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Implementation of autonomous transportation technologies: Diagnosis in home logistics for urban environments*

Implementación de tecnologías de transporte autónomo: Diagnóstico en logística de domicilios para entornos urbanos

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Abstract

The aim was to diagnose the status of the implementation of autonomous transportation technologies in home logistics. Positivist paradigm research, with quantitative method and descriptive-correlational approach, field research and non-experimental-transversal design. The sample was 28 courier companies, with at least one year of experience and a plant with at least five (5) workers in charge. The survey technique is used, using a collection instrument with a Likert-type scale. There is a global trend towards the automation of package distribution systems and this is known by a good part of the target audience in this study. To achieve a high rate of implementability of these technologies in the local urban environment, it is necessary to adapt changes in aspects such as road infrastructure, legal regulations and sociocultural adoption of the technology, in addition to a reduction in costs to an affordable range. such that the adoption of these new autonomous technologies is encouraged in the Latin American environment and particularly in small and medium-sized cities.

Keywords: Technological management, Urban messaging, Home logistics, Autonomous transportation.

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Resumen

Se buscó diagnosticar el estado de la implementación de tecnologías de transporte autónomo en logística de domicilios. Investigación de paradigma positivista, con método cuantitativo y enfoque descriptivo-correlacional, investigación de campo y diseño no experimental-transversal. La muestra fue de 28 empresas de mensajería, con por lo menos un año de experiencia y una planta que contemple por lo menos cinco (5) trabajadores a cargo. Se utiliza la técnica de encuesta, utilizando un instrumento de recolección con escala tipo Likert. Existe una tendencia a nivel global, a la automatización de los sistemas de distribución de paquetes y que esta es conocida por buena parte del público objetivo en este estudio. Para conseguir un alto índice de implementabilidad de estas tecnologías en el entorno urbano local, se hace necesario que se adapten cambios en aspectos como infraestructura vial, reglamentación legal y adopción sociocultural de la tecnología, además de una disminución de los costos a un rango asequible, tal que se fomente la adopción de estas nuevas tecnologías autónomas en el entorno latinoamericano y particularmente en ciudades pequeñas y medianas.

Palabras clave: Gestión tecnológica, Mensajería urbana, Logística de domicilios, Transporte autónomo.

1. Introduction

Global autonomous transportation technologies are setting the tone for a significant transformation in mobility and transportation infrastructure management [1]. Currently, urban transportation systems play a vital role in development and urbanization, and the integration of autonomous vehicles is a logical extension of this paradigm [2].

These technologies represent one of the central axes of the fourth industrial revolution, characterized by the advanced integration of artificial intelligence and robotic systems in the mobility and logistics chain [3]. The increase in the supply of autonomous technological products, from unmanned aerial vehicles to driverless cars, has marked a significant change in contemporary society [4].

The projection of the total adoption of autonomous terrestrial transportation technologies places the period after 2030 as a horizon for the massive integration of this technology [5].

The implementation of autonomous ground and aerial vehicles has the potential to significantly alter the business model of intelligent transportation systems and associated infrastructure, following process control and optimization theories [6].

In Latin America, the adoption of autonomous transportation technologies is in different stages of implementation and development [7]. Factors such as the existing infrastructure, the regulatory framework and the economic disposition play an important role in the degree of integration of these technologies [8].

In this region, the Inter-American Development Bank (IDB) plays a crucial role as a promoter of technological innovations in the mobility sector [9]. In the Colombian context, certain entities have shown a particular willingness to advance in the research and commercialization of autonomous vehicles [10]. This commitment suggests a collective drive towards an evolution in the transportation system that aligns with the developments of more advanced countries in this matter [11].

Efforts made by different institutions are highlighted, reported directly by representatives of each one, thus providing a valuable internal perspective on the role of future users and the usefulness of a guidance document for this field [12].

In summary, although Colombia has shown growing interest and has begun the incorporation of autonomous transportation technology, evidenced by advances in sectors such as mining and collaboration between public and private entities, it is clear that the path towards the general implementation of autonomous vehicles is still under development [13]. Due to everything discussed so far in this work, we sought to diagnose the state of the implementation of autonomous transportation technologies in home logistics.

2. Materials y Méthods

The research work is framed in the positivist paradigm, with quantitative method and descriptive-correlational approach, field research and non-experimental-transversal design [14]. With regard to the study population, it is necessary to study the characteristics of the parcel delivery service providers, the sample was 28 courier companies, the selection criterion for the choice of companies to be characterized was small and medium-sized urban courier companies operating only at local level, The Centre is a company with at least one year's experience and a plant with at least five employees.

The survey technique was used, using a Likert scale collection instrument and whose alternatives were, Totally agree, Agree, Neither agree, or in disagreement, In disagreement, Totally in disagreement [15].

The statistics are descriptive, in particular, frequency distribution and central trend measures were used. In the study carried out, a point of comparison was established to interpret the collected data. The purpose of this was to compare the results obtained during the data collection process, based on arithmetic mean and set on a scale from 1 to 5, which corresponds to the lowest and highest possible value of the response scale used in the data collection instrument applied to the population under study [16].

Table 1. Weighted scale for the analysis of averages

Courage	Alternative	Intervals	Categories	Convention
5	Totally agree	4,20 – 5,00	Very present	MP
4	Agreed	3,40 – 4,19	Present	P
3	Neither in agreement, nor in disagreement	2,60 – 3,39	Moderately present	MEP
2	At odds	1,80 – 2,59	Little present	PP
1	Totally at odds	1,00 – 1,79	Absent	A

Source: Authors

Table 1 below shows the scale used for the average analysis of the indicator in this investigation. In addition, to complement the results of the study, dispersion measures were calculated, specifically the standard deviation of the arithmetic averages obtained for each dimension and indicator by using the instrument. A corresponding scale was established for these dispersion measurements, ranging from 0.00 which is the minimum value by definition, to 1.74 as the maximum value of the standard deviation. Below, in Table 2, is the scale used for the analysis of the data collected from the application of the items of the data collection instrument in this research.

Table 2. Weighted scale for standard deviation analysis

Courage	Intervals	Categories	Convention
5	1,39 – 1,74	Very high dispersion	MAD
4	1,05 - 1,38	High dispersion	ALD
3	0,70 – 1,04	Intermediate dispersion	DI
2	0,35 – 0,69	Low dispersion	BD
1	0,00 – 0,34	Absent dispersion	AD

Source: Authors

3. Results

Table 3, presents the results obtained for the dimension Implementation of autonomous transportation technologies in package delivery companies, whose indicators are the degree to which the implementations of autonomous transportation systems are changing the package delivery system at the national level. globally, at the Latin American level and at the local level.

Table 3. Autonomous transportation technologies in package delivery companies

Indicators/ Items	Never		Hardly ever		Sometimes		Almost always		Always		Total		$\bar{X}$		σ	
	Fa	%	Fa	%	Fa	%	Fa	%	Fa	%	Fa	%				
Global autonomous transportation technologies	1	4%	5	18 %	15	54 %	7	25 %	0	0%	28	100	3,00	MEP	0,76	DI
Autonomous transportation technologies in Latin America	0	0%	9	32 %	18	64 %	1	4%	0	0%	28	100	2,71	MEP	0,52	BD
Local autonomous transportation technologies	0	0%	14	50 %	13	46 %	1	4%	0	0%	28	100	2,54	PP	0,57	BD
													Overall Mean of the Dimension		2,71	
													General dimension category (Medium)		Moderately Present (MEP)	
													Overall dimension standard deviation (σ)		0,57	
													General dimension category (Standard deviation σ)		Low dispersion (BD)	

Source: Authors

Firstly, in the indicator that measures how the implementations of autonomous transportation systems are changing the package delivery system globally, it is evident that 54% of general managers of home delivery companies respond that they have sometimes heard about ways in which the implementation of these systems is changing the package courier industry, 25% indicate almost always, while 18% report almost never.

This result shows that the aforementioned indicator is moderately present in the population under study, with an average of 3.00 according to the scale established for data analysis.

Likewise, a standard deviation of 0.76 is obtained, which indicates an intermediate dispersion of the responses.

In the case of the indicator that measures how the implementations of autonomous transportation systems are changing the package delivery system at the Latin American level, it is observed that 68% of the general managers of home delivery companies always respond and sometimes have heard of the implementation of autonomous terrestrial driving technologies applied to urban messaging processes, while 32% indicate that they have almost never heard about these implementations.

For the third indicator that measures how the implementations of autonomous transportation systems are changing the package delivery system at the local level, it is observed that 50% of the general managers of home delivery companies respond that they have almost never heard of the implementation of terrestrial autonomous driving technologies applied to urban courier processes at the local level, while 48% indicate that they have sometimes heard about technological implementations that tend to automate package shipments at this level.

These results indicate that this indicator is little present in the population under study, with an average of 2.54 according to the scale established for data analysis. Likewise, a standard deviation of 0.57 is obtained, which indicates a low dispersion of the responses.

Considering these results, the general average places the dimension Implementation of autonomous transportation technologies in package delivery companies in the moderately present category, with an average of 2.71 according to the established scale. Additionally, the standard deviation of the dimension is estimated at 0.57, which indicates a low dispersion in the general responses of the dimension.

The results previously presented show that, although in general terms the indicator Implementation of autonomous transport technologies in package delivery companies is little present in this study, it is notable that as the measurement of the perception of the respondents about these implementations, a higher level of presence of the indicator is found.

This is because in the media it is normal to observe how technological innovations are changing the way of working in first world countries and that it is only a matter of time before these technologies reach the local level, regardless of them, currently. The indicator shows a low presence of current implementations working in the packet messaging sector.

On the other hand, there are also reasons beyond the available technology, which are decisive when implementing this type of technology, some of the reasons that could limit the transfer towards the use of autonomous transport vehicles in the courier industry. packages could be the following:

High cost: At least initially, autonomous vehicles can be much more expensive than other vehicles. However, over time, automation functions will be able to be produced in large quantities. Until that time, the benefits of autonomous vehicles may only be available to certain people [17]. Therefore, the economic limitation results in the surveyed public not yet considering these technologies as a viable option.

Uncertain Environmental Conditions: Vehicles face numerous challenges due to unpredictable environmental conditions, such as unexpected obstacles, heavy rain or snow that reduce visibility. While people use reasoning and social norms to deal with these situations, autonomous vehicles rely on hardware and software that have only been tested under a limited number of conditions. Ensuring the safety of a vehicle in all circumstances can still take time [18].

Regulations and legal limitations: Regulations and legal limitations in some countries may limit the adoption of autonomous transportation technologies. As is known, some countries are still developing regulations for autonomous vehicles [19], which may limit the adoption of these technologies.

Safety Concerns: Some people may have concerns about the safety of autonomous vehicles and autonomous transportation systems. Hackers could infiltrate the command and control system of autonomous vehicles, and it could be disastrous if several autonomous vehicles were taken over by criminals [20]. Therefore, cybersecurity for autonomous transportation must be ensured before the launch of self-driving vehicles [21].

Conclusions

It can be concluded that there is a global trend towards the automation of package distribution systems and that this is known by a good part of the target audience in this study. However, to achieve a high rate of implementability of these technologies in the local urban environment, it is necessary to adapt changes in aspects such as road infrastructure, legal regulations and sociocultural adoption of the technology, in addition to a reduction in costs to a affordable range, such that the adoption of these new autonomous technologies is encouraged in the Latin American environment and particularly in small and medium-sized cities. Emphasis should be placed on maintaining active observation in the technological field to be aware of the evolutions related to autonomous driving and how these can be efficiently integrated into the logistics of home package deliveries in urban environments. Home package delivery logistics companies are reminded that it is essential to stay informed about emerging trends in urban logistics to capitalize on innovations that arise, especially those that are heading towards greater automation, improving quality and efficiency. Customer experience.

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