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Logistics Models Employing The Internet Of Things

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Abstract

In recent times, the term internet of things has been positioned in different sectors, the objective of this article is to address the applications of IoT in its entirety in the field of fleet management, both in the field of processes and methods, in addition to analyzing how logistics management is executed for the control and monitoring of operations focused on geolocation, performance analysis, telemetry and fuel savings, pollution reduction, improved driving, showing the importance that has today, the use of the internet of things in this sector. IoT has its effect on almost all advanced fields of society, as it has an impact not only on work, but also on the lifestyle of the individual and the organization. (Malik et al., 2021) Currently in the world the population is growing exponentially, which in turn generates a growth of different factors such as the increased number of vehicles for the transport of food, input materials among other elements, that in order to carry out this transport must take into account that you must have control, you must perform the monitoring of routes and identifying the most efficient routes in order to reduce costs in addition to generating a performance analysis, telemetry control and fuel savings, reduction of polluting emissions to the environment and can even provide valuable information to improve the driving of vehicles, This paper explores the opportunity to incorporate the IoT to manage automotive fleets in order to generate an optimization of fleet frequency..

Keywords: Fleet management, Internet of things, Logistics, Vehicle fleets.

1. Introduction

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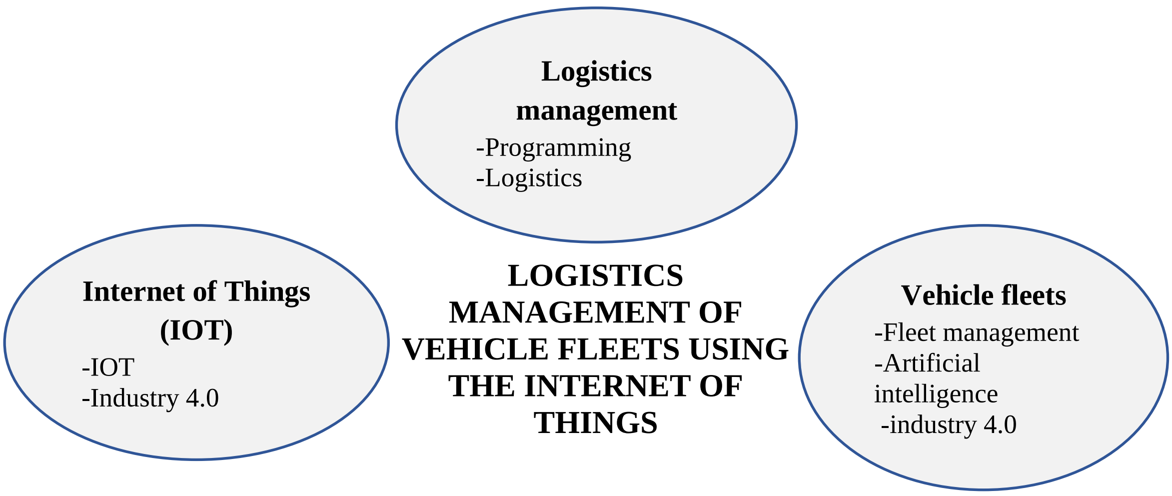
The global scope of the Internet of Things (IoT) is massive and growing exponentially across different industry sectors, those in the emerging digital world have recently witnessed the proliferation and impact of IoT-enabled devices, according to (Nord et al., 2019) IoT has provided new opportunities in the field of technology, while increasing the level of concern population growth combined with rapid urbanization and the growth of private motor vehicles, are helping to increase pollution, making Colombia a very polluted country, especially air pollution has become a serious problem, which generates concern about the increase in the number of motor vehicles has grown exponentially in the city over the years.

Logistics in fleet management involves short-term operations such as material and inventory handling and communications, there are four perspectives on logistics: 1) rebranded, 2) traditionalist, 3) intersectionist, and 4) unionist. The first merely changes the name of logistics to CS. The second one places CS within logistics, and the third one states that they have some intersections, while the last one treats logistics as a part of CS.(Golpîra et al., 2021)On the other hand, the competition in the logistics industry is getting fiercer and fiercer, therefore, the use of Internet of Things technology to manage smart logistics is to enable better synchronization and sharing of information, in addition to the use of Internet of Things technology can better avoid human errors, with these implementations in logistics, visualization technology can be used to observe logistics information in real time. (Lei, 2022). according to this the context of SCM, IoT has been defined as a network of digitally connected physical objects to detect, monitor and interact within a company and between a company and its supply chain allowing for greater control in the supply chain, (Rejeb et al., 2020).

Figure 1. Central terms



The application of IoT in fleet management is essential and important in today's life, as it is an evolving paradigm that seeks to connect different intelligent physical components for multi-domain modernization, to automatically manage and track vehicles with minimal human intervention. (Sinha & Dhanalakshmi, 2022)In addition to the importance of logistics, which has become a critical part of transportation operations and strategies, logistics plays a key role in improving the planning, execution and control of the flow and storage of goods, services and information from the point of origin to the point of consumption in order to increase customer satisfaction.

2. Materials and Methods

2.1. Logistics management

Logistics involves short-term operations such as material and inventory handling and communications, there are four perspectives on logistics: 1) rebranded, 2) traditionalist, 3) intersectionist and 4) unionist. The first simply renames logistics as SC. The second one places CS within logistics, and the third one states that they have some intersections, while the last one treats logistics as a part of CS.(Golpîra et al., 2021)On the other hand, the competition in the logistics industry is getting fiercer and fiercer, therefore, the use of Internet of Things technology to manage smart logistics is to enable better synchronization and sharing of information, in addition to the use of Internet of Things technology can better avoid human errors, with these implementations in logistics, visualization technology can be used to observe logistics information in real time. (Lei, 2022). according to this the context of SCM, IoT has been defined as a network of digitally connected physical objects to detect, monitor and interact within a company and between a company and its supply chain allowing for greater control in the supply chain, (Rejeb et al., 2020).

2.1.1. Logistics planning

In the supply chain, logistics is a very important activity, including food supply chains, it enables the delivery of food around the world and other activities such as customer service, parts and service support, inventory control, distribution, material handling, order processing (Surucu-Balci & Tuna, 2021) among other activities, logistics can be described as "the process of planning, implementing and controlling operations involving different variables and circumstances, applied in the field of efficient and effective movement or transportation and storage of goods, including services, and related information, from the point of origin to the point of consumption, in order to meet customer requirements. This definition includes inbound, outbound, internal and external movements". (Paciarotti & Torregiani, 2021)One of the most, one of the most used topics throughout logistics planning is reverse logistics, this term refers to the movement and planning of goods and services from the customers to the point of origin of manufacture, in order to initially recover a percentage of the added value. (Prajapati et al., 2019)The term logistics has evolved over time due to technology trends and the application of these technologies in everyday life, and logistics is no exception.

2.1.2. Planning and scheduling with technology

Planning takes place at four different levels: 1) cognitive orientation level, 2) cognitive strategy level, which are cognitive processes of decision making, 3) material practice level, includes the gathering of teaching and learning materials, and 4) social process level involves the participation of seminar attendees in the process, companies or authorities (Woschank & Pacher, 2020).

There are several factors to take into account in the operational field related to logistics planning one of these is the location of logistics facilities, therefore planning this factor is important as these facilities represent the main senders and receivers of goods, logistics expansion has contributed to changes in the geography of urban freight transportation (Aljohani & Thompson, 2016)The objective of informative route planning is to calculate the routes of robots that act as mobile sensors in order to accurately estimate the route to be taken by these intelligent mobile devices, typically a spatio-temporal field, achieving that the routes are fulfilled. (Tokekar et al., 2016).

It is important to be able to identify the factors that affect the logistics operations, for this a planning focused on the activities of the system is carried out, the main factors in the current tools are the characteristics of the product, which refer to the inherent properties of the initial materials and final products, of the process, of the organization that refer to the administrative conditions and of the chain refer to the conditions during the supply and the relations with other companies and organizations of the chain. (Macheka et al., 2017)In order to ensure that these weaknesses do not affect an organization, modern planning has been used today, in which intelligent methods are applied, one of these is TS, TS refers to the applications of artificial intelligence and data science technologies, many applications of TS have shown promise in improving efficiency and effectiveness in various logistics operations and transportation systems. (Chung, 2021)A ULS is an intelligent freight transportation system, goods from the city's logistics park are transported through subway tunnels that connect to terminals of logistics networks, residential areas, shopping malls or delivery ticket offices, it is unmanned and automated. (Guo et al., 2021)In addition, some technologies such as Field-Programmable Gate Array (FPGA) chips that can transfer DSP or microprocessors, the Internet of Things (IoT) system integrated in Field-Programmable Gate Array (FPGA) is the main communication strategy that is applied for the regional intelligent logistics labor market balancing system to balance in the economic field, marketability and flexibility. (Ding et al., 2021).

2.1.3. Fleet logistics management

Logistics management is very important in the fleet of vehicles since the flow of information is as important as the flow of vehicles, the different companies that manage this type of fleet generate information such as the amount of accumulated inventory, procurement, production and delivery time among others so that this can be analyzed in real time companies manage information systems that operate in the cloud where the information is immediately that allows decision making is more effective not as the old method of storage and exchange of information that everything was by paper documents or email or telephone, It is for this reason that most of these use more efficient systems such as the cloud in order to improve the efficiency of the processes is for this reason that it is of vital importance that access to current information on the status of a transport unit in real time is the key element for a successful and efficient organization of logistics processes. Today there are solutions using GPS (localization) and GPRS (data transmission) that allow tracking of means of transport and, from time to time, of cargo units (mainly intermodal cargo units).

2.2. Internet of Things (IoT)

The global scope of the Internet of Things (IoT) is massive and growing exponentially across different industry sectors, those in the emerging digital world have recently witnessed the proliferation and impact of IoT-enabled devices, according to (Nord et al., 2019) IoT has provided new opportunities in the technology arena, while raising the level of concern, but in order to talk more about IoT one must know what it means, (Alonso et al., 2020) defined that the Internet of Things (IoT) refers to the connection of multiple heterogeneous objects such as machines, vehicles or buildings with electronic devices such as sensors and actuators through different communication protocols to collect and extract data, the IoT serves as a basis for research and development of solutions in smart homes, smart cities, Industry 4.0, logistics and transportation , energy efficiency, healthcare or agriculture furthermore (Ray, 2017) states that it refers to machine-to-machine (M2M) communications which is a crucial component of the recent growth of the digital market, this complements it (Khanna & Kaur, 2019) because it has defined it as the global information infrastructure of society, which provides advanced services through the interconnection of things (physical and virtual) based on existing and evolving information and communication technologies, but what objective or purpose does the IoT have, this explains it (Bittencourt et al., 2018) IoT aim to perform the following tasks: it is to connect and communicate thousands of devices to take full advantage of their applications and transform the collected data into information knowledge. Although a look of new applications is enabled by IoT, this is also a source of further heterogeneity: different applications also have different requirements, which must be met by the computer system that must meet the computer system that combines IoT devices with their applications.

2.2.1. Evolution of the Internet of Things

In the mid-1980s, communication was limited to voice over telephone lines or letters, with the passage of time, the term Internet emerged and communication acquired a new platform (Khanna & Kaur, 2019). Over the years, the current era left behind the concept of the Internet and has emerged with the concept of IoT. (Villa-Henriksen et al., 2020). But according to (Tzounis et al., 2017) the term as it is known today was actually coined by a British visionary, Kevin Ashton, in 1999. As the phrase "Internet of Things" reveals, the IoT paradigm will provide a technological universe in which many physical objects or "Things", such as sensors, tools and everyday equipment empowered by computing power and networking capability can play a role, either as individual units or as a as a swarm of heterogeneous devices collaborating with each other, as according to (Tabaa et al., 2020) this is a new concept that is becoming increasingly popular in the field of wireless communications. (Villa-Henriksen et al., 2020).

2.2.2. IoT opportunities for transportation and logistics

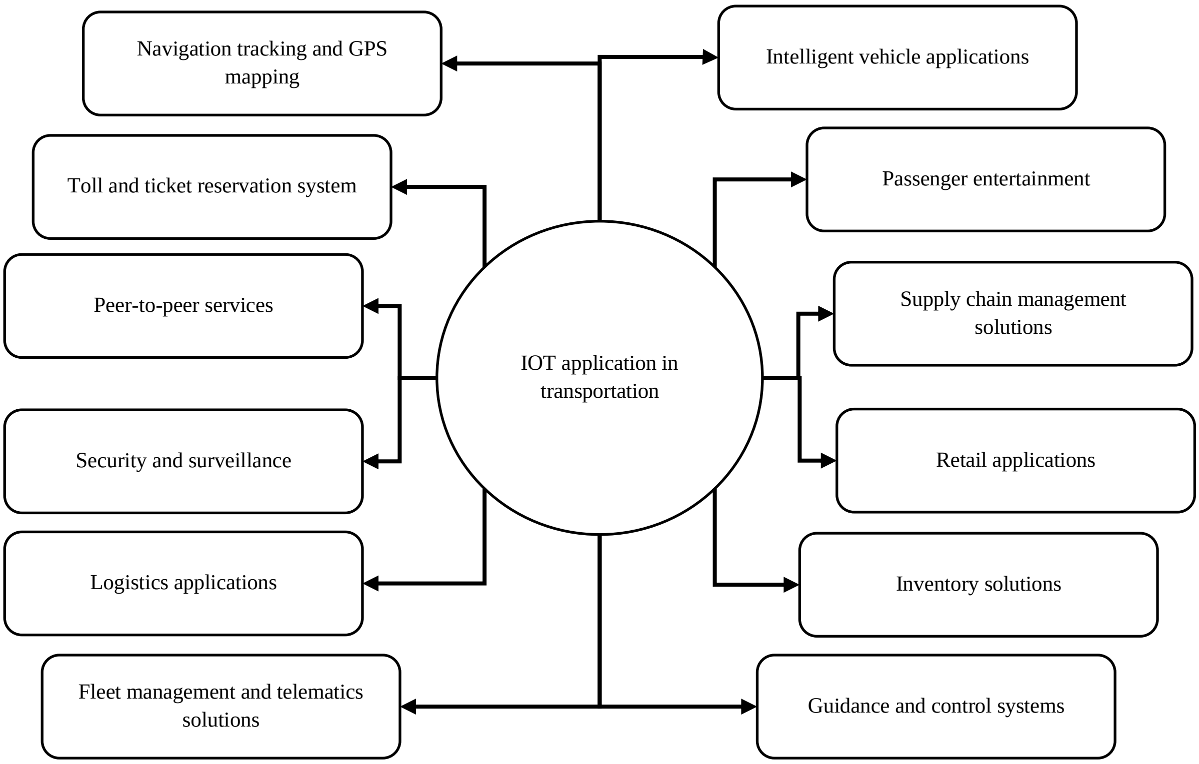
The Internet of Things offers numerous opportunities in the transportation and logistics sector [5]. These opportunities include various applications or needs of a transportation system. By using IoT, vehicles can be monitored with respect to their movement, location, whether it is running or stopped, or at any risk, etc. All these aspects can be monitored intelligently using IoT systems. (Villa-Henriksen et al., 2020).

In most cases, vehicles are used for logistic purposes or to transport heavy loads that are packed inside the truck. In such cases, it is very important to measure the interior conditions of the truck, such as temperature, humidity, light conditions, etc. In addition, the payment service near tolls or any parking lot can be automated with the vehicle tracking number and driver ID number, etc. IoT also helps in vehicle guidance and navigation control systems (road transport, air transport, maritime transport).(Khanna & Kaur, 2019)

Transportation governance is very much possible with the use of IoT. Here, multiple vehicles can be monitored by a central control connected via the network. This also helps to manage imports and exports of materials and goods. It also offers a live and integrative service to monitor the status of deliveries by indicating the location using GIS mapping.

IoT could help to control traffic and gives suggestions to take other lines.

Figure 3. IoT applications



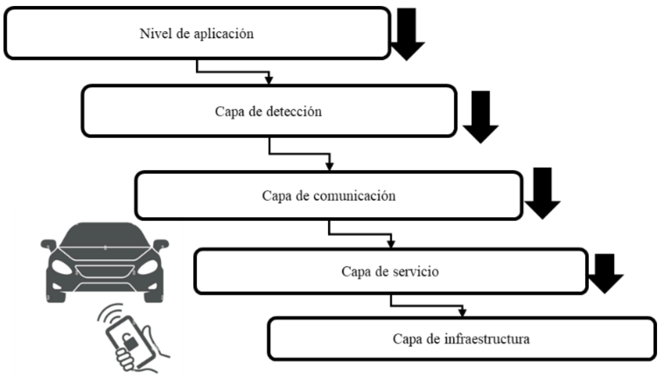
2.3. Vehicle fleets

Fleet management is a recent term is a broad concept that incorporates decisions about fleet size and configuration, fleet allocation and vehicle routing, considering homogeneous or heterogeneous vehicles. Both deterministic and stochastic problems can be considered. (Baldacci et al., 2008) provides an overview of the various approaches to vehicle fleet management in the context of the heterogeneous vehicle routing problem (Hoff et al., 2010) reviews in more detail the problems of fleet composition and routing for both maritime and land transport in the goods movement sector, however in this case it is analyzed in the land sector, the author states that routing is fundamental and should be already programmed in a predetermined way, however, routing and composition decisions should be considered simultaneously.

2.3.1. Internet of things for the transportation system

The IoT architecture for the transport system consists of five different layers, see Table. These layers include the application layer, sensing layer, communication layer, service layer, and infrastructure layer, see Fig. 4. (Ushakov et al., 2022).Transport is mainly used to move a thing or a living thing from one place to another. In daily life, transportation is involved in many activities, such as moving goods or people, whether by road, water or air.

Figure 4. IoT architecture.



The transport system, as an area of study, involves the study of many parameters. All these parameters must be detected and transferred to the service layer through a suitable communication channel. From the service layer, appropriate decisions are made to control the system according to the needs. The relevant and detected data are stored in the infrastructure layer.

Table. 1 - Types of architecture for IOT

Layers	Requirements/Components/Tasks to be Executed
Application Layer	Goods, Junctions, Terminals, Service Areas, People, Roads, Vehicles
Sensing Layer	Parking Detection, Compass Terminals, Camera, Fee Collection, Environment Monitoring, Vehicle Monitoring, Logistics Tracking, Microwave Detection, Passenger Flow Detection
Communication Layer	3G/4G/5G Network, Wi-Fi, Wired Network, Optical Fiber, Public and Private Network
Service Layer	Logistics Service Platform, Passenger Vehicle Platform, Fleet Vehicle Service Platform, Highway Integrated Platform, Intelligent Travelling Service Platform
Infrastructure Layer	GIS Mapping Service, Cloud Computing, Cloud Storage, Big Data

On the other hand, in the project called "Internet of Things, control and tracking of an automobile", it is observed that a tracking system for automobiles is implemented through an Android application. It makes use of the Mobil-D methodology oriented to the development of mobile applications. As for the hardware, it makes use of the Arduino electronic development board together with the GSM module (SIM900), which is essential for communication. (CHOQUE, 2016) This is achieved thanks to the IOT-based car control and tracking system, which is something new, since its purpose is to make wireless connections at a distance.

According to (Bandyopadhyay & Sen, 2011)According to the IOT in vehicles has allowed the inclusion of different types of services among those mentioned are the following:

- Improved vehicle logistics and safety.
- Reduction of travel times.
- Reduced maintenance and ownership costs.
- Provision of info-entertainment services.

Similarly, (Ramson et al., 2020) mentions the different applications of the internet of things in vehicles and their management.

- Infotainment systems.

- Remote access to:
- Car door locks.
- Engine ignition.
- The opening of garage doors.
- Turning on the lights in the home.

These technological advancements are only due to the application of the internet of things according to (Pourrahmani et al., 2022). One of the main advances in vehicle technology is related to the internet of things that contributes greatly to improve different factors such as safety, comfort among other aspects, to achieve the improvement in the safety of each vehicle was achieved through Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I). Moreover, there are three effects on the total return on investment in the infrastructure sector. First, infrastructure as an end product contributes directly to GDP formation through transportation, drinking water supply, electricity production, wastewater and communication services.

An example of how this connection of vehicles can be carried out is the MY SEAT application developed and executed by the manufacturer SEAT, (Mistry et al., n.d.). is the MY SEAT application developed and implemented by the manufacturer SEAT and through this application offers different benefits and possibilities such as:

1. Connects the car to the home: thanks to geolocation, the car's temperature can be automatically repeated when the car is at a certain distance from the house. It also allows the programming of remote thermostats that control the temperature in the center of the house, as well as lights or security cameras.

2. Alerts the driver of the vehicle's status: Allows displaying variables such as oil level and fuel level while driving or parking.

3. Monitor driving behavior: provides tips on how to improve driving, tips on how to improve vehicle performance, and tips on how to drive more environmentally friendly.

2.3.2. Vehicle fleet management with the internet of things

Currently fleet management is made in a simpler way as different car manufacturers integrate in their products sensors that allow information to be generated and analyzed as is the analysis of telemetry data for obtaining behaviors and patterns of the vehicle driver.(Eyre et al., 2021)This allows fleet operators to positively impact the efficiency not only of their drivers but of their operations in general, (Killeen et al., 2019)A clear example of this are some companies that collect real-time information from vehicle sensors to generate an intelligent optimization of routes and indicate which is the best way to reduce fuel costs, facilitating preventive maintenance before mechanical problems generate a pause in the activities of the fleet process.(Khodadadi et al., n.d.)

Among the main tools for vehicle fleet management, the following can be found.(Ponnusamy & Alagarsamy, 2021):

- Satellite tracking of each individual vehicle
- Telematics systems that use sensors and trackers to capture all the data generated from a telematics tracker, which is then analyzed and classified in an interface so that a user can interact with the data and the driver.
- Periodic fleet management reports on vehicle and driver performance.

It should be noted that the solutions provided by IOT in fleet management are quite extensive, however the implementation of this technology can represent a high cost since data transmission via satellite has a high value, (Rojas et al., 2020) However, it is the most effective in the management of fleets of vehicles where some cars have to travel through inhospitable and high-risk places but with a route monitoring provides greater confidence to the driver, (Shanthan et al., n.d.) The notification of the status of the vehicle will allow to reduce mechanical failures, at all times there will be a communication with the driver for route planning and control of the goods by reviewing storage variables of the products (Bochtis & Sørensen, 2010).

Autonomous intelligent vehicles are also used in fleet management for route fulfillment is the planning of coverage trajectories. (Sah et al., 2020)Sometimes these vehicles often have difficulties in the route to reach their main objective, the solution is the use of sensors or offline planning through the internet of things. (Hameed et al., 2013)Another type of methods for auto-guidance systems in vehicles are real-time kinematic (RTK) systems, together with global navigation satellite system (GNSS) networks, which provide real-time location and are widely used in precision agriculture. (Fernandez de Sevilla et al., 2021)..

The analysis and detection methods used in intelligent or autonomous vehicles, (Radoglou-Grammatikis et al., 2020) are the use of sensors, sensors fulfill the main function of providing the necessary information to initiate a general analysis of the environment, in current technology there are also several methods that can analyze the different data that can be collected, as is the use of Big data technology, where methods such as blockchain are used, other methods of data analysis such as soft computing, this is a set of computer techniques, such as fuzzy logic (FL), artificial neural networks (ANN) and genetic algorithms (GA) that offer solutions through modeling and data analysis (Huang et al., 2010) (Maes & Steppe, 2019)..

On the other hand, big data (Ossa, 2017). is one of the technologies that are trends for the collection and analysis of information, collecting large amounts of data from different agricultural operations and the management of logistics or supply chain of this field, the use of big data analysis in production processes, processing, logistics, would be a privilege for industry 4.0, the blockchain, is part of this type of technology, applying smart contract or distributed ledger technology. (Liu et al., 2021) Blockchain is a tamper-proof distributed ledger that records transactional data in a peer-to-peer (P2P) network, blockchain serves as a forum for managing and executing smart contracts, data immutability, security, transactional privacy, auditability, integrity, fault tolerance and system transparency, blockchain is being applied in various sectors, such as intelligent transportation, supply chain management, industry for analyzing a large amount of data collected. (Kumar et al., 2021)One of the applications of blockchain is the Edge Layer, which collects all the information by IoT devices, all the information collected by sensors becomes part of the distributed ledger, the data is pre-processed and filtered by Data Analytics techniques, generating knowledge in the same Edge and reducing data traffic and transmission costs to the Cloud. (Alonso et al., 2020)Cloud computing is also in charge of information management and storage, consolidating information from different tasks, this software has the objective of allowing the implementation and validation of complete systems. (Pavón-Pulido et al., 2017)..

Intelligent or automated vehicles normally use a system made up of sensors, according to (Alladi et al., 2020) the most well-known sensors such as, Machine Vision (image-based and robot guidance), Geomagnetic Direction Sensor (GDS), Laser Radar (LADAR), Real-time Kinematic-Global Positioning System (RTKGPS), among others. (Mousazadeh, 2013)Due to the variety and difficulty that can appear on the ground, autonomous ground vehicles must have an adequate traction performance to have the ability to generate sufficient forces to overcome all types of vehicle resistance on the ground where it moves. (Sunusi et al., 2020)Autonomous vehicles (AV) are classified according to the hardware platform used, equipped with sensors and actuators, these are also controlled by means of algorithms and software, they are transported by means of commercial platforms (the most common are tractors and harvesters combined), but due to the great variability of soils, the prototypes can be modified, changing the mechanical components, actuators, chassis, wheels and / or any other mechanical unit. (Macrina et al., 2020) (Roshanianfard et al., 2020).

3. Method

For the development of the research article, the main topics it focuses on were first identified, incorporating a structure according to the set of densities (Fig. 3), these main terms are derived from the general topic and are divided into Internet of Things, Logistics Management and Vehicle Fleets, these are also further divided into subtopics, which were later used for the search in the different databases, as shown in Fig. 4.

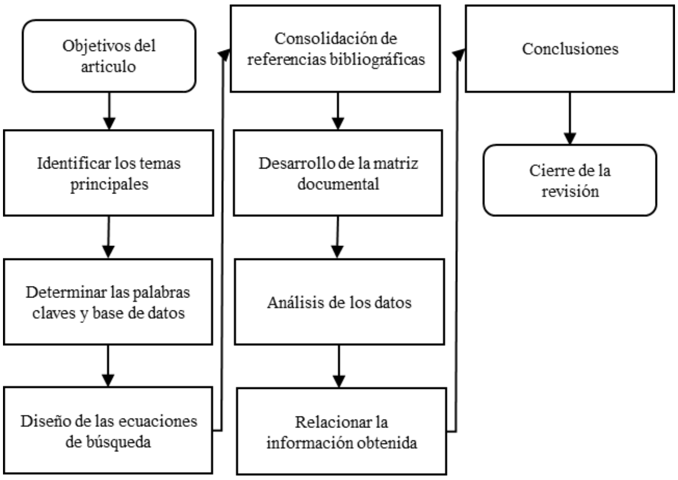
The databases used were Science Direct, Google Scholar, Ieeexplore, SciELO, and then the search equations were constructed, which are made up of keywords that were chosen taking into account the main topics and the general theme of the article.

3.1. Search equations

Eq.Bq 1= vehicle fleets + logistics +internet of things
Ec.Bq 2= Fleet management + logistics + internet of things
Ec.Bq 3 = Fleet management +internet of things + logistics.
Ec.Bq 4=Fleet management +industry 4.0 +internet of things

With the use of the different search equations, the necessary articles were collected to start with the elaboration of the content of the research article, for this we first analyzed each of the articles that were in the databases, selecting those that were approved or published in journals and then separating them by three sections, the first, the Fleet of vehicles, the second, everything related to logistics management and finally, the articles that speak directly of the internet of things and the different applications and technological innovations in fleet management, This matrix consists of compiling all the information of each of the articles that were selected, entering the title, keywords, the journal in which it was published, the year of publication, the authors and other data that were vital for a more detailed analysis of each bibliographic reference, once all the information was obtained, the content of the research was structured, using different arguments of various authors, for which the process ends in the conclusions of the article.

Figure 2. Methodological chart

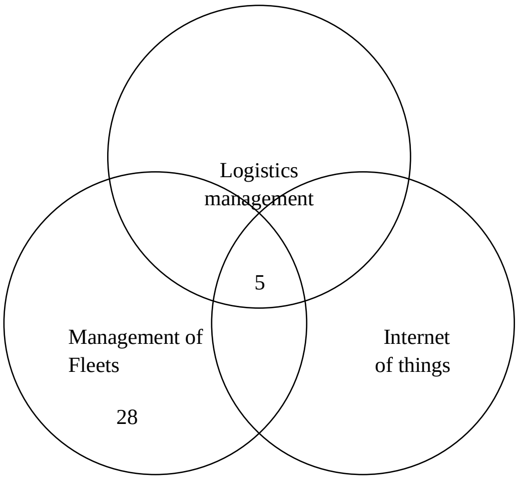


4. Results

4.1. Thematic density

In the present work a total of 52 articles were used as bibliographies for the collection of information, this was divided according to the main theme on which each of the documents was based, this according to the main themes of the article, 15 articles were obtained that focused on the theme of logistics management, 28 articles where the main theme is based on the internet of things and finally 15 articles that focused on logistics management, this thematic density was useful because it provided a specific order when collecting information from each part of the literary content of the article, also 8 of the total of the articles, touches each of the different topics already mentioned and as shown in fig. 3.

Figure 5. Thematic set of results



For the search of the bibliographic articles, a total of four equations were designed, these are made up of different keywords related to the main topic and focus of the research article, the search equations were used in the English language, because in each of the databases, documents or articles are found in the English language, therefore, when using the equations in this language, the search results are significantly higher than when using the equations in the Spanish language, Table 1 shows the number of articles found for each of the different equations. 1 shows the number of articles found for each of the different equations.

Table. 2 - Search equations

N #	Equations	Quantity	Percentage
Eq. Bq 1	vehicle fleets + logistics +internet of things		7,69%
Eq. Bq 2	Fleet management + logistics + internet of things		30,77%
Eq. Bq 3	Fleet management + internet of things + logistics		13,46%
Eq. Bq 4	Fleet management + industry 4.0 + internet of things		48,08%
	Total		

As for the databases that were used, there are several systems, among these the most used for this literary work, Science Direct was highlighted, contributing 72.31% of the total number of articles cited, the research from which information was collected are articles that were published between 2010 and 2021, being of greater volume the articles that were published in the last years (2019 to 2021).

Table. 3 - Database density

Database	Qty	%	2008	2010	2011	2013	2016	2017	2018	2019		2021	2022
Science Direct		92,31%	1		1	1				5			
Google Scholar		3,85%		1	1					1			
Ieeexplore		3,85%				1	1					1	
TOTAL		100,00%	1							5			

The literary writings from which the information was collected are in English and Spanish, of which 50 of the 52 articles cited are in English and only 2 in Spanish, due to what was mentioned above, since the search equations were used in English. 4 shows the language density.

Table 4. Language density.

Language	Qty	%
Spanish		3,03%
English		96,97%
TOTAL		100,00%

In the development and collection of information, the documentary matrix was designed, which contains the general data of each of the different bibliographic articles. Upon analyzing these data, it was observed that most of the articles cited in this document are of European or Asian origin, with densities of 47.69% and 35.37%, respectively.

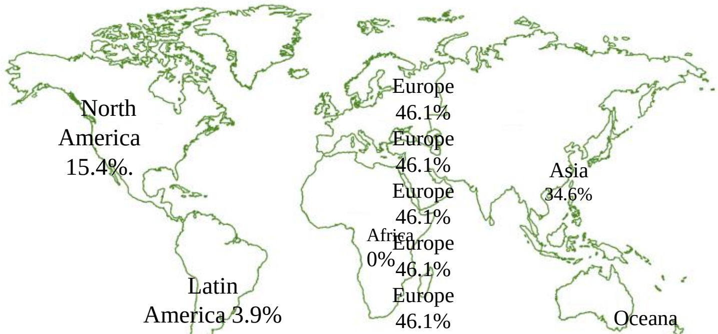
Table 5. Geographic density

Region	Qty	%
Asia		34,62%
North America		15,38%
Latin America		3,85%
Europa		46,15%

Oceania	0	0,00%
Total		100,00%

A total of 23 articles were used that are of European origin, 17 from the Asian continent, 4 from South America and 7 from North America, the exact figures according to the analysis developed are shown in Table 4 and Fig. 4.

Figure 6. Geographic density



5. Conclusions

In fleet management using the internet of things will allow optimizing the administration of vehicle fleets, since it will allow the analysis of real-time information of several variables that are essential in making decisions such as real-time location of the vehicle, the speed and driving style of the vehicle, vehicle status regarding maintenance, which favors decision making while increasing productivity and efficiency of the organization for continuous improvement in driving practices and fleet management.

The internet of things in fleet management is considered as hardware and software architecture, allowing a great improvement in the organization in the optimization of routes with greater inventory control, in addition to a reduction of expenses due to the continuous improvement of driving techniques.

Autonomous technologies are made up of a wide range of intelligent systems, they can vary depending on the functions or objectives to be achieved through their use, they can be made up of sensors, data storage systems and analysis for decision making, these autonomous devices can be terrestrial or aerial, the terrestrial ones fulfill functions such as performing repetitive and continuous activities.

The types of sensors are varied, depending on the environment in which it is being applied, whether they are sound sensors, thermal sensors, motion sensors, GPS, among others, the use of this type of technology in autonomous vehicles is diverse, due to the efficiency and programming that enables autonomous devices to perform their tasks independently without the need for a pilot, through advanced software and hardware programming.

The documentary research that was carried out from the thematic density sets and the four search equations allowed the analysis of 59 documents collected from 4 academic databases and research among which the highest participation was scientdirect with 84.7% where the predominant language within the different articles used in the research was English with 91.5%. in addition to this it can be seen that the region most interested in the topic is Europe as it wants to be at the forefront of technology in the agricultural industry but closely followed by Asia, subsequently it is analyzed that in the timeline during the period from 2011 to 2021 the growth in the number of publications of articles was increasing as the topic is becoming of great interest due to the multiple benefits of IoT applied to fleet management.

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Makalenin Türkçe başlığı buraya yazılır....

Özet

Türkçe özet.

Anahtar sözcükler: anahtar sözcükler1; anahtar sözcükler2; anahtar sözcükler3

AUTHOR BIODATA

Insert here author biodata**.**