СИСТЕМНА МОДЕРНІЗАЦІЯ ЕКОНОМІКИ В КОНТЕКСТІ ЦІЛЕЙ СТАЛОГО РОЗВИТКУ: ВИКЛИКИ ТА СТРАТЕГІЧНІ ПРІОРИТЕТИ

КОЛЕКТИВНА МОНОГРАФІЯ

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
ХАРКІВСЬКИЙ НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ РАДІОЕЛЕКТРОНІКИ

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Монографія об’єднує комплексні дослідження в області цифрової трансформації, інновацій, безпеки, екологічних викликів та соціально-економічних процесів. Автори аналізують регуляторні, інвестиційні, технологічні та управлінські аспекти розвитку, формуючи цілісне бачення шляхів модернізації економіки України та її інтеграції у європейський простір. Монографія є результатом теоретичних і практичних досліджень з удосконалення методологічного та науково-методичного забезпечення функціонування соціально-економічних систем на мікро-, мезо- та макроекономічному рівнях.

Монографія призначена для науковців, викладачів, здобувачів всіх рівнів вищої освіти, фахівців, професіоналів-практиків, які займаються дослідженням механізмів функціонування соціально-економічних систем, напрямів цифрової трансформації в умовах протидії гібридним загрозам, забезпечення економічної безпеки підприємств, галузей, регіонів та країни в контексті цілей сталого розвитку.

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DATA ANALYSIS AND BI IN BUSINESS ENVIRONMENT: FURTHER DEVELOPMENT AND ONLINE TOOLS

In the digital economy, data is a strategic asset. Business Intelligence and data analytics enable organizations to:

- transform raw data into actionable insights;
- optimize operations and resource allocation;
- anticipate market trends and customer behavior;
- enhance competitiveness and innovation;
- support evidence-based policy and strategic decision-making.

In essence, BI systems have evolved from simple data support tools into comprehensive, intelligent platforms that form the analytical backbone of modern organizations. Their effective use determines not only efficiency but also strategic survival in an increasingly data-driven world.

The terms Business Intelligence (BI) and Business Analytics (BA) are often used interchangeably, causing confusion due to the absence of clear, universal definitions. Yet, understanding their distinctions is essential for improving strategic decision-making and efficiency.

For example, Turban et al [1] define Business Intelligence (BI) as: «…an umbrella term that combines architectures, tools, databases, analytical tools, applications, and methodologies for decision support…». Authors also link BI to Business Analytics (BA), describing analytics as the quantitative, data-based analysis component of BI that uses models, statistics, and optimization to derive insights. They pointed out, that BI converts data into information, and information into knowledge. But BI systems are not only technological but also managerial processes that improve organizational performance and competitiveness.

Chen et al. [2] expand the scope by introducing the concept of Business Intelligence and Analytics (BI&A) as «…a new generation of techniques and tools that combine data management, data analysis, and knowledge management to enable fact-based decision making…». They stress that data analytics involves statistical, quantitative, and predictive analysis that turns big data into actionable insights with measurable business impact.

Together definitions in [1-2] mark the shift from traditional reporting toward intelligent, data-driven, and predictive business ecosystems.

In essence, Data Analysts extract insights, BI Analysts convert them into actionable intelligence, and Business Analysts apply this intelligence to optimize processes. Recognizing these roles helps organizations use data more effectively for informed, impactful decisions.

Comparison of Business Intelligence and Business Analytics is summarized at table 1.

The development of Business Intelligence (BI) systems has evolved significantly, reflecting both technological progress and the growing importance of data-driven decision-making through those stages:

Table 1 – Comparison of Business Intelligence vs. Business Analytics

Aspect	Business Intelligence (BI)	Business Analytics (BA)
Definition	Using past and present data to drive current business operations.	Predicting future trends based on historical data.
Focus	Understanding what has happened and what is happening now.	Understanding why things are happening and predicting future trends.
Data Usage	Descriptive analysis to provide insights into past and present performance.	Managers, marketers, and non-technical users
Types of Analytics	Descriptive Analytics, Diagnostic Analytics	Predictive Analytics, Prescriptive Analytics, Cognitive Analytics
End Users	Data professionals, analysts, and technical users	Data professionals, analysts, technical users
Skills Required	Basic math skills, data visualization	Statistical analysis, machine learning, data modeling
Example Tools	Power BI, SAP, Tableau	R, Python, SAS, Advanced Excel
Example	A retail chain using BI dashboards to track daily sales across different locations.	An e-commerce company using predictive analytics to forecast demand during the holiday season.

Source: constructed by authors based on [3-5]

1. *Decision Support Systems* (1960s–1980s), designed to help managers make structured and semi-structured decisions. These systems combined data from internal sources, basic statistical analysis, and what-if modeling. However, they were limited by slow processing and restricted access to real-time data.

2. *Executive Information Systems (EIS) and Data Warehousing* (1980s–1990s). With growing computing power, Executive Information Systems emerged, focusing on providing top management with easy-to-use dashboards. Simultaneously, data warehousing appeared, integrating information from multiple operational databases. This created a foundation for comprehensive historical analysis.

3. *Business Intelligence (BI) Era* (1990s-2000s). The term «Business Intelligence» became widely used, encompassing reporting, OLAP (Online Analytical Processing), and data mining. BI tools enabled trend detection, performance monitoring, and KPI tracking. However, systems remained largely centralized and IT-driven.

4. *Self-Service and Real-Time BI* (2010s). The next step was the democratization of BI. Tools like Power BI, Tableau, and Qlik allowed non-technical users to create their own dashboards. Integration with big data and real-time analytics enabled organizations to react instantly to market dynamics.

5. *Cloud-Based and AI-Driven BI* (2020s-Present). Today, BI systems are integrated cloud-based platforms, offering scalability, collaboration, and advanced analytics. They leverage artificial intelligence (AI**)** and machine learning (ML) for predictive analytics, anomaly detection, and automated insights. Cloud ecosystems like Microsoft Azure, Google Cloud, and AWS BI solutions unify data storage, processing, and visualization in a single environment.

The business intelligence process includes five key stages:

1. Data gathering – collecting internal (CRM, ERP, Google Analytics) and external (market or industry) data sources.

2. Data cleaning / filtering – validating, standardizing, and ensuring data quality and consistency.

3. Data storage – loading and organizing data in a warehouse for future analysis.

4. Data analysis – transforming raw data into actionable insights through analytical techniques.

5. Reporting – presenting results via dashboards and visual tools for decision-making.

Overall, business intelligence is a technology-driven process that transforms unstructured or semi-structured data into meaningful information. BI technologies also support data mining and big data analysis.

The ETL (Extract, Transform, Load) or data integration tools will preprocess raw data from the initial sources and send it to a warehouse in three consecutive steps due to ETL Pipeline (Figure 1) [6]. An ETL pipeline is a workflow for preparing data for analysis. It helps you extract data from various sources and transform it into a consistent and usable format. This transformation might involve cleaning the data, removing duplicates, or converting it into a specific structure.

A key concept worth noting in Business Intelligence is Data Warehousing. In business intelligence, data warehouses are specialized databases that store large volumes of historical data in tabular form. They connect to data sources and ETL systems for input and to reporting or dashboard tools for output, providing a unified view of information from multiple systems.

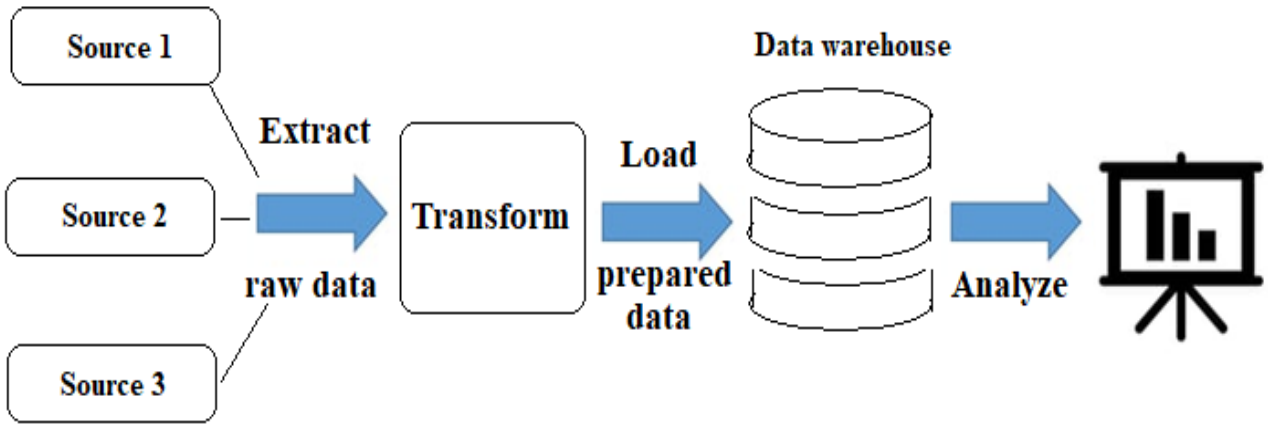

Figure 1 – The ETL Pipeline

Source: [6]

However, warehouses often contain hundreds of gigabytes of data, making query responses slower. When data is unstructured or semi-structured, report generation may become error-prone. To improve efficiency, analytics often require smaller, topic-specific data sets stored separately. Therefore, organizations use additional technologies to ensure faster and more reliable access to focused information segments.

Let’s analyze a several platforms of Business Intelligence. The most popular are Microsoft Power BI, Tableau, SAP BI, Google, Alibaba Cloud, Oracle BI. Gartner in 2022 provided research of BI-systems and formed Gartner Magic Quadrant (Figure 2). Due to research data, Microsoft (Power BI), Tableau (now a part of Salesforce), and Qlik dominate the market.

Figure 2 – Gartner Magic Quadrant of BI-systems

Source: [7]

Microsoft Power BI**,** Tableau**,** Qlik are leading Business Intelligence (BI) platforms, each offering distinct advantages in usability, integration, and analytical capabilities.

Microsoft Power BI integrates tightly with Microsoft 365, Azure, and Excel, making it ideal for organizations within the Microsoft ecosystem. It offers strong data visualization, AI-powered analytics, and cost-effective licensing, but can be complex for non-Microsoft users.

Tableau is renowned for its advanced visualization and intuitive drag-and-drop interface. It provides deep analytical capabilities and high customization but is relatively expensive and requires more technical expertise for complex dashboards.

Qlik stands out with its associative data model, allowing users to explore relationships between datasets dynamically. It supports strong self-service analytics and in-memory processing, though its interface may seem less intuitive for beginners.

In summary, Power BI excels in integration and affordability, Tableau in visualization depth, Qlik in associative analytics.

Microsoft Power BI is one of the most widely adopted and versatile Business Intelligence (BI) platforms, offering a comprehensive ecosystem for data integration, visualization, and advanced analytics. Developed by Microsoft, it seamlessly connects with Excel, Azure, SQL Server, Dynamics 365, and numerous external data sources through built-in connectors.

The platform consists of several components – Power BI Desktop for data modeling and visualization, Power BI Service (cloud-based) for sharing and collaboration, and Power BI Mobile for on-the-go access. Users can combine structured and unstructured data, apply DAX (Data Analysis Expressions) for complex calculations, and create interactive dashboards with AI-driven insights.

One of Power BI's strengths lies in its tight integration with Microsoft technologies, enabling organizations to embed reports in Teams**,** SharePoint, and other Office tools. Its natural language query feature (Q&A) allows users to ask questions about data in plain English, supporting self-service analytics and democratization of data.

The right BI tools adapt to your industry's unique challenges and opportunities, whether you're managing retail inventory, analyzing patient outcomes in healthcare, or tracking donor engagement in the nonprofit world. Here are a few notable examples [8]:

1. Amazon: Amazon is known for its extensive use of data analytics and business intelligence to personalize customer experiences, optimize supply chain operations, and drive targeted marketing campaigns. The company leverages data to make real-time decisions on pricing, inventory management, and customer recommendations.

2. Netflix: Netflix utilizes advanced analytics and BI to analyze user behaviour, preferences, and viewing patterns. This data-driven approach helps them personalize content recommendations, optimize their content library, and make informed decisions about new show acquisitions and production.

3. Starbucks: Starbucks is an example of a brand that has successfully used business analytics to enhance its operations and customer experience. Through their mobile app, Starbucks collects data on customer preferences and purchase patterns, enabling them to personalize offers, optimize store locations, and streamline operations.

4. Spotify: Spotify employs data analytics and BI to understand user preferences and provide personalized music recommendations. They analyze user behaviour, listening habits, and social interactions to create customized playlists, discover new music, and deliver a personalized music experience to each user.

5. Walmart: Walmart utilizes business analytics and data-driven decision-making to optimize its supply chain, inventory management, and pricing strategies. By analyzing sales data, customer behaviour, and market trends, Walmart can make informed decisions to reduce costs, optimize stocking levels, and offer competitive prices.

6. Lufthansa, one of the biggest European airlines, partnered with Tableau to standardize and automate its reporting processes. As a result, data preparation time was reduced by 30 percent. Actionable analytics results became available not only to decision-makers but also to business users due to self-service BI.

7. Uber relies on continuous data analytics to manage driver supply, customer demand, and route optimization. Data used: GPS data, ride requests, driver activity, traffic conditions, weather. Company uses Google Big Query, Apache Kafka, and internal BI dashboards. Real-time analytics and machine learning algorithms were used for surge pricing and demand forecasting. As a result, matching time for drivers and clients was reduced and idle time was reduced on 20%.

8. DHL relies on Domo to ensure the integrity of temperature-sensitive pharmaceutical shipments. With tens of thousands of data points streaming in from IoT sensors across global shipments, the company needed a way to visualize and act on that data in real time. Using Domo, DHL created dashboards that track container temperature, shipping routes, and compliance across its cold chain network. One global operations team used Domo to reduce the time spent investigating shipment anomalies by 80 percent.

These are just a few examples of brands that have successfully leveraged BA and BI to gain a competitive edge and drive business success. Each brand's specific use cases may vary, but they all share a commitment to data-driven decision-making and extracting valuable insights from their data assets.

The evolution of Business Intelligence (BI) has shifted from centralized, IT-driven systems toward self-service BI (SSBI) and the broader democratization of data. Traditionally, BI processes were managed by specialized analysts who controlled data access and report generation, creating bottlenecks and limiting organizational agility. The emergence of self-service BI tools has transformed this model by enabling non-technical users to independently collect, analyze, and visualize data through intuitive interfaces.

This transition supports the democratization of data, where information becomes accessible across all organizational levels, fostering data-driven decision-making and collaboration. Advances in cloud computing, natural language processing, and AI-driven analytics have further enhanced usability, scalability, and

automation. As a result, BI is no longer a function confined to data specialists but a strategic capability that empowers employees to generate insights, accelerating innovation and responsiveness in modern enterprises.

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