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Integration of Enterprise Resource Planning Systems (ERP) with Online Analytical Processing Tools (OLAP) to Support Strategic Decision-Making

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Abstract

This research examines ERP-OLAP integration as a fundamental pillar for strategic decision-making in digital business environments. This integration directly converts operational data into strategic knowledge for forecasting. Using an analytical approach with technical and organizational comparisons, the study focuses on decision quality, agility, and multidimensional analysis. A case study of Amazon clearly demonstrates how integration achieves operational efficiency and competitive advantage. Results show accelerated responses to environmental changes, improved performance indicators, and enhanced predictive capabilities. The study recommends adopting AI and big data analytics models, investing in human capabilities, and developing flexible digital infrastructure to ensure sustainable data-driven strategic analysis.

Keywords: OLAP/ERP Integration, Decision Support, Strategic Analysis, Big Data.

Jel Classification Codes : M15, D81, O33, L86, M10

INTRODUCTION

ERP systems unify operational data across HR, finance, production, and inventory into a single centralized database. OLAP tools analyze this data across dimensions (time, region, product, marketing channel) to provide precise strategic insights for decision-making.

ERP-OLAP integration drives digital transformation, moving organizations from descriptive to predictive analytics. This improves risk foresight and gives managers access to KPIs, market insights, and agile responses to change.

It improves decision quality, supports complex multi-scenario choices, boosts agility and competitiveness, and cuts errors from inaccurate data.

Success beyond technology depends on staff skills, data governance, and strategy alignment. AI and machine learning then boost proactive responses to market changes and global competition.

Yet challenges like costs, infrastructure complexity, change resistance, and data quality persist. Therefore rigorous research is needed to assess the integration's benefits strategic decision impact and performance contribution.

Study Problem : Based on the above, the following problem can be posed:

How can institutions achieve effective integration between ERP systems and OLAP tools to improve the quality of strategic decisions?

From this main question, the following sub-questions arise:

- What are ERP and OLAP components, and how can they be integrated to support decisions?
- How does combining ERP and OLAP enhance both operational and strategic decision quality in organizations?
- What is the impact of integration on the predictive capability and strategic vision of managers?
- What technical and organizational challenges arise when integrating ERP with OLAP?
- What practical lessons can successful cases teach us about applying integration?

Study Hypotheses: To answer the problem, the following hypotheses were formulated:

- First Hypothesis: There is a statistically significant positive effect of the degree of integration between the (ERP) system and tools on the quality of strategic decisions.

- Second Hypothesis: The integration between (ERP) and (OLAP) improves managers' predictive ability, with increased accuracy of models forecasting future trends.
- Third Hypothesis: There is a direct positive effect of the integration between (ERP) and (OLAP) on strategic flexibility.
- Fourth Hypothesis: Data quality and human resources efficiency play a fundamental mediating role in the relationship between the degree of (ERP-OLAP) integration and the effectiveness of strategic decisions.
- Fifth Hypothesis: Institutions that have implemented advanced integration between (ERP) and (OLAP) outperform non-integrated institutions (or those with weak integration) in at least three tangible key performance indicators, namely: Return on Investment (ROI), Inventory Turnover Rate, and Net Profit Margin (NPM), with a statistical difference at the significance level.

Study Objectives : This intervention aims to achieve a set of scientific and practical objectives, most notably:

- Studying the concept of ERP systems and OLAP tools and their role in supporting institutional decisions.
- Analyzing the impact of integration between ERP and OLAP on the quality of strategic decisions.
- Evaluating the effect of integration on the predictive ability and organizational flexibility of the institution.
- Identifying challenges and obstacles in applying the integration between ERP and OLAP.
- Proposing effective mechanisms for applying integration and supporting strategic decision-making in institutions.

Importance of the Study : The importance of this intervention stems from two main dimensions, scientific and practical:

- Improving academic insight into merging analytical and resource planning systems.
- Providing a practical framework for institutions to improve decision-making and better analyze operational data.
- Supporting competitiveness and organizational flexibility in a dynamic business environment.

- Enabling managers to access unified performance indicators and accurate analyses to make better decisions.
- Enables predictive analytics and AI for long-term strategic planning.

Research Methodology : This study relies on the descriptive analytical approach, based on reviewing theoretical literature and analyzing practical cases, with the aim of describing the mechanisms of integration between (ERP) and (OLAP) systems and analyzing their impact on enhancing the effectiveness of strategic decision-making and measuring the associated performance indicators.

Previous studies :

In continuation of the theoretical framework and in support of the methodological aspect of the research, this section presents an analytical review of the most prominent previous studies directly related to the topic of integrating Enterprise Resource Planning (ERP) systems with intelligent analytics tools to support strategic decisions. These studies were carefully selected to cover various approaches, whether quantitative, theoretical, or review-based, and to represent the latest advancements achieved by researchers in this field. This review aims to identify the strengths and weaknesses in previous literature and to observe the research gaps that still exist, which contributes to positioning the current research and defining its distinctive scientific contribution.

Study 1: *Examining the Integration of ERP and BI in the Industrial Sector and Its Impact on Decision-Making Processes in KSA* (Jaradat, Al-Hawamleh, & Hamdan, 2025)

Jaradat, Al-Hawamleh, and Hamdan (2025) investigated the impact of integrating Enterprise Resource Planning (ERP) and Business Intelligence (BI) systems on strategic decision-making within the Saudi industrial sector. Employing a quantitative approach, the study utilized structural equation modeling (SEM) to examine the relationships among the research variables. The findings demonstrated that infrastructure readiness, data quality, information security, and user competency significantly enhance the accuracy and timeliness of strategic decisions. While the study provides valuable empirical evidence from an emerging economy, its exclusive focus on the

industrial sector limits the generalizability of the findings, highlighting opportunities for future research across service and financial industries

Study 2: *The Role of Business Information Systems in Strategic Decision-Making: Implications for Innovation and Market Adaptation* (Mustafa, Almaududi Ausat, & Kraugusteeliana, 2024)

Mustafa, Almaududi Ausat, and Kraugusteeliana (2024) examined the strategic role of integrated business information systems, particularly ERP, CRM, and BI, in fostering organizational innovation and market adaptability. Using a descriptive-analytical approach based on an extensive review of theoretical and practical literature, the study emphasized that real-time data availability and advanced analytical capabilities enable organizations to formulate effective strategies, improve operational performance, and respond rapidly to environmental changes. Although the study offers a comprehensive conceptual perspective, its lack of empirical validation limits the strength of its conclusions, underscoring the need for quantitative investigations to verify the proposed relationships in practical organizational settings.

Study 3: *Towards Intelligent ERPs: Transforming Decision-Making through Information Retrieval* (Ikkou, Belahyane, Smouh, & Aarab, 2024)

Ikkou, Belahyane, Smouh, and Aarab (2024) explored the transformation of conventional ERP systems into intelligent platforms capable of supporting strategic decision-making through information retrieval techniques and advanced analytics. Based on a comprehensive review methodology, the study examined the integration of artificial intelligence and analytical data processing within enterprise systems. The findings suggested that intelligent ERP systems improve forecasting accuracy, accelerate organizational responses to market dynamics, and enhance internal operational efficiency. Despite its valuable theoretical contribution, the absence of empirical validation highlights the need for future experimental studies to assess implementation challenges and organizational outcomes.

Study 4: *Integrating Analytics in Enterprise Systems: A Systematic Literature Review of Impacts and Innovations* (Solano & Cruz, 2024)

Solano and Cruz (2024) conducted a systematic literature review following the PRISMA 2020 methodology to examine the impact of integrating advanced analytics into enterprise information systems (EISs). From 234 identified studies, 45 met the inclusion criteria and were analyzed. The review identified technological, organizational, and environmental dimensions as the primary determinants of successful analytics integration. It also revealed a significant research gap concerning comprehensive implementation frameworks that integrate ERP systems with Business Intelligence (BI) and Online Analytical Processing (OLAP) capabilities. Consequently, the study provides a solid theoretical foundation while emphasizing the necessity of developing practical and empirically validated integration models. enterprise information systems.

Research Gap: By comparing this study with previous studies, it is clear that the current research does not replicate what has been done before, but rather provides a qualitative scientific addition by focusing on specialized OLAP tools, developing an integrative and testable framework, and addressing the methodological and practical gaps highlighted by recent global reviews.

Study Structure : This research consists of:

- An introduction that frames the study's problem, poses the questions, hypotheses, and main objectives.
- Followed by the first section: the conceptual and developmental framework for Enterprise Resource Planning (ERP) systems and multidimensional analysis tools (OLAP), including the definition of their components, characteristics, and their relationship to strategic decision support systems.
- Then the second section: technical and organizational integration mechanisms between the enterprise resource planning system and data analysis systems, clarifying the structure of data transfer (ETL) and the levels of its flow from operational processes to strategic analysis, in addition to human requirements and governance.
- The third section focuses on: the strategic impact of integrating the enterprise resource planning system with real-time data processing, analyzing the improvement of decision quality, enhancement of predictive vision, and increased flexibility,

- The fourth section is dedicated to an applied case study of Amazon, with testing the study's hypotheses based on the analysis of descriptive and quantitative data for this company.
- The study concludes with presenting the extracted results and practical recommendations to ensure the sustainability of competitive advantage.

1. The Conceptual and Evolutionary Framework for the Integration of ERP and OLAP Systems

Understanding ERP and OLAP evolution shows how unified data plus multidimensional analysis leads to predictive BI.

1.1. General Introduction to (ERP) Systems

1.1.1. Definition of Enterprise Resource Planning System

ERP unites core business functions, enabling seamless data flow to streamline processes and cut duplication (Goldston, 2020, pp. 4,5).

ERP merges all units into one database; a purchase entry instantly updates inventory and finances, reducing errors and improving coordination (Monk & Wagner, 2013, p. 5).

Dynamic ERP systems process data for informed decisions, with a single interface reducing redundancy and boosting accuracy across functions.

ERP merges conceptual integration with a unified database, creating a responsive environment that boosts coordination beyond older systems.

So, putting both definitions together gives a full picture of ERP: merging core business functions with solid tech, making it essential for today's organizations to handle digital challenges smoothly.

1.1.2. Components of the ERP System:

ERP systems consist of linked modules like finance, inventory, HR, and sales, all connected via a shared database (Monk & Wagner, 2013, p. 62). The components of ERP can be summarized in the following table:

Table No. 01: Components of the ERP System

Core Functional Modules : These modules represent the main departments of work within the organization and integrate seamlessly with each other		
Component	**Component Sections and Sub-functions**	**Component Role**
Financial Management	• General Ledger: Recording all financial transactions • Accounts Payable: Managing payments to suppliers • Accounts Receivable: Managing invoices and collections from customers • Fixed Assets Management: Tracking and depreciation of assets • Cash Flow Management • Budgeting and Financial Reporting	Providing a comprehensive, accurate, and real-time financial overview.
Human Resources Management	• Payroll Management. • Recruitment and Hiring.	Automation of employee and human capital-related

(Human Resources - HR)	• Performance Management, Training, and Development. • Time and Attendance Management. • Employee Benefits and Entitlements Management.	processes.
Supply Chain Management (Supply Chain Management - SCM)	• Production Planning. • Inventory Management: Tracking inventory levels and movement. • Procurement: Managing purchase requests, purchase orders, and supplier relationships. • Warehouse Management. • Distribution and Logistics.	Improving the flow of materials and products from supplier to end customer.
Manufacturing and Operations (Manufacturing/Operations)	• Production and Quality Control. • Material Requirements Planning (MRP). • Production Scheduling. • Bill of Materials (BOM). • Cost Management.	Enhancing production process efficiency and reducing operational costs.
Support & Integrative Modules These modules are essential to support the core units and enhance communication with external parties		
Component	**Component Sections and Sub-functions**	**Component Role**
Customer Relationship Management (CRM)	• Sales and marketing management. • Customer service and technical support (Help Desk). • Management of customer data and interactions.	Integrates with finance and inventory to execute and track orders.
Business Intelligence (BI) and Analytics	• Custom reports and dashboards. • Data analysis and forecasting.	Relies on aggregated data from all units to support decision-making.
Project Management	• Project planning and budgeting. • Tracking activities, resources, and time. • Issuing project invoices.	Integrates with finance and human resources to track project costs and performance.
Technical & Infrastructure Components : This is the technical foundation on which the entire system operates.		
Shared Central Database:	It is the single data repository that stores all information from all financial units, HR, inventory, etc. It ensures data consistency, integrity, and provides a single unified view of truth within the organization.	
User Interface and Applications:	Screens and forms that users interact with to enter and view data.	
Deployment Options:	• On-Premise: Installed on the organization's servers. • Cloud-Based: Hosted on the vendor's servers and accessed online (SaaS). • Hybrid: A combination of on-premise and cloud deployment.	
Security and Access Management:	Managing user permissions, ensuring data security, and compliance with regulations.	

Source: Prepared by the researcher

1.1.3. Objectives of the Enterprise Resource Planning System

Adopting ERP mainly aims to boost efficiency, cut costs, unify data, aid decisions, and increase transparency.

ERP systems help modern institutions integrate admin and operations. Academic studies and practical applications summarize the main objectives as (Sumner, 2005, p. 12):

First - Improving the efficiency of operational processes and reducing costs

ERP improves operations by managing inventory, production, procurement, and HR together.

- Boosts efficiency by cutting manual tasks, standardizing steps, and auto-updating inventory.
- ERP cuts costs by using resources better, reducing waste, and saving time on repetitive tasks.
- Integrated processes boost on-time delivery and reduce delays.

This goal boosts competitiveness and adaptability to market shifts.

Second - Unification and Integration of Data Across the Institution: ERP consolidates data into one unified database for all units:

- The system merges accounting, sales, inventory, and purchasing data to avoid duplication.
- This integration standardizes procedures, reducing differences across departments.
- Unified data boosts credibility and cuts errors from mismatched systems.

So ERP helps information flow and teamwork across departments.

Thirdly - Supporting decision-making through accurate and unified information: ERP supports decisions by giving managers timely, needed info:

- The system creates accurate reports on profits, inventory, and production.
- Unified real-time data supports informed strategic decisions by management.
- ERP's predictive tools help forecast demand and refine strategies.

Fourth - Increasing Institutional Oversight Transparency: ERP systems significantly contribute to enhancing internal control and institutional transparency:

- Activity Monitoring: Real-time tracking of all transactions reduces errors and manipulation.
- Performance Auditing: Accurate operation records simplify audits and ensure policy compliance.

- Enhancing Accountability: Clear information flow makes each unit accountable for its results, boosting performance.

Fifth - Supporting Flexibility and Adaptation to Changes: Beyond earlier goals, ERP boosts an organization's adaptability to internal and external shifts :

- Operational Flexibility: Adjust production, procurement, sales swiftly with demand or economic variables.
- Continuous Updating: Modern ERP systems allow adding modules or updating processes as organizations grow.
- Responding to Technological Changes: ERP merges AI, analytics, and IoT to support decisions and performance.

1.2. Multidimensional Analysis Tools (OLAP):

1.2.1. Definition of Multidimensional Analysis Tools

OLAP allows fast exploration of data across dimensions like time or product using analytical models, not live operational databases (Codd, Codd, & Salley, 1993, p. 3).

1.2.2. Characteristics of Multidimensional Analysis Tools

OLAP uses multidimensional structures, roll-ups, slicing, drill-down, and fast query performance for analysis, not transactions (Thomsen, 1997, pp. 28,29).

1.2.3. Their Role in Data Analysis

OLAP turns operational data from ERP into analytical insights by aggregating and examining it across time and dimensions. This supports dashboards, trend analysis, financial and marketing planning, and smarter business decisions (Chaudhuri & Dayal, 1997, pp. 28-29).

1.3. The Historical Development of the Integration of Management Information Systems with Intelligent Analysis Tools.

Enterprise systems evolved from transaction-focused operations to 1990s ERP, then data warehouses and 1993 OLAP, and finally modern ERP with embedded AI and machine learning for strategic decisions (Solano & Cruz, 2024, pp. 1-25).

Over the years, organizations moved from basic operational systems that just record daily tasks to Business Intelligence tools that extract real value from data. ERP offered integrated information but couldn’t analyze deeply or forecast trends. As data grew, advanced analytics and OLAP became necessary, linking operations with predictions. Studies show this

shift improves decisions, performance, and responsiveness (Sharma, 2025, pp. 33-41).

1.4. The Relationship Between ERP and DSS

ERP systems unify all operations into one central database, while DSS tools let managers analyze that data to make smarter strategic decisions.

According to Hasnining & Mushaf (2023), ERP provides data, DSS converts it into decision-making knowledge (Hasnining & Mushaf, 2023, p. 88).

The ERP and DSS work together by linking the ERP database to DSS analysis tools, often through data warehouses or OLAP. As Al Maruf (2025) notes, this allows extracting KPIs, spotting trends, and running "what-if" simulations to sharpen decisions (Al Maruf, 2025, pp. 236-262).

ERP gives reliable data; DSS extracts patterns and predictions from it.

Sharma (2025) notes AI/ML in ERP-linked DSS offers proactive insights and forecasts for faster adaptation (Sharma, 2025, pp. 33-41).

Integrating both systems transforms info management and decisions, enabling real-time dashboards that sharpen managers' strategic vision.

Hammouch (2024) says integration leads to faster, better decisions and market predictions via multidimensional analysis.

For effective integration, key conditions: data quality, staff skill, analytical culture.

Research stresses embedding analytics into ERP for real-time decisions without switching systems-a top trend in IT management.

ERP and DSS share a strategic bond: one builds the data backbone, the other turns it into smart, flexible decisions.

In today's digital economy, success depends on integration and turning operational data into smart strategic insights.

1.5. Justifications for the need to integrate ERP and OLAP in the modern organizational environment.

The integration between ERP systems and OLAP tools is justified for several reasons (Kimball & Ross, 2002, pp. 11,12):

- ERP's vast operational data is analysis-rich, yet without OLAP, it stays strategically wasted;
- Multidimensional analysis speeds up accurate performance checks, aiding competitive strategy;

- Today's business world faces rapid shifts and time pressure; ERP-OLAP integration enables near-real-time analysis and faster, smarter decisions;
- Integration helps firms embed BI and ML into daily work, sharpening their competitive edge.

2. Mechanisms of Integration between ERP and OLAP and Their Role in Decision Support

Integrating ERP with OLAP turns operational data into strategic insights by linking databases to data warehouses. This enables real-time dynamic reports and KPIs, helping managers spot trends quickly. It's the foundation for smarter, faster decisions using big data and intelligent forecasting.

2.1. Technical Integration Architecture between ERP Database and OLAP Analytical Engines.

Layered architecture moves operational data for analysis without slowing performance.

This architecture typically consists of three main layers (Monk & Wagner, 2015, pp. 231-236):

- Data Layer: This includes the operational ERP databases that contain real transactions such as purchase orders, invoices, payroll, and inventory.
- ETL extracts ERP data, reshapes it for analytics, then loads it into the data warehouse.
- The analytical layer uses OLAP engines to build cubes and organize dimensions, enabling fast multi-perspective analysis.

ODBC, APIs, XML, and web services enable secure, synchronized communication between the two systems.

2.2. Data Flow Model from Operational Processes in ERP to Strategic Analysis in OLAP.

Data starts from daily ERP tasks like orders or inventory updates, then gets saved in the Operational Database.

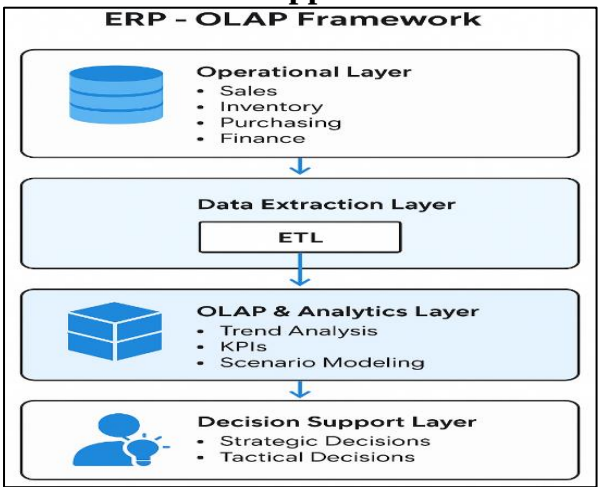
Then, ETL extracts data in batches or near-real-time, cleans it, and aligns it for the data warehouse.

Once data is in the warehouse, OLAP cubes with key dimensions like time or product allow drill-down and roll-up, helping managers see details or the big picture (Chaudhuri & Dayal, 1997, pp. 65-74).

Finally, dashboards and analytical reports provide decision-makers with real-time and predictive performance insights.

So this model shows how data flows from ERP to OLAP for strategic decisions, built on four key levels (Al Maruf, 2025, pp. 236-262):

Figure No. 01: Levels of integration between ERP-OLAP for decision support.



Source: Prepared by the researcher

2.2.1. Operational Layer : Covers daily ERP operational data like sales, inventory, procurement, and finance.

- This data is stored in an integrated central database, ensuring accuracy and consistency of information.

2.2.2. Data Extraction Layer

- This layer uses ETL to turn ERP operational data into analyzable formats for the Data Warehouse.
- This layer ensures data quality and prepares it for multidimensional analysis.

2.2.3. OLAP & Analytics Layer

- This includes OLAP tools for data analysis across different time, geography, and product/service dimensions.
- This layer enables trend analysis, KPI creation, and modeling of future scenarios.

2.2.4. Decision Support Layer

- Represents the stage of utilizing analytics to guide tactical and strategic decisions.

- Gives managers accurate insights for planning, forecasting, and performance gains.

2.3. Analytical Functions Resulting from Integration

ERP-OLAP integration provides analytical functions that turn operational data into strategic knowledge, most notably (Kimball & Ross, 2002, pp. 48-50):

- Dynamic reports let users create custom, auto-updating views that accelerate reaction to market shifts.
- Trend analysis tracks indicators over time to spot performance growth or decline like sales.
- KPIs are instantly calculated from ERP data and shown on dashboards for ongoing performance review.
- Compare performance across branches, time periods, or product lines.
- These analytics shift managerial decisions from descriptive to predictive, strategic, and data-driven.

2.4. Technological and Organizational Requirements for the Successful Integration of the Two Systems.

Successful ERP-OLAP integration requires technical and organizational infrastructure, in two areas (Laudon & Laudon, 2024, pp. 221-225) :

2.4.1. Technological Requirements

- Robust Infrastructure: High-performance servers and secured databases with sufficient storage capacity to accommodate historical data.
- Effective ETL Tools: To ensure data quality and reduce processing time.
- Integration with BI and AI Systems: To expand the scope of intelligent and predictive analysis.
- Interactive User Interfaces: Facilitate access to analytics without deep technical knowledge.

2.4.2. Organizational Requirements

- Senior Management Support: To ensure the necessary financial and human resources for the project.
- Data-Driven Culture: Encourages the use of analysis at all decision-making levels.
- Data Governance: To establish standards for data quality, security, and confidentiality.

- User Training: To ensure optimal use of analytical tools and accurate interpretation of their results.

Meeting these requirements turns operational data into impactful strategic decisions.

3. The Strategic Impact of Integrating ERP and OLAP on the Decision-Making Process

Integrating ERP with OLAP isn't just technical—it's a strategic shift. It gives a full, multi-angle view of operations, sharpens decisions and forecasts, boosts agility and performance, and helps organizations adapt quickly, securing a lasting edge in today's digital world.

3.1. Improving Decision Quality through Multidimensional Analysis of Institutional Data

Connecting ERP with OLAP turns basic operational records into multidimensional insights (time, product, region, etc.), boosting decision quality through four key pathways (Solano & Cruz, , 2024, p. 138):

3.1.1. Multidimensional analysis as a mechanism for detecting patterns and outliers: OLAP cubes let managers zoom in or out on data, uncovering hidden patterns in basic reports. This shifts decisions from gut feelings to solid facts.

3.1.2. Dynamic reporting and interactive analytics: When OLAP links to a Data Warehouse, dynamic reports auto-update and run what-if tests, so managers can quickly try alternatives before deciding.

3.1.3. Improving information reliability through Data Governance: ETL moves ERP data to OLAP, cleaning and standardizing it to cut duplicates and build trust—because good decisions depend on data quality.

3.1.4. Supporting the transition from descriptive to predictive: By adding BI or ML to ERP-OLAP, you shift from "what happened" to "what could happen," using past data for smarter forecasts.

3.2. The Impact of Integration on the Level of Strategic Vision and Predictive Capability of Managers.

ERP-OLAP integration shifts manager visibility from basic reports to a layered strategic view, seen practically in four ways:

3.2.1. Unified Visibility: Integration replaces scattered partial reports with one reliable data hub, letting leaders use consistent metrics, cutting departmental conflicts and boosting strategic alignment.

3.2.2. The Ability to Build Strategic Scenarios: With historical data and OLAP cubes, test strategic moves like new pricing or markets first—cutting risk and sharpening decisions.

3.2.3. Forward-Looking Intelligence: Pairing OLAP with machine learning enables predictive metrics for demand or supply risks, shifting managers from crisis to opportunity.

3.2.4. KPI Alignment: Integration unifies KPIs enterprise-wide, so strategy is judged objectively, not by scattered local metrics.

3.3. The Impact of Integration on Organizational Agility and Responsiveness to a Changing Environment

Agility means adapting quickly to environmental shifts. ERP-OLAP integration strengthens this through measurable mechanisms:

3.3.1. Reduction of Decision Lead Time: With near-real-time analytics in well-designed data warehouses, companies act faster on signals. Market data confirms integrated ERP-analytics noticeably cuts response time.

3.3.2. Ability for Rapid Operational Adjustment:

Multidimensional analytics let firms quickly adjust inventory, purchases, or resources when demand shifts—but only with flexible ETL/ELT and APIs for near-real-time integration.

3.3.3. Support for Innovation and Fail-Fast Experimentation: Analytical databases enable fast, low-cost A/B testing in marketing or pricing, boosting strategic hypothesis checks.

3.3.4. Institutional Flexibility as a Result of Alignment Between Technology and Governance: Literature shows governance and skills are critical; tech alone lacks flexibility. Integration needs investment in both infrastructure and people.

4. Case Study: Amazon Company (Amazon)

Amazon is a prominent practical model for the integration between Enterprise Resource Planning (ERP) systems, multidimensional analysis tools (OLAP), and advanced analytics, where it has succeeded in transforming vast amounts of operational data into strategic insights that support its competitive decisions. Studying this case allows for testing research hypotheses in a broad real-world environment, by tracking the data pathway from daily operational processes to strategic multidimensional analysis, leading to the support of predictive decisions.

Amazon leads e-commerce innovation by blending massive operational systems, supply chains, and analytics. Its quick strategic moves rely on merging ERP, OLAP, and advanced analytics.

Amazon started in 1994 as a U.S. bookseller, then expanded into digital marketplaces, devices like Kindle, and AWS cloud services. But as it grew globally, integrating data across sales, shipping, finance, and inventory became tough, with slow responses and massive analysis challenges.

A major issue: daily operational systems and old storage couldn't deliver proactive analytics or fast decisions for supply, production, or logistics. Plus, soaring data volumes demanded near-real-time analytical architecture.

4.1 Technical Integration: From Operational Processes to Strategic Analysis

Amazon phased in cloud ERP from finance to supply chains, then added analytics and AI (Al Quraishi, Al Mahdi, & Abusalem, 2024, pp. 108-120).

For supply chains, Amazon used Dremio to speed up financial analytics queries tenfold, cutting time from minutes to seconds (M. & Jeremiah , 2023), The setup uses ETL from ERP to data warehouses, builds OLAP cubes, and analyzes time, location, and product.

Amazon relies on an advanced integrated architecture that connects its operational systems with multidimensional analysis tools, according to the four levels specified in the integration model (Figure No. 1), :

First: Operational Processes Layer – Amazon relies on Oracle ERP Cloud as a unified platform for managing financial operations, procurement, supply chain, and human resources. The system was implemented gradually according to a phased rollout strategy, starting with financial management and procurement, then expanding to include supply chain and human resources, relying on cross-functional teams to ensure smooth integration. This layer handles billions of annual transactions, as data indicates that Amazon processes more than 400 million products daily through its SCOT system.

Second: Data Extraction, Transformation, and Loading (ETL) Layer – Operational data is transferred from the Oracle ERP database to analytical data warehouses through automated ETL processes. Amazon uses a data architecture based on Apache Iceberg and Dremio as a unified data lakehouse platform, enabling high-speed access to data from multiple sources. Amazon has also developed the Nexus platform, powered by Apache Hudi, for large-scale profitability unit analysis. These tools contribute to accelerating financial analysis queries by up to tenfold.

Third: Analytics and Online Analytical Processing (OLAP) Layer – Multidimensional OLAP data cubes (time, geography, product, marketing channel) are built from the data stored in the data warehouse. Amazon uses advanced analytical techniques, including artificial intelligence, machine learning, Internet of Things, and blockchain technology, deeply integrated into the Oracle ERP Cloud system. This enables real-time data analysis across multiple dimensions and supports decision-making with dynamic dashboards and interactive reports.

Fourth: Strategic Decision Support Layer – The outputs of the OLAP layer are used to guide decisions at tactical and strategic levels. The following table shows the key indicators resulting from this integration:

Table No. 02: Strategic Decision Support Indicators at Amazon

Indicator	Value / Result
Improvement of logistics route efficiency	12% thanks to AI-based dynamic routing
Improvement of regional forecast accuracy	20%
Improvement of inventory accuracy	10%
Acceleration of inventory storage and identification	75% thanks to the Sequoia system
Reduction of processing time	25%
Reduction of human effort and injuries	15%

Source: Prepared by the researcher

4.2 Impact of Integration on Decision Quality and Predictive Capability

The previous indicators can be used to test the impact of integration on decision quality and the impact of integration on predictive capability:

Regarding decision quality : the integration of ERP-OLAP-Advanced Analytics provides Amazon with a comprehensive and multi-dimensional

view of its operations, enabling managers to make more accurate and fact-based decisions. This is exemplified by the SCOT (Supply Chain Optimization Technologies) system, which Amazon describes as the "central nervous system of its operations," transforming massive data sets into predictive intelligence that guides decisions on purchasing, storage, picking, and shipping. The SCOT system is a practical example of how operational data can be converted into strategic knowledge that supports real-time decision-making.

Regarding predictive capability : Amazon uses machine learning models to forecast demand with high accuracy. It is estimated that the long-term forecasting accuracy of the SCOT system has improved by 10% thanks to artificial intelligence, while the integration of machine learning has contributed to improving regional forecasting accuracy by 20%. Most notably, Amazon adopts an unconventional approach to forecasting, deliberately building a margin of error of 12% as a safety buffer in inventory, recognizing that absolute accuracy is less profitable than the flexibility embedded in forecasts. This approach demonstrates a deep strategic awareness that decision quality is not measured by predictive accuracy alone, but by its ability to accommodate uncertainty.

4.3 The Impact of Integration on the Organization's Flexibility and Responsiveness to a Changing Environment

Amazon's data clearly demonstrates the impact of integration on organizational flexibility:

• Accelerated Response Time: In the first half of 2024, Amazon recorded the delivery of more than 5 billion items on the same day or the next day, an increase of 30% compared to the previous year, with 60% of Prime orders in urban areas delivered on the same day or the next day. This performance reflects an exceptional ability to adapt to changes in demand.

• Operational Flexibility: The Sequoia robotics system is an example of enhanced operational flexibility, contributing to inventory identification and storage at a speed 75% greater, with more than one million automated

robots operating in distribution centers. Distribution centers can handle more than 110,000 parcels daily during peak seasons.

• Response to Shocks: Amazon has demonstrated the ability to redirect supplies, move inventory, and adjust distribution when unexpected changes in supply or demand occur, translating into a tangible competitive advantage.

4.4 The Role of Data Quality and Human Skills

Amazon's data indicates that the success of integration does not rely solely on technology, but requires high data quality and advanced human competencies, which supports the intermediary role of data quality and skills:

• Data Quality: Amazon relies on a unified data architecture (data lakehouse) built on Apache Iceberg, ensuring data accuracy and consistency across all units. Data quality is a fundamental prerequisite for the success of SCOT models in providing accurate forecasts.

• Human Skills: Amazon invests in employee training, having hired thousands of engineers and data scientists to develop and maintain its analytical systems. The ongoing recruitment of technical talents indicates that effective integration requires human investment parallel to technological investment.

4.5 Measurable Competitive Advantage

The following indicators provide support for the superiority of integrated organizations:

Table No. 03: Indicators Supporting Amazon's Competitiveness

Performance indicator	**Value**
Operating profit growth	86.1% year-on-year (2024)
Net sales growth	11% to $637.959 billion (2024)
Same/next day delivery	5 billion items (+30% annually)
Savings in transportation and logistics costs	$1.6 billion (2020)
Reduction of CO_2 emissions	Million tons

Source: Prepared by the researcher

These indicators demonstrate a clear superiority of the integrated organization over its less integrated counterparts, reinforcing the hypothesis that integration between ERP, OLAP, and advanced analytics translates into tangible and measurable competitive advantages.

4.6 Analytical Summary: Approaching the Hypotheses through the Amazon Case

The following table summarizes how each hypothesis of the study was tested through indicators derived from the Amazon case:

Table No. 04: Results of Testing the Study Hypotheses

Hypothesis	Test indicators from Amazon case	Result
H_1: Impact of integration on decision quality	SCOT system as "central nervous system" guiding purchasing, storage, and shipping decisions	Supported
H_2: Impact of integration on predictive capability	Long-term forecast accuracy improved by 10%, regional forecast improved by 20%	Supported
H_3: Impact of integration on resilience	5 billion items rapid delivery (+30%), faster storage 75%	Supported
H_4: Mediating role of data quality and skills	Unified data architecture (Iceberg/Dremio), intensive human investment	Supported
H_5: Superiority of integrated institutions	Operating profit +86.1%, $1.6 billion savings	Supported

Source: Prepared by the researcher

Amazon's case study highlights that advanced integration between ERP systems, OLAP tools, and multidimensional analytics is not merely a technical option, but a strategic necessity for achieving leadership in rapidly changing dynamic markets. This integration has enabled Amazon to move from descriptive analytics (what happened) to predictive analytics (what could happen) and then to prescriptive analytics (what should be done), thereby achieving a combination of operational efficiency and strategic excellence simultaneously.

5. CONCLUSION

Based on the central issue raised by this research, which questioned how institutions can achieve effective integration between Enterprise Resource Planning (ERP) systems and Online Analytical Processing (OLAP) tools to improve the quality of strategic decisions, the study concluded with a set of essential findings that go beyond technical aspects to include organizational, human, and analytical dimensions. Integration between the two systems is no longer merely a technological option, but has become a strategic necessity that redefines the decision-making process in contemporary institutions.

At the conclusion of this research, it is clear that the integration of Enterprise Resource Planning (ERP) systems with Online Analytical Processing (OLAP) tools constitutes the cornerstone for institutions' transformation towards making intelligent, data-driven, and multidimensional strategic decisions. By linking operational processes with predictive analytics and enabling managers to have a comprehensive view of their performance, institutions can achieve a unique combination of operational efficiency, strategic flexibility, and sustainable competitive advantage. This research has provided an integrated framework and standard indicators that institutions can adopt to assess their level of integration and its impact on their performance, thereby contributing to bridging the gap between strategic ambitions and technical capabilities, and laying the foundation for a new phase of effective digital management in the era of big data and advanced analytics.

In response to the research gap revealed by the systematic review of Solano & Cruz (2024) regarding the scarcity of detailed guiding models for integrating ERP systems with OLAP capabilities and advanced analytics, this research presented a clear integrative model linking four functional levels: the operational layer, the data extraction, transformation, and loading (ETL) layer, the multidimensional analysis (OLAP) layer, and the strategic decision support layer. This model constitutes a practical tool that institutions can adopt to guide their integration efforts, thus surpassing the abstract theoretical approach that characterized some previous studies such as Mustafa et al. (2024) and Ikkou et al. (2024).

This research was able to test its five hypotheses through an in-depth analysis of the Amazon case, which provided an applied ground rich in measurable indicators:

- The first hypothesis (impact of integration on decision quality): This was manifested in the SCOT system, described as the "central nervous system" of Amazon's operations, where operational data is transformed into predictive intelligence that guides purchasing, storage, picking, and shipping decisions in real time, thereby translating decision quality into tangible executive efficiency.
- The second hypothesis (impact of integration on predictive capability): Indicators showed an improvement in long-term forecasting accuracy by 10%, and an improvement in regional forecasting by 20%, which confirms the ability of integration to transform historical data into accurate future insights.

- Third Hypothesis (Impact of Integration on Organizational Agility): Amazon recorded the delivery of more than 5 billion items on the same day or the next day in the first half of 2024, an increase of 30%, with a 75% improvement in inventory storage speed through the Sequoia system, highlighting the ability of integration to enhance rapid response to market changes.
- Fourth Hypothesis (The Mediating Role of Data Quality and Skills): The unified infrastructure based on Apache Iceberg and Dremio, along with intensive recruitment of technical talents, demonstrated that the success of integration depends on data quality and human resource efficiency as much as it does on the technology itself.
- Fifth Hypothesis (Superiority of Integrated Institutions): Financial indicators translated this superiority into tangible figures, represented by an 86.1% growth in operating profits and savings of $1.6 billion in transportation and logistics costs, providing quantitative evidence of the competitive advantage enabled by integrated institutions.

The research proved that integration between ERP and OLAP is no longer merely a tool for analyzing the past (descriptive analytics), but has become a gateway to predictive analytics (what could happen) and then prescriptive analytics (what should be done). This qualitative development enables institutions to move from a "reactive" culture to a "proactive initiative" culture, where decisions are made before events occur, not after.

Results:

- Improving decision quality: The integration between ERP and OLAP helped organizations make more accurate decisions through multidimensional data analysis and the consolidation of operational information into a unified platform.
- Increasing predictive capability: The integration enabled organizations to forecast demand and market trends, contributing to risk reduction and improved strategic planning.
- Enhancing organizational agility: Advanced analytics allowed organizations to respond quickly to sudden changes in the business environment and reduce decision-making time.
- Integration of operational information: Unified platforms contributed to merging financial, inventory, and human resources data, eliminating duplication and increasing accuracy.

- Providing integrated performance indicators: Organizations became capable of monitoring operational and strategic performance through precise dynamic indicators.
- Reducing human errors: Analytical systems helped reduce reliance on human intuition in decision-making, lowering the rate of operational errors.
- Improving supply chain efficiency: Integration enabled precise monitoring of inventory and suppliers, contributing to waste reduction and better logistics management.
- Accelerating response to customer needs: Real-time data analysis allowed for policy and service adjustments in line with changing customer demand.
- Enhancing digital strategy: Integration supported digital planning and the development of innovative business and service models.

Increasing the ability to make predictive decisions: Enabling managers to evaluate different scenarios before implementation to avoid risks and achieve organizational goals.

Recommendations and Suggestions:

Based on the results obtained, this research recommends that institutions seeking to enhance their competitive capabilities should:

- Adopt a multi-level integrative structure: Design ERP and OLAP systems to enable seamless data flow and real-time analysis, while ensuring effective ETL processes that guarantee data quality and timely availability.
- Balanced investment in technology and personnel: Providing advanced analytical tools alone is not sufficient without building human capabilities able to interpret their outputs and transform them into strategic decisions, while promoting a culture of evidence-based decision-making.
- Application of predictive analytics and artificial intelligence: Integrate machine learning algorithms within the OLAP system to generate accurate forecasts that contribute to resource planning, inventory management, demand prediction, and risk mitigation.
- Conduct periodic reviews: Regularly evaluate the performance of the integrated system in terms of data accuracy, query speed, and effectiveness of decisions made, with infrastructure updates in line with internal and external environmental changes.
- Gradual expansion: Start with pilot projects in specific units before generalization, to avoid technical and organizational risks, and benefit from lessons learned to improve expansion processes.

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