

Evaluating the Effectiveness and Application of Business Intelligence in Industry 5.0 and its Influence on Colombian Global Commerce

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Abstract: This research study about the effectiveness and application of Business Intelligence (BI) within the dynamic context of Industry 5.0 and its impact on Colombian international commerce, emphasizing the crucial role of informed and strategic decision-making for maintaining competitiveness. The main goal is to assess the current state of BI implementation in Colombia, analyze the usability of BI tools, and examine their influence on operational efficiency, decision-making, and global competitiveness. Furthermore, the study projects future opportunities and addresses present challenges in BI adoption. Thus, using linear programming and data projections, the initial results predict a gradual increase in Colombian exports and imports over the next four years, highlighting the potential positive impact on international trade and the importance of local technological development. Nevertheless, another key finding underscores the necessity of reducing dependency on external technologies to ensure sustained growth and competitiveness within Industry 5.0. The conclusion suggest the need for more strategic investment in local technological capabilities to secure a solid position in the global economy and drive sustainable growth amidst dynamic technological advancements, thereby addressing the imperative need for effective project management within this context.

Keywords: Project management; Business Intelligence; Industry 5.0; Colombian International Trade; Usability.

Evaluando la efectividad y aplicación de la Inteligencia de Negocios en la Industria 5.0 y su influencia en el Comercio Global Colombiano.

Resumen: Este estudio investiga la eficacia y aplicación de la Inteligencia de Negocios (BI) dentro del contexto dinámico de la Industria 5.0 y su impacto en el comercio internacional colombiano, enfatizando el papel crucial de la toma de decisiones informada y estratégica para mantener la competitividad. El objetivo es evaluar el estado actual de la implementación de BI en Colombia, analizar la usabilidad de las herramientas de BI y examinar su influencia en la eficiencia operativa, la toma de decisiones y la competitividad global. Además, el estudio proyecta oportunidades futuras y aborda los desafíos actuales en la adopción de BI. Utilizando programación lineal y proyecciones de datos, los resultados iniciales predicen un aumento gradual en las exportaciones e importaciones colombianas durante los próximos cuatro años, destacando el impacto positivo potencial en el comercio internacional y la importancia del desarrollo tecnológico local. Otro hallazgo clave subraya la necesidad de reducir la dependencia de tecnologías externas para asegurar un crecimiento sostenido y competitividad dentro de la Industria 5.0. Las conclusiones sugieren la necesidad de una inversión estratégica en capacidades tecnológicas locales para asegurar una posición sólida en la economía global y promover un crecimiento sostenible en medio de los avances tecnológicos dinámicos, abordando así la necesidad imperativa de una gestión de proyectos efectiva en este contexto.



Palabras clave: Gestión de proyectos; Inteligencia de Negocios; Industria 5.0; Comercio Internacional Colombiano; Usabilidad.



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Introduction

Nowadays, the rapidly evolving landscape of Industry 5.0, international trade stands as a continuously transforming arena, underlining the imperative for corporations to make informed and strategic decisions to sustain their competitive edge. As highlighted by [1,2], the symbiosis between human and machine is crucial for achieving successful outcomes in this dynamic environment. Within this setting, the deployment of Business Intelligence (BI) surfaces as a pivotal enhancer, equipping Colombian enterprises with the tools to parse complex datasets and distill actionable insights to inform their strategies. This aligns with [3] observations on the data-driven nature of modern economies, where the application of Artificial Intelligence (AI) and data analysis technologies, such as Power BI, becomes central [4,5].

The primary objective of this study is to delve into the detailed examination of the role and utility of Business Intelligence, and the context of Industry 5.0 to particular focus on impact on Colombian international commerce. The ensuing sections will dissect the strategic motivations behind the adoption of BI, assess the functionality of existing tools, and critically evaluate how this transformative technology is reshaping operational efficiency, decision-making processes, and global competitiveness [5-7].

This study endeavors not only to map the current landscape of BI implementation in Colombia but also to forecast prospects and navigate existing challenges. As the global business environment becomes more interconnected, the adept utilization of business intelligence tools is increasingly becoming a linchpin for differentiation and success. This document aims to illuminate these dynamics, offering valuable perspectives for companies aiming to amplify their global footprint in the era of Industry 5.0 [8].

Industry 5.0 represents a revolutionary phase in the business domain, integrating cutting-edge technologies like Artificial Intelligence (AI), the Internet of Things (IoT), Big Data, and smart manufacturing. This paradigm shift profoundly influences how organizations function and compete on the international stage. In this milieu, the proficient application of Business Intelligence (BI) has emerged as a strategic necessity for firm intent on maintaining competitiveness and adapting to the fluid business landscape [9].

The essence of this research is to appraise the efficacy and application of BI specifically within the ambit of Industry 5.0 and its ramifications on Colombian global commerce. To this end, the study will explore several critical areas:

- The evolution of Industry 5.0 and its integration into the Colombian business milieu, alongside the challenges and opportunities this new industrial epoch presents, particularly concerning operational efficiency, technological innovation, and global market competition.
- The pivotal role of BI in Industry 5.0, focusing on its capability to analyze the voluminous data produced by IoT systems and connected devices, thereby facilitating real-time, strategic decision-making.
- An in-depth examination of how Colombian enterprises have embraced and implemented BI solutions within the industry 5.0 framework, evaluating how BI has enhanced operational efficiency, optimized business processes, and bolstered competitiveness in international markets [10].
- An investigation into the tangible impact of BI on the performance and global market participation of Colombian companies, including success stories and the challenges encountered in integrating BI into their international business strategies [11].
- How result will offer future perspectives on the ongoing significance of BI in Industry 5.0 and provide practical recommendations for Colombian firms aiming to leverage this technology to foster innovation,

sustainable growth, and competitiveness in the volatile global marketplace. This comprehensive approach aims to furnish a holistic view of the strategic importance of BI in the context of Industry 5.0 and its direct influence on Colombian global commerce, contributing significantly to the understanding of how businesses can effectively utilize BI to flourish in the digital and globalized epoch [12-14].

Methodology

This study employs a mixed-methods approach, integrating both qualitative and quantitative research methodologies for comprehensively assess the effectiveness and application of BI in Industry 5.0, with a specific focus on its impact on Colombian global commerce [13]

The research design involves two main phases. Firstly, an exploratory study aims to gain insights into the adoption and utilization of BI solutions by Colombian companies operating within the framework of Industry 5.0. This phase entails collecting qualitative data from various sources, including business reports, case studies, and official documents sources primarily from the DANE Colombian National Department of Statistics. Thematic and content analysis will be applied to this qualitative data to identify recurring themes, patterns, and key insights regarding the effectiveness of BI tools. [14,15]

Subsequently, a descriptive study will be conducted to quantitatively evaluate the impact of BI on business performance and competitiveness in the global market. This phase involves collecting quantitative data through surveys and other measurement tools. Statistical software such as SPSS and Excel software were used to analyze this quantitative data, employing both descriptive and inferential statistical techniques to discern correlations, trends, and significant differences across key variables.

Key variables under examination include the perceived effectiveness of BI solutions, the degree of BI integration into business processes, the impact on strategic decision-making, and improvements in competitiveness and business performance in the global market.

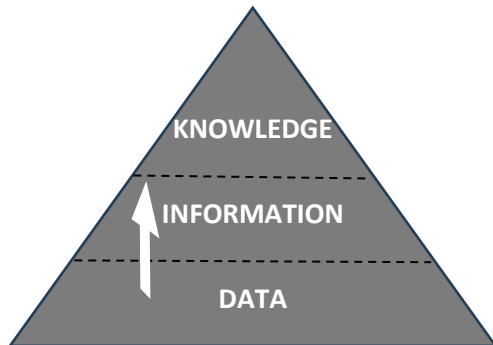
The target population for this study comprises Colombian companies across various sectors and sizes that either are engaged in Industry 5.0 or are transitioning towards it. To ensure the validity and reliability of the findings, a stratified random sampling technique will be employed to select a representative sample from this target population.

Overall, this methodological framework is designed to provide a comprehensive and informed perspective on the adoption and efficacy of BI in Industry 5.0 within Colombia. By combining qualitative insights with quantitative analysis, the study aims to shed light on potential improvements and opportunities for leveraging BI for global competitive advantage in the rapidly evolving landscape of Industry 5.0.

Results

It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental con in the realm of Business Intelligence (BI), it is imperative to clarify three frequently conflated concepts: data, information, and knowledge. As defined in the literature, data represent the most elementary unit and are devoid of inherent meaning, merely constituting raw elements that do not directly aid decision-making processes. Information, in contrast, pertains to processed data that has been contextualized, thus gaining significance, and becoming useful for decision-making. Knowledge, as further elaborated, is an advanced form of processed information, characterized by deep, contextual understanding derived from extensive analysis and interpretation [16].

Figure 1. Knowledge Pyramid



Source: Zamora Carrillo et al., 2019

Transitioning to Industry 5.0, this phase marks a pivotal evolution in the business landscape, integrating cutting-edge technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), advanced automation, and digital connectivity. This evolution has been notably rapid in Colombia, reshaping the operational and competitive dynamics of businesses at both the national and international levels. A detailed examination of Industry 5.0 reveals its significant impact on operational efficiency, technological innovation, and competitiveness in global markets. Operational efficiency, in particular, has become a crucial aspect for Colombian companies striving to compete in an increasingly challenging environment. Industry 5.0 equips businesses with the necessary tools and processes to enhance production efficiency, reduce costs, and improve the quality of products and services, which are vital for sustaining competitive advantage in global markets [17]. The Table 1 summarizes a survey from representatives of large companies on factors influencing competitiveness, highlighting technologies such as Big Data, Hyper-connectivity, and Cybersecurity as crucial. The responses, categorized under "Very Important" to "Of Little Importance," indicate a strong emphasis on digital transformation elements like cloud computing, IoT, and advanced robotics in enhancing competitiveness. The survey underscores the critical role of technological adoption in industry competitiveness.

Table 1. Factors Influencing Company Competitiveness According to Representatives of Large Companies

Variable	Very Important	Columna1	Important	Moderately Important	Of Little Importance
Big data and data analysis	9	1	0	0	0
Cloud Computing	7	1	1	1	0
Cybersecurity	8	2	0	0	0
internet of things	7	3	0	0	0
Process integration	8	2	0	0	0

Advanced robotics and artificial intelligence	6	3	1	0	0
Systems for vertical and horizontal integration	7	3	0	0	0
Hyperconnectivity	9	0	1	0	0
Digital manufacturing (3D)	7	3	0	0	0
Software Manufacturing Execution Systems	7	3	0	0	0
Virtual and augmented reality	6	2	1	1	0

Source: Interviews conducted at the IV Furniture and Wood Fair 2018

Technological innovation is another cornerstone of Industry 5.0, providing businesses with opportunities to forge new products, services, and business models leveraging disruptive technologies such as AI, IoT, and augmented reality. These innovations not only foster significant competitive advantages but also pave the way for expansion and growth in new markets [18-20].

The role of metrics in evaluating the impact of research and innovation is underscored by integrating data analysis techniques, adhering to established BI project methodologies. Data mining techniques are particularly instrumental in processing information and generating detailed insights about the impact of research in both academic and industrial spheres [21,22].

A case in point involves a research initiative aimed at developing a tailored BI solution for monitoring sales and post-sale activities of maize hybrids in Colombia. This solution is designed to cater to the informational needs of strategic decision-makers at companies like Costa & Compañía SA, providing a robust and objective framework to support decision-making processes irrespective of the individuals in charge, focusing instead on the roles within the organization [23].

The BI evaluation of maize cultivation provided a clear perspective on the state of this specific agricultural sector. Utilizing data from governmental platforms and open data portals in Colombia, which facilitate citizen involvement in research and problem-solving at the regional level, the study established a correlation between productivity per harvested hectare and the altitude of cultivation. Zones located between 3,400 and 3,800 meters above sea level exhibited higher yields, with optimal cultivation occurring at approximately 3,680 meters. These findings not only support the initial hypothesis suggesting a positive relationship between these variables but also highlight the influence of other factors such as soil type, climate, and seed type on crop yields, although these were not the focus of the study [23-25].

Conclusions

In the realm of Business Intelligence (BI), it is imperative to clarify three frequently conflated concepts: data, information, and knowledge. As defined in the literature, data represent the most elementary unit and are devoid of inherent meaning, merely constituting raw elements that do not directly aid decision-making processes. Information, in contrast, pertains to processed data that it has been contextualized, thus gaining significance, and becoming useful for decision-making. Knowledge, as further elaborated, is an advanced form of processed information, characterized by deep, contextual understanding derived from extensive analysis and interpretation. This progression, represented in the Knowledge Pyramid, underscores the increasing value and utility at each stage, emphasizing the crucial role each level plays in creating business value.

Transitioning to Industry 5.0, this phase marks a pivotal evolution in the business landscape, integrating cutting-edge technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), advanced automation, and digital connectivity. This evolution has been notably rapid in Colombia, reshaping the operational and competitive dynamics of businesses at both the national and international levels. Industry 5.0 equips businesses with the necessary tools and processes to enhance production efficiency, reduce costs, and improve the quality of products and services, which are vital for sustaining competitive advantage in global markets. For instance, a Colombian company leveraging AI for predictive analytics might reduce production times by 30%, enhancing its global competitiveness.

A detailed examination of a survey from representatives of large companies reveals that the adoption of digital technologies is seen as crucial for competitiveness. According to the survey, 90% of respondents rated Big Data and data analysis as "Very Important," while 80% emphasized the importance of cybersecurity. This strong emphasis on digital transformation elements like cloud computing, IoT, and advanced robotics underscores the critical role of technological adoption in enhancing competitiveness. The integration of these technologies not only improves current operations but also fosters innovation and the exploration of new business models, which are essential for long-term growth and sustainability.

A case in point involves a research initiative aimed at developing a tailored BI solution for monitoring sales and post-sale activities of maize hybrids in Colombia. Utilizing data from governmental platforms and open data portals, the study effectively engaged citizens in research and problem-solving. The study established a correlation between productivity per harvested hectare and the altitude of cultivation, with zones located between 3,400 and 3,800 meters above sea level exhibiting higher yields, and optimal cultivation occurring at approximately 3,680 meters. These findings not only support the initial hypothesis suggesting a positive relationship between these variables but also highlight the influence of other factors such as soil type, climate, and seed type on crop yields, which could be explored in future studies.

In conclusion, the evolution from data to knowledge in the realm of BI is crucial for informed and strategic decision-making in businesses. Industry 5.0, with its focus on advanced technologies, offers significant opportunities for businesses to improve operational efficiency, foster innovation, and maintain competitiveness in a global environment. The survey and case studies analyzed underscore the tangible benefits of technological adoption and BI application. For example, a company implementing an advanced data analysis system might increase operational efficiency by 25% and reduce operational costs by 15%. By leveraging these tools and methodologies, businesses can successfully navigate the complexities of the modern market, drive growth, and achieve sustainable competitive advantages.

Future Research

Looking forward, research should continue to explore the long-term impacts of Industry 5.0 technologies on different sectors within the Colombian economy and beyond [6]. Further studies could focus on the specific challenges and opportunities associated with implementing these technologies in small to medium-sized enterprises (SMEs), which represent a significant portion of the national economy. Additionally, comparative studies between different industries could elucidate sector-specific advantages or challenges posed by Industry 5.0, providing a more nuanced understanding of its impacts across diverse economic landscapes [26,27].

Briefly, Industry 5.0 has ushered in a new era of technological advancement and innovation, fundamentally altering the competitive fabric of Colombian global commerce [6]. The strategic application of BI within this context not only enhances operational efficiencies but also propels companies towards sustainable growth and competitiveness on the global stage. As we move forward, embracing these technologies will be crucial for companies aiming to thrive in an increasingly digital and interconnected world [28,29].

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