the service. As all profit-oriented companies, their goal is to make the highest profit possible so thanks to this principle the concept of UBI insurance will progress since every company will be wanting to take a part of the cake.

Automakers

Automakers produce the product for which UBI insurance was created, the car itself. But the importance of automakers in the environment is not only because they produce the product to be insured, but because of the technology that the automakers are introducing to the cars. It is said that cars are more and more becoming like smartphones with wheels, and that is the main reason why automakers are becoming more and more one of the most important players of the filed.

In the beginning, when the UBI concept wasn't still out there, cars where basically all mechanical and the electronic parts where very limited. Little by little electronics were gaining space in the car bill of materials. In 1988 a standard was introduced, the OBD port. It was still not compulsory to install to all the vehicles, but it was a starting point. As it has been explained, the OBD port is needed to connect the OBD used for sending all the car data to the insurers cloud. In 1996 the obligation to mount an OBD port in all cars was imposed. The OBD port was first used for car diagnose purposes, but automakers evolved it and made it useful for other applications, such as the connection of an OBD to send data to the cloud as previously said. This has been the most used way to date to transmit data, so the development of the OBD port has been crucial for the viability of UBI insurance.

But in the last years automakers have started new developments that will probably remove the UBI device from the game. Actually, some of these developments are already on the market and functional. We are talking about the digital and online services of the new generation of connected cars. While the scope of this project is to not deeply enter into this topic, it is thought that a brief explanation it is needed. This new service offered in the new cars it is not available in all brands and models. At the time of writing, only the mid/high level range cars have online services included. In the incoming years, though, it is expected to become a new standard as the OBD port was. These online services allow the user to enjoy different online functionalities like controlling the car from an application, in order to for example set the heating on. But one of the characteristics of these online cars that users many times doesn't appreciate but it is very useful for automakers is the constant upload of data from all the sensors and devices of the car. This data can then be sent to the insurance company under a contract made between the insurer and the owner allowing the first to have the data for UBI insurance purposes.

This is a recent example of the power of the automaker in the UBI environment that also give us a preview of the future where all cars will be online and the UBI insurance method will be a reality used in most of the cases. Of course, the long-term purpose of these online cars is the connected cars reality, where auto drive will be provably dominant and the scope of having an insurance will probably be much more different.

Telematic solution providers

Telematic solution providers are a crucial player in the UBI insurance environment. They are the ones in charge of evaluating the data arriving in the cloud, prepare the models while working all the data and releasing the results and evaluation of each user. Usually these are separate companies used to deal with data and statistics, an occupation that is usually not carried by the insurance companies, despite some of the big ones have their own team. So, to enter more into detail, telematic solution providers solve the following insurers problems:

- Collecting data: telematic solution providers are used to deal with great amounts of data and they usually store data not only from insurer companies but other customers. Insurers rely on them since it means a big operational cost reduction and are not ready to receive and store all the data coming from the users.
- Integrating all the driving data: for the insurance companies is not easy to manage large volumes of driving data and then leverage the insights to find the expected demand for all their UBI different services
- Updating risk models: appropriate risk models are very important in order to set the premiums price. Telematic solution providers help creating and constantly evolving these models, thanks to the coding and scientific background. Like any mathematic model based on data, the more data you

have the richer it gets the model since you can reduce the error associated to the variable coefficients or just add new coefficients that helps defining the driving score/premium cost.

- Helping insurance to engage with customers: one of the key benefits of technology and the particular result of receiving so much user's data in particular is the fact that by working on, it telematic solution providers can design personalized programs for each customer profile so it is easier to have happy customers.

So, as it has been seen in the previous points, telematic solution providers are the ones dealing with all the data, the brain making the usage-based insurance a reality.

Smartphone providers

The importance of this actor in the environment relies on the fact that most of the drivers, in order to avoid having to set any device in the car prefer to be monitored and tracked while driving through the phone. That is why phone manufacturers are included in the environment. As many other realities and services being launched these days, most of them gain the customers attention thanks to the link with the phone. In this particular case, insurances can offer many services through the app in the customer's smartphone apart of being used as the tracking device who sends the data to the cloud.

Smartphones rely on the GPS position and the different sensors (like accelerometer, inclination sensors…) to register the data of the customers driving and later send it through the internet. The precision of the data is not as good as the one provided by an OBD port, or the car integrated system but is still good enough to use without compromising the quality of the data. While most of the insurance companies offers the possibility of using the phone as the tracking device, for some specific policies companies may ask the user to install the OBD port due to its highest precision.

OBD Manufacturers

The OBD is a device that it is connected to the car through the OBD port, usually hided near the driver legs. The function of this device is to read all the instant car data and send it to the cloud. While the telematics solution provider might be crucial for the management of the 'invisible' actor, the data; the OBD port is the physical actor crucial for the reading and sending of the car's data. While some could argue that the smartphone auge is killing the need for OBD devices in the UBI insurance field, the truth is that smartphones cannot send as much accurate and diverse data as OBD devices, since they are not connected to the car. The real threat for the OBD producers is the fact that cars are going online and as said before, the trend goes towards fully connected cars where there will not be a need for these devices anymore.

To conclude with this point, in the following table it can be seen the previous information that has been explained with a bit more of detail:

Dedicated Telematics Device (OBD or Wired) with Cellular Connectivity	Telematics Device with Bluetooth connectivity to smartphone	Pure Smartphone + Optional BLE Beacon
Key Features • OBD Dongle plugs into the OBDII port of Vehicle. Wired GPS Device is installed with connection to vehicle's power • Built-in GPS, GPRS and sensors enable location tracking and driving behaviour monitoring	**Key Features** • OBD Dongle uses BT connectivity to send data to Driver's smartphone. • Optionally, Device has memory to save trip data in case phone not present	**Key Features** • Uses Driver's Smartphone's Sensor and GPS Data for Driving Behaviour monitoring • Optionally, uses a BLE beacon in vehicle for detecting presence in Insured car.
Pros • Works without User intervention. • Accurate logging of Trip information. • OBD devices record internal car data for connected car features	**Pros** Medium cost solution combines accurate Distance and Driving Behaviour including Distracted Driving.	**Pros** **Low cost and scalable** as no dedicated Device required. Measures Distracted Driving.
Cons **High upfront and Operational Cost** : Initial fixed cost for the Device and ongoing cellular data connectivity costs. Cannot detect Distracted Driving	**Cons** **Medium upfront cost for the Device but lower operational cost.** Works in co-operation with Driver to enable BT connect.	**Cons** Works in co-operation with Driver. Does not record trip in case the Driver doesn't have the App installed or required permissions not given
Target Segment ▪ Car owners who need Tracking / Anti-theft ▪ Commercial Vehicles (Passenger and Goods) ▪ PAYD/PHYD for Mid to High end Personal cars	**Target Segment** ▪ PAYD/PHYD for Mid end Personal cars ▪ Combine UBI with other value-added services like car servicing	**Target Segment** ▪ Mass market UBI for both 4W and 2W ▪ PHYD and Reward how you drive models ▪ Certain variants of Pay-as-you-drive model

Source: Telematics wire

Table 11: Comparing telematics technology options for UBI

Analysis phase

Until this point the introduction to the topic has been done. It has been reviewed the history of the insurance industry and big data. Then it has been explained how these two concepts can be combined to deliver better results, and a particular product that it is forecasted to be the future has been presented, explaining how it works and all the implications.

In the following points it will be made different analysis in order to determine whether usage-based insurance has a future in the industry and the main difficulties will be explained.

It is important to note that these analyses have been written following the methodology previously explained and it is the first document that takes all the information available on the internet and synthetizes the important points. After this, I have applied a critical point of view and my knowledge taken from experience and subjects like innovation, project management or similar to give the reasons and outcomes of every particular situation.

6.1 SWOT analysis

In this chapter it is going to be developed a SWOT analysis of the UBI model. After all the previous points in which many realities have been presented, it will be useful to conglomerate all of them in what it can be called the strengths, weaknesses, opportunities, and threats of this new insurance services.

Strengths

One of the strengths of this new service is the creation of better models for pricing: they are more accurate, not subjective or based in old parameters and data backed. This helps the insurer to make sure he is not risking to much the margin associated with their products when setting low prices and helps the user knowing he is paying a fair price, usually lower than the price offered in the old-fashioned way.

Another strength related to the data founded technology, is personification. Nowadays this term is more and more used to attract new customers and has been linked to modernization of the products. And in this case is not an exception. Customers can be attracted to the fact that the premium to pay depends on him and does not have to pay to compensate for others bad driving.

Moving to the insurers side, the company is interested in these products not only because it is directly beneficial and it is a must for not running behind the market, but also for the amount of data they can collect and use for other purposes related to their business. It is said data is the black gold of this century and by offering these products the insurer is granted a huge amount of data.

Weaknesses

One of the main weaknesses is that this product it is still a voluntary one. This is, moving the insurance policy to a UBI one means that the user must make the effort to sign a new contract and set up all the environment to start running the new service. In the particular cases of less modern cars the OBD must be fitted, or an app has to be downloaded and turned on every time the user drives the car. This can stop many people to move to this system, particularly in those countries where insurance policies are already low, so people prefer to not be bothered or for the customer segment who is not very concerned about the price. It is well known the typical case in which another company offers you a better product for a better price, but one does not accept just by thinking all the discomfort a process of changing something can generate.

Linked to the previous point, there will always remain some users which will prefer the old-style insurance policies. As long as some companies still offer insurance products based on the old ways transition to the new model will be harder. One important point backing the reluctance of some users to adopt this new modality is the fact that many will not like the idea of being tracked everywhere they go by car.

There are two weaknesses related to the data. The first one is the fact that since this modality is still in development, the models that define the driver's score are still

unfinished, in the sense that they need to be perfected. This is partially a weakness since time will solve this problem, partially. The second weakness cannot be solved with time. As it is known, models can get very closer to reality, but they will never be able to predict reality, and it get particularly harder when talking about car crashes. This will leave the insurers exposed in the few cases where these models can fail and not be able to face a particular unexpected situation. In any case, for these situations there exist the reinsurances, which duty is to protect insurance companies from this problem.

Opportunities

Some opportunities that are already a reality in some regions are linked to the proved contribution of these services to an increased safety in roads and greener driving. Since the insurance sets a price depending on your driving and there are personalized tips for a safer and more efficient drive, the user feels the need or the convenience to improve the driving in order to meet a higher driver score and benefit from a lower insurance price. Thanks to this, governments are promoting this policies and associations defending a greener world are also supporting them.

Another opportunity is the fact that this is a techy product, and newer generations are likely to embrace them. Another helping point is the fact that newer generations don't have the barrier of having to change their premiums: since they are new in the market, they can start from their first day of driving using a UBI product. Another extra point for young generations is that, as explained in the paper by Miremad Soleymanian: '*Sensor Data, privacy and Behavioral Tracking'*, younger generations are the ones who benefit the most from this product since they will easily adapt to the tips given by the insurer in order to increase the driving score.

The last opportunity is again related with the future. As explained before, cars are continuously improving, and the next generations will all have internet connection. This connection facilitates enormously the adoption of UBI services since the user does not have to do anything, just give the permission to connect the car data with the insurance company database. As an example, Tesla is already offering his UBI service in the same process of purchasing a car, without the need for installation the equipment since their cars are already sending lots of information to Tesla's database.

Threats

The main threat that will and actually is already starting to face is the privacy concern. This topic is very present nowadays and has a lot to do with UBI services. As an example, the GDPR privacy policy was recently ruled in Europe and other countries have followed. The fact that the car is sending constantly the information of the user to the insurers cloud opens the debate of whether this modality has to be restricted in some way or not. As an example, in the state of California car insurance companies cannot get all the data they want as in the other states, just mileage and a few other things. This regulation

was ruled to protect users from insurance companies using personal data for other purposes like selling to third parties.

So, to conclude and to concretize, the main threat UBI services are facing is the possibility of further regulations limiting the use of data that could harm all the potential this new modality has to offer and the adoption form users.

6.2 Porter's analysis

This analysis will be done in order to understand the main competitive forces at work in the Usage-based insurance environment. One of the points that this study will help to measure is the attractiveness of the market, that alongside with the rest of the studies and all the information exposed will help in writing the conclusion and forecasting the future of data in the insurance industry. The Porter's analysis goes through the study of different points which are the bargaining power of suppliers, the threat of new entrants, the threat of substitutes, the competitive rivalry, and the bargaining power among suppliers. It has to be said that all these points will be faced from an industry trend point of view and not a company point of view.

Bargaining power of suppliers

Usually, insurance products never depend on suppliers, but in this case it is different. In the UBI methodology, since it relies heavily on data there is the need of software and hardware in order to collect and process all the information. This fact makes it rely a bit on suppliers. The exposure and the 'power of suppliers', though, remains low. Suppliers in the UBI segment could be categorized in two: tangible products and non-tangible products.

On the tangible side we have the suppliers of the hardware needed for transmit the data to the insurers cloud: the OBD devices. These devices look like a brick made basically to be connected in the OBD port under the steering wheel and their function is to read all the information delivered by the car and send it via Bluetooth to a phone or via Wi-Fi to the insurers cloud. It is a very basic device, and it cannot be said that suppliers have a lot of power to negotiate. Since the product it is not very complex almost any electronic manufacturer can produce it. In the long term this product will become unnecessary since the new cars already emit all the trip data via Wi-Fi to any server without the need for any particular device. Usually, the suppliers of OBD devices are more focused on the devices that are also connected in the OBD port but used to diagnose the car when, for example, taken to the workshop to fix an issue with the car. In fact, the OBD devices where first created for this purpose.

On the other side, there are the providers of non-tangible products. These non-tangible products consist of all the software needed to process the data. This software in the

majority of the cases is not developed internally by the insurance company. The most common procedure is the company subcontracting an IT company that works on all the processing and analysis side. Since the UBI modality is still departing, the subcontracting of these companies can be a bit expensive and there might not be many interested in developing the software for this new modality. But as the time goes by and UBI insurance becomes more generalized the rates should go down and so the power of bargaining of the providers of this IT services.

To conclude this point, it can be said that suppliers should not difficult the expansion of this new trend as their power is limited and the provided products are not difficult to find in the market.

Threat of new entrants

This point, due to the scope of this analysis, will be faced in a different way than if it was an analysis made by a company. In this case the question would be: can the irruption of new entrants become a danger for the future of the Usage-Based Insurance concept?

For answering to this question there is the need to understand first how the small new companies/start-ups enter in the business of the insurance world. These small companies entering in the business all follow the same pattern. They are all techy start-ups trying to find a space where they can exploit their novelty. As it happens in many other industries, these start-ups end up dead or being bought by the big insurance companies. The big insurance companies keep a close eye on these start-ups since they know the future of insurance business goes to personalized products powered by data but are too big to make any changes and bother the investors. They transformation is done by buying small successful start-ups that bring new ideas to the portfolio of the big insurance companies.

So, answering to the question, can new entrants be a threat to the expansion of usage-based insurance? The answer is no, in fact it is a healthy symptom. The more start-ups entering to the business the faster this new modality will grow for many reasons. On one side, these start-ups are the one evolving the usage-based insurance products so making them more mature to penetrate the market; and on the other side big companies will see how these small companies eats their customer base and margins so they will feel more and more the urgency to switch to usage-based insurance.

Threat of substitutes

This point fortunately should be started with the notation that the product itself is already a substitute in some way of the traditional insurance product. The threat of substitutes as a result it could be said that is quite low. In fact, having done a market overview and having studied the different products offered worldwide, it is more likely that usage-based insurance is left for an improved evolution of the same than for a new product substituting the UBI one.

At the same time, the lack of potential substitutes can harm the speed of development of usage-usage insurance. This can demotivate insurance companies to enter in the race of being the leaders.

To conclude this point, it can be said that usage-based insurance is very unlikely to get harmed by the apparition of substitutes.

Competitive rivalry

The competition in a market it is usually seen as a positive factor, but it can lead to just the opposite. This is because in the case of a strong rivalry usually companies take strong actions in order to make their products more attracting. And this usually is achieved by price cutting the portfolio, high marketing expenditures or high spending on service innovation and improvements. All this measures, while might be appreciate from a customer side, limit the profits, and puts in danger the future of the business.

In the case of the insurance business, historically has had high levels of margins. At the same time, there is generally a healthy environment, economically speaking, of numerous companies but with certain taking the role of leaders so there is not a particular fight for a take in the market. In any case, since it is being studied the UBI modality at a worldwide scale, this should be studied region by region. This 'static' healthy environment has historically led to a slow industry innovation evolution. But the rate of this evolution is not only due to the 'healthy' established environment but also due to the particular service offered. Since usage-based insurance can make a significant change in the industry, the methodology is evolving in a fast way considering the slow rate of innovation previously mentioned.

To finish, as just reviewed it can be said that the status of the rivalry in the industry it might not be the best one due to an established comfortable situation of the big companies, not willing to risk their income while it keeps flowing in a good shape. In any case, even if the situation is not the most favorable the UBI insurance is making its way even in this situation and it is expected a growth that will consistently increase in the next years.

Bargaining power among buyers

The bargaining power of buyers is the pressure that a customer can put on the insurance business to get it to provide higher quality products, lower premiums, and a better customer service. In this case, the power of the buyer on deciding to have another modality insurance.

From the insurance business side of view, it is always a win because by law a user of a car has to contract an insurance. But, how much a potential customer can 'play' with the insurer in order to get a lower UBI premium? Well, here the competitor is found inside the same company, and it would be mainly the traditional premium. And the answer is: potential customers has very low bargaining power towards UBI insurance. Why is that?

The reason behind the previous affirmation is the fact that by definition, UBI insurance is less costly than the traditional insurance. This makes very hard for a user to decide to take a traditional policy rather than a usage-based policy. While it is true that in some cases usage-based insurance could be more costly than a traditional policy, these are a minority.

Another point to add here is the fact that if this new modality becomes the new standard in the industry and the traditional insurance policy disappears, the bargaining power of the customer will be reduced to zero since it is obliged to contract an insurance policy and it will be the only option in the market. Of course, before this situation arrives it will take some time.

So in conclusion, customers are unlikely to get a different insurance product than UBI if they value only factors that are taken into account in the Porter's analysis. There will always remain the fact that some customers will prefer to pay more in order to not having to send their driving data to the insurance company.

Porter's overall result

Having explained all the different points and seen the reasons why every porter's force can help or difficult the expansion of usage-based insurance, let's now see what it is the outcome of the study.

It can be said that overall, the situation is very favorable for the expansion of usage-based insurance. There is not a single point where there is a notorious threat that could remove usage-based insurance from the map. On the downside, the characteristics of the industry where this product is found, as seen in two different previous points, will make the expansion a bit slower than an innovative product in a different industry probably would. Having said this, in order to give a general outcome this analysis has to be combined with others, like the Pestel analysis that will be also done, in order to see the whole picture.

6.3 Pestel analysis

Another tool for studying a viability of a project is the Pestel analysis. This tool is widely used when a project has to be launched or in the innovation filed. By going through a Pestel Analysis a potential investor can realize if different external situations will be in favor or against the project to be launched. The points that are included in a Pestel analysis are the following: political, economic, social, technological, legal, and environmental. Let's now confront the usage-based insurance service to these different points and see if they can help or not to establish this method as the predominant in the future.

Political

This point is the most ambiguous since some governments might want to help the expansion of UBI insurance while others might be a bit more hesitant. Let's first review why politically talking UBI services can be helped from a political side of view.

The main reason that has some governments pushing for the implementation of UBI insurance is the benefits that this system can bring to society: as previously mentioned the use of this method increases the safety in the roads and carries benefits for all users. If a government sees these points as beneficial for their citizens, it will try to help implementing the new service. As an example, many countries in Asia are adopting this position.

On the other side, governments can be concerned about giving so much private information to non-public companies. While without having the law on their side they cannot do a strong opposition, some of them will look for a space in the regulatory side to try to minimize or limit the expansion of UBI insurance as it has already happened in California. As a recent and anecdotic example, there was not so long ago a confrontation between the government of California and Elon Musk, that will be better explained in the legal part.

Economic

From the economic side there are many positive indicators. Let us start with the most general.

The car market has always been very strong, and the forecast is that the number of cars sold every year will keep increasing. While it is still uncertain which will be the fuel for the car of the future, the tendency in worldwide car sales is clear. This means that the higher the number of cars circulating the higher demand for insurance products, being UBI insurance the most likely to take the lead in the new car insurance products. Economic growth in the long term also will help emerging countries to have access to a car and thus helping maintain this positive tendency in car sales.

Another important point is the fact that globalization will help not so advanced countries to catch up in this new modality. This is a point that it's already happening since as explained previously, many countries from Latin America and Asia have the highest potential of UBI policies adoption.

Another point is the increasing cost of life, which makes every time more and more customers to look for different ways to save money. And as stated before, the selling point of UBI services is the possibility to lower the insurance policy cost only by adopting the new method. While it is true that not all participants in this new modality will get a discount in their policy, the truth is that most of them receives it. In fact, there are companies that only by contracting an UBI policy guarantee that the policy price will decrease whatever is the driving style. And looking from the other side, it is proved that

the UBI modality does not only carry a saving for the user but also for the insurance company.

To conclude, it can be said that from an economic perspective the future for UBI insurance looks bright.

Social

On the social side, the biggest point with which UBI insurance will have to fight is the expanded idea and realization in society that data should be private to everyone and rarely shared. The fact of letting the insurance company get a detailed look at one's driving behaviors is not always welcome by users. According to a 2021 Telematics Consumer survey made by Arity, a telematics provider, how driving data is used or shared was the top concern, with a weight of a 35%.

Also, according to this survey, more than two-thirds (34%) of survey participants were also concerned about driving data being fairly assessed. On the other side, some respondents (31%) were worried that a Usage-Based Insurance using data could increase their car insurance rates. About a quarter of respondents thought it would be too much of a hassle to participate (25%) or would not result in enough savings (24%). So as stated before, there is still some marketing to do in this field.

On the positive side, the improve in driving is notorious when entering in one of these programs. This has been confirmed by different studies. Thanks to this fact, drivers can feel better also thanks to the fact of a reduction in sinistrality in the roads and moved by the saving, they can socially start doing passive publicity while explaining how satisfied they are with the service and price reduction.

To finish, the last social positive factor is that there is a constant rotation of old drivers giving up driving and new young drivers starting to drive. This logic rotations implies that socially speaking there will be a constant flow of new customers that usually are more likely to adopt this insurance modality in exchange of old people that not easily would switch to this modality.

Technological

Generally speaking, in all industries that offer products to the customer, there is the new trend of offering tailored goods through the implementation of modern technologies. The insurance sector is not an exception, and the technology development will continue to help pushing this new modality. In a similar way, there is also the trend of the so called 'pay-per-use' and usage-based insurance is the perfect example of a product of this kind.

Another technological point that can help expanding the UBI modality is the standardization of connected cars. This is, the fact that nowadays most of the new sold cars have already connection to the internet and are sending constantly information to

manufacturers will facilitate enormously the adoption of UBI insurance since it will no longer be needed the use of hardware to send the data to the insurance company. Actually, some car brands are taking advantage of this tool and are already offering their own insurance services. This fact will push the global implementation of UBI insurance since it removes one of the customer's barriers to adopt this modality.

In the very long term, the evolution of connected cars could become a problem for this modality. The future of the connected car reality is the autonomous driving boosted by the cars sending information to the others in the environment. The faster this evolution arrives, the less UBI will make sense since the autonomous vehicle is set to change drastically the insurance industry. Having said that this reality is still far away and will not disturb the implementation of this new modality.

To finish with the technology side, another positive point is the fact that the IT companies behind the models that define the driving scores are in a constant loop of improvement. As any mathematic model, by running it regularly the modelers can be refined by adding variables and modifying values.

Legal

This is the trickiest point in this analysis and as later will be discussed more deeply, it is the main point that could slow or limit usage-based insurance. Let us start with the good news.

On one side, there is the determination of some governments, particularly in the Asia region to promote this insurance modality. This is still a political argument, but that could become legal if regulations start to rule out in favor in those countries. India could be a recent example, ruling out the free expansion of usage-based insurance.

On the other side, in most of the developed countries where UBI insurance has already been launched many concerns are being raised towards the privacy of the data generally, being ruled some regulations like the GDPR in Europe or CCPA in the USA. Apart from these well-known regulations, there are also the consumer protection law, which could be applied in these cases. Recording personal data entails many risks from both the insurer and user sides and the last queries to the law sector has been the restriction of the usage of the data so it is not used for another purposes. To understand the dangers for the user, recording the location of a user could be telling a lot from somebody, for example when it is recorded that a user often passes by certain clubs or the hospital.

On the other side, many insurance companies are making extra money by selling location data to other companies, so they provide personalized adds of the area. The ban of this last point should not affect the future of usage-based insurance,

Environmental

The last point in this analysis belongs to the environmental side. It is clear the world is trying to become greener so the question is, how can this help to expand UBI insurance? To answer to this question, it will be first mentioned that in a study made by Miremad Soleymanian and Charles Weinbergpresented in the document 'Sensor Data, Privacy, and Behavioral Tracking: Does Usage-Based Auto Insurance Benefit Drivers?', it is stated that UBI improves driving behaviors in many ways. Taking literally from conclusions it can be read: "Our empirical results show that UBI customers improve their driving behavior by increasing their UBI scores by 9% and reducing by 21% the number of daily hard brakes, which is an important factor affecting the occurrence of accidents". So, how is safety in the driving linked to environmental? The truth is that by driving safely, it is being consumed less fuel. For example, by reducing hard braking there is less fuel burned uselessly.

So the dominant thinking of caring about the environment can help promote this modality.

7. The main risk for usage-based insurance: future regulations

Now it is going to be analyzed one of the main threats concerning UBI insurance services. It is a problem that it's already affecting the industry but has a great potential to future harm the expansion of UBI insurance and slow or limit it.

The threat is originated in the fact that all data must be very carefully managed and nowadays it is subject to many regulations. UBI services are based on data. Without data this new modality has no sense. And these days society and governments are very aware of these problems and these last years many regulations have been released in order to face this problem. Furthermore, the risk is not only linked to a strict legal point of view but also from a social point of view: users are every day more concerned about their private data been used by profit companies.

Before entering into the legal field, let's understand the risks behind a system based on data store and analysis.

Risks for the user

The first risk that come to the mind related to data bases are the ones of data breach, misuse, and fraud. This concept does not only involve the fact of a third-party stealing users' information from the insurers data base but also the unauthorized use of this data. This is, the non-agreed use of the data to know more about facets of consumers´ lives, including sensitive data concerning the customer's habits, location, or financial status. Another risk is the quality of the data taken by the devices. Despite this is not the most serious problem, it is the one that concerns the most the users.

Another category concerning the risks for the user it is the so-called financial exclusion that it is usually related to data-backed methods. The problem relies in the fact that the more information a company has about an individual, the higher the probability that particular users are being discriminated. Like for example, a driver which drives in a very risky way and insurance sees that on data might be not allowed to contract an insurance or if so at an extremely high price. Another risk of this data-based method are aggressive targeted marketing strategies or campaigns targeting the users.

To finish and related to the previous risks but still different, is the fact that the abuse of data privacy can lead to use the data to understand consumer's price sensitivity that leads to the use of price optimization practices that could lead to unfair treatment of some groups of customers. For example, by law it is not allowed to discriminate by gender but by using illegally the data the model could indirectly find a gender difference and start pricing this difference. This is possible especially when combining powerful algorithms such as AI/ ML to identify patterns in data: these algorithms are known for having the capability to find and discriminate classes in training data. As said before, this could increase the risks of unlawful discrimination if there are no adequate governance frameworks in place.

Risks for the insurer

On the insurer's side, there is always the risk of data security and privacy. If the company does not take care of it, it could incur in regulatory fines and sometimes a worst consequence which is the reputational risk in case of breach or data being stolen.

Linked to the previous risk is the fact that companies might be subject to future investments due to new regulatory requirements to make sure the customer's data is never falling into the wrong hands. This can not only mean a higher expense for the company but also mean the need of changing IT systems if the new regulation changes the information flows or any procedure.

So while it might seem that the data privacy could be only an issue for the user, the truth is that it can affect more negatively the insurer side if not well managed.

Having seen the risks from each side, let's now take a look at what really has the power to block the expansion of UBI insurance services: the future laws and regulations still a bit uncertain at this point.

To present this topic let's start with the already mentioned discussion between the California insurance commissioner and Elon Musk, which states very clearly two different positions that might both seem very reasonable. On one side Elon Musk said in the 2021 Tesla earnings meeting that the state of California should change some regulations and they as a company where openly pushing for it. In their own words: "So I think the current California rules are contrary to the best interest of the consumers in California and should be changed". It should be taken into account that California is the

only state in the US that limits the amount and variety of information that an insurance company can acquire from a user. California regulations are not forbidding the UBI method but limiting the capabilities by only letting the insurance companies get limited data: like number of miles driven. But for example, localization is not allowed. In the California's Insurance Commissioner words: "We have allowed vehicle data only to determine actual miles driven, and only in a way that protects the driver's privacy." Lara, the name of the commissioner defended that the state upholds and implements consumer protections outlined in voter-enacted Proposition 103, which has been active since 2009.

Both positions seem to have their more than respectable points but when looking worldwide, which position will be the dominant? Will this make actual privacy regulations more restrictive? If the answer were that regulation it is going to change for a more restrictive reality, this project wouldn't have so much sense because it will mean the death or at least the killing point of its growth. But the probable future scenario will be the free use and exploitation of this modality with regulations controlling that the data is never exposed or used for other purposes.

Let's review in the following lines what are the current regulations affecting UBI insurance services in Europe and the USA.

In Europe the most known regulation when talking about private data is the recently instituted law known as the GDPR. This regulation made it compulsory to ask permission every time a company was using data taken from the customer. This introduced some bureaucratic stuff to be done before applying for UBI products, making them more attractive. After some time, it was ruled for UBI insurance a different procedure. Nowadays the agreement for been tracked is implied when signing for a product but the user has the right to anytime be able to deny the use of his information. The consequences for this were that a traditional insurance product has to always be available for the user, just in case he denies the share of his information.

In the USA the situation varies depending on the state. In that region, the equivalent to the European GDPR is the CCPA. The main problem is that each state has its own laws and regulations regarding automotive usage-based insurance. This can complicate the process of implementing these types of insurance policies, as different states may have different requirements. For example, Illinois has regulations for pay-as-you-drive (PAYD) plans but does not have clear regulations for pay-how-you-drive (PHYD) plans. This inconsistency can create operational challenges for cross-state fleets, as different states may have different requirements for automotive insurance. For example, Illinois requires carriers to advertise their underwriting models, while California has limitations on product pricing parameters. These inconsistent requirements can force insurance companies to provide innovative products and services that comply with regional regulations, leading them to expand their overall product portfolio. The regulatory framework for automotive usage-based insurance often favors lower premiums for

good driving behavior. However, uncertainty around regulations and legislative environments can restrict the growth of the usage-based insurance market for automotive.

So it can be said that one of the main risks is the ambiguity over regulations and legislative Environments.

On another side, another future problem is the fact that by law, generally in all developed countries, an insurance company cannot discriminate by gender, for example. And if there was a different behavior when driving between two genders, data would spot it and price it accordingly. By doing this it would be acting against this law.

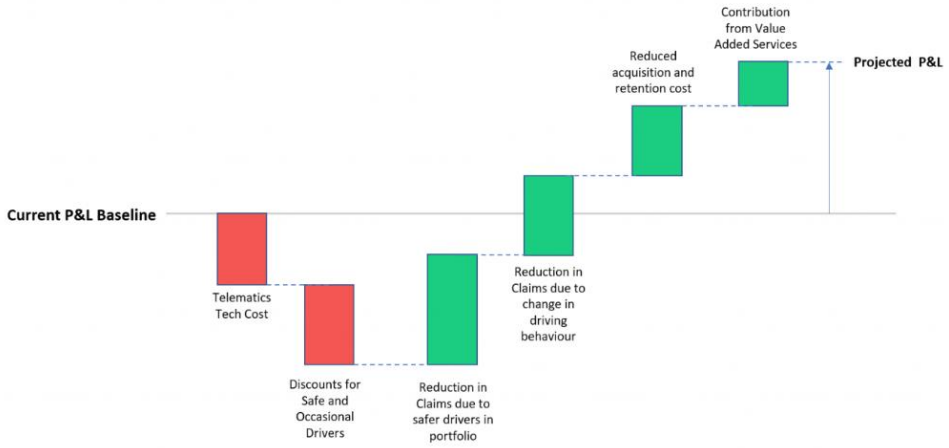
8. How insurance companies can have profit if all insurance premiums are discounted?

So far, a study and analysis of different strong and weak points has been done. But if a conclusion of whether the technology will go far away or fall in disuse is highly correlated to the fact that this new modality has to be profitable for the insurance business.

Arriving to this point, one could ask himself where the benefits are economically speaking for the insurance companies. If all the usage-based products are offered with a lower premium rate as one of their selling points, it is fair to make the question of how insurance companies can benefit from this new modality if they will consistently earn less per customer.

After having done large research on many papers, insurance pages and the internet, the best explanation that can be given is the following. The first step that has to be done is stating that some companies, in the first days of this new modalities, were using and selling some non-sensitive data for the purposes of personalized marketing and others. This was an important source of revenue, but it was closely followed by some regulations that restricted the use of the data to only pricing purposes. It can be said, though, that in a small number of countries where regulations are not so developed some insurance companies still use the data for these purposes and get profit.

But as said, companies in most of the countries are banned for the use of the data for purposes different to the data processing for the driver's risk score. So, back to the question of how insurance companies can make profits if the premiums rates are discounted from a traditional premium rate, it can be affirmed that Insurance companies nowadays are obtaining good margins thanks mainly to a reduction in claims and retention costs. The following table states clearly what previously exposed:



Source: Telematics wire

Table 12: Cost and profits stack for UBI insurance

As it can be seen, on the negative side increasing the costs for the insurance companies there are:

- Telematics tech cost: there is the cost linked to the data-based methodology. This is, on the hardware side, there is the need for an OBD device or similar. On the software side, there usually is an app for the user and of course, the telematics company that analyzes all the data.
- Discounts for save and occasional drivers: compared to a traditional insurance premium, most of the insurance companies are selling this methodology saying that the premium price will be reduced. The amount always depends on the driving. As an example, a user that used the car only a few times a year and now has applied for a usage-based insurance, the discount could be as big as a 40 per cent. Of course, this is an extreme example, but it shows the fact that insurances are less likely to make profits if we focus only on the premium price.

But on the other side, all these increases in cost get neutralized by the following cost reductions and contributions:

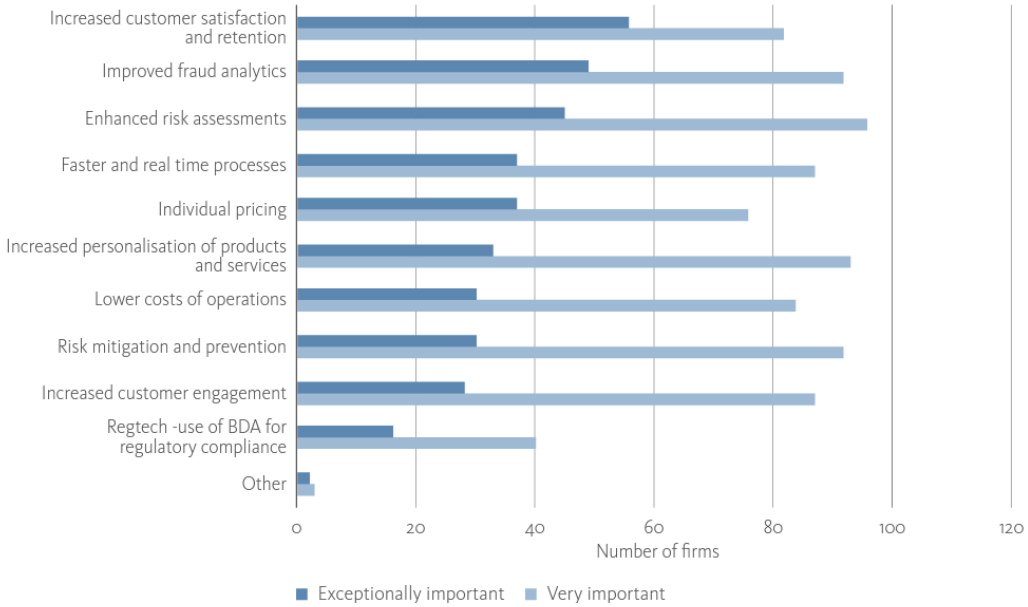
- Reduction in claims due to safer drivers in portfolio: this first point can only be applied while this methodology is starting and getting its first users. The reason for this is that once it spreads and ideally is taken by everybody,

drivers risk average will be the same when beginning. But in this actual stage, it has been proved that users with a lower risk are the first ones to take these new policies. It makes sense since the ones aware of having a more dangerous driving style will keep far from these services in order to avoid being charged a higher price for the insurance. So insurance companies are seeing that even if the discounts are in some cases generous, the ratio premiums paid/incidents has been increased favorably.

- Reduction of claims due to changing in driving behavior: as it is verified in the document by Charles Wienberg '*Does UBI benefit drivers? ',* the users of UBI insurance make a positive progression when driving under a UBI premium. This is mainly because two reasons. The first one is that users will have an extra motivation to drive in a safe way, so the insurance company charges less. The second one, is that when the driver score is not the highest, insurance companies communicate the driver different advice in order to let him drive more safely and improve the punctuation. All these points help improving the driving of every user of this methodology, which means less claims for the insurer.
- Reduced acquisition and retention cost: one of the good points of this new modality is that since it is a very innovative product, marketing efforts can be easier. Another help in the reduction of the costs is that the users are very satisfied with this modality since they see their policies premiums discounted. This makes retention costs a lot lower than in the traditional insurance products.
- Contribution from value added services: this kind of product helps insurance companies to introduce new customers to other products.

Concluding this point, it can be seen that from a starting point the insurance companies incur in higher costs but as the product follows its path insurance companies end up making the same or higher profits than when commercializing the traditional insurance policies.

To complement the previous information, in the following table it can be seen other benefits of UBI insurance that contribute to the business and help explaining the previous points.



Source: EIOPA BDA thematic review

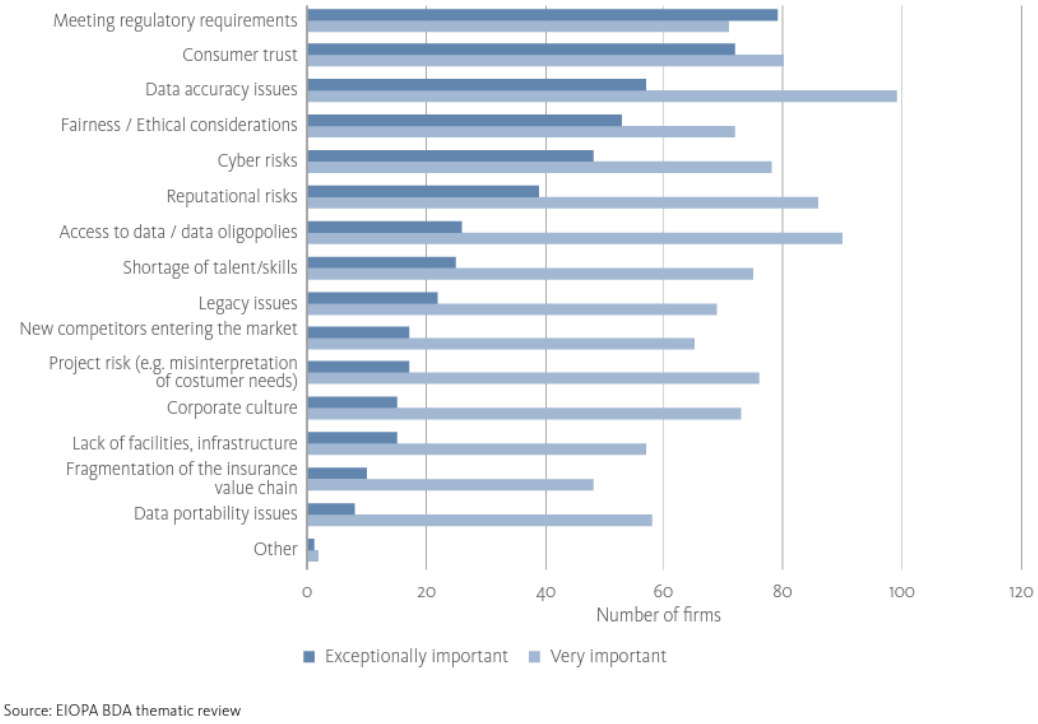
Table 13: UBI opportunities according to insurance firms

As it can be seen in the previous graph, according to the EIOPA study, firms confirmed that increased customer satisfaction and retention is the main gain using UBI insurance, one of the previous points that help increase margins to the insurance companies.

Now that it has been concluded that from an economic point of view this new modality is beneficial for both insurer and users' side, in the next point it is going to be reviewed other challenges that insurance companies face.

9. Main challenges for insurance companies when adopting UBI

As seen in a previous point, the future regarding regulation is the main challenge for usage-based insurance. But is it the only one? Until now with the different analysis it seems that the future for usage-based insurance is bright and clear, with the risk of future regulations, but before entering in the conclusions part of the study, let us put together and review the other challenges. The list, that can be seen below, comes from a recent study carried out by the EIPOPA, European Insurance and Occupational Pensions authority:



Source: EIOPA BDA thematic review

Table 14: UBI main challenges according to insurance firms

In the first position it can be seen the already discussed topic about regulatory requirements.

But closely followed it can be found the problem of the consumer trust. The reality is that nowadays there are still a lot of drivers reluctant to being tracked wherever they go. As said before, this problem it is expected to become minor with time since the more reluctant users are the older ones and an improvement in the control of the purposes of that data.

On the third place there is the problem of data accuracy issues. This problem is no longer present in the most modern vehicles since they have advanced systems always connected to the internet. So, this problem appears when it is used any kind of device for sending data to the insurance company. It is usually the phone which provokes the larger number of headaches to the insurance companies. The reason it is because smartphones, while having many sensors used for creating all the data sent to the insurer, were not created for uniquely measuring and sending this driving data. Of course, the solution would be using the OBD device since their only function is to read and send data. But the use of smartphones is helping to penetrate the market since nowadays everyone has one and it eliminates the incommodity of installing and setting up the OBD device. It also helps saving money to the insurance companies that doesn't have to provide the user with any hardware, just an app for the phone. So at this point insurers have to decide between the incommodity and inconvenience of providing an

OBD device, making more uncomfortable to the user the procedure to contract an usage-based insurance policy but obtaining reliable data, or accept the reception of some packs of unconcise data. So far, the measures insurers are taking are the improvement of this data reception when using the phone and creating efficient procedures for when this data is erroneous and has to be processed to find the driver rating.

The following three points are somehow related between them. The first one, which is fairness/ethical considerations, is related to the storage and use of the data, which sometimes can reveal a lot about a user's life. These considerations are strongly related to the danger of the next point. The next one, cyber risks, is an obvious risk very present nowadays in all companies managing data. The fact that we are all connected and so dependent on the online world has made that cyber-attacks for stealing private information are more and more often happening. The last point is the consequence of the latter, the reputational risk. The truth is that a flaw in the system could make data accessible to unwanted people, and if that happens it could strongly harm the reputation of an entire company leading to great economic and reputational losses. Since the usage-based insurance modality is still not totally expanded, some companies are waiting to the last minute to jump into the UBI train in order to avoid this risk that could put in danger not only the car insurance department, but all the rest of the company.

So this are the main challenges that the insurance companies are facing these days, and due to the fact that this insurances manage high amounts of data, all of the most important are related to the management of it and the impact on the customer. These points show the importance of all the topics regarding data privacy that will have to be taken into account when writing the conclusion and the future strategy to follow.

Conclusion phase

After having seen the outcome of different analysis and having analyzed each problem, it is now time to take all that information and put it together in order to define what will be the future of the usage-based insurance.

Since the intention of this TFM was not only to forecast what is the future of usage-based insurance but also to determine what will be the future of data in the insurance industry, a point about the global industry future will be added in order to apply what learned until now to all the industry, since it is heavily linked.

10.1 Results from analysis

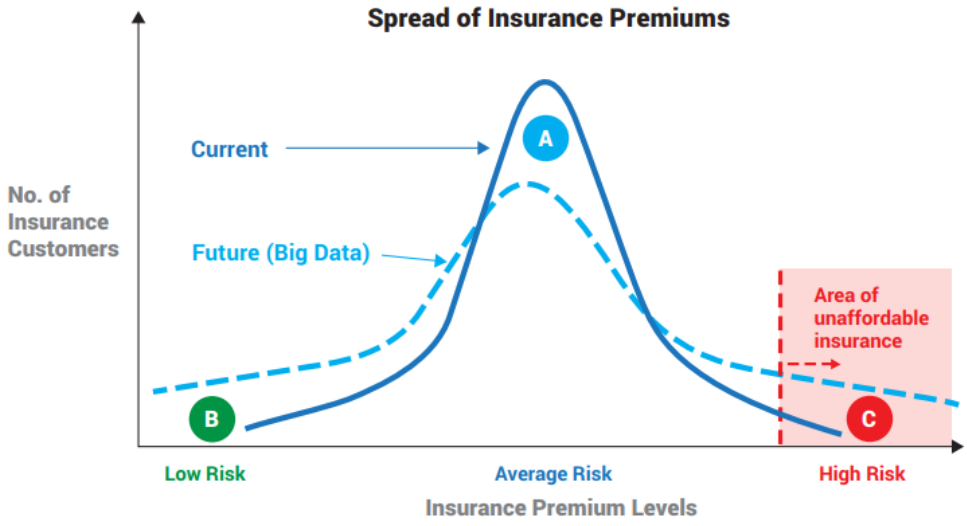
Having finished the analysis phase, it is now time to write down the results that will eventually lead to the conclusion.

The first analysis carried out has been the SWOT analysis. The results of that analysis are a clear mix typical of an innovative product. While there are many positive factors that shows a bright future for this modality, there are still potential threats and weaknesses that if materialized could harm the expansion. Examples of this are the data privacy concerns, the resistance by a particular segment of users to switch to this system or future regulations.

Moving to the Porter's analysis, the outcome can be said that is very favorable. The particularity of auto insurance and the business methods, makes Usage-based insurance a clear winner when performing the analysis. There were no particular power's that can play with the insurance providers and that is very positive for the companies in order to have an adequate progression for the business.

The Pestel analysis helps forecasting whether the actual external situation will help the expansion of UBI or not. And the results showed a mix of positive outcomes but alongside the particular danger of the legal environment. Politically and Social speaking, the results are mixed. They both have some positive and negative aspects. Overall, these two environments are favorable to the UBI growth. On the Economic and Environmental side, there are no problems impeding the growth and actually these can help expand the business. To finish, as it has appeared already many times, the legal environment could present some future problems.

All in all, one of the effects most likely to happen is a new distribution of policy prices thanks to the personalization level that will be reached because of the data-based feature:



Source: Insurance Information Institute, 2019

Table 15: Spread of insurance premiums

10.2 Conclusion

In this study it has been first presented the story of two realities that are expected to have a bright future together: Big Data and the Insurance Industry. And while in the first pages it has been introduced these two topics, right after it has been explained all the possible applications that come from the mix of both. They are all very promising and some of them already very expanded and showing remarkable results.

Right after that, it has been focused in one of these applications: personalized service and pricing, and in particular, Usage-Based Insurance (UBI). Compared to a traditional insurance premium, UBI relies in data generated from the driver instead of the old method of risk pooling. And it is forecasted that the next years will grow exponentially, similarly as it has been already doing for some years. And this growth will be present in all regions, with the only difference of different growth rate and potentials.

Once the topic has been presented, we have explained how this new modality works and all the actors involved in the system. From that part, it can be concluded that while the system and the steps in the UBI system processes are pretty simple, the reality behind is quite particular. Where data is present, it has to be really taken care and found good models for delivering the right score for the driver that satisfy the business income demanded by the insurance companies.

Then there is the analysis part. The conclusions of this part are the ones more interesting and in line with the objectives of this study. From all the different analysis it can be concluded that:

- This new methodology is a data based innovative product and it follows the typical pattern of development of these products with the positive exception of none or very minor financial losses.
- It is a non-disruptive new modality with a current customer category set between early adopters and early majority.
- The environment in which has been born will help the expansion and adoption of this new modality, and it will stay and evolve until the auto industry will switch to fully automated cars.
- Data privacy concerns can reduce the speed of implementation and limit the applications of usage-based insurance. The main danger is the creation of new rules restricting the data taken by the insurers. But there is also a social awareness of data privacy concerns that should be addressed cautiously.
- The big insurance companies will increment the offering of usage-based insurance pushed by the proliferation of small companies offering UBI

premiums. With the commercialization of these new modality, insurance companies are exposing themselves to a risk if not carefully managing users' data, but a higher margin is granted to those investing in this new product.

And moving to the final part, what could we say, in conclusion, about usage-based insurance future? All the analysis performed in this study claim that it is very likely that in the future usage-based insurance policies will be the majority. But the answer to this question might not be in the analysis phase but in the usage-based environment explanation. And the reason is that after all the information showed, it can be said that the insurance market is an oligopolistic market. Details as the business distribution and Porter's analysis back this affirmation. And one of the characteristics of these markets is that big companies have the power to dictate what innovation to follow and which one not to, even if big opportunities for progression are missed.

In my opinion, after all the study of this new modality and the market distribution and characteristics, usage-based insurance will be established since it has already been adopted by the big companies and positive results are coming from that. The forecasts of growth explained in the first points support this affirmation.

10.3 Economic viability of UBI and environmental impact

After the study of a particular concept, one of the main conclusions that can be extracted is the economic implications and the environmental implications that can carry the application of it.

In the economic side, as it has seen previously, in the mid and short term will benefit both insurers and customer's side. In fact, the non-adoption of this new modality by one insurance company could carry important losses after seeing the high probability of expansion of it. This new modality is already proving profitable, and the tendency keeps in the same direction.

In the environmental side, there is not a direct impact since the object of this study has been a non-tangible product. But the more generalized this new modality will get, the more the user's driving will improve. And linked to this improvement, there will be a reduction in emissions and fuel consumption as explained in a previous point. So, it can be said that indirectly there will be a positive impact.

10.4 The future of insurance industry and data

Having seen the results of the study, it is now time to close the document to fulfill the last goal of this study: development of a theory of the future evolution.

The truth is that it has already been concluded that usage-based insurance will dominate the future of the auto insurance market. But while in the beginning of the project it has been focused the attention on the auto industry, to give an adequate answer to that question it is necessary to zoom out. This will be done in two stages: a first theory regarding the products that an insurance company can offer and a second one regarding the future of big data and insurance from a global perspective.

Starting with the first theory, I think an expansion of personalized services with accurate rating thanks to big data will be the next development and innovations in the insurance industry. As an example, in the health insurances similar models to UBI premiums have started to be implemented. In the following graph it can be found the similarities between both models:

Line of business	Type of telematics device	Type of data collected (depends on the telematics device)	Types of services offered (depends on the telematics device)
Motor insurance	On board device (OBD) dongle or "black box", mobile phone app, GPS, emergency message plug, forward facing cameras ("dash cams")	Average speed, maximum speed, acceleration and braking habits (G-forces), geolocation, distance travelled, time of travel (e.g. day or night), number of journeys, crash reports, battery and engine condition, cornering, lane changes	**Risk mitigation and prevention**: premium discounts based on driving habits, preventive push-notifications or alerts (e.g. black-spot roads or bad weather conditions or battery and engine breakdown problems), travel statistics reports, driving coach recommendations, treats and vouchers for good driving behaviour **Assistance:** road assistance in case of accident or car theft, emergency call in case of accident (ecall)
Health insurance	Wearable bracelets and other fitness trackers, mobile phone app, smart watch	Heart beat rate, blood pressure, blood oxygen level, activity data (e.g. sports or step counter), hours of sleep, geolocation, food and water consumption, calorie consumption, glucose level.	**Risk mitigation and prevention:** rewards for healthy habits, health activity reports, diabetes management **Assistance**: medical assistance services in case of accident, safety alarm for elderly (e.g. BDA tools can predict falls from anomalies in usage/activity patterns)

Source: EIOPA BDA thematic review

Table 16: UBI applied to health insurance and motor insurance

As it can be seen, the health insurance model, while nowadays being less evolved, follows the same path as motor insurance. Data is also collected with different devices and discounts and rewards are given for healthy habits. An important point is again, the danger of not correctly managing this data since it is very sensitive.

This kind of applications is expected to appear not only in motor or healthy insurance but also in other applications where premiums are high. (It would not make sense to track a trip of a user to reduce the cost of the trip insurance)

Moving to the last and second theory, how the future of insurance looks like? In this case, as seen in one of the first points, there are many applications of big data in the insurance industry and many of them have already showed positive results. Big data helps in customer acquisition, customer retention, risk assessment, fraud prevention and detection, cost reductions, personalized service and pricing and helps improving internal processes. But the current new trends such are 5G, Internet of things and machine learning could take all the learnings from the data to another level. How can these modern technologies be so important? There are some future trends in which the application of these technologies will be very convenient. These trends are, for example, the end of ownership (young generations are less likely to buy a car, for example) which will increment the demand of usage-based insurance; the fact of having data to study available taken practically from everywhere or the personalized insurance.

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