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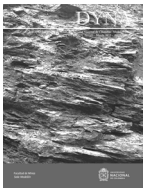

UNIVERSIDAD NACIONAL DE COLOMBIA

Analysis of the Intentionality and usability of business intelligence in the context of Industry 5.0 and its impact on Colombian international trade

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Abstract
In Colombia, integrating educational technology (EdTech) is crucial for enhancing educational quality and efficiency, especially in the post-pandemic context. Researchers [1] highlight the significant role of online platforms, yet challenges persist, such as the need for robust technological infrastructure and comprehensive teacher training. With 55.3% of universities adopting these platforms, reliance on external technologies and insufficient investment in local EdTech hinder innovation, as noted by [2]. [3] advocate for investing in local EdTech to improve education and stimulate economic development. In the industrial sector, under Industry 5.0, Business Intelligence (BI) is vital for boosting international trade through data analysis and informed decision-making. [4] emphasizes tools like Power BI for competitiveness, while DANE data indicates that 40.1% of companies outsource technology management, highlighting the need to develop local expertise to ensure sustainable growth and align BI with national economic goals.

Keywords: Industry 5.0; online platforms; educational quality; technological infrastructure; local development.

Análisis de la Intencionalidad y usabilidad de la inteligencia de negocios en el contexto de la Industria 5.0 y su impacto en el comercio internacional Colombiano

Resumen
En Colombia, la integración de la tecnología educativa (EdTech) es crucial para mejorar la calidad y eficiencia educativa, especialmente en el contexto postpandemia. Los investigadores [1] destacan el papel significativo de las plataformas en línea; sin embargo, persisten desafíos como la necesidad de una infraestructura tecnológica robusta y una capacitación docente integral. Con un 55.3% de universidades que adoptan estas plataformas, la dependencia de tecnologías externas y la insuficiente inversión en EdTech local obstaculizan la innovación, como señalan [2]. [3] abogan por invertir en EdTech local para mejorar la educación y estimular el desarrollo económico. En el sector industrial, bajo la Industria 5.0, la Inteligencia de Negocios (BI) es vital para impulsar el comercio internacional a través del análisis de datos y la toma de decisiones informada. [4] enfatiza herramientas como Power BI para la competitividad, mientras que los datos del DANE indican que el 40.1% de las empresas subcontratan la gestión tecnológica, destacando la necesidad de desarrollar experiencia local para asegurar un crecimiento sostenible y alinear la BI con los objetivos económicos nacionales.

Palabras clave: Industria 5.0; plataformas en línea; calidad educativa; infraestructura tecnológica; desarrollo local.

1 Introduction

1.1 Paper size, margins, columns and paragraphs

In the dynamic landscape characterizing Industry 5.0 today, international trade is defined as a rapidly evolving terrain, emphasizing the crucial importance of conscious and well-founded decision-making for companies to maintain their competitiveness. Furthermore, the relationship between humans and machines is essential for achieving successful outcomes, as [15] mention in their study on human-machine interaction in Colombian international trade. In this context,

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the implementation of Business Intelligence emerges as a vital catalyst, equipping Colombian organizations with the capability to analyze essential data and extract valuable information to guide their strategies, according to [8] in his analysis of business intelligence in the era of Industry 5.0.

Data management and Artificial Intelligence (AI) are fundamental in Industry 5.0, with applications such as Power BI playing a crucial role [4]. This analysis delves into the intent and usability of Business Intelligence within the framework of Industry 5.0, focusing specifically on its impact on Colombian international trade. The subsequent sections will explore the strategic objectives motivating the adoption of BI, evaluate the usability of available tools, and thoroughly examine how this transformative technology influences operational efficiency, decision-making, and competitiveness on a global scale.

This analysis aims to understand the current state of Business Intelligence (BI) implementation in Colombia while also projecting future opportunities and addressing present challenges. [5] highlights the integration of artificial intelligence within industrial processes as a key revolution in Industry 5.0, whereas [6] investigate the impact of digital transformation on international trade. As we progress toward an increasingly interconnected business landscape, the ability to leverage business intelligence becomes a crucial differentiator. [7] highlight the significance of implementing BI strategies in emerging economies as essential for fostering growth and development. This document aims to illustrate this process by offering valuable content and analysis for companies striving to enhance their presence and success in international trade within the framework of Industry 5.0.

2 Theoretical framework

Currently, Industry 5.0 is evolving towards the integration of humans and machines, with the goal of improving efficiency and personalizing production processes. This era is founded on synchronized collaboration between human intelligence and advanced technological capabilities, promoting a more adaptive and transformative work environment.

Furthermore, Business Intelligence (BI) plays a vital role in this context by providing tools and techniques for collecting, analyzing, and presenting business data. According to [8] BI empowers organizations to convert large volumes of data into valuable information that informs strategic decisions. Tools like Power BI, as noted by [4] are indispensable for data analysis and visualization, aiding in the identification of key trends and patterns.

Therefore, International trade, which entails the exchange of goods and services between nations, necessitates that companies quickly adapt to shifting global conditions. Implementing BI can significantly bolster companies' ability to compete internationally by optimizing supply chain management, identifying new markets, and understanding consumer preferences, as argued by [5].

In the Colombian context, specific challenges in adopting BI include a heavy reliance on external technologies and limited internal technological infrastructure. [9] reports that only 17.2% of Colombian companies utilize new technologies internally, while 40.1% depend on external providers. This dependency can hinder companies' ability to develop internal competencies in data analysis. The importance of fostering local technological development is underscored in the studies by [6] and [10].

For this reason, the integration of emerging technologies, such as the Internet of Things (IoT) and Big Data, with business intelligence (BI) tools presents innovative opportunities to enhance operational efficiency and supply chain management. [11] assert that these technologies significantly transform logistics operations, while [12] highlight the value of detailed data analysis in fraud prevention and improving financial security. Business intelligence in Industry 5.0 provides valuable tools to enhance competitiveness in international trade, particularly in the Colombian context, where the effective adoption of these technologies can revolutionize business management and optimize performance in a dynamic global environment.

2.1 Colombia in the domain of business intelligence and Industry 5.0

According to statistics from [9] at the start of the third decade of the 21st century, 17.2% of companies in the commerce sector employed new technologies internally, while 40.1% utilized these technologies in collaboration with external parties. These figures indicate a significant trend toward outsourcing the management of new technologies, suggesting a considerable delegation of essential functions for financial optimization and detailed data analysis [9]. The high reliance on external providers for managing advanced technologies implies that many Colombian companies are not allocating the necessary attention and resources to develop a robust internal technological infrastructure. This situation may hinder their ability to perform rigorous data analysis and continuous process optimization, which are vital for maintaining a competitive edge in a dynamic global environment [13]. According to these authors, Colombian manufacturers that have adopted advanced technologies internally have achieved positive outcomes, underscoring the importance of a proactive approach to internal technological development. Data study and analysis play a crucial role in the ongoing improvement of business processes. [14] contend that, particularly in the context of the COVID-19 pandemic, the capacity to adapt and respond to global changes has heavily relied on the effective use of big data tools and platforms such as Power BI. These technologies enable companies to gather, analyze, and utilize data in ways that allow them to anticipate trends, optimize operations, and make informed decisions [14].

Due to the effective implementation of Business Intelligence (BI) and emerging technologies such as Power BI, within the framework of Industry 5.0, presents a significant opportunity for Colombian companies to enhance their global competitiveness. Integrating BI into business operations not only fosters a deeper understanding of market dynamics but also enables improved supply chain management, the identification of new markets, and analysis of consumer preferences on a global scale ([8,15]. However, to fully realize these benefits, it is essential that Colombian companies invest in developing internal technological capabilities and do not rely solely on external solutions [16,17].

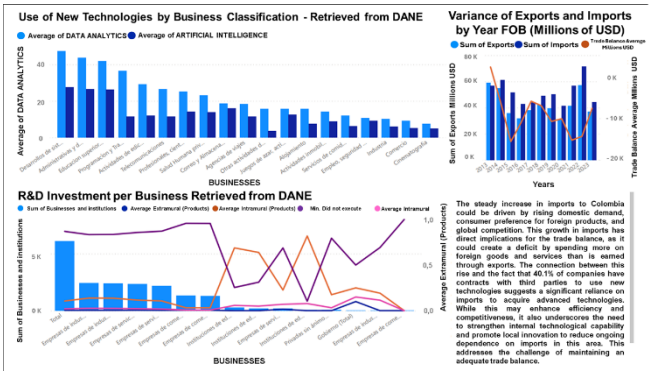

Figure 1. Uses of new technologies by company classification.
Source: Retrieved from DANE, 2023.

In summary, the considerable dependence on external technologies and the absence of a strategic focus on internal technological development could restrict the growth potential and competitiveness of Colombian companies within Industry 5.0. It is crucial to adopt policies and strategies that encourage local technological development to ensure sustainable growth and active participation in the global economy [18,19]. The ability of companies to excel in the adoption and application of advanced technologies will be fundamental to their success in an increasingly competitive and technologically advanced environment.

Thus, although forecasts indicate a favorable outlook for Colombian international trade, there is a risk of a regulated or negative impact if local technological development is not actively promoted. Over-reliance on external technologies could hinder Colombia's ability to innovate, respond swiftly to changes, and sustain a robust competitive position in Industry 5.0. It is crucial that future strategies tackle this challenge and aim to bolster internal technological capacity to ensure sustainable growth and engagement in the global economy, as shown in Fig. 1.

2.2 Intentionality and usability of business intelligence in Industry 5.0: effects on the performance of Colombian international trade

The research question centers on understanding the intentionality and usability of Business Intelligence (BI) within the context of Industry 5.0 and its effects on Colombian international trade. Firstly, intentionality pertains to the goals and objectives that Colombian companies strive to achieve through the implementation of BI in the framework of Industry 5.0. The adoption of BI aims not only to optimize data management but also to enhance strategic decision-making and boost competitiveness in the global market. The technologies of Industry 5.0, which encompass advanced integration of artificial intelligence, automation, and big data analysis play a vital role in the evolution of these intentions. The capacity to analyze large volumes of data and extract valuable insights allows companies to anticipate market trends, adjust their strategies, and respond more swiftly to the demands of international trade [8,4].

On the other hand, the usability of BI tools is crucial for these intentions to materialize effectively. Usability evaluates how practical and efficient these tools are in integrating and analyzing complex data. In the context of Industry 5.0, where emerging technologies require high processing and analytical capabilities, the usability of tools like Power BI is vital for facilitating successful implementation. Ease of use, customization options, and integration with other technologies are factors that determine how Colombian companies can fully leverage BI capabilities. The assessment of these tools focuses on their direct impact on operational efficiency and the ability of companies to manage their business operations more effectively [14,21]. The proposed Boolean search equation—"Business Intelligence" AND "Industry 5.0" AND "Colombian International Trade" AND "Analysis" AND "Usability" AND "Impact"—aids in identifying relevant studies that explore the intersection of BI, Industry 5.0 technologies, and Colombian international trade. This search facilitates the identification of research addressing how the implementation of BI within the framework of Industry 5.0 influences the performance of international trade in Colombia. Furthermore, by incorporating terms such as "Analysis," "Usability," and "Impact," it ensures the acquisition of information regarding the effectiveness and efficiency of BI tools and their influence on the global competitiveness of Colombian companies [16,19].

Therefore, this research on the intentionality and usability of BI within the framework of Industry 5.0 offers a thorough perspective on how these emerging technologies can revolutionize Colombian international trade. Assessing companies' intentions to adopt BI, alongside the usability of the tools, enhances the understanding of the potential effects on their global performance and their ability to compete in a dynamic and technological landscape.

2.3 Impact of BI on Colombian and global international trade

The integration of Business Intelligence (BI) in international trade is transforming business strategies and providing significant competitive advantages. According to [20] in the context of Cemex, despite possessing advanced knowledge, the company has not fully optimized its use of BI due to ineffective implementation. This case underscores a critical gap between theoretical capability and practical application, highlighting the necessity for a more strategic adoption of BI technologies to maximize their commercial benefits. Similarly, [20] analyzes the challenges faced by Command Alkon Colombia SAS, where insufficient BI integration restricts operational performance and illustrates how the lack of a robust strategy can impede improvement opportunities.

In [22] presents a pertinent case involving a fruits and vegetables company in Valencia, where effective use of BI has revolutionized logistics and supply chains. By employing advanced BI tools for data analysis, the company has streamlined its processes and enhanced decision-making, resulting in a significant increase in its competitiveness. This study illustrates the potential of BI to produce positive operational outcomes when applied appropriately and strategically.

In other matters, in the financial sector, data mining has proven vital for detecting fraud and enhancing security in commerce. [12] explore how comprehensive data analysis through Business Intelligence (BI) can identify irregularities and prevent financial fraud, emphasizing the importance of BI tools in preserving financial integrity.

In international trade, the ability of BI to identify niche markets and business opportunities is crucial. In [23] investigates how data analysis facilitates the identification of opportunities in green supply chains, improving sustainability and efficiency in product replenishment. This research demonstrates how the strategic use of BI can optimize supply chain management and generate a competitive advantage in the global market.

The impact of Big Data and advanced data analytics on international logistics is a highly relevant topic. In [14] emphasize how Big Data enables better logistical control in supply chains, facilitating more efficient and precise management. Furthermore, the integration of emerging technologies from Industry 4.0 and 5.0, such as the Internet of Things (IoT), has the potential to significantly transform supply chain management. Finally, in [11] underline how these advanced technologies can enhance the efficiency and sustainability of logistical operations, providing companies with a competitive edge in an interconnected global environment.

Additionally, in [24] focuses on the impact of BI in Colombia, particularly in the area of imports. This analysis highlights how the use of BI tools can optimize business processes in the Colombian context, bolstering the country's competitiveness in international trade. The research also emphasizes the need for policies that promote local technological development to maximize the benefits of Business Intelligence (BI) and ensure sustainable, competitive growth. The importance of strengthening local technological development in Colombia is supported by [10] who argue that internal technological development is crucial for emerging markets to compete effectively on the global stage. This approach is essential to ensure that the benefits of BI translate into sustainable economic growth and a strong competitive position.

3 Methodology

The analysis of the impact of Business Intelligence (BI) on Colombian international trade, within the context of Industry 5.0, was conducted using a comprehensive and multifaceted methodology. Thus, this methodology combines qualitative and quantitative approaches to offer a nuanced and holistic perspective on the subject. The key phases of the methodology employed are detailed below.

3.1 Extensive literature review

The first phase involved an extensive review of relevant academic and technical literature. This process included examining previous studies on Business Intelligence, Industry 5.0, and their impact on international trade. Journals, books, and doctoral theses were consulted to gain a thorough understanding of current theories and approaches. In particular, the contributions of recognized authors in the field were reviewed, such as [25] who analyzed the implementation of BI in the era of Industry 5.0, and Travez [15], who studied the relationship between humans and machines in international trade. Studies on the integration of BI tools, such as Power BI, in business data analysis and their influence on strategic decision-making were also included [4,14].

3.2 Analysis of secondary data

A detailed analysis of secondary data provided by official sources and government agencies was conducted. This included a review of statistics from the National Administrative Department of Statistics (DANE) and the Ministry of National Education regarding the adoption of technologies and BI platforms in Colombia. DANE data (2020) offered insights into the adoption and outsourcing of new technologies by Colombian companies, providing a quantitative basis to evaluate reliance on external technologies and internal technological development capacity. Additionally, reports on technological infrastructure and teacher training were analyzed to understand current needs and challenges related to BI implementation.

3.3 Detailed case studies

The analysis included comprehensive case studies of companies both in Colombia and internationally that have adopted BI tools. Representative cases were chosen to illustrate various aspects of BI adoption and usage. Among the case studies reviewed were Cemex [20] which demonstrated how inadequate BI implementation can hinder operational performance, and Command Alkon Colombia SAS ([21] which underscored challenges and opportunities in BI integration. Additionally, the case of a fruit and vegetable company in Valencia [22] was examined, showcasing how effective BI utilization transformed logistics and supply chains while providing concrete examples of success and areas for enhancement.

3.4 Critical evaluation of BI tools

A thorough evaluation of the BI tools available in the market was performed, with a particular emphasis on Power BI. This evaluation encompassed a review of technical features, usability, and effectiveness of the tools, as well as their adaptation to the specific needs of Colombian international trade. Previous studies and implementation data were analyzed to identify best practices and areas for improvement in the use of Business Intelligence (BI). This analysis facilitated an assessment of how these tools can support informed decision-making and enhance operational efficiency.

3.5 Interviews and surveys with experts

Interviews and surveys were conducted with experts in educational technology and professionals from companies

employing BI tools. These interviews provided qualitative insights into practical experiences with BI implementation, the challenges encountered, and the strategies adopted to address those challenges. The qualitative information gathered complemented the quantitative data and enabled a deeper understanding of the factors influencing the success of BI implementation in Colombia.

3.6 Comparative and critical analysis

A comparative and critical analysis of the collected data, both quantitative and qualitative, was performed. This analysis helped identify patterns and trends in the adoption and use of BI, as well as evaluate the impact of these technologies on operational efficiency and global competitiveness. The results obtained were compared with findings from the reviewed literature and case studies to draw conclusions about the influence of BI on Colombian international trade and to formulate recommendations for enhancing its adoption and use.

4 Results

The implementation of Business Intelligence (BI) has significantly transformed how Colombian companies approach strategic decision-making. Tools like Power BI have proven essential by enabling companies to analyze large volumes of data with a level of detail and accuracy that was previously unattainable. This capability has facilitated a more precise identification of patterns and trends in the market, leading to improved strategic planning and adaptation to the dynamics of the global environment [4,14]. The ability to anticipate changes in demand and adjust strategies accordingly has become a key differentiator for companies striving to remain competitive in a constantly evolving market.

In terms of operational efficiency, the adoption of BI has allowed for a notable optimization of internal processes and a reduction in operational costs. Companies that have integrated BI have successfully enhanced coordination in their supply chains and resource management. For instance, the case of a fruit and vegetable company in Valencia illustrates how the effective use of BI can transform logistics and supply processes, resulting in a greater capacity to meet deadlines and satisfy market demand [22]. This confirms the idea presented by [23] regarding how data analysis facilitates the identification of opportunities in green supply chains, improving sustainability and efficiency.

However, one of the persistent challenges in the implementation of Business Intelligence (BI) in Colombia is the high dependence on external providers for managing advanced technologies. According to statistics from [9] a significant percentage of Colombian companies outsource the management of new technologies, which may hinder the development of the internal competencies necessary for rigorous analysis and continuous process optimization [13]. This dependence can restrict companies' ability to develop a robust internal technological infrastructure, limiting their capacity to adapt and evolve in the global market.

Case studies, such as that of Command Alkon Colombia SAS, illustrate how poor BI implementation can constrain operational performance. This case underscores the need for a strong strategy for integrating BI, as the lack of proper planning can lead to underutilization of available tools [21]. Despite the challenges, it is clear that BI tools have the potential to significantly enhance efficiency and decision-making when implemented correctly.

To overcome these challenges, it is crucial to strengthen local technological development. Investing in internal capabilities and technological infrastructure is essential for reducing reliance on external solutions and improving competitiveness [19]. Policies that promote internal technological development and encourage innovation are vital to ensure sustainable and competitive growth in international trade.

The integration of emerging technologies, such as the Internet of Things (IoT) and Big Data, with Business Intelligence (BI) has significantly impacted the transformation of business operations. These advanced technologies enable more precise and real-time management of the supply chain, offering competitive advantages by enhancing operational efficiency and adaptability [11]. Research by [14] highlights how Big Data facilitates improved logistical control and more efficient supply chain management, supporting the idea that the combination of BI and emerging technologies can revolutionize business management.

Advanced data analytics through BI has also enhanced companies' ability to manage financial risks. The capacity to identify anomalies and prevent fraud is a crucial advantage that adds an additional layer of financial security [12]. Research by [10] underscores the importance of bolstering internal technological development in emerging markets to ensure that the benefits of BI translate into sustainable economic growth and a robust competitive position.

The implementation of BI in Colombia has proven to be a powerful tool for boosting competitiveness and business efficiency. However, to fully harness these benefits, it is essential to continue developing technological infrastructure and fostering an environment that encourages innovation and the adoption of emerging technologies. The evolution of BI within the Colombian context indicates a pathway toward a more competitive and adaptable future, but it necessitates a sustained commitment to technological development and continuous improvement.

5 Discussion

To start, response to the research question, the aim of Business Intelligence (BI) in Industry 5.0 is to enhance strategic decision-making by utilizing data analytics to anticipate trends and optimize processes. According to [26] BI acts as a vital catalyst, enabling organizations to analyze complex data and extract valuable insights to inform their strategies. Furthermore, [27] highlight the essential role of tools like Power BI in this endeavor. The effectiveness of BI lies in its capacity to provide accessible and adaptable information to meet business needs in Colombia, seamlessly integrating with emerging technologies, which is crucial for international trade [28].

Table 1.
Summary of Trade Metrics by Year.

Year	at	ct	Xt	It	Zt
2024	50,33	45,33	555,63	495,63	60
2025	50,36	45,36	606,36	536,36	70
2026	50,39	45,39	657,09	576,09	81
2027	50,42	45,42	707,72	615,72	92

Source: Authors.

In the realm of international trade, BI can enhance competitiveness by improving supply chain management, identifying new markets, and facilitating the understanding of consumer preferences on a global scale, thereby contributing to business performance in a dynamic and technologically advanced environment [29]. This influence is significant for examining how BI tools and data analytics can affect operational efficiency and competitiveness in Colombian international trade.

Linear programming and projections derived from data indicate a gradual increase in Colombian exports and imports over the next four years. While this forecast suggests steady growth in international trade, it is crucial to consider how these outcomes may impact the local context, particularly in the absence of a substantial boost to internal technological development. Applying the principle of Ceteris Paribus, which means "keeping everything else constant," simplifies the analysis and focuses on specific variables of interest, as demonstrated in methods like Ordinary Least Squares [19].

The linear programming procedure commenced with the formulation of the problem, defining the variables of interest and establishing the objective function to maximize the trade balance. The coefficients, based on assumed initial values, incorporate an annual increase of 3%, enabling projections of exports, imports, and the trade balance for the years 2024-2027 (see Table 1).

The results of the linear programming were presented in a table, highlighting the coefficients along with the projections for exports, imports, and the trade balance for each projected year. The analysis of the results concentrated on interpreting the projections in relation to the context of Colombian international trade and Industry 5.0. Potential positive impacts and challenges were assessed, underscoring the significance of local technological development. The anticipated increase in exports could suggest a higher demand for Colombian products in the international market, reflecting a positive adaptation to global trends [29]. However, this growth may be constrained if it is not bolstered by local technological advancements. Dependence on external technologies could lead to vulnerability, as the ability to innovate and maintain competitive quality might hinge on external factors [18].

The rise in imports may indicate a deeper integration of foreign products and technologies into the Colombian economy. While this could facilitate the adoption of advanced practices, it also carries the risk of over-dependence on foreign technologies [19]. Without concurrent support for local technological development, Colombia might find itself at a disadvantage regarding autonomy and the capacity to adapt to unforeseen changes in the international landscape [28].

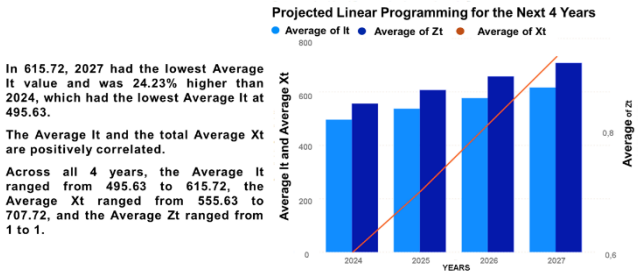

Figure 2. Projected linear programming for the next four years.
Source: DANE, 2023.

The notable percentage of companies outsourcing the management of new technologies (40.1%) may imply a lack of investment or internal capability to spearhead technological advancements. This could lead to a gap in innovation capacity and challenges in maintaining strategic control over business operations [16].

The Fig. 2 show a projected linear programming for the next four years.

6 Conclusions

In the analysis of economic projections and the application of linear programming to Colombian international trade, a potential increase in exports, imports, and trade balance has been identified for the upcoming years. This growth is grounded in a linear trend and specific assumptions regarding the future behavior of these variables [19]. The use of linear programming on economic data indicates a gradual rise in these indicators, reflecting a positive outlook for Colombian international trade. However, when this outlook is combined with the reliance on external technologies, as evidenced by the significant percentage of companies outsourcing the management of new technologies, the urgent need to bolster local technological development is underscored [16,17]. Fig. 2 illustrates the linear programming projection for the next four years (2024-2027), highlighting a steady increase in Colombian exports (Xt) and imports (It). The It values are projected to rise from 495.63 to 615.72, while Xt values are expected to grow from 555.63 to 707.72, ensuring a positive trade balance (Zt). This linear growth indicates promising prospects for Colombian international trade, although sustaining it will require advancements in local technology within the framework of Industry 5.0.

Fig. 3 demonstrates the fluctuating trends of Colombia's imports and exports of goods and services as a percentage of GDP, emphasizing the persistent gap where imports consistently surpass exports. Despite a recovery in both metrics after 2020, challenges such as high domestic demand, reliance on imports, and limited adoption of advanced technologies contribute to this imbalance. This underscores the need for enhanced Business Intelligence (BI) adoption to optimize trade operations, support local production, and align with Industry 5.0 to improve competitiveness in international markets.

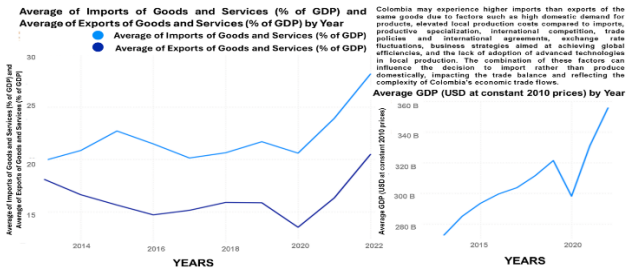

Figure 3. Average Imports of Goods and Services (% of GDP) and Average Exports of Goods and Services (% of GDP) by Year.
Source: Retrieved from DANE, 2023.

The implementation of emerging technologies, such as Business Intelligence (BI) within the framework of Industry 5.0, presents significant opportunities to enhance decision-making and operational efficiency in international trade. BI enables organizations to analyze large volumes of data to gain strategic insights that can optimize processes and business strategies [26]. The capability of BI tools to deliver accurate, real-time information is crucial for competing in an increasingly complex and competitive global environment [30].

However, a lack of a strategic approach to local technological development could hinder Colombia's ability to lead in innovation and adapt to global changes [29,31]. An overreliance on external technologies may create significant vulnerabilities, where improvements in economic projections do not translate into sustainable and competitive growth. Local technological autonomy becomes essential to maximize the positive impact of commercial trends and ensure that Gross Domestic Product (GDP) growth is driven internally [18,4].

The high reliance on external technologies, evident in the 40.1% of Colombian companies that outsource the management of new technologies, highlights a significant gap in the internal capacity to develop and lead technological innovations [28]. This situation may lead to a lack of strategic control and a deficiency in adaptability and innovation capabilities [3]. Investing in local technological development is not only vital for enhancing the quality of education and operational efficiency but also for promoting economic development and job creation in the technology sector [19].

The analysis underscores that while forecasts indicate a positive outlook for Colombian international trade, there is a considerable risk if internal technological development is not actively promoted. An overreliance on external technologies could hinder Colombia's ability to lead in innovation, swiftly adapt to changes, and sustain a robust competitive position in Industry 5.0 [26,17]. It is crucial that future strategies confront this challenge and aim to enhance internal technological capabilities to ensure sustainable growth and active engagement in the global economy [30,18].

To address these challenges, it is vital for the country to implement policies and strategies that foster internal technological development as a core component of its long-term vision for international trade. Sustainable economic success does not merely depend on numerical forecasts but also on the capacity of companies and the nation to excel in the adoption and application of advanced technologies, thus ensuring equitable and resilient GDP growth [29,31]. Collaboration among the government, private sector, and educational institutions will be essential in cultivating an innovative and competitive ecosystem that enables Colombia to remain at the forefront of the global economy [32,4].

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