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Extending the Luftman Maturity Strategic Model

An evaluation of IT-Business Strategy Alignment in the Portuguese Logistics Sector

Beatriz Pina de Sousa e Melo

Dissertation

presented as a partial requirement for obtaining the Master's Degree Program in Information Management

NOVA Information Management School
Instituto Superior de Estatística e Gestão de Informação

Universidade Nova de Lisboa

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EXTENDING THE LUFTMAN MATURITY STRATEGIC MODEL

AN EVALUATION OF IT-BUSINESS STRATEGY ALIGNMENT IN THE PORTUGUESE LOGISTICS SECTOR

By

Beatriz Pina de Sousa e Melo

Master Thesis presented as partial requirement for obtaining the Master's degree in Information Management, with a specialization in Information Systems and Technologies Management

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STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledge the Rules of Conduct and Code of Honor from the NOVA Information Management School.

Lisbon, 2023

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ABSTRACT

This paper examines the significance of IT-business alignment in the logistics sector for establishing a sustainable competitive advantage and ensuring business success over the long term. In the current landscape, the rapid evolution of new technologies underscores the imperative for companies to recognize the potential of technology in enhancing operational efficiency and positively impacting society, the workforce, and overall business strategy. Therefore, this study employs a three-phase methodology with the aim of extending an existing strategic maturity model and applying it in the current Portuguese logistics sector. Derived from Luftman's Maturity model, the expanded model was formulated using insights from the existing literature and subjected to evaluation by a specialist proficient in both IT and logistics. This evaluation resulted in the incorporation of two additional dimensions (Data and Processes) and two new technology attributes. The application of the extended model reveals that, on average, Portuguese 3PL companies operate at Level 4, characterized as "Improved/Managed Process," with a cumulative score of 3.84 points. This study extends a maturity model tailored for the logistics sector and contributes valuable insights into information technology's role as a driver of competitive advantage in the logistics domain.

KEYWORDS

Information Technology; Logistics; IT-Business Alignment; Luftman Model; 3PL; Strategy

Sustainable Development Goals (SGG):

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LIST OF ABBREVIATIONS AND ACRONYMS

1PL	First-party logistics
2PL	Second-party logistics
3PL	Third-party logistics
4PL	Fourth-party logistics
5PL	Fifth-party logistics
AGV	Automatic Guided Vehicle
AI	Artificial Intelligence
APLOG	*Associação Portuguesa de Logística*
AR	Augmented Reality
CIO	Chief Information Officer
CSCMP	Supply chain Management Professionals
DDS	Decision Support Systems
DMCM	Data Management Capability Model
EDI	Electronic Data Interchange
ERP	Enterprise Management Systems
EU	European Union
IoT	Internet of Things
IT	Information Technology
OCR	Optical Recognition
RFID	Radio Frequency Identification
SAM	Strategic Alignment Models
TFEU	Treaty on the Functioning of the European Union
TMS	Transport Management Systems
UAV	Unmanned Aerial Vehicle
US	United States

WMS Warehouse Management Systems

WSN Wireless Sensors Network

1. INTRODUCTION

1.1. BACKGROUND AND PROBLEM IDENTIFICATION

The market is constantly evolving. New technologies are frequently shaping up, standards are dynamic, the product life cycle is compressed, and recent technological advancements need to be adopted at a much faster rate. We are going through Industry 4.0.

According to Deloitte, Industry 4.0 refers to the *marriage of physical assets and advanced digital technologies—the Internet of Things (IoT), artificial intelligence (AI), robots, drones, autonomous vehicles, 3D printing, cloud computing, and nanotechnology.*

The increasing technology available in the market and the processes of digitalization require adjustment in how IT is viewed in a business and what its actual role is.

Companies must understand that technology can help technological operations and improve societal impact, workforce, and overall business strategy.

Therefore, it is essential to understand the power and the meaning of Information Technology (IT) in today´s era.

Information Technology is the technologies engaged in collecting, transporting, storing, exchanging, and using information (George Reynolds, 2015).

According to Chew and Gottschalk (2009), Information Technology leverages businesses to be competitive in the market by creating value for the organization. Although, technology, by itself, does not create any value for the organization. There is a need for alignment between business and IT without a correct alignment. According to Chew (2009), *business and IT work in unison as a single entity, from strategy creation to execution.*

Achieving IT-Business alignment is evolutionary and dynamic. Companies must see IT in harmony with the business and vice versa by addressing both *doing the right things (effectiveness) and doing things right (efficiency*) (J. N. Luftman, 2011). As a result, companies will create a long-term competitive edge advantage and perhaps a sustaining and successful business (Joshy & Thakurta, 2022).

One good example is the logistics sector, where the initial Luftman proposal needs to be adjusted before its application.

Therefore, by analyzing the existing information gap about IT-Strategy alignment to achieve a competitive advantage in the logistic sector, this study aims to extend an existing model for better use in the sector and propose a set of recommendations that allow 3PL companies to make better use of IT to be more competitive in the market. To address this problem, the following research questions were formulated:

RQ 1– What updates/extensions can be made to Luftman's model to make it suitable for today's logistics companies?
RQ2 - What is the current level of IT-Business strategy alignment of 3Pl companies in Portugal?

1.2. OBJECTIVES

To help answer the research questions, the research aims to extend an existing maturity strategic model to be applied in the current logistic sector and to use the created model to assess the current Portuguese IT- Business Alignment.
To provide an answer to the research questions mentioned above, the following intermediate objectives were defined:

- Make a comprehensive literature review about the logistics sector, including technologies used in the sector and their contribution to it.
- Identify competitive advantage drivers inside the logistic sector.
- Explore logistics 4.0 and the contribution of the logistics sector.
- Make a comprehensive literature review on IT-Business alignment models.
- Build a new IT-Business Model adapted to today´s logistic sector.
- Validate the new model with logistic experts and information systems experts.
- Build a survey to assess the alignment between IT and business strategy.
- Apply the survey to third-party logistic companies that operate in Portugal to identify IT strategies applied in the business and the IT/Business alignment awareness.

1.3. IMPORTANCE AND RELEVANCE

According to *Associação Portuguesa de Logística (APLOG)*, regarding the previous year (2021), quantifiable external logistics represents around 14.7 thousand million euros of invoicing volume, 5.7% of the VAB of the national economy, with over 11000 companies and involving 2.8% of total federal employment (Jornal de Negócios, 2022)

In a recent and very enthusiastic paper about modernizing logistics, the authors addressed that, despite the recent slowdown caused by COVID-19, *the global transport and logistics sector market is set to thrive from around US$8 trillion in 2020 to about $12.8 trillion in 2025* (Alessandro Borgogna Partner & Raad Principal, 2022).

Several factors led to the growth of this section. In the paper context, those who stand out are advanced technologies and the enabling and efficient effects of digitization on Logistics (Alessandro Borgogna Partner & Raad Principal, 2022)

Logistic companies are facing an era where digitalization is changing the customer experience. The technologies available in the market enable collaborative operating models, greater efficiency, and more optimized processes.

An essential factor for business health is *aligning new trends in IT with what businesses already do in the organization* (Alsolamy et al., 2014). As Luftman defends, IT-Business alignment is the *application of information technology in an appropriate and timely way, in harmony with business strategies, goals, and needs* (J. N. Luftman, 2000).

As such, Logistics companies have the dimensions, knowledge, and market that can also benefit from IT-Business alignment strategies. Also, digital is still a challenge for logistics companies. This gap must be seen as an opportunity to improve overall performance and the customer journey, leading to a gain of competitive advantage.

With the present study, we expect to contribute with an IT-Business strategy alignment model specifically designed for the logistics sector and provide the proper knowledge about Information Technology in the logistics sector as a competitive advantage driver. Additionally, we will conduct a practical application of the proposed alignment framework within the 3PL sector to gauge its current maturity level.

2. METHODOLOGY

Research, in plain language, refers to a search for knowledge. According to Clifford Woody, it comprises defining and redefining problems, formulating hypotheses or suggested solutions, collecting, organizing, evaluating data, making deductions, and reaching conclusions (Kumar, 2008). In other words, research is an original contribution to existing knowledge and further developments.

The methodology is the procedure of research techniques and the logic of scientific investigation. (Daniel & Sam, 2010), in a way to systematically solve the research problems (Kumar, 2008). According to the Merriam-Webster dictionary, methodology is a body of methods.

Thus, the methodology applied in this study to achieve the specific objectives is composed of three phases, as presented in Figure 1: 1) the Exploration phase, 2) the Analytical phase, and 3) the Conclusive phase. Each phase can be divided into specific sequential steps, as identified in the following Figure:

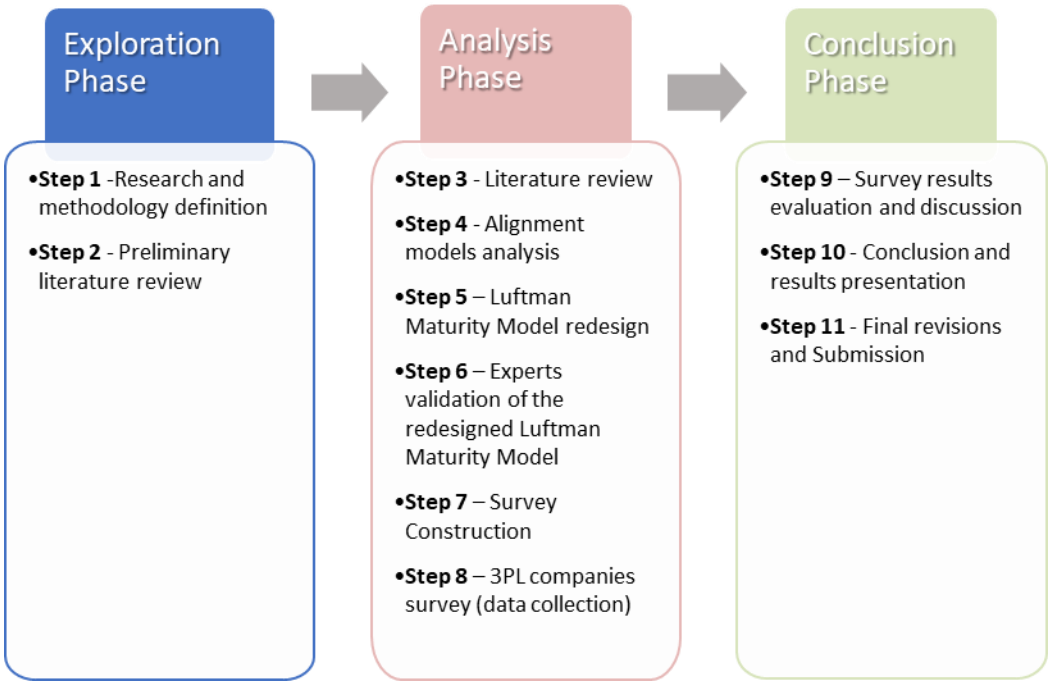

Figure 1: Methodology approach.

The methodology has a total of eleven steps, as described above:

- In the first step, research is performed to understand and define the background, justify the motivation to construct the present study, and determine the best approach to develop the research to accomplish the research questions.
- The second step includes preliminary research about the logistics sector's business strategy and IT strategy to understand how the market is working and what the problems and opportunities could be.
- In the third step (first step of the analysis phase), a literature review will be performed about the logistic sector and the alignment between IT and business strategy. The logistics concept and the different logistics business models will be introduced in the logistics sector part. Conversely, alignment will be deeply explained, referring to the objectives and importance of aligning business with IT strategy. Also, the two most essential alignment models will be introduced: Henderson e Venkatraman and Luftman.
- The fourth step focuses only on deeply analyzing the two most essential alignment models: Henderson e Venkatraman and Luftman. Each model will be individually deconstructed to understand the central assumption, goals, elements, and considerations.
- Following an in-depth examination of the Luftman model, the fifth step revolves around adapting the Luftman Maturity Model to better suit the specific needs and requirements of the logistics sector. This adaptation also accounts for contemporary developments, such as the significance of digital transformation and data.
- Due to incorporating novel domains in the redesigned Luftman Model, the sixth step involves engaging logistics and Information Technology experts to assess the redesigned model's viability and potential for practical implementation. With the expert's opinion, the redesigned model will be updated, originating a revised Luftman Maturity Model.
- Once the redesigned Luftman Model has been finalized, the next step (seventh step) involves creating a survey using Google Forms. The survey's structure must adhere to the guidelines of the Luftman Model. Surveys are widely used to collect data and gain insights from many respondents efficiently. By carefully designing the survey, we can ensure that the questions are clear, relevant, and linked with the research objectives, allowing us to collect valuable data for alignment analysis. The survey questionnaire will be structured into groups of components, each addressing a particular dimension of the IT-Business alignment model. To assign a numerical value to each option, we will use a weighted scoring method, where option one receives one point, option two receives two points, and so on, up to option five,

which receives five points. This classification is based on the assessments presented by Luftman in 2001 (J. Luftman, 2000). To calculate the maturity level score for each component, we will sum the scores for all questions within that component and divide the total by the number of questions answered. This will yield a score between one and five for each component, where a higher score indicates a higher level of maturity. This activity will take place in the seventh step.

- The eighth step necessitates meticulous preparation and coordination to effectively reach the target group (3PL sector). The survey will be provided to a wide range of stakeholders, including C-level, managers, employees, and IT personnel which allows acquiring a comprehensive view of IT-Business alignment in logistics, from multiple viewpoints.
- The first step of the conclusion step (ninth step) aims to evaluate the survey results. This entails compiling and evaluating the obtained data to draw valuable insights. The data collected from the survey questionnaire will be analyzed using appropriate statistical techniques applied in the Luftman model to determine the level of IT-Business alignment maturity in the logistics sector. This analysis will provide helpful information about the IT-Business alignment's strengths, shortcomings, and areas for improvement, allowing it to make educated recommendations for improving the logistics sector's performance and, perhaps, gain more competitive advantage.
- The conclusion and results presentation (tenth step) is intended to highlight the main aspects of the present study and answer the two research questions of the study: "*What updates/extensions can be made to Luftman's model to make it suitable for today's logistics companies?*" and "*What is the current level of IT-Business strategy alignment of 3Pl companies in Portugal?*" as well as preparing the final research presentation for the jury, with the main results and explanation.
- The final step aims to make a last revision of the research produced to correct any mistakes found. After a careful review, the research is ready to be submitted for a grade.

3. LITERATURE REVIEW

3.1. LOGISTICS SECTOR

3.1.1. An In-Depth Overview of Logistics

Two theoretical systems can be identified in economics to explain the small and big picture: Microeconomics and Macroeconomics. Also, logistics' most general aspects can be separated into macro-logistics and micro-logistics.

Macro-logistics aims to ensure the efficient supply of customers, companies, and states with goods by organizing the traffic flows between sources and destinations in a particular country, region, and around the world (Gudehus & Kotzab, 2012).

On the other hand, micro-logistics aims to supply companies and consumers with the required goods most efficiently, based on private orders. To ensure the optimal development of a company, the *task of micro-logistics is to realize and operate logistics systems and to manage transport chains and supply* (Gudehus & Kotzab, 2012) networks to guarantee logistic 3 R's:

- Right place.
- Right time.
- Right Quantity.

Consequently, logistics manages the transportation and storage of materials during their journey from initial suppliers to end users (Waters, 2009). Logistics coordinate the flow of inputs from suppliers, the movement of materials through different operations within the organization, and the flow of materials to the customer. There are two types of flows:

- Inbound: Move materials into an organization from suppliers
- Outbound: More materials from an organization out to customers

Therefore, according to the CSCMP (Supply chain Management Professionals), logistics management can be described as *part of supply chain management that plans, implements, and controls the efficient, effective forward and reverse flow and storage of goods, services, and related information between the point of origin and the point of consumption to meet customers' requirements* (Murphy & Michael Knemeyer, 2015).

The above table (Table 1) describes the activities typically included in logistics and can be seen by following some materials movement through an organization (Waters, 2003):

Table 1: Logistics activities.

Activities Name	**Description**
Procurement	Procedure to find suitable suppliers, negotiate terms and conditions, arrange insurance and payments, etc. It does everything needed to get the materials into the organization.
Inward transport	Responsible for moving materials from suppliers to the organization's receiving area.
Receiving	When the truck from the suppliers arrives at the organization, receiving activity receives the trucks, unloads the car, and checks and sorts the material.
Warehousing	Moves materials to the storage and places them strategically until they are needed.
Stock control	Sets the inventory policies. Stablish stock levels, order sizes, and timing, ensuring the stock never runs out.
Order picking	Finds and removes materials from storage when an order is placed.
Materials handling	Moves materials through the operations within an organization.
Outward transport	Takes finished orders from the departure area and delivers them to customers.
Physical distribution management	Manage all the activities that deliver finished goods to customers.
Recycling, returns, and waste disposal	Return the materials that were not used to suppliers. Manage the activities that return materials from the customers to the organization

	(reverse logistics) and adequately separate all the waste created during the activities.
Location	Find the best location to place those logistic activities. Some factors to consider could be proximity to customers/suppliers, available area, fixed cost, etc.
Communication	Coordinating the information flow with other parties of the supply chain.

When discussing logistics, it is essential to understand what is behind a finished product, which can be a tangible good or service. The answer is *operations*, part of any organization, marketing, and finance (Ivanov et al., 2019). For an organization to produce a product, various inputs (e.g., raw materials) are transformed into outputs (e.g., goods or services).

Figure 2: General transformation process.

The transformation process is where the value-adding of a product is created (Figure 2). The value of a product is when a company clearly understands what the customers are expecting and willing to receive. According to Gudehus and Kotzab (2012), the occurrence of operations varies based on whether they are conducted in operative or administrative stations and involve tangible or intangible objects. The input can be materials/ goods, Internal/external orders, or information/data. The output for the corresponding inputs are Material/goods and information/data.

In the end, the overall aim of logistics is to *achieve high customer satisfaction* (Waters, 2003). To ensure this, the task of the process analysis is critical to ensure the value contribution and customer orientation. It should start with the analysis of the order chain that begins at the order acceptance, followed by order processing, procurement, production, and distribution, and lastly, the handover of the required objects to the customer (Gudehus & Kotzab, 2012).

On the other hand, the Supply chain consists of the *series of activities organization signs that materials move through on their journey from initial suppliers to final* (Waters, 2009), focusing on the coordination among business functions within and across organizations (Murphy & Michael Knemeyer, 2015)

3.1.2. Market Evolution

In the last decades, the logistic market has witnessed a period of changes in market globalization, technological advantage, and world economy stabilization.

In the 60s-decade, companies focused on capturing and creating customer loyalty by translating customers' needs into product or service specifications. In the 1980s, the demand for new products escalated, and the manufacturers had to become more flexible and responsive to meet ever-increasing customer needs (Hoang Tien et al., 2019). Treaty on the Functioning of the European Union (TFEU) is *the right to the free movement of goods originating in EU Member States and of goods from third countries that are in free circulation in the EU Member States* (Ratcliff et al., 2023) was one of the firsts changes in the world economy that converts how the world trade is made.

By the 1st of July 1988, Customs duties and quantitative restriction elimination between EU Member States had *resulted in lower prices for truck shipments* (Murphy & Michael Knemeyer, 2015). They marked the beginning of the remarkable evolution of the logistics sector.

The same happened in Europe. The US reduction in economic regulation, which removed entry barriers and eliminated price-setting officers, allowed a more competitive sector with better services and prices (Lafontaine & Malaguzzi Valeri, 2009)

According to the study produced by Armstrong and Associates (2021), the leader in 3PL market research and consulting, in 2020, the percentage of logistics in the function of the Global gross domestic product was 10.8%. Indonesia registered the highest percentage (22.0%), and the Netherlands registered the lowest percentage (7.4%) (Armstrong & Associates, 2021).

In 1990, managers realized that suppliers had a significant role in meeting customers' needs despite the reduction in economic regulation. This closer relationship with the suppliers allowed them to lower product costs, better quality, improve service, reduce time-to-market, and advance technology (Daugherty, 2011). This change of mentality led to an entirely new type of challenge: getting products to customers when, where, how, and in the quantity that they wanted in a cost-effective manner (Hoang Tien et al., 2019).

Besides the growing relationship with suppliers, other factors led to an increase in the logistic sector: 1) Changes in consumer behavior, 2) Technological Advances, 3) the Growing power of retailers, and 4) Globalization of trade (Murphy & Michael Knemeyer, 2015).

Customers are *increasingly demanding, tough to keep, and costly to replace* (Hoang Tien et al., 2019). Technology is on an exponential evolution and, day by day, is making our lives better and more accessible. Unlike the previous three industrial revolutions, the one we face (the fourth industrial revolution) leverages connectivity and communication among billions of devices. As a consequence of the fourth industrial revolution, logistics activities are more productive and optimized: Faster speed and higher reliability with the help of robots, lower operating cost by using intelligent sensors, and higher efficiency enabled by blockchain (Tang & Veelenturf, 2019)

Another influence on logistics involves the growing power of retailers. According to a study by Deloitte (2022), Amazon achieved the highest retail revenue growth in 2020, soaring by 34.8% year-over-year. Along with Amazon, Walmart leads the world's top 250 global retailers with a total of 559,151M in revenue (FY2020). These two retailers, Walmart and Amazon, are in the top one and two of the largest companies by revenue in 2022 (Fortune, 2023).

The success of both companies is due to the constant adaptation of the business to the evolution of the market and technologies (Deloitte, 2022). Also, the fact that the world trade value is today almost 347 higher than it was in 1950 levels leads us to conclude that the globalization of trade is another aspect that leverages the logistic industry (World Trade Organization, 2023).

3.1.3. Business Models

There are several business models commonly used in the logistics sector:

- First-party logistics (1PL) is the oldest concept used and often associated with 2PL (second-party logistics) (Meidutė et al., 2012) and can be described as having buying operations and selling operations in the exact location (Vasiliauskas & Jakubauskas, 2007). This term is also associated with in-house logistics since the manufacturer manages them alone. (Beidouri, 2018)
- Second-party logistics (2PL) could be seen as the first step in outsourcing logistics operations. The 2PL provides service to the manufacturer for a single or a small number of functions in the supply chain, such as transportation and, sometimes, warehousing. They face low returns, with high levels of asset intensity but low barriers to entry (Vasiliauskas & Jakubauskas, 2007). This concept came into the market when the manufacturers began to

extend their business geographically, and it became tough to manage all the logistics operations independently (Beidouri, 2018).

- Many 2PLs have evolved into 3PLs by adding new logistics capabilities and integrating their operations in response to the growing demand for one-stop solutions (Vasiliauskas & Jakubauskas, 2007). Besides transport and warehousing, third-party logistics can provide value-added operations such as pick-and-pack and cross-docking (Beidouri, 2018) based on information and knowledge. 3PL focuses on logistic solutions and looks for the optimal combination of assets available, making them more of a partner than a supplier (Vasiliauskas & Jakubauskas, 2007). 3PL providers have the expertise, infrastructure, and technology to manage logistics operations efficiently. They can often provide cost savings through economies of scale and allow companies to focus on their core activities instead of dealing with logistics operations (Domingues et al., 2015). The benefits of working with a 3PL provider are cost-saving, scalability, expertise, and technology.
- Fourth-party logistics is an extension of 3PL without any physical assets (trucks and warehouse). This type of service designs the logistic architecture and the information systems applied to the firm´s integrated processes (Beidouri, 2018). Also, 4PL is *responsible for the planning, construction, and integration operations while controlling and optimizing physical, financial, information, and knowledge flows in the delivery, manufacturing, and distribution processes and performing all the necessary activities, which are usually carried out by several 3PL providers* (Meidutė et al., 2012).
- There is also a new approach that appears with the e-commerce boom- Fifth-party logistics or lead logistic providers. The 5PL provides *overall logistics solutions for the entire supply chain* (Vasiliauskas & Jakubauskas, 2007) in conjunction with e-business (Beidouri, 2018). A 5PL's focus is to provide automated and intelligent systems that can improve supply chain performance, and the key to the success of this emerging family is the integration of information technologies and computer systems (Beidouri, 2018). This type of business model will not be deeply analyzed in the literature review once it is not applied in the study.

3.1.4. Competitive Advantage Drivers

Competitive advantage is *an advantage over competitors gained by offering more excellent customer value either by having lower prices or providing more benefits that justify higher prices* (Kotler et al., 2018)

According to Porter, cost leadership, differentiation, and focus are three internally generic strategies (Huggins & Izushi, 2011) that allow companies to separate themselves from their competitors, building a safe position in the market (Kankaew et al., 2021).

Differentiation and focus refer to *creating something perceived as being unique on an industry-wide basis and focusing on a particular buyer group, a segment of the product line, or a geographic market, respectively* (Huggins & Izushi, 2011). On the other hand, cost leadership is a generic strategy applied by companies that want to achieve the lowest production and distribution costs (Kotler et al., 2018).

Figure 3 summarizes Porter's suggested tactics for gaining a competitive advantage.

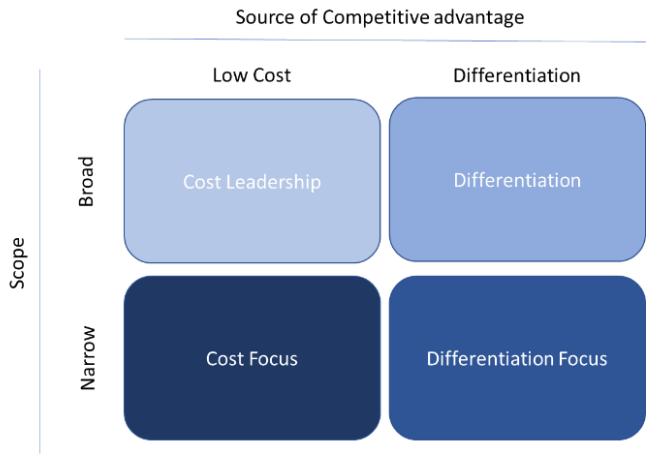

Figure 33: Porter's generic strategies.

Source: Adapted from Porter (1985).

The central question around generic strategies, defined by Michael Porter, is how a firm practices the chosen competitive plan.

Porter presents the answer to this question with the value chain framework in which he isolates nine generic categories of distinct activities (Figure 4).

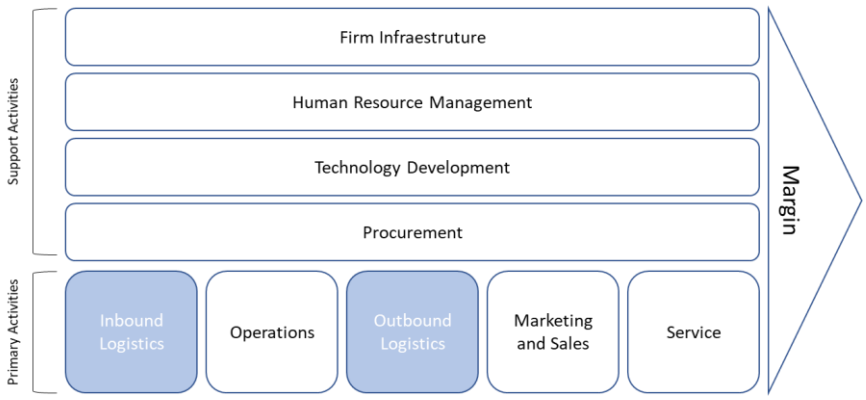

Figure 44: Porter's value chain framework with emphasis on logistics activities.

Source: Adapted from Porter (1985).

The value chain represents a set of activities that a focal firm operating in a specific industry performs to deliver a valuable product or service to the market (Porter, 1985). It describes activities that create, offer, and capture value at each step, starting the raw material stage until a finished product is deliverable to the end customer (Piboonrungroj et al., 2017).

Those activities are divided into two major groups: primary and support activities (shown in Figure 4). Primary activities are composed of five generic categories and represent the activities involved in the physical creation of the product, its sales, and the transfer to the buyer. Additionally, support activities support the primary action by providing inputs, technology, human resources, and various firmwide functions (Porter, 1985).

Inbound logistics and Outbound logistics are two of the nine generic categories part of the primary activities, meaning that any competitive strategy applied to those activities, along with the support of the support activities, will lead to value creation and, perhaps, a higher margin.

As a result, competitive advantage drivers in logistics are a topic discussed in several studies. *Technology* is the most common driver identified in different studies by different authors that plays a vital role in the logistics sector. According to Chang et al. (2022), *IT can transfer data and information in a more secure, efficient, and low-cost manner using tools such as a decision support system (DSS), electronic data interchange (EDI), radio frequency identification (RFID), blockchain, and big data*.

Information is also identified as a driver to creating competitive advantage. Better information in logistics companies aims to ensure greater coherence, high speed, and more efficiency in meeting client´s needs (Jagersma, 2011). Hazen and Byrd (2012) conclude that adopting the right Information Technology into logistics operations, besides having a positive impact on the overall performance in

terms of effectiveness, efficiency, and resiliency will also have a positive impact on the relationships between buyer-supplier.

Another author argues that the interface between logistics and marketing is crucial to delivering *excellent customer service and ensuring customer satisfaction* (Madhani, 2017). Therefore, the firm will earn a strategic position of cost efficiency.

According to Mellat-Parast and Spillan (2014), *logistics process integration* plays a significant role in a firm competitive position. Logistic companies can enhance their competitive edge through *effective integration in inter-organizational processes across logistics and supply chain activities*. Also, Prajogo et al. (2016) defend that *highly integrated logistics activities with suppliers represent a source of competitive advantage for the firms.*

Innovation is also a driver to gain a competitive advantage in the logistics sector. Authors like (Sakchutchawan, n.d.) defend that proper implementation of the logistic invention will benefit not only customer satisfaction, increasing speed or financial gains but also the competitive advantage. In the same study conducted by (Sakchutchawan, n.d.), *the usage of information technology will create assertive, innovative communication between logistics firms and shippers*.

Other drivers are identified in several studies, such as *Infrastructure* (C. H. Chang et al., 2022), *Regulation* (C. H. Chang & Lai, 2017), and *Risk Management integration* (Ricardianto et al., 2023).

3.1.4.1. Information Technology for Logistics Sector

Information data flows are generated from the beginning of the logistic process (Incoming orders) until the end (customer delivery). Giving accompanying information is necessary to identify the items, control the process, and ensure the indisputable risk transfer. According to Gudehus and Kotzab (2012), accompanying logistic information comprises several components. Firstly, Identification information is used to identify the article. Secondly, Sender information specifies the point of origin and the sender. Thirdly, Destination information determines the point of destination and the receiver. Lastly, Control information indicates the delivery chain and intermediate stations. Electronic Data Interchange (EDI) or the Internet facilitates these paperless data transmissions.

Special software can support logistic tasks with the capability of planning and forecasting for specific activities such as warehousing or transportation. Among them, we have *Warehouse Management Systems* (MIS) for managing warehouse activities and *Transport Management Systems* (TMS) for managing transportation activities (Nettsträter et al., 2015):

- WMS describes the control, monitoring, and optimization of complex warehousing and distribution systems. It is the operation and optimization of on-site warehousing systems.
- TMS aims to cover tasks such as planning, optimization, and controlling procurement and distribution structures at a minimum cost. In transport-intensive companies, the use of a TMS is nearly unavoidable.

Enterprise resource planning (ERP) is a tool for comprehensive planning, coordination, and management of companywide tasks. ERP modules, such as warehouse and transport management, can also be used by small and midsize to manage warehouse operations and transportation (Gudehus & Kotzab, 2012)

It is crucial to emphasize that utilizing unqualified software or incorrect parameters can lead to inaccurate results and potentially result in significant damage. For logistics companies, it is essential to thoroughly assess their specific needs and capabilities before selecting the most suitable Information Technology that aligns with their business requirements (Gudehus & Kotzab, 2012), Since it became a more affordable and integrated solutions (Nettsträter et al., 2015).

3.1.4.2. Logistics 4.0

In addition to the widely used and indispensable Information Technology for managing warehouse and transportation tasks, other emerging technologies hold the potential to significantly enhance the logistics industry as part of the ongoing fourth industrial revolution. These technologies form a transformative wave, propelling the logistics business forward and opening new possibilities for optimization and innovation.

The fourth industrial revolution has turned the production of materials and goods highly mechanized and automized (K. Wang, 2016). It is concerned with the application of digital technologies to enable new and more efficient processes, products, and services, combining information and communications technology with production and automation technology (Strandhagen et al., 2017)

The term logistics 4.0 appears as a response and support to the fourth industrial revolution and is defined as the development of labor-saving *and standardization with the evolution of the Internet of Things technology in logistics* (Akkaya & Kaya, 2019).

Additionally, Winkelhaus and Grosse (2020) describe logistics 4.0 as the *logistical system that enables the sustainable satisfaction of individualized customer demands without an increase in costs and supports this development in industry and trade using digital technologies.*

Furthermore, K. Wang (2016) refers the logistics 4.0 or smart logistics (another term broadly used) as the *use of bar codes, radio frequency identification technology, sensors, global positioning systems and other advanced networking technologies through information processing and network communication technology platform*.

By implementing innovative technologies, logistics companies can enhance efficiency beyond what can be achieved through manual labor and revolutionize their behaviors and practices. This transformation enables them to shift from reactive to proactive operations, transition from manual to autonomous processes, and move from standardized to personalized services.

According to Radivojević and Milosavljević (2019) and Akkaya and Kaya (2019), the main components and technologies of Logistics 4.0 are:

1. Wireless Sensor Network (WSN)

Wireless Sensor Networks are systems comprising sensors and wireless communication networks that allow data to be collected and sent between sensor nodes, access devices, and network users.

An example of WSN is RFID, which stands for Radio Frequency Identification, used for autonomous tracking for inventory control (Strandhagen et al., 2017).

The authors Winkelhaus and Grosse (2020) emphasized two benefits of RFID: improved visibility of goods on the data level and reduced errors based on, e.g., inventory inaccuracies.

2. Internet of things

The term Internet of Things refers to *scenarios where network connectivity and computing capability extends to objects, sensors, and everyday items not typically considered computers, allowing these devices to generate, exchange, and consume data with minimal human intervention,* according to the author (Rose et al., 2015.).

Among the other technologies, LoT has outstanding importance, and it is considered by Winkelhaus and Grosse (2020) to be the main application of Logistics 4.0.

3. 3D Printing

3D printing is a contemporary technology for creating three-dimensional objects. According to Radivojević and Milosavljević (2019), *3D printing will considerably impact logistic processes and services: regional logistic networks will become more complex, new supply chain strategies will be developed; companies will be able to offer new logistic services in the field of spare parts supply;*

logistic providers can define a global 3D platform with a digital model base; personalization of products and services, in conformity with users' requirements, is realized by 3D printing in the nearest distribution center.

4. Drones

Unmanned Aerial Vehicle (UAVs), also referred to as drones, refers to developing and utilizing variously shaped aircraft without the need for a human pilot or crew. (Busch, n.d.). The most significant application of drones in logistics is the delivery of customer purchases as well as pallet scanning.

5. Cloud Computing

Cloud computing has been a trending topic and is distinguished as one of the significant competing models. According to the National Institute of Standards and Technology, cloud computing is defined as a *model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction* (Mell & Grance, 2011). Individuals and organizations can use cloud computing to gain on-demand network access to a shared pool of controlled and scalable IT resources, such as servers, storage, and applications (Sunyaev, 2020). Various authors proposed frameworks that led to a consensus that cloud computing can support information and physical flows by providing flexibility and agility and facilitating resource sharing among transportation companies, suppliers, and customers (Novais et al., 2019). Paying attention to the two main activities analyzed in this study, performed in logistics: Distribution and warehouse, Yang et al. (2017) and (Jones & Gupta, 2014) developed service-oriented automation architecture for a distributed manufacturing environment and a cloud-base WMS (warehouse management system) framework with connection with RFID tagged inventory, accordingly.

Yang et al. (2017) conclude that an *intelligent logistics service platform based on cloud computing can be built to collect, store, and handle multi-source heterogeneous mass data from sensors, RFID electronic tags, vehicle terminals, positioning terminals, and APP, and also provide the open-access cloud services including distribution, positioning, navigation, scheduling and other data services for the logistics distribution applications.*

Related to warehousing tasks, Jones and Gupta (2014) investigated *an RFID based WMS (R-WMS) application for mobile devices, including smartphones (such as iPhone, Android, Microsoft Mobile Phone, HTC smart phone, Blackberry, etc) and other handhold smart devices (such as iPad and some*

light/portable Tablet) exchanging real-time information through the cloud which is being used to make near optimal decisions and send information back in an acceptable period and concluded that there is a high initial investment costs but the savings per year will be greater.

Besides the software above that can be used in the cloud, other systems and software can be implemented in the cloud, enhancing the most outstanding results optimizing logistics processes, such as ERP (enterprise resource planning) and TMS (Transportation Management System) (Winkelhaus & Grosse, 2020)

6. Blockchain

Blockchain is a distributed digital ledger of transactions without revealing the identification of the transaction parties capable of exchanging documents quickly and executing transactions in a secure, decentralized, and transparently at a lower cost than the traditional (Sivula et al., 2018). The scope of blockchain technology is not limited to financial applications and cryptocurrencies but can be expanded to the logistics industry.

According to Tijan et al. (2019), blockchain technology creates the ability to trace the origin of goods or to gain more knowledge securely: *…every time a product is exchanged between sides, the transaction could be documented, creating a permanent history of the particular product, from manufacture to sale (from suppliers to customers).*

The use cases for blockchain applicability in logistics identified by Hackius and Petersen (2017) *are*: Reducing paperwork and tracking receipts, invoices, payments, and any other official document; Verifying goods and identifying counterfeit products; End-to-end tracking, recording every single asset; and Operate internet of things.

Tijan et al. (2019) mention that *delays in delivery, loss of documentation, unknown sources of products, errors, etc., can be minimized and even avoided by blockchain implementation*. On the other hand, the same author emphasizes the benefits of integrating blockchain technology in logistics: increased sustainability, reduced errors and delays, minimized transport costs, faster issue identification, increased trust (consumer and partner trust), and improved product transport and inventory management.

7. Big Data

In logistic activities such as warehousing and distribution, a massive amount of data is being produced using Information Technology (ERP, RFID, and EDI) and the help of IoT. The data must be

correctly evaluated and timely to provide the most accurate results that will lead to strategic business decisions (Lamba & Singh, 2017).

Big data is used to describe an extensive collection of unstructured and semi-structured data created by a company and can be seen as a way of making decisions based on data-driven (Y. Wang et al., 2017). According to the National Institute of Standards and Technology, big data describes *a large amount of data in the networked, digitized, sensor-laden, information-driven world* (W. Chang & Grady, 2019).

According to Speranza (2018), three main characteristics distinguish big data from traditional data: Velocity, Volume, and Variety.

Through the analysis of massive amounts of data, logistics companies can make specific forecasts about the future market and the behavior of competitors, modify their growth strategy in real-time, and avoid making blind asset investments, thereby reducing losses. By applying significant data approaches, logistic companies can create a model based on historical data and analysis of users, forecast future behavior, and then create a forward-looking logistics service plan, integrate resources, and enhance customer cooperation (Y. Wang et al., 2017). Logistic companies can optimize profits and maintain competitiveness in a fast-growing market.

Hopkins and Hawking (2018) performed a case study on Big Data and IoT and found that Big Data analysis improves truck routing, recommends optimal fuel purchasing times/ locations, and forecasts predictive and proactive maintenance schedules.

Concerning warehousing activities, Bertsimas et al. (2016) developed a model for inventory predictions, supporting inventory management decisions using web-based Big Data.

8. Robotics and Automation

Automating logistics processes, especially in transportation and warehousing, by using robots improves quality, reduces errors, necessary labor, and costs, and increases safety levels (Radivojević & Milosavljević, 2019). According to a paper by McKinsey & Company (2019), the transportation and warehousing industry has the third-highest automation of any sector.

There are numerous examples and possibilities for applying robots in logistics processes. The following topics summarize some robots that can automate and optimize logistics flows:

- Automatic Guided Vehicles (AGVs) are unmanned vehicles based on sensor and video detection technologies, artificial intelligence, and other information and communication

technologies. Using AGVs in logistic processes reduces costs and labor, increases dependability, productivity, safety, and quality of work, reduces the danger of human errors and damage, and so on. According to DHL Radar, the use cases for Automated guided vehicles are the following: Point-to-point transportation, Loading and Unloading, Order Fulfillment and Assisted Picking, Facility Support, and Inventory Management Automation (Busch, n.d.).

- Besides the AGVs, outdoor autonomous vehicles are another logistic automation trend identified by DHL radar, focusing on a vehicle that is either wholly driverless or at least highly automated with occasional control by a human driver. This trend will impact logistics, change human workers' operational tasks, and alter how customers interact with logistics providers. The use cases identified by DHL radar are the following: Automated yard operations, Long-haul optimization, and new las-mile models (Busch, n.d.).
- Optical recognition or OCR (optical character recognition) is a software capability that can read semi-structured and structured data without needing a human worker. According to a study performed by Dekhne et al. (2019), OCR technology can be used to automate the sorting of packages, eliminating the need for a human worker, leading to a faster process and increased efficiency.

9. Augmented Reality

Augmented reality (AR) denotes the additional or superimposition of information or other visual elements directly into the real world to enrich human senses and abilities (Rejeb et al., 2021). Although the application in logistics is still in its infancy, AR can directly influence flexibility, speed of operations, delivery processes, and responsiveness. These dimensions are critical for logistics effectiveness operations.

Nowadays, most processes in in-house logistics are fully automated. However, some processes remain to be improved where performance largely depends on human experience, decisions, and expertise.

According to W. Wang et al. (2020), order picking is one of the in-house logistic activities that are not fully automatic and depends on the human's action to perform several steps in order to complete, successfully, an order. This series of tasks requires the pickers to have maximum concentration and a high level of proficiency since errors can cause damage to the quality of delivery and the relationships with customers and suppliers.

Smart glasses are an example of augmented reality and wearable technology that could be applied in picking, reducing possible human mistakes. The smart glasses provide hands-free step-by-step

instructions to employees while they are performing operational tasks. According to DHL, *smart-glass picking process solutions offer hands-free operation and have increased productivity while reducing error rates; these represent substantial benefits for DHL customers* (Busch, n.d.).

W. Wang et al. (2020) presents *other application of AR in storing/warehousing:*

- Inform an operator about a newly allocated task.
- Display the optimal storage location of incoming items.
- Display pictures and details of the item to be stored.
- Display real-time maps with traffic information (dynamic).
- Indicate the best route to a storage location.
- Indicate the picker's status as well as the next step of the process.
- Check locations requiring replenishment while storing.
- Book the goods in the warehouse management system.

Regarding shipping and handling, AR can also have a positive impact on some activities, as (W. Wang et al., 2020):

- Show what type of cardboard to use.
- Show the best way to place picked items in a package.
- Indicate the correct location/pallet for the shipment.
- Show where to place each order on a pallet/in a truck according to the type of order, destination, and fragility.
- Indicate the appropriate loading area.
- Check products to be loaded on a truck.

Despite AR's high potential and applications in logistics, AR still raises several technical issues (e.g., Object recognition) (Rejeb, 2019). Conversely, AR technology in logistics can save labor costs, improve logistics operations efficiency, and enable full logistics process automation.

10. Wearable technology

Wearable technology can be described as devices worn directly on or loosely attached to a person to track body movement or vital functions integrated into wearable products (Godfrey et al., 2018).

According to DHL trend radar, wearable technology could be helpful in the logistics sector to capture data and process it to identify process waste and optimize operational processes. Another use case identified by DHL experts is ergonomic health. Wearable technology can be used to collect data to

lower musculoskeletal disorders risks by alerting the employee in real-time when a hazardous movement such as bending and twisting is performed (Busch, n.d.).

Location identification was another use case mentioned in the DHL radar trend. The ability to track employee location in real-time can lead to a layout redesign by analyzing the congested areas and reducing them (Busch, n.d.).

The introduction of Logistics 4.0 is becoming imperative for all companies that want to stay competitive in the market. Some advantages of Logistics 4.0 are: Increased visibility, flexibility, and performance of supply chains, availability of advanced technologies for analysis of unlimited amount of data, the opportunity for real-time communication between system users, machines, and other systems, opportunity of lead times decreasing for products and services directly responding to customer's needs (Oleśków-Szłapka & Stachowiak, 2019; Radivojević & Milosavljević, 2019).

The effort of implementing Logistics 4.0 brings numerous benefits to companies. Nevertheless, there are some disadvantages of the solutions as well. Some of the disadvantages identified by Oleśków-Szłapka and Stachowiak (2019) are the following: high implementation cost, strict requirements concerning the implementation of process-oriented management methods (Just-in-time or Lean Management), requirements concerning implementation of industry 4.0 technologies.

Logistics 4.0 is a transformative and recent concept that has the potential to revolutionize the logistics industry. It is not just about embracing new technology, but also about developing a strategic vision and a willingness to adapt to change. Companies that successfully implement Logistics 4.0 will be well-positioned to remain competitive in the digital age and create value for their stakeholders. As the logistics industry continues to evolve, it is clear that Logistics 4.0 will play a crucial role in shaping the future of logistics.

The correct use of those technologies will allow us to construct predictions based on real-time and real-world information, driving a more optimized layout of the logistics network, improving costs, performance, reliability, and ultimately, customer satisfaction (K. Wang, 2016).

3.2. IT-Business Strategic Alignment Models

3.2.1. Concepts

IT-Business addresses how IT and Business systems are in harmony with one another, ensuring the IT department effectively supports the business's goals and objectives (Chen, 2010). It can be defined as applying Information Technology appropriately and timely, harmonizing with business strategies,

goals, and needs. According to Reich and Benbasat (1996), IT-Business alignment is the link between business and IT strategies, and it is seen as an adaptive process rather than an event (Chen, 2010b).

The principal objectives of IT-Business alignment are improving performance and competitive advantage through IT (Gellweiler, 2021).

The importance of alignments has been widely recognized and documented through several studies. A recent survey conducted by Njanka et al. (2021) reported the following main benefits of IT-Business alignment in an organization: Enhance cooperation, enhance competitive advantage and performance, facilitates organizational processes and growth and provides higher return on investment.

Another study found that *when an organization achieves a good alignment, it will not only be able to gain benefits from the IT system and improve performance, but it will also be better able to manage people in business and IT to make sure staff in both units are ready for new technology that will arise in the future* (Charoensuk et al., 2014).

These references show the importance of aligning IT and business strategies. However, it is essential to note that achieving alignment requires ongoing strategic planning, continuous effort, commitment, and leadership from IT and business leaders (Chen, 2010). Despite the benefits of IT-Business alignment, there are still some challenges: Poor governance, Inadequate Skills, Lack of communication, Difficulty in sustaining IT and business alignment in the long run, and failure of IT to provide benefits to the organization (Njanka et al., 2021).

Although companies understand that IT and business strategy should be aligned, research from Boston Consulting Group found that 70% of digital transformations fall short of their objectives (Forth et al., 2020), consistent with the 70% failure rate reported by McKinsey & Company in 2016.

According to an article by CIO Magazine, *various IT teams and business units (…) cannot see how their roles fit into their organization's roadmaps and overall strategic objectives. That lack of widespread alignment delays project delivery times stunts the ability to create all the potential capabilities initially identified, and tanks a project's success* (Pratt, 2023).

Several models have been proposed to explain how IT and business alignment can be achieved and maintained. The two well-established approaches are discussed below, each with its advantages and disadvantages. Finally, choosing the best approach to the type of activity or research being undertaken is critical.

3.2.2. Alignment Models

An alignment model is a framework used to align various aspects of an organization, such as its strategies, processes, and systems, to achieve its objectives. An alignment model aims to ensure that all aspects of an organization work harmoniously to achieve a common goal. Alignment models can be used in various areas of an organization, including human resources, Information Technology, and operations.

Several models for IT-Business strategy alignment have been widely applied in academic and industry settings. Some of the most well-known models include Luftman and Henderson and Venkatraman models (Chen, 2010;Torres-Moreno & Aponte-Melo, 2021; Oehlhorn et al., 2020). These models have been applied in various settings and industries to improve IT-business alignment and deliver value to organizations and are going to be described in the following sections.

3.2.2.1. Henderson and Venkatraman

Henderson and Venkatraman's alignment model was introduced in 1993 in an article published in the IBM Systems Journal and has been the basis for much of the strategic IT research (Avison et al., 2004).

Venkatraman and Henderson (1999) argue that the difficulty in realizing value from IT investments stems from a lack of alignment between the business and IT strategies of the organizations making investments, as well as a lack of a dynamic administrative process to ensure continuous alignment between the business and IT domains. As such, they develop a model for conceptualizing and directing the emerging strategic Information Technology management area. The strategic alignment model (SAM) is defined in terms of four fundamental domains of strategic choice: 1) Business Strategy, 2) Information Technology strategy, 3) organizational infrastructure and processes, and 4) Information system infrastructure and processes (Venkatraman & Henderson, 1999).

The fundamental domains presented above are divided into two building blocks: Strategic fit (interrelationships between external and internal components) and Functional Integration (integration between business and functional domains). SAM also distinguishes the external perspective of IT and the internal focus of IT, recognizing the potential of IT in shaping and supporting the business strategy (Avison et al., 2004).

The internal domain concerns the company structure, processes, product development, customer service, and human resources. On the other hand, the external domain portrays the ecosystem around a company where competitive advantages and market positioning are born (Venkatraman & Henderson, 1999).

Venkatraman and Henderson (1999) describe four dominant alignment perspectives (Figure 5) that can be derived by drawing a line through the three dominant domain types: anchor domain (most robust representation and is the initiator of change), pivot domain (indicates which functional or strategic domain will ultimately be affected by the change initiated within the anchor domain) and impacted domain (impacted the greatest by the change initiated in the anchor domain) (Avison et al., 2004). The four dominant alignment perspectives explained above run from the anchor domain to the impacted domain via the pivot domain (Avison et al., 2004):

1) Strategic Execution – This perspective views the business strategy as a driver for organizational design choices and IS infrastructure design. Nonetheless, in order for this perspective to be successful, the writers contend that it is critical to determine the specific role of management.
    a. Top manager role – Provide the technology vision to articulate the logic and choices regarding IT strategy that will best support the chosen business strategy.
    b. IS manager role – Design and implement the necessary IS infrastructure in an efficient and effective manner that is consistent with the external component of IT strategy.
2) Technology Potential – This alignment perspective involves the assessment of implementing the chosen business through appropriate IT strategy and the articulation of the required IS infrastructure and processes. Unlike the preceding viewpoint, this one aims to identify the optimal IT competencies by means of suitable placement within the IT industry and corresponding internal IT architecture.
    a. Top manager role – Strategic formulator.
    b. IS manager role – strategy implementer.
3) Competitive Potential – This alignment perspective is concerned with the use of emerging IT capabilities to influence new products and services (business scope), key strategic attributes (distinctive competencies), and the development of new forms of relationships (business governance). In contrast with the other perspectives, this one allows the adaptation of business strategy by emerging IT capabilities.
    a. Top manager role – Articulates how the emerging IT competencies and functionality and changing governance patterns in the IT industry would impact the business strategy.
    b. IS manager role – Identify and interpret the IT environment trends to help the business managers in comprehending the potential opportunities and threats from an IT perspective.

4) Service Level – According to the authors, the fourth perspective focuses on how to build a world-class IT/IS organization within an organization. This requires comprehending the external dimensions of IT strategy and the internal design of the I/S infrastructure and processes. The above strategic fit for IT creates the capacity to meet I/S customers' needs.
    a. Top manager role – Who articulates how to best allocate limited resources both within the organization and in the IT marketplace (via joint ventures, licensing, and minority equity investments).
    b. IS manager role - Responsible for carrying out specified duties to ensure the internal service business succeed in accordance with top management's operating requirements.

Further alignment perspectives applied to SAM were identified in other research. According to Coleman and Papp (2006), Organization IT infrastructure, Organizational infrastructure strategy, IT organization infrastructure, and IT infrastructure strategy were additional alignment perspectives recognized using SAM models. The authors' research concludes that the most used alignment perspective by industry is strategy execution (Coleman & Papp, 2006)

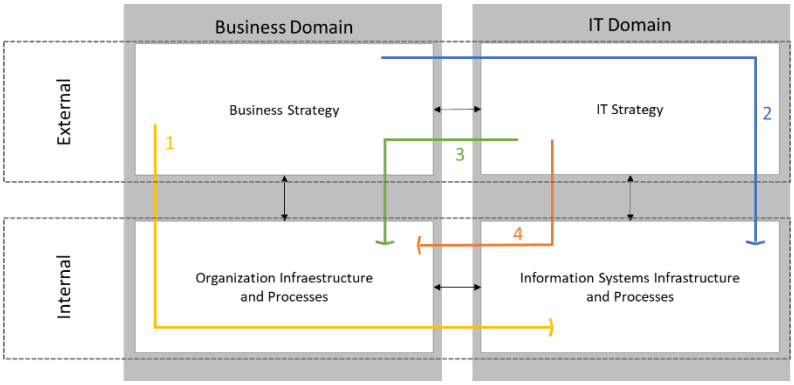

Figure 55: Henderson and Venkatraman strategic alignment model.

Source: Adapted from Venkatraman and Henderson (1999).

After deeply analyzing the SAM, the following key takeaways are retrieved:

- Neither strategic nor functional integration alone can effectively align an organization (cross-domain perspectives).
- Organizational strategic alignment can occur only when three of the four corporate domains are aligned.

- Change cannot occur in one domain without affecting at least two of the remaining three domains.
- There is no one universally superior mode to formulate and implement strategy. *The four dominant alignment perspectives that use the two strategies as drivers are equally valuable and influential in thinking about the role of IT in organizational transformation* (Venkatraman & Henderson, 1999).

3.2.2.2. Luftman Maturity Model

Jerry Luftman, a renowned scholar and researcher in the field of IT management, developed a strategic alignment model for assessing the maturity of a firm´s IT-Business alignment.

According to the author, *the alignment maturity assessment approach described (…) provides a comprehensive vehicle for organizations to evaluate IT-Business alignment in terms of where they are and what they can do to improve alignment* (J. Luftman, 2000).

The Luftman strategic alignment model combines six different organization components (communication, value measurement, governance, partnership, technology scope and architecture, and skills) into a strategic alignment maturity score from 1 (lowest) to 5 (highest) that will be further described in this chapter. Each dimension is composed of a set of criteria that must be evaluated to classify the organization's maturity.

The six dimensions are the following, as presented in Figure 6:

- **Communication Maturity** - The communication component evaluates the effectiveness with which ideas, knowledge, and information are exchanged between IT and business organizations so that each can comprehend its own goals, risks, and priorities as well as its own business and IT environments. It is essential to understand how well IT and business executives understand each other and if they connect easily and frequently. According to Dorociak and Rigoni (2008), the overall average maturity score for communications is 3.10, placing it fourth among the six SAM components.
- **Value Measurement Maturity** – According to J. Luftman (2000), too many IT organizations *cannot demonstrate their value to the business in terms that the business understands.* This component refers to the use of metrics to illustrate the benefits of Information Technology and IT organization to the business so that the business and IT can understand and accept each other. Luftman (2000) argues that what is needed is a balanced "dashboard" that *demonstrates the value of IT in terms of contribution to the*

business is needed. With an average maturity score of 3.09, maturity evaluations placed this component as the second-to-last SAM component (Dorociak & Rigoni, 2008).

- **Governance Maturity –** Luftman describes the governance component as the most critical enabler/inhibitor of alignment. It defines the *authority for IT decisions and the processes IT and business managers use at strategic, tactical, and operational levels for setting IT priorities and allocating IT resources* (Dorociak & Rigoni, 2008). With an average maturity score of 3.20, governance has been ranked #1 overall in maturity assessments (Dorociak & Rigoni, 2008).
- **Partnership Maturity –** From Luftman's perspective, another factor that ranks highly among the facilitators and inhibitors is the relationship that exists between the business and IT departments. As alignment strategies defend, IT functions should have an equal role in defining business strategies among other strategic areas. The partnership should involve a point where IT enables and drives changes to business processes and strategies (J. Luftman, 2000). With an average maturity score of 3.19, partnership maturity is tied for second place overall in maturity assessments, behind technology scope and architecture maturity (Dorociak & Rigoni, 2008).
- **Technology Scope and Architecture** – The scope and architecture component measures if IT has a flexible infrastructure that is transparent to all business partners and customers, its evaluation and application of emerging technologies, its ability to enable or drive business processes and strategies, and its deliverable of customized solution that fulfill all the customer's needs (J. Luftman, 2000). With an average maturity score of 3.19, technology scope and architecture maturity are tied for second place with partnership maturity in overall maturity assessments (Dorociak & Rigoni, 2008).
- **Skills -** Skills measure human resources practices, such as retention, hiring, performance feedback, training, innovation encouragement, career opportunities, and individual skill development within IT. Luftman formulated some crucial questions for mature organizations: *Is the organization ready for change in this dynamic environment? Do individuals feel personally responsible for business innovation? Can individuals and organizations learn quickly from their experience? Does the organization leverage innovative ideas and the spirit of entrepreneurship?* (J. Luftman, 2000). According to overall maturity ratings, Skills are the least mature (last) of the six components, with an average maturity score of 3.03 (Dorociak & Rigoni, 2008).

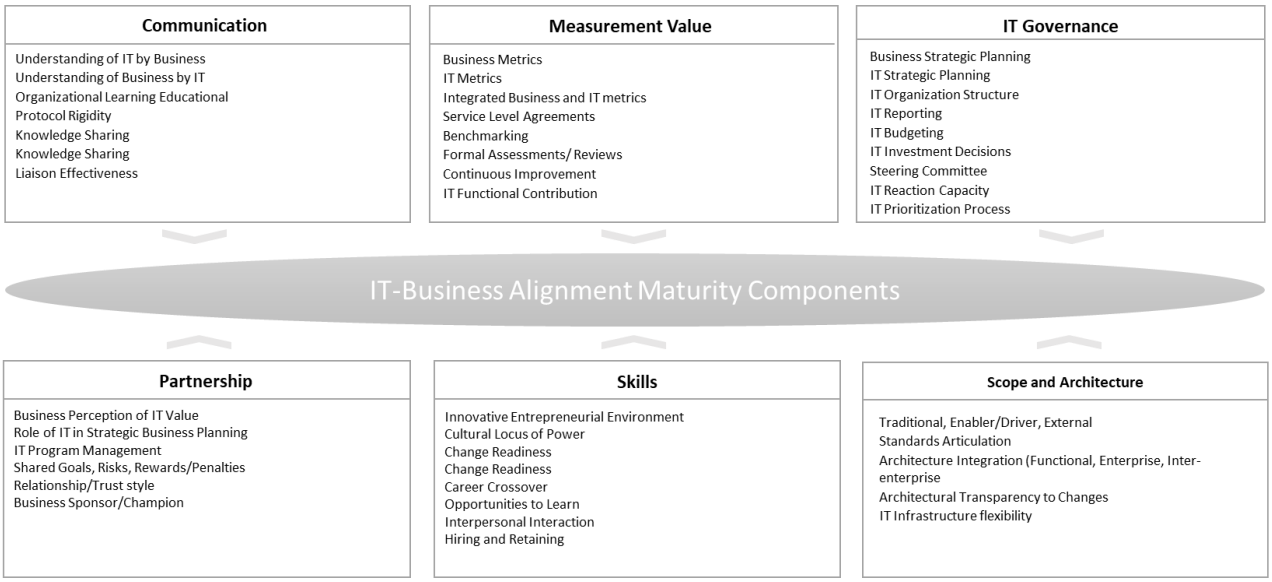

Figure 66: IT-Business alignment maturity components.

Source: Adapted from J. Luftman (2000).

Each of the six-dimension described before is evaluated in driving the level of strategic alignment maturity (J. Luftman, 2000):

- *1 = This does not fit the organization, or the organization is very ineffective.*
- *2 = Low level of fit for the organization.*
- *3 = Moderate fit for the organization, or the organization is moderately effective.*
- *4 = This fits most of the organization.*
- *5 = Strong level of fit throughout the organization, or the organization is very effective.*

The average of results evaluation is distributed between five levels of maturity, according to Figure 7 (J. Luftman, 2000):

- **Level 1 (Initial/AD HOC Process)** – Business and Information Technology are not aligned or harmonized. The organizations typically have inadequate business and IT communication and a poor appreciation of each deliver's value or contribution (J. Luftman & Kempaiah, 2007).
- **Level 2 (Committed Process)** – The organization has committed to beginning the strategic alignment Maturity process. This level tends to be directed to all local situations or functional organizations within the enterprise (J. Luftman & Kempaiah, 2007).
- **Level 3 (Established Focused Process)** – Business increasingly integrates IT. With this degree of strategic alignment, Governance, processes, and communications are focused by maturity on specific corporate goals. Business is increasingly integrating IT. IT resources are utilized across the entire organization, and application systems show a planned, managed transition

from traditional transaction processing to systems that use data to drive business decisions (J. Luftman & Kempaiah, 2007).

- **Level 4 (Improved/Managed Process)** - This level shows efficient governance and services supporting Information Technology as a value center. IT is viewed as an innovative and Imaginate strategic contributor to success (J. Luftman & Kempaiah, 2007).
- **Level 5 (Optimized Process)** – With a strategic alignment maturity that is optimally aligned, the business leverages IT assets enterprise-wide to expand its reach (the IT extra structure) into customer and supplier supply chains (J. Luftman & Kempaiah, 2007).

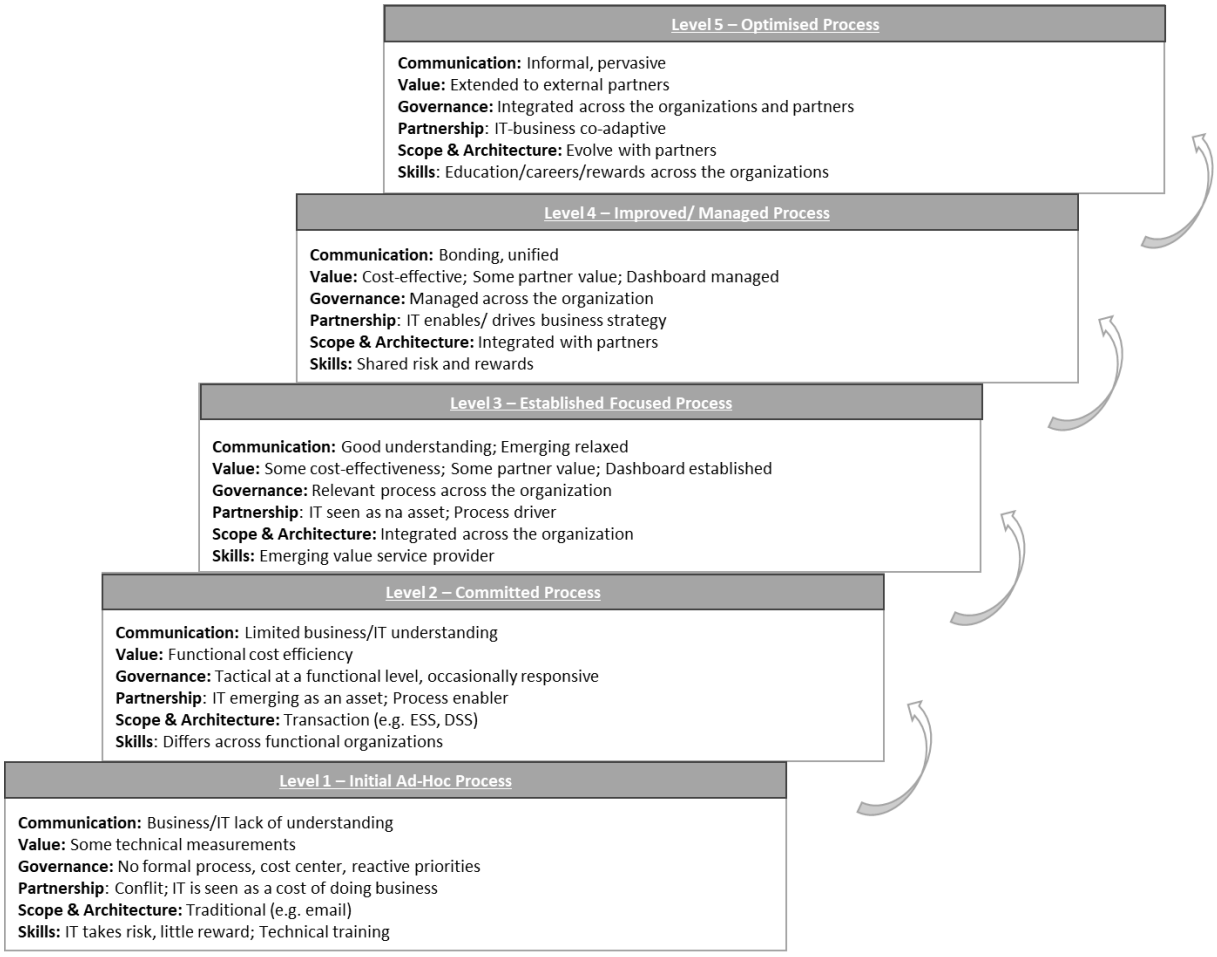

Figure 77: Maturity levels.

Source: Adapted from J. Luftman (2000).

The approach applied to attain and sustain IT-Business strategy alignment *focused on understanding the alignment maturity and on maximizing alignment enablers and minimizing* (J. Luftman, 2000). According to Luftman, the primary objective of the assessment is to identify specific

recommendations to improve the alignment of IT and the business. The process includes the following six steps:

1. Set goals and establish a team;
2. Understand the IT-Business linkage;
3. Analyze and prioritize gaps;
4. Spefivy the actions;
5. Choose and evaluate success criteria.

Luftman Maturity Model Extensions

The Luftman model has been applied in many research among different sectors (Brodbeck et al., 2009; Chen, 2010; Khaiata & Zualkernan, 2009; Puspitasari et al., 2022; Torres-Moreno & Aponte-Melo, 2021).

Since the date when the model was conceptualized (2000), no updated model by the actor was found during the research about the restructured model.

However, El-Mekawy et al. (2012) proposed a framework based on the Luftman model, as shown in Figure 8. The actors claim that the Luftman model deals with effectiveness and efficiency but does not consider "How things are done." Therefore, the studies where the Luftman model was applied did not consider organizational culture. For the actors, culture is a critical topic and should be addressed when analyzing the strategic alignment maturity of the organizations. Organizational culture is defined as *the common expectations, goals, and norms of the people in an organization, which varies from one organization to another* (Helen Deresky, 2017).

The proposed model, represented in Figure 8, classifies each dimension according to the context:

1) Organization-related (labeled as Organizational): *The attributes that are implemented in organizations according to their functions without/with minor human interactions* (El-Mekawy et al., 2012)
2) Organization culture related (labeled as Organization culture): *The attributes that are only dependent on human interactions* (El-Mekawy et al., 2012)
3) Hybrid attributes (labeled as Hybrid): *The attributes that are influenced by both organizational functions and people's organizational cultural characteristics* (El-Mekawy et al., 2012)

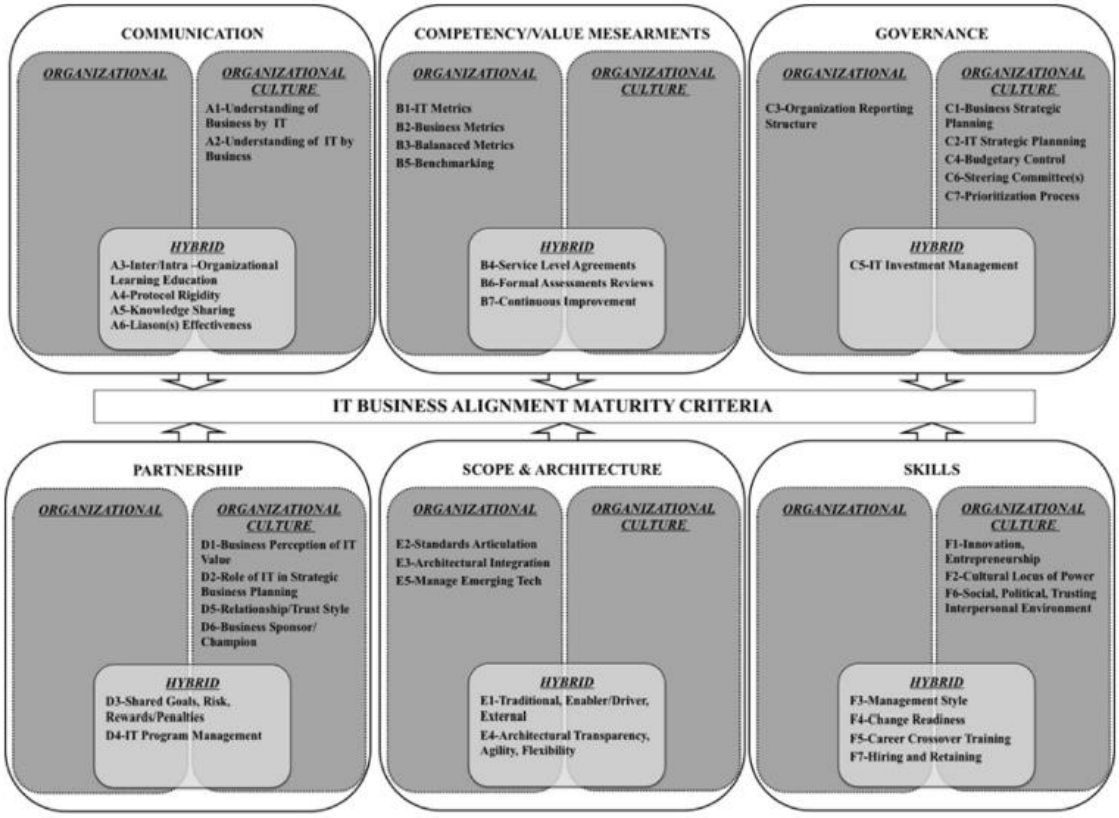

Figure 88: The proposed extension of the SAM Model.

Source: Extracted from *An Organization Culture Perspective in IT-Business Alignment* (El-Mekawy et al., 2012).

An empirical study evaluated the extended SAM proposed by the actors within six different Swedish medium and large organizations. The study concludes that:

1. The model can be used *not only for assessing an organization's BITA maturity level but also to highlight the business areas in which the organizational culture impacts the BITA maturity level* (El-Mekawy et al., 2012).
2. The model *shows an invaluable contribution in presenting higher accuracy in assessing BITA maturity by splitting the complex attributes that have different influences from organizational as well as organizational culture characteristics (…). This offers a more comprehensive image to the decision-makers. It is also seen as a way to decrease the complexity of the original SAM* (El-Mekawy et al., 2012)
3. The model *proposes a new way for business and IT managers to assess BITA maturity using the Luftman (2000) model and to find the high-level barriers in their business related to organizational, organizational culture or hybrid aspects which causes a misalignment between business and IT domains* (El-Mekawy et al., 2012).

Luftman Maturity Model Applied to Logistic Sector

As presented in Chapter 3.1, Logistics is *responsible for all aspects of the movement and storage of materials on their journey from original suppliers to final customers* (Waters, 2009). Therefore, a variety of activities are within the logistic scope.

This chapter will only focus on the two main activities in the logistics sector: Transportation and Warehousing. A third-party logistics provider performs these two logistic activities, as explained in Chapter 3.1.3.

According to a study produced by J. Luftman and Kempaiah (2007), the transportation sector is leading the worldwide business/IT alignment benchmark, with a total of 3.54 on a scale of 1 to 5. This means that the transportation industry falls under level 4: the gap between IT understanding the business and the business understanding IT has closed. As a result, organizations have effective decision-making, and IT provides services that reinforce the concept of IT as a value center (J. Luftman & Kempaiah, 2007).

The component with the highest score was "Value," with a total of 3.8, and the lower score belonged to the component "Communication," with a score of 3.1.

The total business/IT alignment maturity average is 3.05 meaning *IT assets become more integrated enterprise-wide* (J. Luftman & Kempaiah, 2007). The processes are established and focused but could be improved.

Besides the above study, no other study was found that detailed the maturity of strategic alignment using Luftman's model. However, the logistic sectors were part of some studies where IT-Business alignment maturity was assessed (Dorociak & Rigoni, 2008; J. Luftman et al., 2010; B.Derken & J.Luftman, 2012; Miyamoto, 2018; Isal et al., 2016).

As reported by Dorociak and Rigoni (2008), *with most organizations obtaining SAM level 2 and level 3 scores, there are still significant opportunities to improve IT business alignment.* Based on an investigation of 385 responses from 138 companies, three were in the transportation sector.

Miyamoto (2018) concludes *that to achieve alignment between IT and business, communication between those components (skills, value, governance, communication, partnership, and scope) is required in the process of alignment, which means that all information should pass all these linkages without any bias*.

According to Isal et al. (2016), compatibility denotes the ability to distribute any information across any technology component, and it is one of the four components of IT infrastructure (connectivity,

modularity, compatibility, and flexibility. Therefore, the study concludes that, among the four components of IT infrastructure, *compatibility positively and significantly impacts IT-business strategic alignment*.

3.2.2.3. Data Governance Maturity Model

According to Gupta and Cannos (2020), *maturity, in the context of data governance, refers to current organizational governance processes* targeted *at achieving strategic and tactical data governance goals and objectives.* To make assessment meaningful, there are three interrelated and primary drivers that help the organizations identify the purpose behind an assessment initiative: 1) Integration, 2) Integrity, and 3) Insights.

1) Data integration, within the context of data governance, involves addressing the complex and often chaotic flow of data in and out of an organization, emphasizing the need to assess input and output gates and the intricate chain of data storage, retrieval, analysis, sharing, and modification processes. Such assessments become essential when data flows lack structure, leading to data silos and inaccessible insights, ultimately impacting data quality and the quality of organizational decision-making, highlighting the importance of maturity models in identifying and rectifying weaknesses in data integration (Gupta & Cannos, 2020).
2) Data integrity is an ongoing challenge that organizations face due to the dynamic nature of data, making it unrealistic to consistently achieve 100% integrity. Critical data and metadata are the key focus areas that must maintain integrity, as errors in these categories can undermine trust in all data, leading to compromised decision-making and reliance on intuition over data-driven insights, necessitating an overdue assessment of data quality (Gupta & Cannos, 2020).
3) In organizations with advanced data utilization capabilities, data insights serve as a valuable driver for assessment, enabling them to gain deeper and richer insights from their data. The focus is on strengthening their market position by exploring additional perspectives, data sources, and insights to enhance the quality and timeliness of decision-making, ultimately using data as a competitive weapon (Gupta & Cannos, 2020)

Most data maturity models incorporate five standard levels as a framework to monitor the expected progression in stages or steps within the domain under evaluation (Gupta & Cannos, 2020):

Level 1 (Initial) - The organization is in the initial stages of embracing data governance and lacks knowledge regarding industry best practices. It engages in minimal activities to maintain data quality and integrity and does not yet recognize data as an asset. Senior management's support for data

governance is weak due to their limited understanding of the field, and there is a lack of a defined data strategy, with stakeholders not fully aligned with the initiative.

Level 2 (Repeatable) - The organization is beginning to explore data governance, with various units scattered across the organization engaging in data governance initiatives. These units are establishing policies, procedures, and processes to standardize data governance activities. As a result, they are starting to experience the advantages of their data governance efforts.

Level 3 (Defined) - The organization maintains a well-documented standard for consistently performing the assessed activities, effectively utilizing relevant tools. Employees recognize that data governance is a lasting commitment rather than a temporary trend. Numerous well-established policies and procedures exist, and many units employ some, if not all, data governance tools.

Level 4 (Managed) – The data governance process is well-established, closely monitored, and actively tracked. Employees clearly understand their responsibilities within the data governance framework and are aware of the accountability associated with their roles. They are well-informed and highly educated about the mandatory nature of policies and procedures. Each unit within the organization sets specific data governance objectives, and the recommended tools are consistently implemented throughout the organization, reflecting a culture of standardization.

Level 5 (Optimized) - The practice of data governance undergoes ongoing evaluation and enhancement, with no tolerance for overlooking or dismissing any deficiencies or shortcomings. Instead, these issues are openly and promptly addressed. Senior management values a transparent approach that acknowledges and learns from failures rather than focusing solely on positive outcomes. Maturity levels are systematically monitored and measured across all organizational units, and unit leaders are accountable for utilizing data to attain their key performance indicators.

Next, we list some of the existing data governance maturity models:

- Data Management Maturity Model (DMM)

The Data Management Maturity (DMM) Model was created by adapting the principles and structure of the Capability Maturity Model Integration (CMMI) from the CMMI Institute, a well-established approach for performance improvement in software and systems development. This model, which draws from over two decades of experience, encompasses six key functional domains: Data Management Strategy, Data Quality, Data Operations, Platform and Architectures, Data Governance, and Supporting Processes (Baolong et al., 2018).

- Data Management Capability Model (DCAM)

The Data Management Capability Model (DCAM) is a framework created by the Enterprise Data Management Council that offers best practices for managing data across interconnected processes. It defines the capabilities required to establish a mature data management discipline, emphasizing the importance of managing data as "meaning" within a well-defined control framework. DCAM helps organizations address data management challenges and provides guidance to assess and enhance data programs, enabling better decision-making and operational efficiency. The model is organized into eight core components: Data Management Strategy, Data Management Business Case and Funding Model, Data Management Program, Data Governance and Data Architecture (Enterprise Data Management Council, 2014)

- IBM Maturity Model

The IBM Maturity Model measures the data health of an organization along six dimensions: Strategy, Information, Analytics, Culture and Execution, Architecture, and Governance (Gupta & Cannos, 2020).

3.2.2.4. Processes Maturity Model

Assessing processes in terms of maturity is another crucial aspect. In this regard, two models have been identified for evaluating process maturity levels: CMMI (Capacity Maturity Model Integration) and BPMM (Business Process Maturity Model).

According to Lee et al. (2007), BPMM is *a conceptual model that compares the maturity of an organization's current practices against an industry standard*, helping organizations set priorities for improving their product or service operations. By applying BPMM, an organization can *efficiently and effectively manage its business process while trying to achieve and realize its business objectives and values*.

The authors Linstedt and Olschimke (2015) propose on the book "Building a scalable data warehouse with data vault 2.0" that CMMI is a *process improvement framework that has been developed to address a broad range of application environment*. The same authors mention that there are three different models based on the CMMI framework: 1) CMMI for Development, 2) CMMI for Acquisition, and 3) CMMI for Services. According to Selleri Silva et al, (2015), the frameworks aim to streamline costs, reduce defect rates, and improve timelines and quality.

Both frameworks (BPMM and CMMI) have five levels of maturity, being identified as the following:

Level 1 (Initial) – Indicates that an organization has ad-hoc and chaotic processes and does not have a stable process environment (Lee et al., 2007; Linstedt & Olschimke, 2015).

Level 2 (Managed) – The processes lack full definition or are only partially defined, yet capable resources are carrying out measurement and performance control for a work unit. (Lee et al., 2007; Linstedt & Olschimke, 2015).

Level 3 (Defined) – Indicates a well-characterized and understood process that is documented according to standards, procedures, tools, and methods, being refined over time. Monitoring and controlling of the process performance are being carried out for the overall organization and not only for a work unit (as it happens in level 2) (Linstedt & Olschimke, 2015; Selleri Silva et al., 2015).

Level 4 (Quantitatively managed) - Organizations employ quantitative goals to manage their project's quality and process performance. Specific subprocesses are chosen for measurement, with process performance assessed through the collection and statistical analysis of targeted metrics. The process performance is systematically controlled (Linstedt & Olschimke, 2015; Selleri Silva et al., 2015).

Level 5 (Optimizing) – Processes undergo continuous improvement through a quantitative approach aimed at comprehending variations and their outcomes. The primary emphasis remains on consistently enhancing process performance by making incremental refinements to processes and the utilized technology (Linstedt & Olschimke, 2015; Selleri Silva et al., 2015)

4. STUDY

In this study, through a survey (appendix B), we aim to evaluate the IT-Business strategy alignment maturity of the logistics sector, more specifically, the third-party providers (3PL).

This chapter comprehensively describes the research strategy, Luftman, survey design, data sample, and data collection methods used.

Utilizing the Luftman model as previously described, the survey will be used to gather information from logistics companies in the area to assess the degree of alignment between business strategy and IT capabilities.

The study will hopefully contribute to the current body of knowledge on IT-Business alignment by identifying the level of maturity in the logistics sector and the factors that influence it. The study's findings will likely inform the development of strategies for enhancing IT-Business strategy alignment in the logistics sector and have practical consequences for logistics organizations looking to improve their performance and competitiveness.

4.1. LUFTMAN MATURITY MODEL ADAPTED FOR THE LOGISTIC SECTOR

4.1.1. Assumptions

In the literature review, it has been elucidated that logistics entails the management of input flow from suppliers, moving materials across various operations within the organization, and distributing materials to the customer. Given its intricate nature, proficiency in knowledge and skills is indispensable for ensuring timely and accurate product delivery, precisely where and when it is needed, and in the appropriate quantity.

As per the findings of the literature review, the focal points in logistics are the following: firstly, the optimization and integration of well-defined processes with other operational aspects; secondly, the adoption of suitable technology to bolster logistical operations; and third, how data is collected and used to increase operation’s efficiency and effectiveness This will lead to higher customer satisfaction and, perhaps, gain competitive advantage.

When selecting technology to support the business in the logistics sector, it is essential to align it with the organization's specific needs, strategy, and capabilities. It is not unusual for businesses to embrace popular technologies without carefully considering how well they align with their operations. Making such a snap decision may result in higher expenses and lower productivity.

Therefore, the choice of technology should be based on carefully evaluating the business's unique characteristics. Conducting an As-IS analysis is essential to identify existing gaps that could potentially be addressed through technological solutions. Once these gaps have been identified, conducting thorough market research to explore available technologies that can effectively fulfill those requirements is essential. Subsequently, evaluating potential vendors and comparing their offerings against the business requirements becomes the next critical step.

It is essential to recognize that organizations in the logistics sector are diverse and possess distinct characteristics. Thus, these unique attributes must be considered when formulating the overall strategy, including adopting new technology.

Based on the literature review, the following technologies/systems are deemed necessary for supporting logistic operations:

- Artificial Intelligence
- Information Technology (ERP, WMS and TMS)
- Robotics and Automation
- Big Data and the Internet of Things

By leveraging these technologies, logistics operations can be optimized, improving efficiency, accuracy, and customer satisfaction.

4.1.2. Redesign Model Proposal

The established alignment model developed by Jerry Luftman in 2000 is widely recognized for assessing the maturity of IT-Business strategy alignment in organizations across various sectors. It serves as a comprehensive framework for organizations to evaluate their current alignment status and identify areas for improvement. However, the model is outdated and misses essential aspects relevant to organizations today due to the rapid technological advancements and the emergence of new paradigms like Digital Transformation.

Moreover, the logistics sector possesses unique characteristics that were not adequately addressed in the Luftman 2000 model. A new model has been proposed after an extensive research endeavor to bridge this gap and address the specific challenges and opportunities of IT-Business strategy alignment in the logistics sector. This model considers the impact of the fourth industrial revolution on the logistics industry.

The proposed model presented below (Figure 9) provides a tailored framework for evaluating and enhancing IT-Business strategy alignment within logistics organizations. By incorporating relevant

aspects of digital transformations and data and acknowledging the sector-specific characteristics, this model offers a more comprehensive and up-to-date approach to address the alignment challenges faced in the logistics sector.

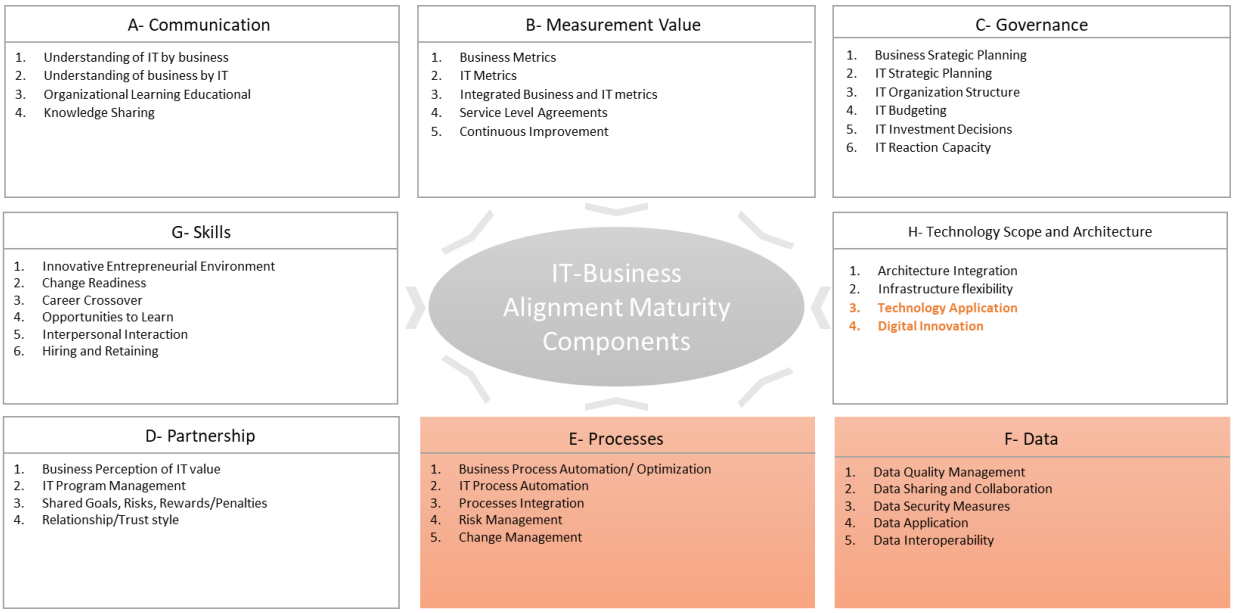

Figure 99: Redesigned Luftman maturity model applied to the logistic sector.

The original Luftman model comprises six components: Communication, Measurement of Value, Governance, Skills, Partnership, and Scope and Architecture, composed of a total of 41 attributes that are used to assess each component. However, additional dimensions and attributes have been introduced in the redesigned Luftman model tailored for the logistics sector to address the industry's unique requirements better and adapt to market evolution. The redesigned Luftman model, applied to the logistics sector, encompasses a total of eight components and a total of 39 attributes distributed among the components:

A) *Communications (adapted)*: This dimension emphasizes the importance of effective communication and collaboration between business and IT stakeholders within the logistics organization. It underscores the need for transparent and efficient information exchange, promoting a mutual understanding of functionalities. *Protocol Rigidity* and *Liaison Effectiveness* attributes were not included in the redesigned model.

B) *Measurement of Value (adapted):* The value dimension in the context of the Luftman model focuses on evaluating the integration of value creation between business and IT. It emphasizes the importance of measuring service level agreements to assess performance and the continuous improvement efforts required to adapt to the evolving market dynamics. This dimension provides

valuable insights into enhancing IT-Business strategy alignment within logistics organizations, enabling them to optimize IT strategies and deliver maximum value to overall business objectives. The attributes *of IT Functional Contribution, Benchmarking,* and *Formal Assessments/ Reviews* were excluded from the redesigned model.

C) *Governance (adapted):* Governance evaluates the decision-making processes, IT budgeting, IT organization structure, and mechanisms in place to guide and control IT activities within the logistics organization. It emphasizes the need for effective IT and Business governance structures to ensure alignment and accountability. The name changed from "IT Governance" to "Governance" to embrace IT and business. The attributes *Reporting*, *Steering Committee*, and IT Prioritization *Process* were excluded from the redesigned model.

D) *Partnership (adapted):* Partnership examines how well the organization works together and how much trust there is when it comes to sharing goals, risks, rewards, and penalties. Additionally, it assesses how valuable IT is perceived by the business, the management of IT programs, and the function of IT in strategic business planning. The attributes of the *Role of IT in Strategic Business Planning* and *Business Sponsor/Champion* were excluded from the redesigned model.

E) *Processes (new):* The process dimension seeks to evaluate and enhance the efficacy, efficiency, and adaptability of an organization's operational processes. This dimension aims to ensure that procedures are explicit, followed consistently, and in line with the company's strategic goals. *Business Process Automation/Optimization* to improve processes and boost productivity, as well as *IT Process Automation* for effective IT operation, are all included in the processes dimension. Additionally, *Process Integration* fosters cooperation among business and IT, *Risk Management* addresses potential challenges, and *Change Management* facilitates successful transitions during process changes, minimizing the impact on operations.

F) *Data (new)*: The data dimension comprehensively assesses data management, quality, and utilization within the logistics organization. It evaluates *Data Quality Management* to ensure accuracy and reliability and *Data Sharing and Collaboration* to facilitate proper information exchange. Additionally, *Data Analytic Tools* are scrutinized to verify if they are the right tools for the organization and if they are being used to their full potential. *Data Security* evaluation is critical to ensure data is adequately protected against unauthorized access, corruption, or theft. Furthermore, the dimension considers *Data Application*, evaluating how well data supports logistics operations. Another crucial component is *Data Interoperability*, which confirms whether systems are appropriately integrated and lessens the need for manual procedures. By a comprehensive

examination of these attributes, the data dimension helps businesses to maximize the use and handling of data, which promotes increased effectiveness and success in logistics processes.

G) *Skills (adapted)*: The Skills dimension evaluates the competencies and capabilities of personnel engaged in both IT and logistics roles. It underscores the significance of possessing the requisite skills and knowledge to effectively leverage business opportunities. Within this dimension, various attributes are examined, including *Change Readiness*, *Career Crossover*, *Opportunities to Learn*, *Interpersonal Interaction*, and *Hiring and Retaining* processes. By comprehensively assessing these attributes, the Skills dimension guarantees that the company employs a workforce with the necessary skills to take advantage of opportunities, adjust to changing circumstances, and advance effective IT-Business strategy alignment in the logistics industry. The attribute *Cultural Locus of Power* was excluded from the redesigned model.

H) *Technology scope and Architecture (adapted):* The Technology and Architecture dimension primarily focuses on evaluating the maturity of Information Technology within the logistics sector. Two new attributes were added to be critical for the logistics sector: *Technology Application* and *Digital Innovation*. Besides the two new attributes added, the dimension thoroughly assesses the suitability of technology solutions and their alignment with the logistics architecture, considering factors such as *Architecture Integration* and *Infrastructure Flexibility*. By comprehensively exploring these attributes, the Technology and Architecture dimension ensures that the logistics organization's IT infrastructure is optimized, resilient, and well-equipped to leverage digital advancements in addressing business needs and enhancing overall efficiency. *Traditional, Enabler/Driver, External*, and *Standards Articulation* attributes were excluded from the redesigned model.

Through the integration of two new dimensions (*Processes* and *Data*) and their respective attributes, along with the addition of the two new attributes (*Digital Innovation* and *Technology Application*), and adapting the other six dimensions, the redesigned Luftman model provides a more targeted and comprehensive assessment framework specifically tailored to the logistics sector. It helps companies assess and enhance their IT-Business strategy alignment to reflect the industry's unique characteristics and evolving market dynamics.

It is important to note that in the redesigned model, not all attributes from the Luftman Maturity Model (2000) were included in the redesigned model as mentioned above. The exclusion of those attributes was not based on specific criteria but rather on the intention to narrow the original scope and accommodate potential new dimensions and attributes to enhance the model. By carefully refining the attributes, the redesign model aims to offer a more focused and relevant assessment of IT-Business alignment in the logistics sector.

4.1.2.1. Redesign Maturity Levels Proposal

Due to introducing two new dimensions (*Data* and *Process*) and adding two attributes to the *Technology Scope and Architecture* dimension, it became necessary to restructure the maturity levels to accommodate these modifications within this study.

In the context of the Data Dimension, the five generic maturity levels were applied based on chapter 3.2.2.3.

Regarding the *Process* dimension, two maturity models were used to define the five maturity levels (chapter 3.2.2.4): CMMI (Capacity Maturity Model Integration) and BPMM (Business Process Maturity Model).

By adding the new two dimensions and applying the above methods to define the five maturity levels, the final maturity levels to the redesigned Luftman model (Figure 10) are the following:

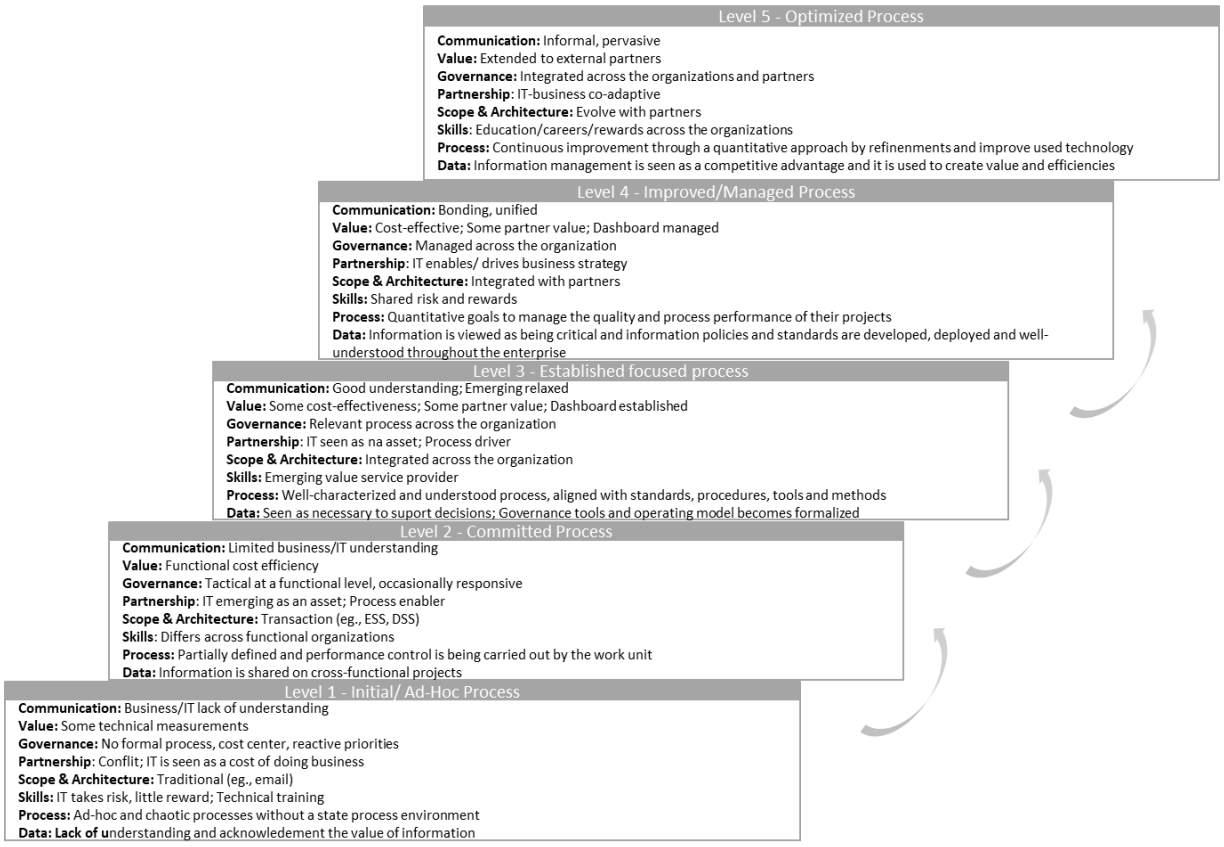

Figure 1010: Redesigned Luftman maturity levels incorporating new dimensions.

Level 1 (Initial/Ad Hoc Process) – Level 1 organizations are the least mature when it comes to coordinating their IT and business strategies. Fulfilling the requirements for Level 1 signifies a notable

absence of probability for these organizations to effectively achieve alignment between their IT and business strategies. As a result, they continue to underutilize their IT investment significantly.

Level 2 (Committed Process) – Organizations that meet the characteristics of level 2 demonstrate a dedication to initiating the journey towards strategic alignment maturity. These organizations are often oriented towards specific local scenarios or functional domains (such as marketing, finance, etc.) within the broader enterprise context. Nonetheless, achieving IT-Business strategic alignment can be challenging due to limited mutual understanding between the business and IT sectors concerning the diverse ways various functional units utilize IT resources. At this point, the enterprise rarely realizes the full potential of IT-Business alignment, even though the opportunities to do so are becoming increasingly apparent.

Level 3 (Established Focused Process) - Organizations that display the characteristics of Level 3 closely integrate IT with business operations and concentrate their governance, procedures, and communication efforts on particular business goals. At this point, the enterprise's entire IT infrastructure, including application systems, demonstrates a purposeful, well-managed transition from traditional transactional processing to systems that employ data to make strategic business decisions. The organizations are characterized as having established a focused strategic alignment maturity.

Level 4 (Improved/Managed Process) – Organizations that meet the characteristics of level 4 showcase adept governance and services that strengthen the perception of IT as a center of value. It is harnessed comprehensively throughout the enterprise, with application systems prioritizing the enhancement of business processes to secure a lasting competitive edge. These companies view IT as a creative and innovative strategic asset that helps them achieve their goals.

Level 5 (Optimized Process) – Organizations that meet the characteristics of the attributes for level 5 can be characterized as having sustained governance processes that integrate the IT strategic planning process with the strategic business process. By utilizing IT resources across the entire organization, these companies increase their influence in the supply chains of their suppliers and customers.

4.2. LOGISTICS AND INFORMATION TECHNOLOGY SPECIALISTS' OPINIONS

In this research, a redesigned version of the Luftman Model is introduced, as the original model, developed in 2000, has not been updated to reflect the current market trends and lacks specificity for the logistics sector. Logistics and Information Technology experts were consulted to validate the redesigned Luftman model (see Figure 9).

One of the specialists (S1) is affiliated with a Big4 company, serving as principal in the technology strategy department, bringing extensive expertise in information systems and technologies.

Specialist number two presently holds the Senior Supply Chain Manager position at one of Europe's fastest-growing startup companies. In addition, he is concurrently pursuing an MBA in digital production. Furthermore, specialist number three, within the logistics sector, brings a wealth of knowledge in logistics operations, encompassing warehouse and transportation expertise, gained through her role as a Senior Team Lead in warehousing and delivery. He also brings valuable prior experience from one of the Big Four companies.

The following table (table 2) briefly overviews each participant's background:

Table 2: Specialist painel.

Specialist	**Professional Background**	**Academic Background**
S1 (Portuguese)	Current: Technology Strategy and Architecture Principal Previous: Technology Strategy and Architecture Lead	Master's degree in electronic and computers Engineer
S2 (German)	Current: Senior Supply Chain Manager Previous: -	MBA, Digital Production
S3 (Portuguese)	Current: Senior Team Lead Warehouse to Deliver Previous: Big4 SAP consultant, Retail Logistics Consultant	Master's degree in industrial engineering and management and Lean Certified

The purpose of selecting experts with different backgrounds is to have a set of different perspectives about the redesigned model.

The interviews were all conducted individually with each specialist between August and September 2023, using Zoom or Microsoft Teams.

Before the interview, a presentation and questions were sent to the specialist to provide more context about the model. The questions are the following:

Q1: Do you agree with including the Process and Data dimensions to be evaluated? Please explain.

Q2: Are there any additional dimensions you believe should be evaluated within the project's scope?

Q3: Do you have any criticism of the proposed model? Please explain.

Q4: Do you have any recommendations or suggestions for further improvements to the proposed framework?

The validation process began with a preparatory presentation, providing the specialists with essential context and outlining the research's primary objectives and key research questions. This was followed by a comprehensive overview of the research journey, highlighting the various stages of the study. An introduction to the Luftman model was presented, followed by an exposition of the rationale underlying the redesign of the new Luftman Model. The novel dimensions and attributes incorporated into the model were meticulously described, with particular emphasis on their value and significance within the measurement framework.

The ensuing discourse with the experts centered on these newly introduced elements. The questions above were made at this phase. To augment the contextual understanding, a diagram was presented illustrating the practical application of the Luftman Strategic Model. Since the interview was semi-structured, the specialists were open to asking additional questions, which allowed them to complement the interviews and extract the distinct knowledge of the participants.

The initial specialist (S1) interview occurred on August 20th through Teams. Following a brief overview of the Luftman model and the revised proposal model, the expert expressed agreement with the inclusion of *Process* and *Data*, emphasizing that data is crucial for a business's success and highlighting the pivotal role of processes within an organization. After a comprehensive evaluation of all the dimensions integrated into the model, the expert concluded that there was no necessity to incorporate any additional dimensions. While explaining the attributes, the expert raised questions concerning *Business Process automation/optimization* and *Risk Management*. The specialist's perspective was that the primary process attribute should be *Business Process Enablement* instead of *Business Process Automation/Optimization*, as the aim is to assess how effectively processes can empower the business in an optimal and efficient manner. Concerning the attribute *Risk*

Management, the expert suggested renaming the attribute from *Risk Management* to *Process Resilience/Impact*, as its purpose is to assess the process's capacity to prevent, withstand, and recover from disruptions. Regarding the *Data* dimension, the expert endorsed all the proposed attributes but emphasized the importance of evaluating *Data Ownership*. This aspect holds significant importance in determining responsibility for change management, as often, organizations lack a clear definition of this attribute, leading to unresolved changes. The expert advised establishing criteria for excluding certain attributes from the revised model, as not all the attributes put forth by Luftman were included in the proposed model.

The virtual meeting with the second specialist took place on September 3rd via Google Meet. During the meeting, the specialists provided valuable insights into their daily routines and challenges as senior supply chain managers. The specialist expressed agreement with the proposed new dimensions (*Process and Data*) and the new attributes added to the *Technology Scope and Architecture* dimension. Regarding the *Process dimension*, the specialist emphasizes the critical need for well-defined procedures to ensure the accurate delivery of the right product to the correct location in the right quantity. Furthermore, the specialist stressed the importance of process flexibility to adapt to various circumstances, such as specific requirements from major clients (e.g., connections using an EDI).

Expanding upon the process dimension, the specialist provided a pertinent example illustrating the significance of change management during the COVID-19 pandemic. In this context, the specialist highlighted that their company lacked a well-established risk management plan, leading to an inability to assess the adverse effects the pandemic would have on their product delivery and the methods they could employ to overcome these challenges. Regarding the *Data dimension*, the specialist underscores the critical nature of retaining only the necessary data. At times, companies fail to define their business requirements adequately and end up incorporating data that does not contribute any value to their operations. To prevent the accumulation of irrelevant data, it is essential to establish well-defined business needs.

As for the *Technology and Architectural dimension*, the specialist provided no comments or input. The specialist did not offer any criticisms regarding the model. However, he suggested that it could enhance the analysis by assigning a weighting to each dimension based on its significance within the 3PL sector.

The meeting with the third specialist occurred on September 26, 2024, via Google Meetings. Before delving into the extended model's explanation, the specialist raised inquiries concerning the omitted attributes and sought clarification on the rationale behind their exclusion. The specialist disagreed

with excluding the *IT Reporting* attribute, emphasizing its significance in determining responsibility when implementing changes. Additionally, the specialist underscored the importance of a business sponsor in all projects (whether IT or non-IT) to ensure the completion of deadlines and the achievement of goals. The specialist agreed with the added dimensions, mentioning that they cover all the essential things about logistics.

Regarding the Process dimension, the specialist mentioned that the *Process Integration* attribute should also emphasize the significance of standardizing processes. Especially in logistics processes, such as those in warehouses, technology plays a vital role, and these processes are applied across various warehouses. If the processes are not standardized, it becomes challenging to optimize operations, resulting in losses. The technology used in logistics relies on specific and well-defined processes to support the overall operation. This does not imply that third-party logistics providers (3PL) can't offer customized services to their clients. It simply means that the client's needs should be translated into the specific internal requirements to ensure smooth operations.

The specialist suggested that the *Risk Management* attribute should indicate whether the risks associated with processes are being assessed and considered. For instance, the specialist provided an example of integrating new clients. Do 3PL companies consider the potential impact and risks associated with an increased demand for their existing processes, including the technology used in various activities? According to the specialist, this point must be evaluated in a 3PL business.

Concerning the *Data* dimension, the specialist pointed out that the name of the attribute, *Data Sharing and Collaboration*, doesn't accurately convey its intended meaning. The specialist suggested renaming it to *Data Accessibility*.

At the conclusion of the meeting, the specialist recommended assigning varying weights to different dimensions, considering that the significance of each dimension may vary across sectors. By allocating weights based on the logistics sector, the overall average (equivalent to the level of maturity) will better reflect the real-world logistics scenario. The specialist also emphasized the importance of the theme "Aligning IT with Business Strategy" in their daily work. He highlighted that a significant portion of warehouse activities rely on technology, making it vital not only to have the right technology in place but also to maximize its potential to enhance overall performance and competitiveness.

The input from three specialists within the logistics and technology domains has proven invaluable, as it has enriched the proposed model (Figure 10) by aligning it more closely with the industry's

practical dynamics and requirements. Their insightful viewpoints have greatly improved the model's relevance and application to actual situations, significantly helping in its continual enhancement.

4.3. REVISED MODEL

Using the feedback from the conducted specialists' interviews, the redesigned Luftman model presented in Figure 9 suffered some changes, resulting in the following revised model (Figure 11):

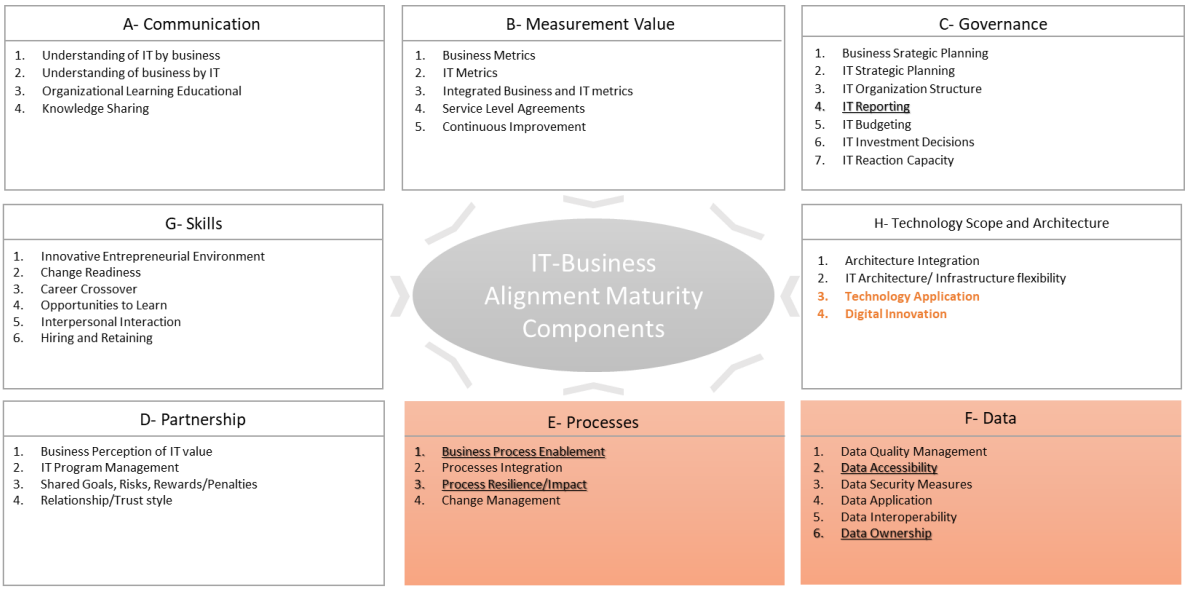

Figure 1111: Revised Luftman maturity model.

The list provided above provides a summary of the alterations implemented in response to the reviews conducted by specialists:

- Addition of the excluded attribute *IT Reporting.*
- The former process attribute known as *Business process automation/optimization* has been revised to *Business Process Enablement*.
- The former process attribute referred to as *Risk Management* has been modified to *Process Resilience/Impact*.
- The previous Data attribute, named Data Sharing and Collaboration, has been adjusted to *Data Accessibility* for increased clarity and relevance.
- An additional attribute in the *Data* dimension, labeled *Data Ownership*, has been introduced due to its identification as a critical factor by a specialist.

Next, a summary of each new attribute is provided to give a better context about their purpose in the revised Luftman Maturity Model:

- Business Process Enablement - Focusing on utilizing and applying technology within logistics operations, the objective is to boost and empower an organization's fundamental operational processes, ultimately leading to increased efficiency, flexibility, and effectiveness. This entails assessing the integration of automation tools, like robotic process automation or workflow systems, to improve these operations' speed, accuracy, and cost-effectiveness.
- Process Integration - Assesses the coordination and synchronization of processes to boost overall productivity, decrease duplication, mitigate delays, and enhance output quality. In logistics operations, process integration is used to align disparate processes into a unified and effective system, thus streamlining and optimizing operational workflows (including the flow of goods and information). However, prior to integration, it is essential to standardize and clearly define these processes in accordance with technological prerequisites and the specific needs of the logistics operation.
- Process Resilience/impact – Evaluate the systematic identification, assessment, mitigation, and monitoring of potential risks that can impact the smooth flow of goods, information, and services throughout the warehouse and transportation operations to ensure smooth and efficient logistics processes. One specific aspect of risk management in logistics is evaluating the potential risks associated with onboarding new clients or customers since the target is the 3PL companies.
- Change Management – Assess how changes are planned, carried out, and managed to guarantee their effective adoption and increased competitiveness, efficiency, and affordability in the dynamic logistics industry. An example could involve the adoption of new technology to support a vital activity or the onboarding of a new client.
- Technology Application - Analyzes the strategic utilization of technology tailored to address the distinct requirements of the logistics industry. This includes selecting and incorporating appropriate hardware, software, and tools with care in order to strengthen logistics procedures, improve customer satisfaction, and increase operational efficiency.
- Digital Innovation - Centers on evaluating the organization's aptitude for embracing digital innovation (how early adopters are) and harnessing emerging technologies to secure a competitive advantage. This entails endeavors like exploring IoT (Internet of Things), AI (Artificial Intelligence), blockchain, and other pioneering technologies with the potential to transform the logistics sector and elevate service offerings.
- Data Quality Management - Focuses on the procedures and methods used to guarantee data reliability, consistency, accuracy, and completeness in logistics operations. It assesses the

steps done to preserve high-quality data, which is necessary for streamlining procedures, cutting down on errors, and making wise business decisions.

- Data Accessibility - Evaluates how widely data is shared and used cooperatively across various logistics sector functions. It considers data sharing between various stakeholders, such as suppliers, partners, and customers, to improve visibility, coordination, and overall supply chain efficiency by using the right tools.
- Data Security Measures - Evaluate the strategies and safeguards in place to protect sensitive and confidential data. It includes measures like encryption, access controls, user authentication, intrusion detection, and other practices aimed at preventing unauthorized access and data breaches.
- Data Application - Examines how data is effectively applied in decision-making, process improvement, and innovation within the logistics sector. It assesses the utilization of data analytics, business intelligence tools, and other technologies to extract valuable insights, forecast trends, and drive performance optimization.
- Data Interoperability - Assesses the degree of harmonious data exchange and compatibility among the various systems, platforms, and applications employed in logistics operations. In order to improve operational efficiency and reduce data isolation, this evaluation attempts to ensure the effective transfer and utilization of data across a variety of IT systems.
- Data Ownership – Considers the definition of a person's rights and obligations with regard to data. This is paramount to ensure that, when a data modification is required, the person responsible for the task is accurately identified and designated.

4.4. Survey Design

The survey was designed using Google Forms, incorporating the "scorecery" add-on. This add-on enabled the calculation of an overall score and displayed the result to the respondent upon survey submission.

The survey consists of two groups: The first group comprises eight sections, each of which directly corresponds to the eight dimensions proposed in the revised Luftman model (refer to Figure 10). Each section comprises questions designed to assess the attributes of each of the eight dimensions. As previously mentioned, each question has a scale from 1 to 5, where 1 represents the lowest level of maturity, and 5 represents the highest level. The survey's final score is the average of all the points given in response to the questions. The second group aimed to assess the impact and relevance of each dimension to the reality of the 3PL companies.

Following the score presentation, an explanatory text indicates the corresponding maturity level. This provides valuable information to assess the level of maturity in the logistics sector and offers the respondent an overview of their organization's alignment between business and IT.

It is crucial to understand that the explanatory text accompanying the survey result does not offer tailored recommendations for the company. Instead, it is based solely on the answers provided by the respondent, offering a generalized understanding of the organization's level of maturity in IT-business strategy alignment.

5. PRACTICAL APPLICATION OF THE ALIGNMENT MODEL IN LOGISTICS COMPANIES

5.1. DATA SAMPLE

The study's participants are companies that adhere to the subsequent criteria: they were founded/ have offices in Portugal and provide transportation and warehousing services (as a 3PL company). Further information about the participating companies can be found in the table above (table 3):

Table 3: List of 3PL Portuguese companies.

Company name	Foundation year	Number of employees (approx.)	Official website
***Transportes* Pascoal**	1968	201-500	http://www.transpascoal.com/
Garland		201-500	http://www.garland.pt/
Logic	1994	51-200	http://www.logic.pt/
TORRESTIR	1962	1001-5000	http://www.torrestir.com/
Luís Simões	1948	1001-5000	http://www.luis-simoes.com/
TJA	1947	1001-5000	http://tja.pt
Santos e Vale	1982	1001-5000	http://www.santosevale.pt/
LASO	2007	501-1000	http://www.laso.pt/
***Transportes* Paulo Duarte**	1946	501-1000	http://www.transportespauloduarte.pt

5.2. DATA COLLECTION

The survey was disseminated via LinkedIn, contacting employees from the mentioned companies through direct chat. The selection of participants was made carefully, with a focus on their specific roles and professional backgrounds. While outreach efforts extended to 70 individuals, only 12 actively participated in the study by responding to the survey, resulting in a conversion rate of 17.14%.

5.3. Results Analysis

The survey encompassed 39 questions (Appendix B) to assess the level of maturity regarding the alignment of IT with business strategy and was directed at employees employed by one of the companies listed in Table 2. The survey collected a total of 12 responses.

Most of the respondents held positions in Management Roles, comprising 58% of the total, while there were no participants from the IT Staff (as shown in chart 1).

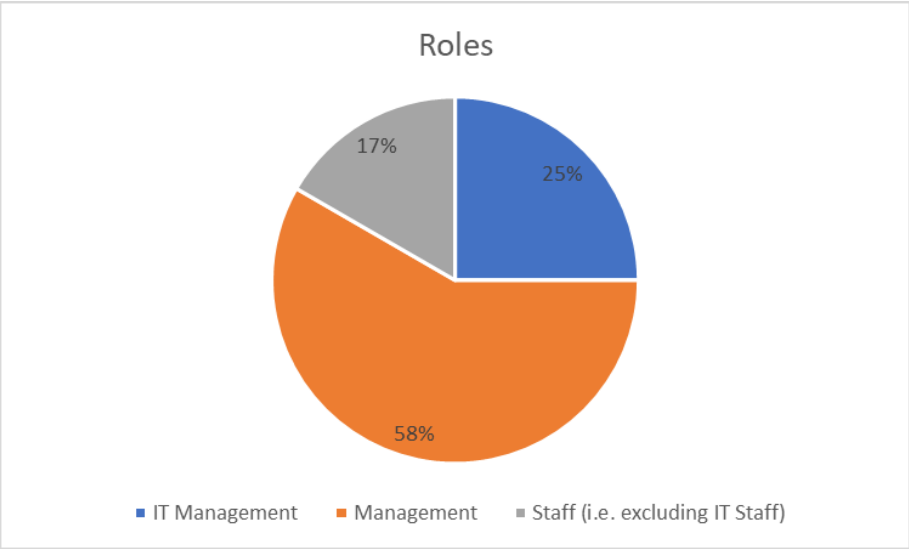

Chart 1: Survey participant's roles.

Regarding departmental affiliation, the results exhibited a more varied distribution, with the transportation department representing the largest segment, closely followed by the warehouse department (34% and 25%, respectively), as shown in Chart 2.

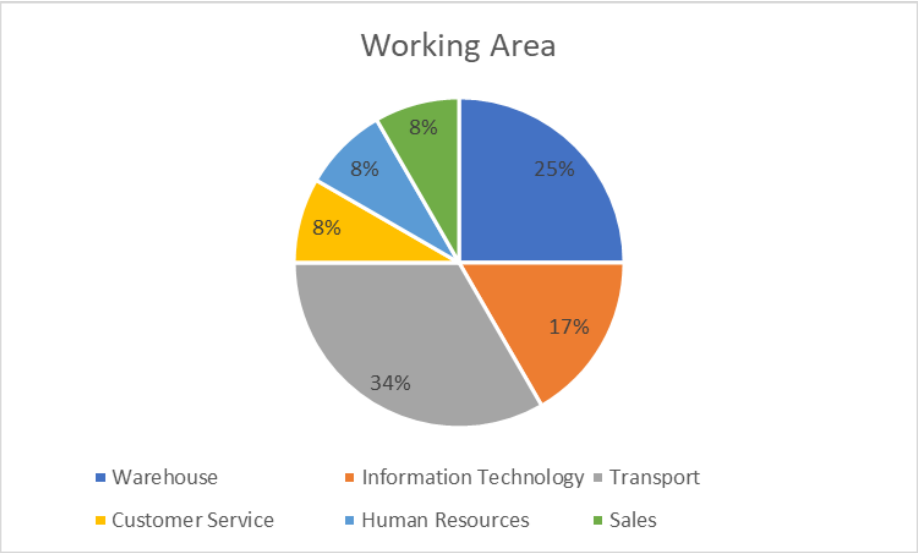

Chart 2: Survey participants' working area.

The findings indicated that the mean level of maturity regarding the alignment of IT and business strategy within the 3PL sector, according to the 12 responses, is 3.84 points out of 5 (Appendix A). This range encompasses the lowest level in a response of 3.16 and the highest level in a response of 4.52. Chart 3 demonstrates that 50% of the responses fall within the range of 3.47 points to 4.24 points regarding the level of maturity between IT and business strategy within the 3PL sector.

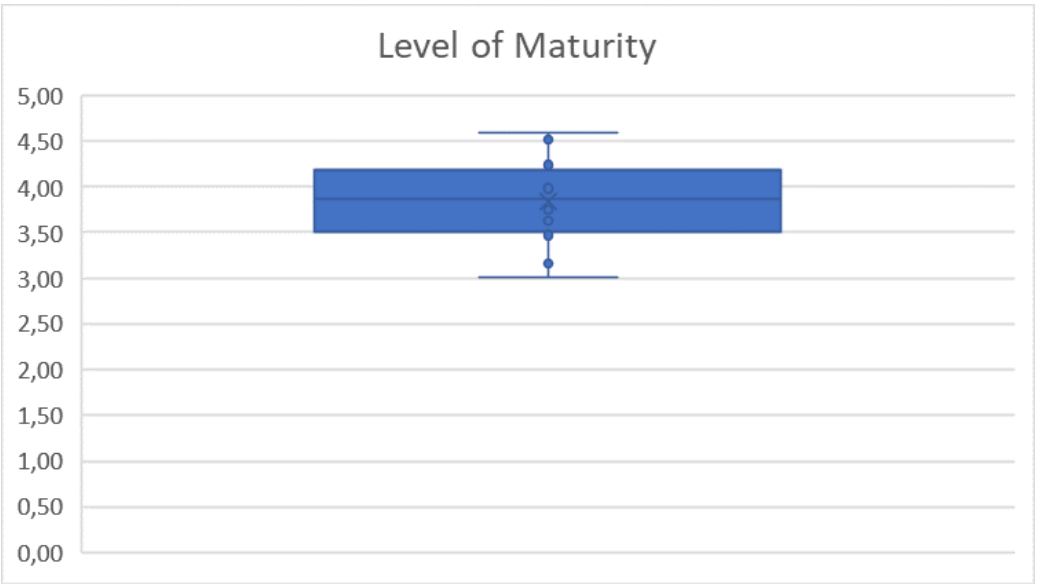

Chart 3: Level of maturity in IT-Business strategy alignment in the Portuguese 3PL sector.

Among the dimensions examined, *Governance* exhibited the highest level of maturity, registering a score of 4.03 out of 5. Following closely, the *Data* dimension achieved a score of 3.99, with the *Processes* dimension trailing just behind at 3.98.

Skills dimension secured the fourth position with a score of 3.86 points, making it the fourth dimension with the highest level of maturity. In the fifth position, we find the dimensions of *Communication* and *Technology Scope and Architecture*, both scoring 3.81 points out of 5.

The *Measurement of Value* dimension held the sixth place with a score of 3.68, while the *Partnership* dimension emerged as the one with the lowest level of maturity, recording 3.58 points. Details can be found in Appendix A.

The following chart (chart 4) represents the different levels of maturity by each dimension analyzed:

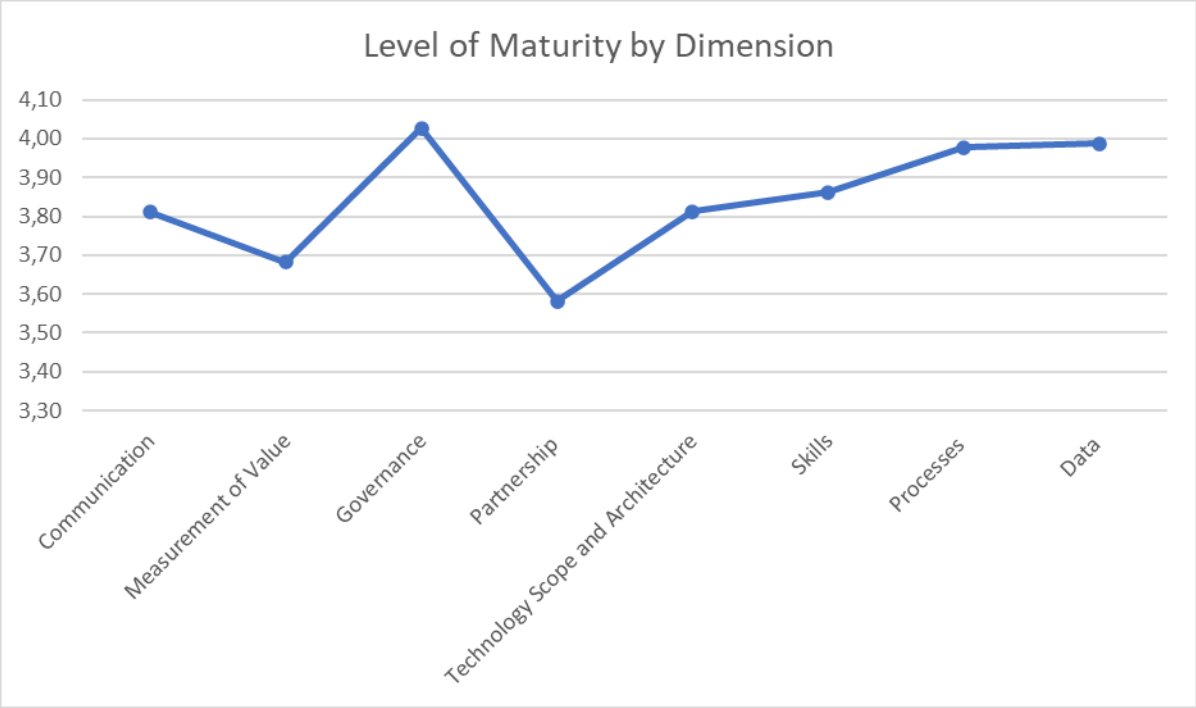

Chart 4: Level of maturity by dimension.

As the survey was applied to a specific sector (3PL), the dimensions could hold varying degrees of significance/importance for the 3PL industry. In light of this, we requested respondents to assign a relevance score to each dimension, indicating its importance within the logistics landscape. These assessments, ranging from 1 (indicating the lowest level of importance) to 5 (indicating the highest level of importance), are detailed in the table provided above (Table 4).

Table 4: Significance levels of each dimension in the 3PL sector.

Dimensions ↓ Answers →	Comunication	Partnership	Measurement of Value	Governance	Skills	Technology Scope and Architecture	Processes	Data
A1	4	4	5	4	4	5	5	5
A2	4	5	5	3	4	4	5	4
A3	4	4	4	4	4	3	3	3
A4	3	3	4	4	4	3	3	4
A5	5	5	4	5	4	4	5	5
A6	4	4	4	4	4	4	4	4
A7	4	4	3	3	4	4	3	3
A8	5	5	5	5	5	5	5	5
A9	5	5	5	5	5	5	5	5
A10	5	5	5	5	5	5	5	5
A11	3	3	4	4	3	4	4	4
A12	4	4	4	4	4	4	4	4
Average	**4,17**	**4,25**	**4,33**	**4,17**	**4,17**	**4,17**	**4,25**	**4,25**

Using the average of the level of significance attributed to each dimension, each dimension's weight was calculated (Table 5) and applied to determine a new level of maturity (Table 6).

Table 5: Weighted significance of dimensions.

	Level of Significance	**Weight**
Communication	4.17	7.69%
Partnership	4.25	15.38%
Measurement of Value	4.33	23.10%
Governance	4.17	7.69%
Skills	4.17	7.69%
Technology Scope and Architecture	4.17	7.69%
Processes	4.25	15.38%
Data	4.25	15.38%
Total		**100.00%**

Table 6: Derivation of the revised maturity level based on significance criteria.

	Without significance criteria		**With significance criteria**	
	Weight	Level of Maturity	**Weight**	Level of Maturity
Communication	12.5%	3.81	**7.69%**	3.81
Partnership	12.5%	3.58	**15.38%**	3.58
Measurement of Value	12.5%	3.68	**23.1%**	3.68
Governance	12.5%	4.03	**7.69%**	4.03
Skills	12.5%	3.86	**7.69%**	3.86
Technology Scope and Architecture	12.5%	3.81	**7.69%**	3.81
Processes	12.5%	3.98	**15.38%**	3.98
Data	12.5%	3.99	**15.38%**	3.99
Level of Maturity	3.84		**3.82**	

As indicated in Table 6, the application of significance criteria reduced the maturity level, declining from 3.84 points to 3.82 points out of a possible 5, by applying the following formula:

$$New\ level\ of\ maturity$$
$$= (7.69\% * 3.81) + (15.38\% * 3.58) + (23.10\% * 3.68) + (7.69\% * 4.03)$$
$$+ (7.69\% * 3.86) + 7.69\% * 3.81) + (15.38\% * 3.98) + (15.38\% * 3.99)$$

Notably, the dimension *Measurement of Value* played a pivotal role in this decrease, as it held the highest level of significance within the 3PL sector, as conveyed by the feedback from the 12 survey respondents (as shown in Table 4), also possessed the second lowest maturity level, scoring 3.68 points.

6. CONCLUSIONS

6.1. SYNTHESIS OF THE DEVELOPED WORK

The current work has undertaken a comprehensive exploration of the Information Technology and business strategy alignment within the context of the Portuguese logistics sector.

The findings emphasize the pivotal role of technology, information, innovation, and logistics process integration as drivers for gaining a competitive advantage in this sector.

The integration of two new dimensions (Processes and Data) and two new attributes (Technology Application and Digital Innovation) into the Luftman Maturity Model allows for a more advanced evaluation of the elements affecting a competitive advantage in the logistics industry (answer to RQ2). This extension to the model addresses the specific needs and challenges of the logistics sector, providing a targeted framework for evaluation and a more updated model as the Luftman Maturity Model has not been updated since the date of creation (2000).

After including the specialists' opinions in the extended model (resulting in a revised model), the model was applied to three third-party logistics (3PL) companies in Portugal, revealing a maturity level of 3.84, corresponding to Level 4, "Improved/Managed Process" (answer to RQ1). This implies that these organizations' IT and business strategies are admirably aligned. At this level, businesses exhibit competent governance and services, establishing IT as a key value center. Furthermore, these companies see IT as a creative and innovative strategic asset, contributing significantly to their overall achievements.

The research has effectively addressed the two primary research questions:

RQ 1– What updates/extensions can be made to Luftman's model to make it suitable for today's logistics companies?

RQ2 - What is the current level of IT-Business strategy alignment of 3Pl companies in Portugal?

Considering these findings, it is evident that IT-business alignment is a critical factor for success not only for the logistics sector but also for other sectors. Companies must see IT in harmony with business strategy to create a long-term competitive edge advantage and perhaps a sustaining and successful business. As the logistics industry evolves, the proposed extended model provides a valuable tool for organizations to strategically assess and enhance their IT-business strategy alignment, fostering innovation and resilience in an increasingly digitalized and competitive environment.

6.2. LIMITATIONS

There were certain restrictions with the extended model's development, assessment, and validation. First, based on what was determined to be most significant for the logistics sector, the dimensions and attributes added to the extended model were chosen according to the literature review. It does not claim to assess all crucial aspects of the industry comprehensively. Its generality may render it unsuitable for certain types of logistics businesses due to its specifications.

Furthermore, the five maturity levels that have been identified provide general evaluations of business positioning. However, they might not match precisely or might even lead to misleading conclusions about the state of business today. Moreover, time constraints prevented the interview of a few 3PL companies to formulate more customized recommendations for each maturity level.

Additionally, it is essential to highlight that not all attributes from the Luftman Maturity Model were integrated into the extended model. This exclusion was not guided by specific criteria but rather by the intention to refine the original scope and accommodate potential new dimensions and attributes to enhance the model. Considering all attributes, including the added ones, in the extended model would have significantly expanded the survey, potentially reducing its responsiveness across a broader audience.

The extended model underwent review by three experts, with only one possessing Information Technology expertise. It would be beneficial to add four experts to the assessment process: two information technology specialists and two logistics experts.

The survey developed to evaluate the extended model within the three Portuguese companies (Appendix B) was designed with questions intended to assess each attribute. This task presented a significant challenge because only one question was required to measure a attribute. As a result, different questions that may better match the corresponding attribute could be developed to determine the maturity level of each attribute.

6.3. RECOMMENDATIONS FOR FUTURE WORK

As previously noted, soliciting input from other information systems and technology experts could enrich the extended model with valuable insights. Consequently, we recommend seeking an additional expert opinion in the field of Information Technology or someone from the logistics domain with an academic background in Information Systems/Technology.

Additionally, working with these specialists is crucial in order to determine which characteristics from Luftman's framework should be included in the expanded model and which ones should be left out.

To enhance the accuracy of assessing maturity levels in Portuguese third-party logistics (3PL) companies, we propose administering the survey across a diverse spectrum of companies. Additionally, conducting interviews with selected participants from the study will provide a deeper understanding of their business contexts, contributing to a more precise determination of maturity levels.

For the interviews, it is advisable to engage with companies representing various maturity levels within the logistics sector. This approach will enable a detailed categorization of maturity levels, aligning with the proposed five levels.

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APPENDIX A

Dimension	Attribute	Question	Average
Communication	Understanding of Business by IT	On a scale of 1 to 5, how do you think the IT department takes the company's overall strategy into account when making a decision?	4,33
	Understanding of IT by Business	Is the business area aware of the added value that IT can bring to its overall strategy?	3,92
	Knowledge Sharing	How is knowledge sharing carried out within your organisation?	3,41
	Organizational Learning Educational	On a scale of 1 to 5, how would you rate the effectiveness of learning and education initiatives within your organisation?	3,58
		Subtotal	3,81
Measurement of Value	IT Metrics	How would you characterise the metrics used by the IT department to measure its activity?	4,00
	Business Metrics	How would you characterise the metrics used by the business area to measure its activity?	3,33
	Integrated Business and IT Metrics	On a scale of 1 to 5, how would you rate the relationship between business and IT metrics?	3,75
	Service Level Agreements	How do you classify service agreement levels?	3,50
	Continuous Improvement	On a scale of 1 to 5, how would you rate the organisation's dedication to continuous service improvement?	3,83
		Subtotal	3,68
Governance	Business Strategic Planning	How do you classify your company's business strategy?	3,83
	IT Strategic Planning	How do you rate the overall IT strategy?	3,67
	IT Organization Structure	What position does the systems/technology director report to within your organisation?	4,75
	IT Reaction Capacity	On a scale of 1 to 5, how would you rate the IT department's ability to react to sudden changes or unexpected events?	3,92
	IT Budgeting	On a scale of 1 to 5, how would you rate the management and application of the budget in the IT department?	3,92
	IT Investment Decision	How do you characterise the investments made by the IT department?	4,08
		Subtotal	4,03
Partnership	Business Perception of IT Value	The company perceives information technologies as:	3,58
	Shared Goals, Risks, Rewards/ Penalties	Does the IT department share rewards / risks with the business area?	3,08
	IT Program Management	On a scale of 1 to 5, how do you think technology projects are managed in your company?	3,75
	Relationship/ Trust Style	On a scale of 1 to 5, how would you rate the relationship between the business area and the IT department?	3,92
		Subtotal	3,58
Technology Scope and Architecture	Architecture Integration	What is the level of communication between the technologies/applications used by the company (e.g. document sharing without human intervention)?	3,75
	IT Architecture/ Infraestructure Flexibility	On a scale of 1 to 5, how would you rate the effectiveness of the systems architecture in adapting to and managing a change?	3,67
	Technology Application	On a scale of 1 to 5, how do you think technology supports your daily functions?	4,00
	Digital Innovation	How would you rate your company in terms of digital innovation?	3,83
		Subtotal	3,81
Skills	Innovative Entrepreneurial Environment	On a scale of 1 to 5, to what extent does your organisation promote a business environment that encourages creative thinking and company development?	3,67
	Change Readiness	How do you rate your organisation's workforce when it comes to adapting to and adopting business changes?	3,92
	Career Change	How do you characterise job promotions in your company?	3,75
	Opportunities to Learn	How would you rate the learning and professional development opportunities offered by your company?	3,67
	Interpersonal Interaction	On a scale of 1 to 5, how would you rate the communication and interaction between different employees within your organisation?	3,92
	Hiring and Retaining	On a scale of 1 to 5, how likely are you to stay with the company in the near future?	4,25
		Subtotal	3,86
Processes	Business Process Enablement	How do you classify business processes?	4,25
	Process Integration	Integração de processos - Como classifica a integração de processos que ocorrem nas operações de armazém e transporte?	4,08
	Process Resilience/ Impact	On a scale of 1 to 5, how would you rate the effectiveness of your organisation's risk management practices in identifying, mitigating and addressing potential risks in current processes?	3,92
	Change Management	On a scale of 1 to 5, how would you rate the effectiveness of implementing change management practices in current processes?	3,67
		Subtotal	3,98
Data	Data Quality Management	On a scale of 1 to 5, how often do you use data to make decisions or solve problems?	4,00
	Data Accessibility	How would you rate the level of data sharing in your organisation?	3,75
	Data Security	How do you rate the strategies/measures implemented to protect sensitive and confidential data?	3,92
	Data Application	How do you assess the role of data in promoting innovation in the company?	3,92
	Data Integration	How would you rate the level of compatibility and continuous data exchange between the different systems in your organisation?	4,00
	Data Ownership	How do you classify data property management?	4,33
		Subtotal	3,99
Total Level of Maturity			**3,84**

APPENDIX B

Assessing the maturity of Business-IT alignment within the logistics sector

Context:
Business-IT alignment can be defined as applying information technology in an appropriate and timely way, in harmony with business strategies and needs. Recent studies highlight several key advantages of aligning business with IT strategy, including improved collaboration, heightened competitive advantages, streamlined organizational processes, growth facilitation, increased return on investment, and enhanced overall performance.

Objective:
The primary goal of this survey is to assess the maturity of Business-IT alignment within the logistics sector, although its applicability extends to other industries as well. Employing the Luftman Strategic Model as a framework, this survey seeks to collect insights from logistics firms across eight key dimensions: Communication, Value Measurement, Governance, Skills, Technology Scope and Architecture, Partnership, Processes, and Data. Each dimension comprises a set of questions offering five response options aligned with a given maturity level (with 1 representing the lowest level and 5 signifying the highest).

Output:
Upon survey submission and based on the provided responses, the survey will yield a maturity level calculated from the average points.

Contribution:
This study will hopefully contribute to the current body of knowledge on Business-IT alignment by identifying the level of maturity in the logistics sector and the factors that influence it. The study's findings are likely to inform the development of strategies for enhancing Business-IT alignment in the logistics sector, as well as have practical consequences for logistics organizations looking to improve their performance and competitiveness.

(total time = 8 min)

* Indica uma pergunta obrigatória

1. What is your company role? Please select the one that provides the best fit to your current role. *

Management roles - Include all logistic roles responsible for planning, decision-making and overseeing the work of others
IT Management roles - Include all roles related to information systems/ technology responsible for planning, decision-making, and overseeing the work of others

Marcar apenas uma oval.

- ◯ Management
- ◯ IT Management
- ◯ Staff (i.e., excluding IT Staff)
- ◯ IT Staff

2. Which area do you work? *

Marcar apenas uma oval.

- ◯ Transportation
- ◯ Warehousing
- ◯ Customer service
- ◯ Procurement
- ◯ Inventory
- ◯ Accounting/Finance
- ◯ Information Technology (IT)
- ◯ Marketing
- ◯ Sales
- ◯ Outra: _____

Communication Dimension

This dimension underlines the importance of effective communication and collaboration between business and IT stakeholders within the organisation, with a focus on assessing the level of understanding/communication between the IT department and the business.

3. Understanding of Business by IT - On a scale of 1 to 5, how do you think the IT department takes the company's overall strategy into account when making a decision? *

IT = Information Technology

Marcar apenas uma oval.

	1	2	3	4	5	
Nev	◯	◯	◯	◯	◯	Always

4. Understanding of IT by Business - Is the business area aware of the added value that IT can bring to its overall strategy? *

IT = Information Technology

Marcar apenas uma oval.

- ◯ No - IT department perceived as support only
- ◯ Yes, but awareness of the value of IT is limited
- ◯ Yes, and it's starting to incorporate IT strategy into its overall strategy
- ◯ Yes, it is aware of the potential of IT but does not always take it into account in its overall strategy
- ◯ Yes, it always takes the IT strategy into account when defining its overall strategy

5. Knowledge sharing - How is knowledge sharing carried out within your organization? *

Marcar apenas uma oval.

- ◯ There is no sharing of knowledge
- ◯ When necessary, in an unstructured way
- ◯ Structured only for key processes
- ◯ Based on a clear plan defined by the company
- ◯ Consistently and clearly internally, with a component for sharing knowledge with the outside world (e.g. holding a webinar)

6. Organization Learning Educational - On a scale of 1 to 5, how would you rate the effectiveness of learning and education initiatives within your organization?

Marcar apenas uma oval.

	1	2	3	4	5	
Non	◯	◯	◯	◯	◯	Higly Effective

Value Measurement Dimension

This dimension focuses on evaluating the integration between the business area and information technologies in terms of creating added value.

7. IT metrics - How do you characterize the metrics used by the IT department to measure its activity? *

IT = Information Technology
IT Metric - Measures used to track IT processes to judge the performance level

Marcar apenas uma oval.

- ◯ Non-existing
- ◯ Technical and non-functional - Not related to the business (eg., network latency)
- ◯ Tradicional Finance - Focus on budgeting
- ◯ Cost effectiveness
- ◯ Comprehensive focus and use in measuring external partners

8. Business Metrics - How do you characterize the metrics used by the business area to measure its activity? *

IT = Information Technology

Marcar apenas uma oval.

- ◯ Created ad-hoc with no connection to IT
- ◯ Focus on functional organization
- ◯ Tradicional financial (eg., liquidity ratios)
- ◯ Customer based (eg., customer satisfaction, retention rates)
- ◯ With a comprehensive focus and used to measure external partners

9. Integrated business and IT metrics - On a scale of 1 to 5, how would you rate the relationship between business and IT metrics?

IT = Information Technology

Marcar apenas uma oval.

	1	2	3	4	5	
Unli	◯	◯	◯	◯	◯	Linked

10. Service Level Agreements - How do you classify the organization's SLA? *

SLA are are plain-language agreements between you and your customer (i.e. between the IT department and the business) that may include one or more of the other metrics

Marcar apenas uma oval.

- ◯ The organization has no defined or documented SLAs
- ◯ Technicians and at an operational level
- ◯ Comprehensive, but unclear
- ◯ Well defined and used throughout the company
- ◯ Well-defined, comprehensive and extended to external partners (e.g. suppliers must perform the service within 3 days)

11. Continuous Improvement - On a scale of 1 to 5, how would you rate the organization's dedication to continuous improvement in its services? *

Marcar apenas uma oval.

	1	2	3	4	5	
Very	◯	◯	◯	◯	◯	Excelent - Always one step ahead

Governance Dimension

This dimension assesses the effectiveness of the company's business governance structures and information technologies (IT) to ensure alignment and response to different situations.

12. Business strategy planning - How would you rate your company's business strategy? *

Marcar apenas uma oval.

- ◯ Created ah-hoc
- ◯ Basic and at a functional level
- ◯ At departmental level but not aligned with global strategy
- ◯ Universal and applied to the entire organization
- ◯ Integrated across and outside the organization

13. IT strategy planning - How do you rate the overall IT strategy? *

Marcar apenas uma oval.

- ◯ Created ad-hoc
- ◯ Reactive, focusing only on support (e.g. responding to software incidents)
- ◯ Defined but unclear and comprehensive
- ◯ Proactive and comprehensive, with a focus on innovation and future projects
- ◯ Clear and comprehensive, aligned with the overall business strategy (partnership between the IT department and the business)

14. IT Reporting Structure - Who does the Chief Information Officer report? *

Marcar apenas uma oval.

- ◯ My company doesn't have a systems/technology director
- ◯ Operational manager
- ◯ Chief Operation Officer
- ◯ Chief Financial Officer
- ◯ Chief Executive Officer

15. IT Reaction Capacity - On a scale of 1 to 5, how would you rate the IT department's ability to react to sudden changes or unexpected events?

Marcar apenas uma oval.

	1	2	3	4	5	
Very	◯	◯	◯	◯	◯	Very hight

16. IT Budgetary Control - From 1 to 5, how do you classify IT budget?

Marcar apenas uma oval.

	1	2	3	4	5	
Erra	◯	◯	◯	◯	◯	Investments focused on growth and improvement

17. IT Investment Management - How do you characterize the investments made by the IT department? *

Marcar apenas uma oval.

- ◯ Erractic spending
- ◯ Operations maintenance
- ◯ Specific process driver
- ◯ With a focus on cost effectiveness for the entire organization
- ◯ Extended to external partners (e.g. investment in technologies to improve communication with external partners)

Partnership Dimension

This dimension examines the collaboration and trust between the business and the IT department in the organization.

18. Business perception of IT value - The company perceives information technologies as: *

Marcar apenas uma oval.

- A cost to the business
- An emerging asset
- Asset
- Part of business strategy
- Partner to achieve common goal

19. Shared Goals, Risks, Rewards/Penalties - Does the IT department share rewards / risks with the business area? *

Marcar apenas uma oval.

- No - The business area and the IT department do not share rewards or risks
- Rarely - Only on specific subjects or projects
- Yes - The IT department takes most of the risks with few rewards
- Yes - The rewards are shared but the risks are not
- Yes - Risks and rewards are shared unanimously between the business area and the IT department

20. Relationship/trust style - On a scale of 1 to 5, how do you think technology projects are managed in your company?

Marcar apenas uma oval.

	1	2	3	4	5	
Dire	◯	◯	◯	◯	◯	Valued Partnership

Technology and Architecture Dimension

This dimension focuses on assessing the maturity of information technologies.
It assesses in depth the applicability of technological solutions and their alignment with business architecture.

21. Architecture Integration - What is the level of communication between the technologies/applications used by the company (e.g. document sharing without human intervention)? *

Marcar apenas uma oval.

- ◯ They don't communicate with each other as they are isolated, giving rise to significant data silos, hampering operational efficiency.
- ◯ Communication is limited and there are notable inefficiencies in data exchange
- ◯ They communicate quite well, but there are occasional challenges in sharing and integrating data
- ◯ They are fully integrated internally, allowing seamless communication and data exchange.
- ◯ Estão totalmente integradas a nível interno e externo, permitindo uma partilha óptima de dados sem necessidade de intervenção manual

22. Architecture/ Infraestructure flexible - On a scale of 1 to 5, how would you rate the effectiveness of the systems architecture in adapting to and managing a change?

IT Architecture: Design framework and standards to ensure that an organization's technology systems align with its business goals and adapt to changing needs.
IT Infrastructure: Comprises the physical and virtual components, including hardware, software, networking, and storage, that form the foundation of an organization's IT operations

Marcar apenas uma oval.

	1	2	3	4	5	
Inef	◯	◯	◯	◯	◯	Effective

23. Technology application - On a scale of 1 to 5, how do you think technology supports your daily functions?

Marcar apenas uma oval.

	1	2	3	4	5	
Lacl	◯	◯	◯	◯	◯	Appropriate technology, allowing productivity to increase

24. **Digital Innovation** - How would you rate your company in terms of digital innovation? *

Marcar apenas uma oval.

	1	2	3	4	5	
Tecl	◯	◯	◯	◯	◯	Tech[illegible]equirements

Skills Dimension

This dimension assesses the skills and capabilities of the teams involved in IT and business functions.

25. Innovative Entrepreneurial Environment - On a scale of 1 to 5, to what extent does your organization promote a business environment that encourages creative thinking and company development?

Marcar apenas uma oval.

	1	2	3	4	5	
Disc	◯	◯	◯	◯	◯	Highly Encouraged to the all organization

26. Change Readiness - How do you rate your organization's workforce when it comes to adapting to and adopting business changes? *

Marcar apenas uma oval.

- ◯ Highly resistant, no flexibility
- ◯ It differs from department to department, but in general it is resistant
- ◯ The need for change is recognized by the teams, but the necessary measures are not taken
- ◯ The need for change is recognized by the teams and the necessary measures are taken
- ◯ The teams are totally open and always looking for possible changes

27. Career Crossover - How would you rate the career crossover in your organization? *

Marcar apenas uma oval.

- ◯ None
- ◯ Minimum
- ◯ It depends on the manager and there is no defined process
- ◯ Happens only between departments (horizontal)
- ◯ Across the entire organization

28. Opportunities to learn - How would you rate the learning and professional development opportunities offered by your company? *

Marcar apenas uma oval.

- ◯ None
- ◯ Minimum
- ◯ Depend on the department
- ◯ At a operational level
- ◯ They cover the entire organization, without any restrictions

29. **Interpersonal Interaction -** On a scale of 1 to 5, how would you rate the communication and interaction between different employees within your organization? *

Marcar apenas uma oval.

	1	2	3	4	5	
Non	◯	◯	◯	◯	◯	Collaborative and dynamic environment

30. **Hiring & Retaining** - On a scale of 1 to 5, how likely are you to stay with the company in the near future? *

Marcar apenas uma oval.

	1	2	3	4	5	
Very	◯	◯	◯	◯	◯	Very Likely to Stay

Process Dimension

This dimension assesses the effectiveness, efficiency and adaptability of the organization's operational processes. It aims to ensure that processes are well defined, consistently executed and aligned with the organization's strategic objectives.

31. Business Process Enablement - How do you classify business processes? *

Marcar apenas uma oval.

- ◯ Non-existing/ Ad-hoc
- ◯ Rudimentary
- ◯ Confusing and poorly automated
- ◯ High level of automation/optimization but not being applied by all stakeholders
- ◯ Totalmente automatizados/optimizados e estão a ser aplicados por toda a organização

32. Process Integration - How do you classify the integration of processes that take place in warehouse and transportation operations? *

Marcar apenas uma oval.

- ◯ Non-existent - Teams work individually and processes are not integrated
- ◯ Only a few key processes are integrated
- ◯ Integrated but not standardized processes
- ◯ Integrated and standardized processes, but not fully optimized
- ◯ Fully integrated, standardized and optimized processes

33. Risk Management - On a scale of 1 to 5, how would you rate the effectiveness of risk management practices within your organization in identifying, mitigating, and addressing potential risks in the current processes?

Marcar apenas uma oval.

	1	2	3	4	5	
Non	◯	◯	◯	◯	◯	Highly Effective

34. **Change Management** - On a scale of 1 to 5, how would you rate the effectiveness of your organization's risk management practices in identifying, mitigating and addressing potential risks in current processes? *

Example of risk management in logistics processes: Risk assessment in a process given the implementation of three new customers OR Risk assessment on the possibility of anomalies or interruptions in a technology used in a logistics process

Marcar apenas uma oval.

	1	2	3	4	5	
Non	◯	◯	◯	◯	◯	Highly Effective

Data Dimension

This dimension encompasses a comprehensive assessment of the management, quality and use of data in the organization given its importance and criticality to the business.

35. Data Quality Management - On a scale of 1 to 5, how often do you use data to make decisions or solve problems? *

Marcar apenas uma oval.

	1	2	3	4	5	
Rare	◯	◯	◯	◯	◯	Always

36. Data Accessibility - How would you rate the level of data sharing in your organization? *

Marcar apenas uma oval.

- ◯ There is no data sharing as the company does not perceive data as a valuable asset
- ◯ Only in cross-functional projects and data sharing is done in an unstructured way
- ◯ When decisions need to be made, with the help of specific tools
- ◯ Shared throughout the organization, in a formalized and structured way, using the right tools
- ◯ Shared in real time through the appropriate tools, governed by established rules and policies

37. Data Security Measures - How do you rate the strategies/measures implemented to protect sensitive and confidential data? *

Marcar apenas uma oval.

- ◯ I am not aware of any data protection policy or strategy
- ◯ They lack documentation and are communicated verbally
- ◯ Documented and available, but immature
- ◯ Well documented and available, but not applied throughout the organization
- ◯ Universally applied throughout the organization and supervised by a designated authority

38. Data Application - How do you assess the role of data in promoting innovation in the company? *

Marcar apenas uma oval.

- ◯ Decisions are not based on data
- ◯ Teams recognize the importance of data, despite its low quality, throughout the organization
- ◯ Data is used by some teams/departments to improve specific processes, activities or strategies
- ◯ Data is used to drive innovation throughout the company
- ◯ The organization perceives data as a competitive advantage

39. Data Interoperability - How do you rate the level of compatibility and continuous data exchange between the different systems in your organization? *

Marcar apenas uma oval.

- ◯ There is no exchange of data between systems as the systems are not interconnected
- ◯ Limited
- ◯ Occasional, insufficient to meet needs
- ◯ Automatic, but not in real time
- ◯ Automatic, optimized and in real time

40. Data Ownership - How do you classify data property management? *

Marcar apenas uma oval.

- ◯ Non-existing
- ◯ Defined Ad-hoc
- ◯ Defined but not put in practice
- ◯ Defined but with number gaps
- ◯ Well-established and precise

41. Total score

Dimensions Importance for 3PL Companies

Dimensions = Communication, Partnership, Value Measurement, Governance, Skills, Architecture and Technology, Processes and Data

42. Based on the dimensions presented in the previous section, how do you assess them in terms of their relevance and impact on the 3PL (third-party logistic) sector? *

1 - The lowest level of significance and influence

5- The highest level of significance and influence

If you consider that all dimensions have the same level of relevance and impact, please select level 5.

Marcar apenas uma oval por linha.

	1	2	3	4	5
Skills	◯	◯	◯	◯	◯
Data	◯	◯	◯	◯	◯
Process	◯	◯	◯	◯	◯
Partnership	◯	◯	◯	◯	◯
Technology Scope and Architecture	◯	◯	◯	◯	◯
Measurement of Value	◯	◯	◯	◯	◯
Communication	◯	◯	◯	◯	◯
Governance	◯	◯	◯	◯	◯

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