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Analysis of maturity in use of the information technology in a sustainable management of transport logistics, according to the perception of specialists

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The management of transport logistics in industries is a good opportunity to implement sustainable organizational management practices. All over the world, the great concentration of cargo transport by land modal raises the cost of sustainable management of transport logistics, favoring the development of models about the impact of Information Technology (IT) use. This article aims to analyze the perception of transport specialists regarding the degree of contribution of information technologies in the more sustainable management of transport logistics in industries from a sampling of transport logistics in a beverage industry operating in the American continent. The research methodology involved a case study with a focus group, addressing the relationship between information technology and sustainability. Within the same transport operation, benchmarking the effects of sustainable performance with the use of IT capability are also analysed. The results of the study indicate that, for the Southern region of the American Continent, existing technologies when used in the transport operation have a greater degree of contribution to sustainable management.

KEYWORDS: Green Technologies. Transport. Smart Cities. Sustainability.

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INTRODUCTION

Recent studies that seek to improve the way in which vehicle capacity is utilized use Information Technology (IT) to reduce the use of fleet in the handling of road cargo, and to minimize the operational costs (JUNQUEIRA et al., 2013; CLEGG, 2018). Thereby, there is a complexy logistcs network that can be a possible barrier that challenges the efficiency of the managers' routine (MARTINSUO; LUOMARANTA, 2018).

In this context, the use of software in the transport structure of companies to send products to major wholesalers is necessary, as well as supplying factories and Distribution Centers (DCs) by third party or own. In the field of transport logistics management, there is a recurring question about the use of IT to influence on sustainable performance or like a competitive advantage for companies (SHI et al., 2019).

It is important that researchers and stakeholders realize in their evaluations, the impact of the environmental and economic success in use sustainable improvements based in information systems (IS) during the

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Perspectivas Contemporâneas
Revista Eletrônica de Ciências Sociais Aplicadas

operationalization of transports, and about the business value of IT (PORTER, 2001; OXBORROW; BRINDLEY, 2018).

This research was developed with the objective of analyzing the perception of transport expert as to the contribution level of Information Technology on the more sustainable management for the Transport Logistics in Industries as from a sampling of transport logistics in a beverage industry, which operates in the American continent.

INFORMATION TECHNOLOGY IN SUSTAINABLE DIGITAL TRANSPORT

The concept of transport logistics cannot be defined in the traditional way, in other words, focusing on the use of a single and absolute modal. The possibility of alternating the model highlights the importance of the concept of cargo transportation by synchromodality; it consists of an activity with multiple ways of transporting the load, favoring this employment with flexibility and dynamism of the most ecological mode (LEMMENS et al., 2019).

The transport logistics policy of the company should favor adoption of a parallel action of multiple forms of transport, without prejudice to the activity, destination, and its stock, according to strategy or convenience, with the use of intermodal terminals (PEREZ-RODRIGUEZ; HOLGUÍN-VERAS, 2014). Thereby, the synchromodality increases the level of freedom of the logistics operator in the use of available modals. As a benefit, it allows the management of intrinsic risks approximately in real time, that favors the reduction of impacts, uncertainties, and disruptions in the process (LAVALLE, 2017).

Because operators can change the strategy easily, the performance of sustainable practices is favoured, and it is not compromising on costs or responsiveness, even if transportation is slower or on smaller modals (CHHABRA et al., 2017).

It is worth mentioning that advances in transhipment technologies are important in this process. The difficulty of access or even the lack of such IT can influence the dynamics of the strategy previously defined (ANGELINI et al., 2019). So, non-availability or difficulty in accessing the tool can affect the sustainable performance of the company's transport logistics.

There is the attraction of skilled workers that lives in other regions, for perceiving practicality in corporate daily life as a differential, generating a structure that provides a better quality of life at work. Added to the positive feeling of being part of a responsible organization that produces greenhouse gases (RADONJIČ; TOMPA, 2018), and yet, it manages to be sustainable by contributing to the mitigation of environmental problems, with the use of renewable energies and a reduction in the gas emissions.

Thereby, some factors, such as the geography of the operating location and the infrastructure provided by the cities, are fundamental for the transportation operation to have alternatives that become economically sustainable. The same perception occurs in regions with flat and narrow streets as they present aspects that allow, in a complementary way, logistics operators to choose modals, such as the bicycle, that keep the duration of trips within the established standard, meeting deadline delivery time. Thus, it is important to keep a low stress network, with connectivity islands and the support of a

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Perspectivas Contemporâneas
Revista Eletrônica de Ciências Sociais Aplicadas

management mechanism to facilitate the identification and forecasting of the complex barriers presented by street standards (PUTTA; FURTH, 2019).

The use of IT and, in more detail, the properties that favor connectivity and the features that contribute to the dynamics of the transport system, favour the perception of a structure in levels to explore the complex traffic network. Therefore, the division into parts within the regions, to represent local connectivity, allows the development of techniques and methods adaptable to applications at various scales in space and time in the different city structures (YU et al., 2019).

With empirical analysis it is possible, inside the urban traffic system, to develop a classification on three levels: from zero to slow and fast (LI et al., 2019). Therefore, leaving the view of traditional applications that perform traffic and congestion monitoring by collecting data from the vehicles present, that is, working with a lag in data delivery by using fixed routing protocols not considering different situations (YILDIRIM et al., 2018).

Given this scenario, it is possible to develop specific technologies for the different characteristics of cities, contributing to the existence of a platform that discusses cleaner production, in the theoretical and practical field, addressing environmental and sustainability issues (LAKSHMANAPRABU et al., 2019). The increase in security and the volume of sustainable information technologies, that is, green, drives the concept of smart cities.

The current context of the 4.0 revolution has been affecting the structure of companies that operate transport and need to gain access to distant markets through improved management of operating costs, time savings and the search for new service providers to support the activity end. The management of unforeseen costs, synthesized by some managerial inefficiency, generates the provision of a low-quality service (ELLIS, 2018).

Therewith, the cost of implementing new practices classified as lean can generate, with IT, a maximum utilization of the potential for organizations. It happens with the use of BIM - building information modeling - developed and used in civil construction (FAN et al., 2019). In this way, it is possible to verify in the components of the lean methods functionalities that can be replicated as good practices for the transport area, but for this to be done, the company needs to accommodate its activities with features and tools (LATIFFI et al., 2013; AKINADE, 2017).

With the use of IT in the transport operation routine, some concerns are highlighted, such as: the infrastructure and architecture software available in the operation. Thus, it is possible to search for access to the freight and services markets, reduce transportation times, increasing the reliability and the level of quality of service provision. Some companies are developing logistical solutions in accordance with the concept of Industry 4.0, this action is only possible for companies that have developed a horizontal integration based on networks, which facilitates the development of an internal interaction (STOCK; SELIGER, 2016).

As a next activity, it is possible to develop a vertical action that integrates the subsystems, giving the most flexible production process to adapt to future demands with product customization (ABRAMOVICI; HERZOG, 2016). With this, it is possible to check and adjust the internal logistics of the

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Perspectivas Contemporâneas
Revista Eletrônica de Ciências Sociais Aplicadas

transport area through appropriate equipment for a movement capable of reacting quickly to unforeseen events, operating independently between the starting point and the destination point (PORTER, 2015).

The transportation system is an alternative to reduce pollutant emissions and offer options to reduce energy and fuel consumption and waste generation. Thus, it is possible to achieve a balance between economic, social and environmental values. As the industry's production chain ends up being influenced by the digitization of its structure, it is possible to verify that the use of big data, of industry 4.0 practices, advanced tracking technologies, additive manufacturing, directly influence the emergence of digital logistics, which demands that transport and its management be adequate to the processes (ADDO-TENKORANG; HELO, 2016; KÜPPER et al., 2016; NGUYEN et al., 2017).

The adoption of 5Vs: volume, variety, velocity, veracity and value characterize Big Data. The highlight is the value and veracity for directly implying knowledge extraction from immense amounts of data (WAMBA et al., 2017). Technology 4.0, as it is based on collaborative cyber-physical systems, represents an intelligent network concept, where machines and products interact with each other, regardless of human action, which reconfigures the structural dynamics (IVANOV, 2018). Thus, through the IoT (internet of things), the transport operation can seek alignment with the demands, that is, in an empirical way to learn from the execution of routines.

Additive or 3D manufacturing is the joining of layer upon layer, as opposed to methods such as machining, that is, subtractive (SILVA, 2017). Thus, as this model reduces the need for inventory and demand, transport needs to be aware of the higher speed of delivery by reducing the distance between the product and the customer, and not having bottlenecks in the process.

The tracking functionality with recently acquired technologies favors the sharing of information in real time, allowing quick and necessary adjustments to the planning of actions and the coordinated implementation of recovery policies (SHEFFI, 2015; LI; HUANG, 2017). With this, any good can be traced back to its destination avoiding tampering, which protects the transport operator himself who will be able to work for multiple clients.

The contribution of IT in the financial performance of transport and software for the management and reduction of environmental impact are also known as “IT´s” Green Information Technologies that observe the laws that impose restrictions on the circulation of trucks on days and times (MUDULI et al., 2013). In this way, companies that comply with legal regulations regarding environmental effects mitigate the strong external pressures that exist for the adoption of green practices in environmental management, such as: market, regulation, competition, suppliers and society. Consequently, the results increasingly demonstrate that environmental management is a strategic issue for organizations and can result in a positive long-term impact on organizational performance (FRANCO et al., 2017).

METHODOLOGY

Data collection started with the observation of the image that the company passes through management reports, without prior consultation of the literature so as not to influence the research

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instrument. That is, the researcher, when checking the reports, with previous concepts of applicability the company, made notes on actions and portrayed images.

With that, it was possible to identify, by capturing words used in the text, own expressions that were converted into specific notes, the so-called verbatin, specific vocabulary to guide the execution of the research protocol in this step. In a second moment, as it is an exploratory research, the bases used to identify concepts and theories for analysis and discussion in the thematic context of the research were based on the analysis of the data occurred through theoretical principles taken primarily from electronic research sources as CAPES Journal Portal, Scopus and Web of Science on the topic, observing thematic hierarchy to facilitate analysis and discussion

The third moment was the perception of the main problems dealt with in everyday life, which, when confronted with the bibliography, enabled the organization to contribute levels of the use of ITs with a focus on sustainable management in a transport operation of a large beverage industry that operates in the American continent from the point of view of the professionals who define the transport strategy.

The last step was the preparation of the focus group - FG with six respondents, which took place partly in person, and partly via a communication application that made it possible to contemplate employees from other population groups, such as people from different regions or countries (KLEINE et al, 2016). Figure 1 illustrates the flow used by the methodology consisting of four phases and each column represents the activities of each phase.

1 **Collection occurred through the identification of *verbatin* and as defined in the research protocol**	2 **Data analysis occurs through theoretical principles taken from the literature**	3 **Proposal for a sustainable management system model in response to problems dealt with daily after reading technical reports and bibliography**	4 **Structuring the focus group**
When checking the company's reports, actions were taken, and images portrayed by the company	The green characteristic was used as a selection criterion hierarchy	The relationship between IT use and sustainability	Preparation of questions with semi-flexible characteristics
The definition of specific vocabulary to guide the execution of the research protocol in this step.	Sustainable transport logistics	TI's contribution to the financial performance of transport;	Definition of the place and structure of the discussion
Previous literature and concepts were avoided at this stage.	The effect of sustainable performance with the use of IT capacity on the logistics of transport	Effect of sustainable performance with the use of IT capacity;	Choice of participants and time management to make the most of the
	The elements that influence digital transport logistics	Sustainable management practices through IT in the transport area	Presentation of topics through questions

Figure 1 - Stages of the research process
Source: Authors

In their research, Almond and Verba (1963) resorted to the use of questionnaires on the attitudes of individuals towards the political system, to measure the civic competence of different countries. In this specific case, numbers were fundamental instruments for explaining the phenomenon under analysis.

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Perspectivas Contemporâneas
Revista Eletrônica de Ciências Sociais Aplicadas

To complement the analysis, the data from the institutional reports were used by 44 professionals with training in administration or engineering and directly involved with the transport strategy or in related areas. Data were collected from January to August 2019. The sample of the research had, as its primary source, the transport area of a large beverage industry that operates in Latin America. As it has an extensive transport network and was delimited in the analysis of six countries that make up its operation, where they adopt sustainable management practices with use of ITs in its distribution to retail.

The research was based on the correlation between the contexts analyzed and the possible contributions of IT to the transport operation. The responses were consolidated and submitted to the focal group - FG of teachers working in management and logistics to identify the opinion of interest to substantiate the online search for selected statements (AJANI et al., 2013).

The script questions after the pre-test were sent to and answered in a period of 45 days, counting from the sending of the first invitation to all eight managers. The participants are based in Mexico City, within the corporate structure of logistics and are responsible for defining the road logistics strategy for the industry operating in 16 Latin (latin american) countries. As shown in Figure 2, the six most relevant ones taking the survey from Brazil, which present an average of 1354 km per day traveled by trucks, are: Colombia, Peru, Ecuador, Mexico, and the Caribbean.

The average mileage traveled reflects the transport of finished products between factories and distribution centers, without considering the distances between deliveries and the point of sale. Thus, as the truck mode has the greatest impact, with the others having little representation, the operation builds a large part of its decisions on the use of this as an indicator.

ANALYSIS OF RESULTS

The daily problems presented in the organizational reports were identified in the literature and organized by the authors who present solutions for the correct use of technologies to solve them, through the formatting of processes. Thus, it is possible to indicate the relationship between the use of software and sustainability, and to point out the importance in the acquisition by the company of an IT that can assess the strategic fit of assets (BAUER; MATZLER, 2014). In this way, the company demonstrates aspects that characterize the effects of sustainable performance with the use of IT capacity to meet environmental issues, and other demands that the operational reality demands.

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Perspectivas Contemporâneas
Revista Eletrônica de Ciências Sociais Aplicadas

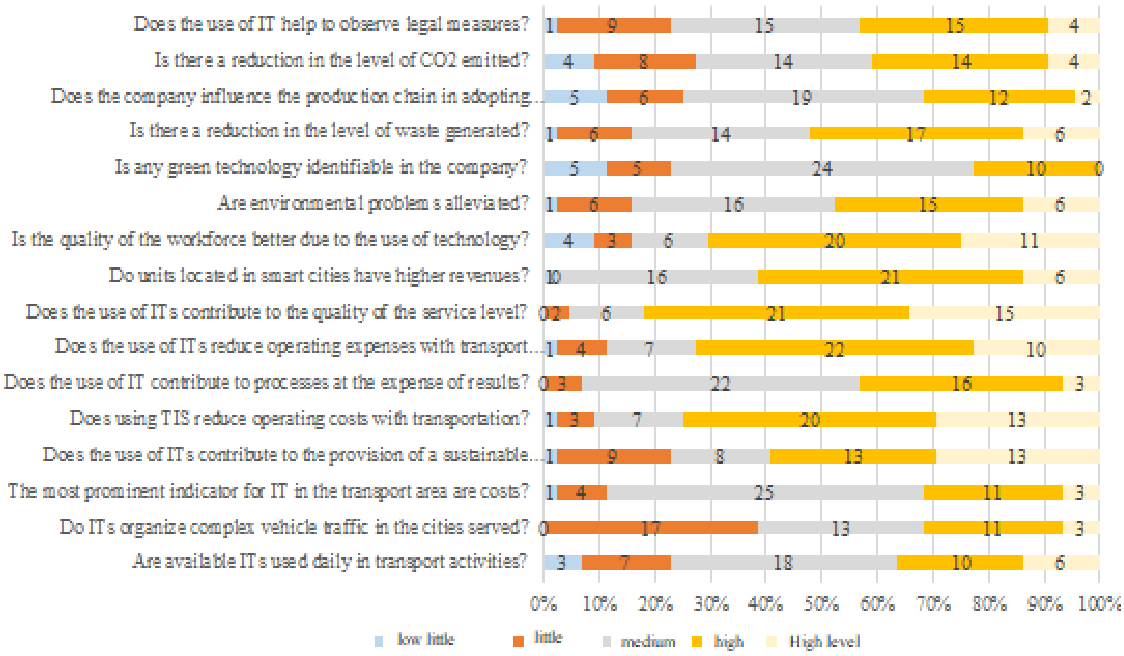

Figure 2 - Comparison of the assessment of the effects of sustainable performance with the use of IT capacity
Source: Authors

According to figure 2, the result of the research presented, as a major concern, the quality of the employed labor and the use of a good part of the functionalities available in IT, different from the evaluation of the values attributed to the aspects by the operation of the South, with higher marks and more uniform distribution. Thus, the organization can segment the transport operation according to the needs and planned production conditions and customize the types of tires used to reduce consumption, which is one of the biggest sources of operating expenses (PASCUAL et al., 2019).

Due to its contribution to sustainable performance, IT is classified as green, as it favors the increase of organizational transparency, by maintaining the protection of economic, environmental and human capital, providing security to shareholders through a composite index (NIKOLAOU et al., 2019). With that, the solution for many first level demands already exists, in functionalities that the software presents and are not used by the organization. Thus, the solution would be the training guided by the learning directed to the objectives and strategies of organizational learning (GRECO et al., 2019).

So, the company's commitment to identifying the collective phenomenon, such as organizational learning, supports government actions, contributing to society for sustainable development, essential in the global sustainability solution and in the redesign of the consumer partner (FELIN et al., 2015). One of the main critical sources of pollution is road transport activity, which the company can reduce the effects of using IT and sustainable management practices, favoring the adoption of an operational routine (SHI et al., 2019). Thus, it presents the constant need for a better understanding of the relationship between sustainability strategies and green practices applied to the IT area (GONZÁLEZ; EPSTEIN, 2015).

Managers using cultural change can encourage the adoption of green practices, implementing reward and incentive methodologies to facilitate employee participation in ecological practices (LI et al., 2017).

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Perspectivas Contemporâneas
Revista Eletrônica de Ciências Sociais Aplicadas

Thus, it is not perceived how much sustainable actions can provide high gains, by associating the good management of limited resources with a tolerance, reducing losses (DEIMLING et al., 2017).

PROPOSITION OF THE SUSTAINABLE MANAGEMENT SYSTEM MODEL

Data analysis did not indicate that the company is familiar with the definition of sustainability in manufacturing, with the formalization of a systematic of some aspects of application of its stages. In this way, it is perceived that not all the techniques available for use in the identification and evaluation of the contribution are fully known as the most used for the evaluation, management of deadlines and return on investment.

Within this context, the first relationship that the manager needs to analyze is the use of all IT functionalities already available in the company (SMITH; SRINIVAS, 2019), favoring the assessment of management systems and organizational structures, adopting a lean and sustainable process. With that, it was possible to carry out a vertical analysis between the frequencies of the answers to perceive the level of contribution of the operational activities using as a score the sum of the marks attributed as high and very high in each question, as shown in table 1.

Table 1 - Vertical analysis of responses with high and very high impact

Question	Punctuation	Concentration
Does the use of ITs contribute to the quality of the service level?	36	10.20%
Does the use of TIS reduce operating costs with transport?	33	9.30%
Does the use of ITs reduce operating expenses with transport operations?	32	9.10%
Is the quality of the workforce better due to the use of technology?	31	8.80%
Do units located in smart cities have higher revenues?	27	7.60%
Does the use of ITs contribute to the provision of a sustainable transport service?	26	7.40%
Is there a reduction in the level of waste generated?	23	6.50%
Are environmental problems alleviated?	21	5.90%
Does the use of IT contribute to processes at the expense of results?	19	5.40%
Does the use of IT help to observe legal measures?	19	5.40%
Is there a reduction in the level of CO2 emitted?	18	5.10%
Are available ITs used daily in transport activities?	16	4.50%
Do ITs organize complex vehicle traffic in the cities served?	14	4.00%
The most prominent indicator for IT in the transport area are costs?	14	4.00%
Does the company influence the production chain in adopting green practices?	14	4.00%
Is any green technology identifiable in the company?	10	2.80%

Source: Authors

As a result, the concept of agile methods cannot be discarded because it favors the constant inspection and adaptation of the logistical economics process, which will go through the automation of logistical processes, to improve the overall performance of the supplier, as much as possible to reduce the number of intermediaries. In this context, the relationship between the levels of maturity and the integration of management systems gains importance as it directly affects sustainable performance.

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Perspectivas Contemporâneas
Revista Eletrônica de Ciências Sociais Aplicadas

Given this scenario, it is possible to build a model, step by step, that guides the process of changing the current situation through a sequence of approaches necessary for continuous improvement that characterizes production systems as sustainable (LASRADO et al., 2016). In addition, informal activities and potential benefits that influence maturity, and the form of possible interventions can be made official.

Through the maturity model, it is possible to provide information for a structured approach to the problems and challenges of an operation, identifying points that are a reference to assess the capacities and roadmaps for improvement (LAKSHMANAPRABU et al., 2019). In an overview, the model reduces the negative impacts on the environment caused by economic growth, by avoiding the waste of time guiding the development of the action in five stages, as shown in Figure 3.

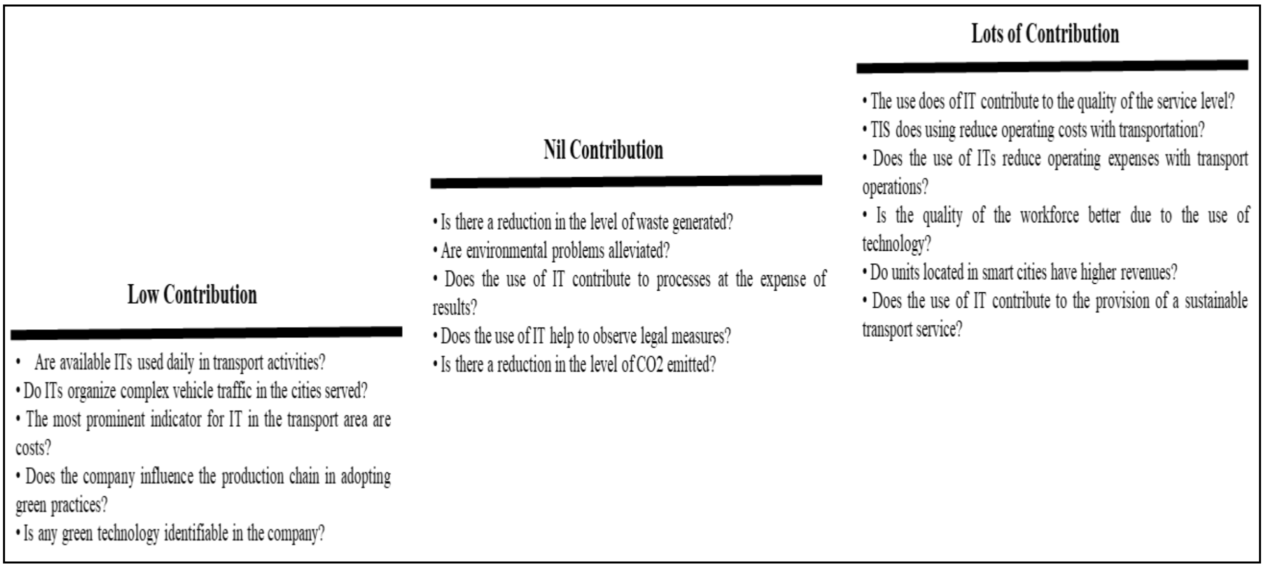

Figure 3 - Evolution stages of the maturity model
Source: Authors

The separation into three groups favors the understanding of the stages of a maturity model that should start the approach of the process by the current level of operational model. This operational model, that is in force, is characterized by being all mechanic, with the driver being responsible for all management activities, without the support of automation that demands a greater amount of time in the activity with reflexes in the industrial processes. At the initial level, the vehicle is controlled by the driver, but some steering assistance features may be included in the vehicle design. At this stage of the process, it is important to involve the driver to identify tasks that do not work or are obsolete and in many cases the user will not want them anymore.

The vehicle can combine some automated functions, but the driver remains engaged in the task of driving and always monitoring the environment. At this stage it is important to record all tasks to avoid the personal influence of the operators, which can divert the focus from the activity and characterize the level of the known. The next level is standardization, where the focus is on driving because there is a need to monitor the environment, not the driver. Although the driver must be ready to always take control of the vehicle, this step is critical for reaching maturity in operation. It is the moment of perception of the necessary adjustments for formatting the process.

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Perspectivas Contemporâneas
Revista Eletrônica de Ciências Sociais Aplicadas

At the management level, the vehicle must be able to perform all steering functions under certain conditions, the driver still has the option of controlling the vehicle, upon prior notice of any non-conformity or completion of the activity. Thus, it will be possible to propose a new formatting of the manufacturing processes favoring new and more sophisticated products than the old ones.

At the next level, the vehicle can optimize and perform all steering functions under all conditions, favoring the improvement of various sales channels, improving the reliability of product delivery to the customer and providing actions that can be translated into a set of guidelines or recommended solutions to increase customer satisfaction.

Maturity proposes stages and levels to become more sustainable with the integration of management systems. To explain it in detail, table 2 presents the aspects of the model that guide the integration of the operator with the software.

Table 2 - Sustainable management system model

Maturity Levels	Impact of using IT	Action	Classification of tasks	Manufacturing space	Sustainable business value	Author
Current	Does not occur	The driver is responsible for all driving activities, without automation	Isolated	In separate areas	Difficult to measure	GUNASEKARAN et al., 2015
Initial	Driver assistance	The vehicle is controlled by the driver, but some steering assistance features may be included in the vehicle design.	Partially joint	In separate areas	Structures and organizes information to model and understand traditional land use in dimensions using georeferencing	OLIVEIRA et al., 2019
Known	Partial Automation	The vehicle is able to combine some automated functions, but the driver remains engaged in the task of driving and monitoring the environment at all times.	Human and IT not co-located.	In the same task.	Starts managing custom processing with customer order information and shareholder interests	WAN et al., 2016
Standardized	Conditional automation	Steering is a necessity to monitor the environment, not the driver must be ready to always take control of the vehicle.	Human and IT co-located	In the same task.	Allows performance sizing avoiding idle production lines, with CO2 emission control and intelligent production	SHU et al., 2016
Managed	High automation	The vehicle can perform all steering functions under certain conditions, with the option of controlling the vehicle, with prior notice.	Human and IT co-located	In separate areas	The implementation in the company of mobile services and cloud computing technology favoring the development of an intelligent manufacturing environment	RADANLIEV et al., 2019
Optimized	Complete automation	The vehicle can perform all steering functions under all conditions and can decide whether to control the vehicle.	Human and IT co-located	In separate areas	By integrating and applying cloud computing technology in its dynamic resource management and sharing activities, it is possible to propose a sustainable customer-oriented production process	ZHANG, 2016.

Source: Authors

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Perspectivas Contemporâneas
Revista Eletrônica de Ciências Sociais Aplicadas

In short, the matrix presents how to organize the levels and favour the dissemination of knowledge and good practices. In this way, the progress in observing the levels characterizes logistics as transformational because it includes activities that were not measured in the process and identifies the fundamental points in the crossing of information (THIEM; DUSA, 2012; FISS, 2011).

In these conditions, it is possible to follow the serious and rapid changes that the infrastructure influences by the actions of global economy, taking advantage of the benefits that economic agent obtains to be able to receive the order and serve the consumer of the goods or services in the shortest period. As the processes can occur simultaneously in different operations, evaluating the existing relationship, it is possible to search for green practices, choose the rhythm and the management system that the activities take place and as a result will define the time and budget spent at the maturity levels.

CONCLUSION

In general, the FG found that the lack of decision-making mechanisms makes it difficult to disseminate the benefits that the resources employed urgently need to undergo systematic examinations that meet the needs of the various areas within logistics. Thus, the management of the technology available in the company is important because it provides information to the areas responsible for transforming routine and periodic activities into activities of significant improvement during its process. Thus, the aggregated standards and criteria are modeled more frequently by the influence of internal and external factors, producing not only the intended effects, but also the unintended ones. With this interaction, the adjustments are discussed with a higher level of security, making it possible to increase the efficiency of the transport logistics operation in the areas of two different regions of Latin America by adopting a green management system.

As a result of the FG, it was noticed that the ordering of impacts by IT and tasks contributed to the proposal of an efficient model that presents some opportunities in the search for sustainable values to the business. Given this scenario, the authors analyze that the contributions are not restricted to the business logistics environment of these regions. The effects are also perceived in areas such as the environment, mainly for contributing to the rational use of fuels, which will have the consequence of reducing polluting gases such as CO^2. Achieving this synchronization between production and suppliers by means of technology minimizes subassemblies linked to the release of space in the stock and warehouses, reducing the number of people involved in carrying out warehouse operations.

In addition, the proposed model, based on direct delivery by the manufacturer, has reduced contact and the number of products damaged by handling, the emergence of spaces for intermediate storage. With this, it is possible to look for alternative suppliers to perform the integrated assessment. Thus, the green strategy favors the effective assessment of parameters optimized in production logistics, providing entities with conditions in the digital economy.

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