الجمهورية الجزائرية الديمقراطية الشعبية
Ministry of Higher Education and Scientific Research
وزارة التعليم العالي والبحث العلمي
People's Democratic Republic of Algeria

HIGHER SCHOOL OF MANAGEMENT AND DIGITAL ECONOMY

H.S.M.D.E

المدرسة العليا للتسيير والاقتصاد الرقمي

Master thesis in Partial Fulfillment of the Requirement for a Master's degree in the field of

E-Business

THEME:

Impact of SAP B1 on Digitalizing Pharmaceutical Supply Chains

CAS: Pharma-Invest

Submitted by

Ms. **DJAGHROURI LAMIS**

Supervised by

Ms. **CHIBANE ASSIA**

Academic year

2024/2025

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DEDICATIONS

All praise and gratitude belong to Allah, whose infinite mercy guided me through every challenge and made this achievement possible.

To my beloved parents:

My beautiful mother, whose prayers carried me through difficult times, your unwavering love has been my foundation.

My father, whose strength taught me perseverance,

To my sisters and brother, my lifelong companions, thank you for being my constant support.

To my dearest friend Narimane, your friendship was a treasure that made these years unforgettable.

To every kind soul who offered help, a word of advice, or simply a smile when I needed it most, your presence made all the difference in my journey.

To myself, for wiping away the tears, for pushing through endless nights, for choosing perseverance when surrender seemed easier

This triumph is ours to share.

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To everyone who supported me and contributed to my academic journey

Thank you.

List of figures:

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List of abbreviations

SCM: Supply chain management

DT: Digital transformation

ERP: Enterprise Resource Planning.

IOT: Internet of things.

RFID: Radio Frequency Identifier.

IT: Information technology

MRP: Material requirements planning

SAP: Systems, application, and products (in data processing)

B1: Business one

SL: Service Layer

QMS: Quality management system

SD: Sales and distribution

AR: Augmented Reality

VR: Virtual Reality (VR)

ANPP: National Pharmaceutical Products Agency

SaaS: Software as a Service

SME: small and medium-sized enterprises

CRM: Customer Relationship Management

SDK: Software Development Kit

MRP: Material Requirements Planning

API: Application Programming Interface

RMA: Return Merchandise Authorization

SMACIT: Social, Mobile, Analytics, Cloud, Internet of Things

Abstracts

This dissertation examines the contribution of digital transformation to the optimization of the pharmaceutical supply chain through a case study conducted at Pharma Invest. The focus is on the implementation of the ERP system SAP Business One and its integration with complementary digital tools. The objective is to evaluate how such systems impact operational performance, traceability, and supply chain resilience.

Digital transformation plays an increasingly vital role in enhancing supply chain performance, particularly in the pharmaceutical sector where precision, transparency, and adaptability are essential. This research explores how enterprise resource planning (ERP) systems support the modernization of supply chain processes, highlighting both the opportunities and challenges of digital integration. The case study demonstrates the potential of digital tools to improve operational efficiency, data reliability, and informed decision-making across supply chain activities. It also underscores the importance of organizational readiness, user engagement, and strategic alignment to ensure the success of digital transformation efforts.

Ultimately, this study offers insights into the benefits and limitations of ERP implementation in the pharmaceutical supply chain and emphasizes the critical role of user training and system integration in realizing the full potential of digital transformation.

Keywords: Digital transformation; ERP (SAP Business One); Pharmaceutical supply chain; Operational performance; Pharma Invest.

Résumé

Ce mémoire examine la contribution de la transformation numérique à l'optimisation de la chaîne d'approvisionnement pharmaceutique à travers une étude de cas réalisée chez Pharma Invest. L'accent est mis sur la mise en œuvre du système ERP SAP Business One et son intégration avec des outils numériques complémentaires. L'objectif est d'évaluer l'impact de ces systèmes sur la performance opérationnelle, la traçabilité et la résilience de la chaîne d'approvisionnement.

La transformation numérique joue un rôle de plus en plus crucial dans l'amélioration des performances de la chaîne d'approvisionnement, notamment dans le secteur pharmaceutique où la précision, la transparence et l'adaptabilité sont essentielles. Cette recherche explore comment les systèmes de planification des ressources d'entreprise (ERP) peuvent soutenir la modernisation des processus de la chaîne d'approvisionnement, en mettant en lumière à la fois les opportunités et les défis de l'intégration numérique. L'étude de cas démontre le potentiel des outils numériques pour améliorer l'efficacité opérationnelle, la fiabilité des données et la prise de décision éclairée dans l'ensemble des activités de la chaîne d'approvisionnement. Elle souligne également l'importance de la préparation organisationnelle, de l'engagement des utilisateurs et de l'alignement stratégique pour assurer le succès des initiatives de transformation numérique.

Cette étude apporte des éclaircissements sur les bénéfices et les limites de la mise en œuvre des ERP dans la chaîne d'approvisionnement pharmaceutique, tout en insistant sur le rôle clé de la formation des utilisateurs et de l'intégration des systèmes pour exploiter pleinement le potentiel de la transformation numérique.

Mots-clés : Transformation numérique ; ERP (SAP Business One) SAP ERP, chaîne d'approvisionnement pharmaceutique ; Performance opérationnelle ; Pharma Invest.

الملخص

تناولت هذه المذكرة مساهمة التحول الرقمي في تحسين إدارة سلسلة الإمداد الدوائية من خلال دراسة حالة أجريت في شركة .Pharma Invest. يتركز البحث على تطبيق نظام تخطيط موارد المؤسسات SAP Business One (ERP) ودمجه مع الأدوات الرقمية المكملة, بهدف تقييم تأثير هذه الأنظمة على الأداء التشغيلي، تتبع المنتجات وكذا تقييم مرونة سلسلة الإمداد.

يلعب التحول الرقمي دورًا متزايد الأهمية في تعزيز أداء سلسلة الإمداد، لا سيما في القطاع الدوائي حيث الدقة والشافية والقدرة على التكيف تعتبر عناصر أساسية. تستكشف هذه الدراسة كيف تدعم أنظمة تخطيط موارد المؤسسات تحديث عمليات سلسلة الإمداد، مع إبراز التحديات المرتبطة بالتكامل الرقمي. تُظهر دراسة الحالة الإمكانيات التي توفرها الأدوات الرقمية لتحسين الكفاءة التشغيلية، موثوقية البيانات، واتخاذ القرارات المبنية على المعلومات عبر أنشطة سلسلة الإمداد. كما تؤكد الدراسة على أهمية جاهزية المؤسسة، مشاركة المستخدمين، والتوافق الاستراتيجي لضمان نجاح جهود التحول الرقمي.

تقدم هذه الدراسة رؤية شاملة حول فوائد وحدود تطبيق نظام تخطيط موارد المؤسسات في سلسلة الإمداد الدوائية، مع التركيز على الدور الحاسم لتدريب المستخدمين ودمج الأنظمة في تحقيق الإمكانات الكاملة للتحول الرقمي.

الكلمات المفتاحية:

التحول الرقمي؛ تخطيط موارد المؤسسات؛ سلسلة التوريد الصيدلانية؛ الأداء التشغيلية؛

Pharma Invest

General Introduction

General Introduction

The pharmaceutical industry constitutes a critical pillar of global health systems, confronted with rigorous demands to safeguard patient safety, maintain product integrity, and ensure uninterrupted supply chain continuity within an environment characterized by stringent regulatory frameworks and complex logistics. These imperatives necessitate exceptional operational efficiency, transparency, and resilience, thereby elevating digital transformation from a strategic advantage to an operational imperative. In this context, Enterprise Resource Planning (ERP) systems particularly SAP Business One (SAP B1) have become indispensable tools for optimizing supply chain processes by providing integrated functionalities that facilitate real-time data sharing and process automation.

However, implementing SAP B1 alone does not guarantee transformational outcomes. Its actual impact on performance depends largely on how intensively the system is used, how well it is integrated with complementary digital tools (such as warehouse management systems, transportation platforms, or CRM solutions), and how effectively the organization supports users through training and change management. These factors collectively shape the success or failure of digital transformation efforts in supply chain management (SCM).

Despite the growing prevalence of ERP systems in industry, the specific impact of SAP B1 on pharmaceutical SCM remains insufficiently explored. Notably, Fosso Wamba et al. (2022) emphasize the role of digitalization in enhancing supply chain resilience but do not explicitly address SAP B1's sector-specific contributions.[1] Similarly, Queiroz et al. (2023) investigate blockchain applications for pharmaceutical traceability, yet do not consider the potential of ERP systems tailored to SMEs[2]. This study seeks to address this gap by examining the potential of SAP B1 to optimize pharmaceutical supply chain operations, particularly in the domains of regulatory compliance and real-time data accuracy, using Pharma Invest, an intermediary pharmaceutical distributor with a 4.1% market share in Algeria, as a case study.

Our research explores the digital transformation journey of Pharma Invest, focusing on the usage of SAP Business One and its interoperability with other digital tools. This case provides a relevant and practical foundation for understanding how ERP systems contribute to

[1] *Fosso Wamba, S., Queiroz, M. M., & Khan, S. A. R. (2022). Digital transformation and supply chain resilience: The moderating role of firm size. Journal of Business Logistics, 43(3), 315-336.*
[2] *Queiroz, M. M., Fosso Wamba, S., & Khan, S. A. R. (2023). Blockchain for pharmaceutical traceability: A systematic review. International Journal of Production Economics, 255, 108670.*

SCM optimization in pharmaceutical distribution, an area of increasing strategic importance in emerging markets like Algeria.

From an academic perspective, this topic aligns with the objectives of e-business education, which encompasses the integration of new information and communication technologies to improve business processes, customer relationships, and overall operational efficiency. Understanding the role of ERP systems like SAP B1 in this context is crucial for both theory and practice.

From a professional perspective, the insights gained during internship at Pharma Invest have highlighted both the challenges and opportunities that come with ERP implementation in pharmaceutical SCM. This hands-on experience, combined with academic knowledge, has inspired a deeper inquiry into the strategic role of digital tools in ensuring continuity, compliance, and competitiveness within pharmaceutical supply chains.

The main research problem can be summarized as follows:

"How does the use of SAP Business One influence the operational performance of the pharmaceutical supply chain?"

To address this research problem, the study will focus on the following sub-questions:

1. How does the advanced use of SAP modules impact data accuracy in pharmaceutical supply chain management?
2. What role does interoperability between SAP and complementary digital tools play in improving supply chain visibility and mitigating operational risks?
3. How does user training and organizational adoption affect the effectiveness of SAP in supply chain optimization?

By answering these questions, the research aims to provide actionable recommendations for addressing challenges, maximizing benefits, and enhancing the overall impact of SAP B1 on pharmaceutical supply chain.

The elements of response to the formulated problem will be provided by verifying the following hypotheses:

Hypothesis 1: Advanced use of SAP B1 improves data accuracy.

Hypothesis 2: Integration of SAP B1 with other tools enhances visibility and reduces supply chain risks.

Hypothesis 3: User training and adoption levels influence SAP B1's effectiveness and process efficiency.

The research will follow a descriptive and analytical method to investigate the research problem, focusing on quantitative approaches to gather relevant data. Data will be collected through a structured questionnaire and key performance indicators (KPIs) to effectively collect and analyze information

This research employs a descriptive and analytical methodology, predominantly quantitative in nature. Data collection will be conducted through structured questionnaires and the analysis of Key Performance Indicators (KPIs) at Pharma Invest, facilitating an objective evaluation of SAP B1's impact on pharmaceutical SCM performance.

In line with this logic, we will address these questions by subdividing our research work into two chapters

Chapter one provides the theoretical foundation for the digital transformation of the pharmaceutical supply chain. It begins by defining Supply Chain Management (SCM), its principles, objectives, and importance in the pharmaceutical sector. Next, it examines the emergence of digital transformation, outlining its drivers, challenges, and expected benefits. The chapter then focuses on SAP Business One, describing its functionalities, integration features, and role in improving traceability, performance, and resilience.

Chapter Two focuses on the practical application of the study through a case analysis of Pharma Invest, a pharmaceutical distribution company. It provides an overview of the company and examines the impact of SAP Business One on its supply chain operations. The chapter analyzes relevant data to assess the system's effectiveness and concludes with recommendations to enhance digital tool utilization and supply chain performance.

The study concludes by synthesizing findings, discussing theoretical and practical implications, offering evidence-based recommendations for digital transformation initiatives, and suggesting avenues for future research on ERP integration and user engagement in SCM.

CHAPTER I:

Theoretical Foundations of Digital Transformation in the Pharmaceutical Supply Chain

Introduction

In the rapidly evolving pharmaceutical industry, where regulatory rigor, product sensitivity, and supply chain complexity intersect, digital transformation has emerged as a strategic imperative. This chapter establishes the theoretical groundwork for understanding how digital technologies particularly Enterprise Resource Planning (ERP) systems like SAP Business One (SAP B1) can optimize supply chain management (SCM) in this high-stakes sector.

The chapter begins by dissecting the fundamental concepts of SCM (Section 1), defining its core components, objectives, and key flows (information, materials, finances). It then explores the evolving nature of supply chains, setting the stage for the unique challenges faced by pharmaceutical logistics.

Section 2 shifts focus to digital transformation in the pharmaceutical sector, highlighting its definition, key technologies (e.g., IoT, blockchain), and the transformative role of digital tools in addressing industry-specific challenges. A critical analysis of the benefits and barriers of digital adoption underscores the sector's tension between innovation and compliance, while the emerging paradigm of Pharma 4.0 illustrates the future of smart, connected supply chains.

The final section focuses on ERP systems, with a particular emphasis on SAP and its strategic role in supply chain optimization. It presents SAP Business One as a solution tailored to the needs of small and medium-sized pharmaceutical enterprises, followed by a comparative analysis of ERP platforms, deployment models, and integration with broader e-business strategies. The discussion also addresses key risks associated with ERP implementation and the role of performance indicators in evaluating logistics outcomes. Together, these theoretical insights form the foundation for the empirical investigation presented in the next chapter.

Section 1: Fundamental Concepts of Supply Chain Management (SCM)

Supply chain management (SCM) plays a crucial role in ensuring the efficient flow of goods, information, and finances across various stakeholders. In the pharmaceutical sector, SCM is particularly complex due to strict regulations, temperature-sensitive products, and global distribution networks. This section provides an overview of SCM, its key components, objectives, and the essential flows that drive its operations. Additionally, it highlights how supply chains have evolved in complexity over time.

1.1 Definition and key components of supply chain management

In this part we will discuss the Evolution, the different meanings of the supply chain management and its key components.

a) Evolution of Supply Chain Management:

The concept of supply chain management (SCM) has evolved significantly over time, adapting to the changing needs of industries and the global economy. From its origins in traditional logistics to the digital era of supply chains, it has undergone multiple transformative phases that have shaped its modern structure and functionality.

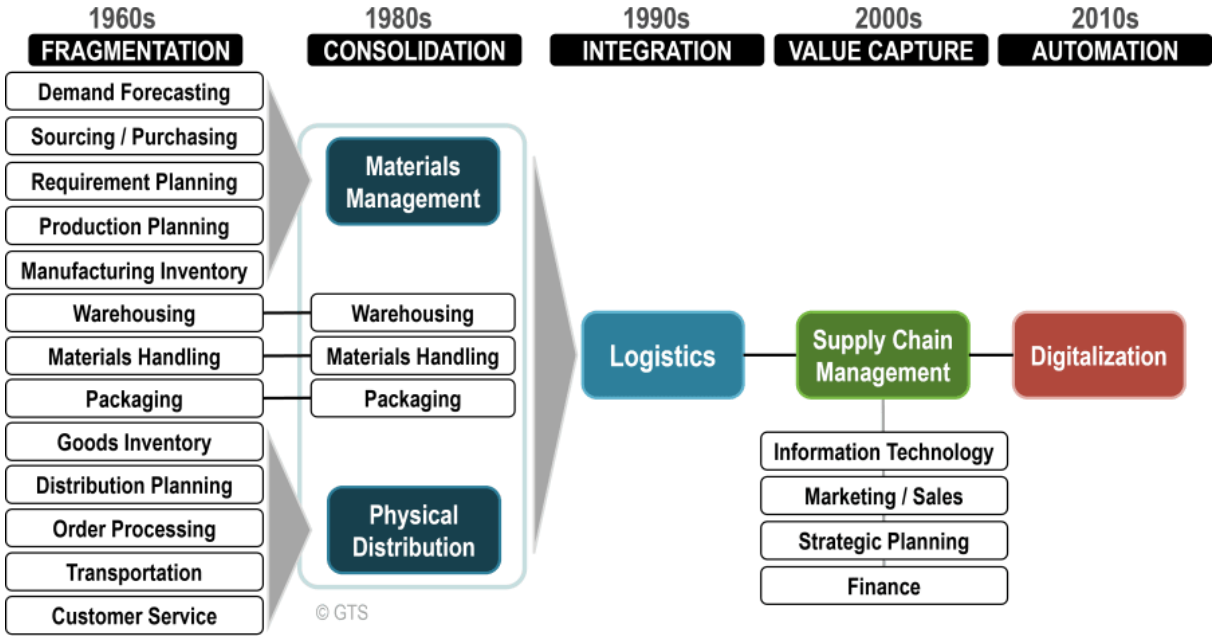
Initially, logistics focused on the movement, storage, and distribution of goods within an organization, emphasizing operational efficiency in activities such as inventory management, transportation, and warehousing. Over time, the concept of integrated logistics emerged, which aimed to coordinate these functions more effectively across the organization, reducing costs and improving efficiency.[1]

With the growing complexity of global markets, technological advancements, and the need for greater collaboration, supply chain management emerged as a broader concept. SCM integrates not only logistics but also procurement, production, customer service, and financial flows across all stakeholders, including suppliers, manufacturers, distributors, and customers. Unlike traditional logistics, SCM adopts a holistic approach that aligns internal operations with external partners to ensure the seamless flows of materials, information, and finances.

[1] *Lyonnet, B, Senkel, M.-P., &Clamens, S. (Juin 2019). Supply Chain Management, DUNOD,pp. 2–32.*

Today, modern supply chain management has embraced digital transformation, leveraging technologies such as artificial intelligence, blockchain, and the Internet of Things (IoT) to enhance visibility, transparency, and adaptability. Additionally, there is an increasing emphasis on sustainability and resilience to address global challenges, such as market disruptions and environmental concerns.[1]

Figure 1: The Evolution of Supply Chain Management



Source: Retrieved from [https://transportgeography.org/contents/chapter7/logistics-freight-%20distribution/evolution-supply-chain-management/], on 13/02/2025 at 16:00.

The figure (1) below illustrates this progression from logistics to integrated logistics and finally to supply chain management, highlighting how the scope and complexity of supply chains have expanded over time.

This transformation began in the 1960s when supply chain functions operated in isolation, leading to inefficiencies and limited coordination.

By the 1980s, companies started consolidating these functions, merging materials management and physical distribution to improve operational efficiency.

[1] *Transport Geography.(2021).the Evolution from Logistics to Supply Chain Management. Retrieved,from[The Evolution of Supply Chain Management | The Geography of Transport Systems] (Accessed on the 13 /02/2025 at 17:55)*

The 1990s marked a shift toward integration, where logistics emerged as a structured discipline aimed at optimizing the flow of goods and information

In the 2000s, supply chain management evolved beyond logistics, incorporating strategic elements such as information technology, marketing, sales, finance, and strategic planning, making it establishing it as a core driver of competitive advantage.

Finally, in the 2010s, digitalization transformed SCM through automation, real-time data analysis, and advanced decision-making, further enhancing efficiency and responsiveness. This evolution demonstrates how supply chains have grown in complexity, shifting from isolated processes to a fully integrated and technology-driven system.

b) Definition of supply chain management

To understand the supply chain management, we must first establish a clear definition of the term supply chain. The term logistics chain is sometimes used synonymously; however, there is a key distinction. The logistics chain focuses primarily on the physical movement of goods, while the supply chain encompasses not only logistics but also the accompanying monetary and information flows, extending much further in scope.[1]

In literature, various definitions exist, as the concept of the supply chain has evolved over time. The term has been primarily developed in the United States and has been heavily influenced by English-speaking scholars and practitioners.

A supply chain consists of all parties involved, directly or indirectly, in fulfilling a customer request. It includes not only the manufacturer and suppliers, but also transporters, warehouses, retailers, and even customers themselves. Within each organization, such as a manufacturer, the supply chain includes all functions involved in receiving and filling a customer request. These functions include, but are not limited to, new product development, marketing, operations, distribution, finance, and customer service.[2]

Grimshaw (2020) defines the supply chain as: "*The entire process of making and selling commercial goods, including every stage from the supply of materials and the*

[1] *Poluha, R.G., (2016). The Quintessence of Supply Chain Management. Springer, p12.*
[2] *Sunil Chopra,(2019) Supply Chain Management: Strategy, Planning, and Operation, 7th Edition, Global Edition, Kellogg School of Management, p. 15.*

manufacture of the goods through to their distribution and sale. Successfully dealing with supply chains is critical to any company hoping to compete".[1]

Similarly, Irina et al.(2015) state that "*Supply Chain is a complex logistic system where raw materials are transformed into products or services and delivered to end users. The supply chain is a system that includes suppliers, logistics service providers, manufacturers, distributors and retailers, and provides material, information and financial flow between them*".[2]

Meanwhile, supply chain management (SCM) is defined as:" *the oversight of the flow of goods and services, including all processes in transforming raw materials into final products. The primary goal of SCM is to establish efficient and cost-effective supply chains. It encompasses the control, shipping, and distribution of products, enabling companies to reduce operational costs, improve delivery speed, and optimize overall logistics*".[3]

Initially, the difference between the definitions can be distinguished by studying from which side the supply chain is approached, i.e. the customer or supplier perspective.

In the supplier-centric approach, the supply chain is a network of suppliers which manufactures goods. These goods are exchanged both mutually and with other parties. The goods come from the original supplier, and finally reach the target customers. In between, they often pass through middlemen and processing businesses.

In contrast, the customer-centric approach assumes that a supply chain consists of all stages that are, directly or indirectly, involved in and required in order to fulfill a customer request. The focus in this case lies specifically upon the transportation businesses, warehouses, retailers, and the actual customer.

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[1] *Grimshaw. (2020). What is supply chain? A definitive guide. Supply Chain Digital. Retrieved from (https://supplychaindigital.com/digital-supply-chain/what-supply-chain- definitive-guide) (Accessed on the 5 /02/2025 at 18:00).*

[2] *Kozlenkova,I.V.,Hult, G. T. M., Lund, D. J., Mena, J. A., & Kekec, P. (2015). The role of marketing channels in supply chain management. Journal of Retailing, 91(4), p 586-609.*

[3] *Sharma, J. (2023). Difference between supply chain management and logistics management. Shiksha. Retrieved from (https://www.shiksha.com/online-courses/articles/difference- between-supply-chain-management-and-logistics-management) (Accessed on the 5 /02/2025 at 18:45).*

The combination of these two approaches leads to a broader definition: "A supply chain is the coordination of organizations working together to provide the market with products and services efficiently**".**[1]

c) Key components of supply chain management

- ✓ **Planning:**

Effective planning is critical for optimizing supply chain efficiency. Proper planning ensures inventory and operational resource leveling, helping organizations manage supply through source planning and control demand via demand planning. This not only improves cash flow management but also enhances the ability to meet customer needs. Additionally, planning generates valuable data, allowing companies to consolidate shipments for better economies of scale and leverage predictive analytics for more accurate future projection.[2]

- ✓ **Sourcing:**

Selecting the right suppliers is a crucial aspect of supply chain management. Once suppliers are chosen, supply chain managers must monitor and maintain relationships, overseeing tasks such as ordering, receiving goods, managing inventory, and approving payments. Effective sourcing strategies ensure a steady flow of materials while maintaining cost efficiency and quality standards.[3]

- ✓ **Manufacturing (Making):**

The manufacturing process can involve actual raw material into finished goods or performing activities such as repackaging, re-kitting, bundling, assembly, dressing, or staging. Optimizing manufacturing helps reduce variability, enhance predictability, and ensure compliance with customer requirements. Even in highly automated environments, continuous improvement remains essential to boost efficiency and minimize defects.

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[1] *Poluha, R.G., 2016. The Quintessence of Supply Chain Management. Springer, p14-15*

[2] *Globalior. (n.d.). The 5 basic components of supply chain management. Globalior. Retrieved from (https://www.globalior.com/the-5-basic-components-of-supply-chain- management/) (Accessed on the 5 /02/2025 at 10:12).*

[3] *C&D Logistics. (n.d.). The 5 components of supply chain management. C&D Logistics. Retrieved from(https://www.cdlogistics.ca/freight-news/the-5-components-of-supply-chain-management/) (Accessed on the 12/02/2025 at 10:10).*

- ✓ **Delivering**:

A reliable and resilient distribution network is essential for handling fluctuations in demand. Businesses must develop strategies to mitigate common logistics challenges such as port congestion, adverse weather, or transportation delays. While many organizations prioritize sales over supply chain investment, maintaining efficient delivery operations is equally critical to meeting business needs and ensuring customer satisfaction.

- ✓ **Returning:**

Returns are an inevitable part of supply chain operations. Customers may return products due to damage during shipment, quality issues, defects, incorrect orders, or expiration concerns. An efficient return management system is essential for maintaining customer trust and satisfaction. Additionally, businesses should align their return policies with refund processes to enhance the overall customer experience.[1]

1.2 Objectives of Supply Chain Management:

The objectives of supply chain management (SCM) are essential for optimizing operations, reducing costs and achieving strategic business goals.

First, efficiency and cost reduction are primary objectives, focusing on streamlining processes, reducing unnecessary expenses, and leveraging technology and automation to maximize profitability. Companies like Intel and Amazon exemplify this by using advanced technologies to lower costs and improve performance.

Another critical objective is maintaining strong customer relationships by ensuring timely deliveries, high-quality standards, and seamless experiences, which foster customer loyalty and brand recognition, as seen in companies like Nike and Adidas.

Improving product and service quality is equally important, as it enhances brand reputation, builds customer trust, and enables businesses to stay competitive. Companies like Lenovo and Nestlé continually refine their supply chain processes to meet these quality standards.

[1] *Ibid*

Effective inventory management aims to balance sufficient stock levels while avoiding overstocking to minimize costs and disruptions. Additionally, optimizing distribution processes is crucial for delivering products reliably and efficiently, improving customer satisfaction, reducing costs, and expanding market reach.

Risk management plays a vital role in SCM by identifying, assessing, and mitigating risks to ensure smooth operations and maintain brand value. Flexibility and demand fulfillment are also significant, enabling supply chains to adapt to changing customer needs and market trends while delivering products efficiently.

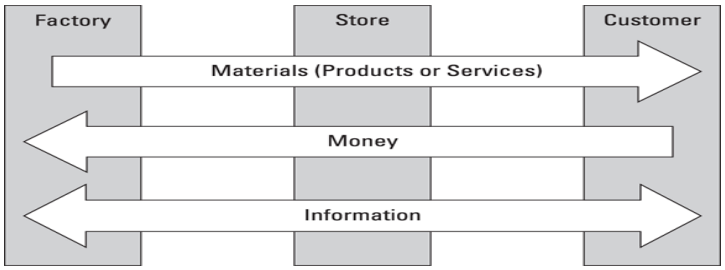
Finally, embracing advanced technology allows businesses to improve decision-making, reduce errors, and enhance overall efficiency, thus maintaining their competitiveness in the evolving market.

By aligning these objectives, businesses can build a well-coordinated, resilient, and efficient supply chain, thus ensuring sustainable growth and maintaining competitive positioning in a dynamic and competitive environment.[1]

1.3 Key Flow in Supply Chain Management (Information, Materials and Finances):

In supply chain management, three essential flows ensure the smooth movement and coordination of resources: information flow, material flow, and financial flow. These flows are critical for maintaining efficiency, enabling seamless communication, ensuring timely delivery, and facilitating financial transactions across the supply chain. Figure 2 illustrates the interconnection among these flows.

Figure 2: Three flow of supply Chain



Source: Stanton,D.(2023)Supply Chain Management for Dummies.3rdedn.Hoboken,NJ: John Wiley &Sons, p. 51.

[1] *Sharma, J. (2023, September 30). 8 Most Crucial Objectives of Supply Chain Management. Shiksha, p8.*

These flows are fundamental to the efficient functioning of supply chain management, ensuring seamless coordination between suppliers, manufacturers, and customers.[1]

In the following section, we will examine each of these flows in more detail to understand their distinct roles in ensuring effective supply chain management:

- ✓ ***Information Flow:***

Information sharing is a key aspect that demonstrates collaboration in supply chain management, as stated by Li, Yan, Wang and Xia.[2] As Simatupang and Sridharan describes , information sharing is "the ability to see private data in a partner's systems and monitor the progress of products as they pass through each process in the supply chain. This activity includes monitoring (data capturing), processing, and dissemination of customer data, end-toend inventory status and locations, order status, costs-related data, and performance status".[3]

As per these authors, sharing information ensures that partners in the supply chain can meet demand more quickly. The flow of information within supply chain management occurs when partners share information, allowing for effective decision-making. "Information flow is the flow of information from supplier to customer and from customer back to supplier. This flow is bi-directional, that is, it goes both direction in the supply chain".[4]

- ✓ ***Material Flow:***

According to Karsten Weiß the material flow**:"** describes the path taken by materials or products from procurement to sales within or between companies. It includes all processes and stations through which the material or product passes, such as production, storage, picking and distribution".

Beyond the operational definition provided by Weiß, several researchers have emphasized the strategic significance of effective material flow management, as demonstrated by Suhaiza Zailani " Many supply chain management practitioners acknowledge the

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[1] *Lisa Anderson, "Flow In Supply Chain," EdrawMax, published on February 26, 2021. Available at (https://www.edrawmax.com/templates/1002556/) (Accessed on the 12 /02/2025 at 13:20)*

[2] *Li, G., Yan, H., Wang, S., & Xia, Y. (2005). Comparative analysis on value of information sharing in supply chains. Supply Chain Management: An International Journal, 10(1), 34–46*

[3] *Simatupang, T.M. and Sridharan, R. (2002). Supply chain discontent: sources and remedies. Supply Chain Management: An International Journal. 7(3), p354-364.*

[4] *Stanton, D. (2023) Supply Chain Management For Dummies. 3rd edn. Hoboken, NJ: John Wiley & Sons.pp51-53.*

significance of effectively managing material flows throughout the supply chain as a crucial strategic success factor. According to the paper by Chin, Rao Tummala, Leung and Tang, They have identified the control of seamless material flow as the focal point of optimal SCM design and practices, suggesting that supply chain performance can be enhanced through the re-engineering of material flows."[1]

- ✓ ***Financial Flow:***

Financial flow involves the movement of money from the customer to the supplier. When the customer receives the product and verifies it, the customer pays and the money travels back to the supplier. Sometimes the finances flow in the other direction (from supplier to customer) in form of debit.[2]

After reviewing various definitions in the literature, it became clear that creating a simplified definition would help clarify the concept. Therefore, we have formulated the following definition: Material flow refers to the movement of items within a company, from production to sales. This process includes manufacturing, storing, receiving, and distributing them. Material flow management is focused on optimizing the movement of goods to ensure efficient production, minimize waste, reduce costs, and meet customer demands. It includes both the physical movement of materials and the related information flow, such as tracking inventory levels, managing orders, and coordinating shipment.

[1] *Suhaiza Zailani (January 2012). Effects of Information, Material and Financial Flows on Supply Chain Performance: A Study of Manufacturing Companies in Malaysia. International Journal of Management Vol. 29 No. 1 Part 2 Mar 2012, pp.295.*
[2] *Ibid.*

Section 2: Digital Transformation in the Pharmaceutical Sector

In recent years, the pharmaceutical supply chain has faced increasing complexity due to regulatory requirements, global disruptions, and the growing demand for efficiency. To address these challenges, digital transformation has emerged as a key driver of innovation, integrating advanced technologies to enhance visibility, automation, and decision-making. This section explores the fundamentals of digital transformation, its impact on pharmaceutical supply chain management, and the role of cutting-edge technologies in optimizing operations. Additionally, we examine the benefits, challenges, and the revolutionary concept of Pharma 4.0, which represents the next phase of digital evolution in the industry.

2.1 Overview of pharmaceutical Supply Chains

Pharmaceutical supply chains differ fundamentally from conventional logistics. Their definition and unique characteristics are examined below to explain both their complexity and sector-specific challenges.

2.1.1 Definition and Unique Characteristics:

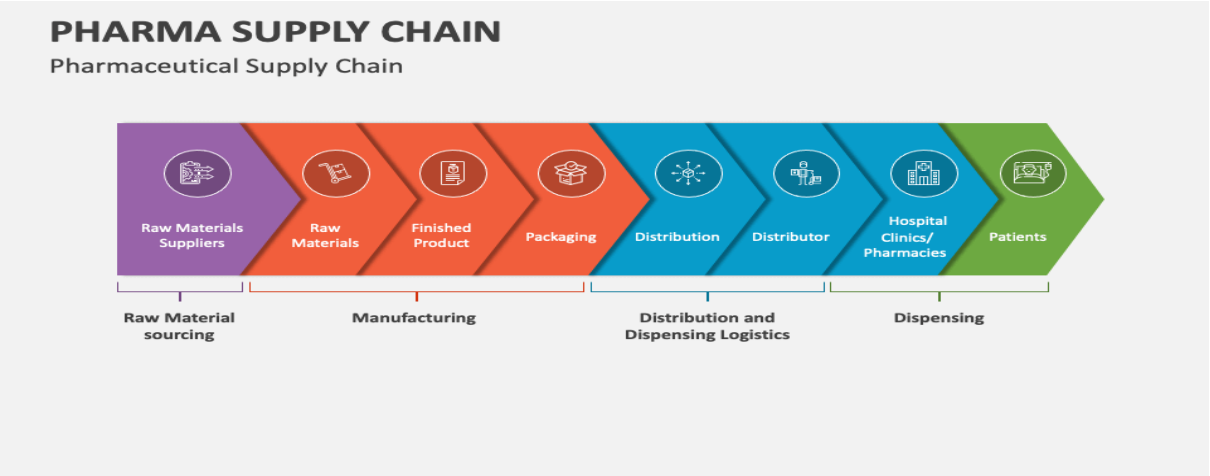
The pharmaceutical industry is one of the most complex and dynamic sectors of the global economy, with high demands for quality, safety, and efficiency. The pharmaceutical supply chain, which encompasses the entire process of delivering medications from raw materials to patients, is a critical component of the industry's success.[1]

Therefore; the pharmaceutical supply chain refers to: the overall network of processes, stakeholders, as well as technologies involved in the production, distribution, and also delivery of pharmaceutical products from manufacturers to end consumers (patients). It thoroughly ensures that medicines as well as healthcare products are produced, properly stored, safely transported, and effectively dispensed. In addition to that, this is done efficiently whilst still maintaining quality, safety, and complete regulatory compliance.

The figure 3 illustrates both the stages of the pharmaceutical supply chain process, from the procurement of raw materials to the commercialization and distribution of the finished product to wholesalers.

[1] *FasterCapital. (2024, June 1). Gestion de la chaîne d'approvisionnement pharmaceutique : Créer une entreprise prospère dans la gestion de la chaîne d'approvisionnement pharmaceutique. Retrieved from (*Gestion de la chaine d approvisionnement pharmaceutique creer une entreprise prospere dans la gestion de la chaine d approvisionnement pharmaceutique - FasterCapital*) [Accessed on the 14/02/2025 at 18:52].*

Figure 3 Pharma Supply chain processes:



Source: Retrieved from (https://www.collidu.com/presentation-pharma-supply-chain) on 27/03/2025 at 14:22

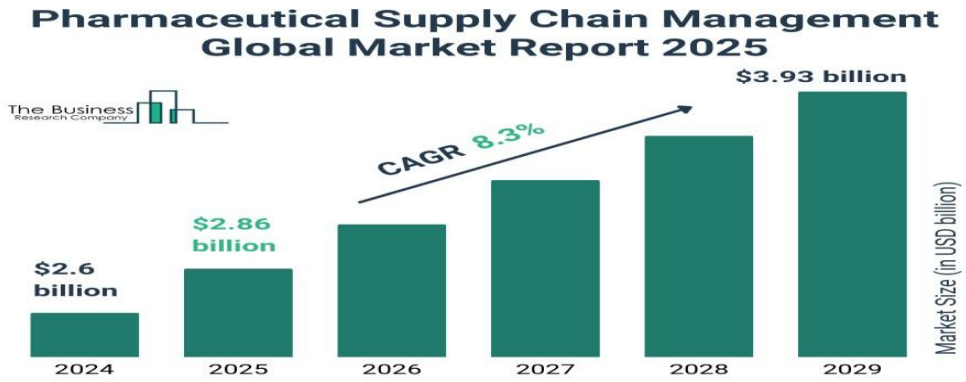
The pharmaceutical supply chain management market size has grown strongly in recent years. It will grow from $2.6 billion in 2024 to $2.86 billion in 2025 at a compound annual growth rate (CAGR) of 9.9%. The growth in the historic period can be attributed to regulatory compliance, globalization, risk management, demand for personalized medicine, sustainability.[1] The figure(4) below shows this expecting growth from 2024 to 2029 according to the market size.

The pharmaceutical supply chain management market size is expected to see strong growth in the next few years. It will grow to $3.93 billion in 2029 at a compound annual growth rate (CAGR) of 8.3%. The growth in the forecast period can be attributed to precision medicine, resilience planning, data security, E-commerce integration, real-time monitoring and visibility, circular economy initiatives. Major trends in the forecast period include digital transformation, technological advancements, collaboration and visibility, environmental sustainability, advanced analytics and AI integration, blockchain technology adoption.[2]

[1] *The Business Research Company (2025) Pharmaceutical supply chain management global market report 2025 by component (solution, service), by deployment mode (on-premise, cloud-based), by end-use (healthcare manufacturers, healthcare providers, distributors, logistics) – market size, trends, and global forecast 2025-2034. Retrieved from: [Pharmaceutical Supply Chain Management Market Report 2025, Statistics] (Accessed: [27/03/2025] at 14:22).*

[2] *Ibid*

Figure 4: Pharmaceutical Supply Chain Mangement Global Market Report 2025



Source: the business research company, 2025 Report.

2.1.2 Challenges in Pharmaceutical Supply Chains:

Managing the pharmaceutical supply chain is a highly complex undertaking as it involves numerous challenges and risks, such as:

- ✓ **Regulatory compliance**: The pharmaceutical supply chain must adhere to strict regulations and standards set by various authorities, such as the Food and Drug Administration (FDA), the European Medicines Agency (EMA), and the World Health Organization (WHO). These regulations aim to ensure the quality, safety, and efficacy of medications while preventing counterfeit, substandard, or expired products from entering the market. However, complying with these regulations can be costly and time-consuming and may vary across regions and countries.

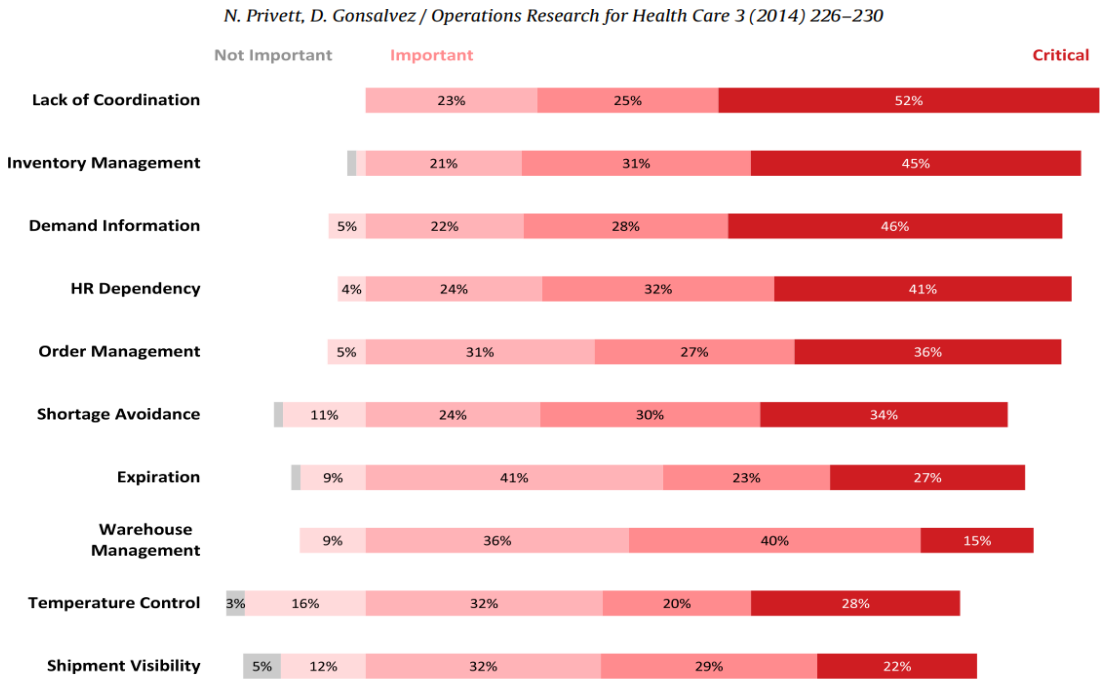
- ✓ **Demand and supply variability**: The pharmaceutical supply chain must deal with fluctuations in the demand and supply of medications, which can be influenced by factors such as outbreaks, epidemics, pandemics, natural disasters, political instability, consumer preferences, and innovation. These factors can create uncertainty and complexity within the supply chain, necessitating effective forecasting, planning, and inventory management to balance supply and demand [1].

[1] *FasterCapital. (2024, June 1). Gestion de la chaîne d'approvisionnement pharmaceutique : Créer une entreprise prospère dans la gestion de la chaîne d'approvisionnement pharmaceutique. Retrieved from (https://fastercapital.com/fr/contenu/Gestion-de-la-chaine-d-approvisionnement-pharmaceutique---creer-une-entreprise-prospere-dans-la-gestion-de-la-chaine-d-approvisionnement-pharmaceutique.html#Qu-est-ce-que-la-gestion-de-la-cha-ne-d-approvisionnement-pharmaceutique-et-pourquoi-est-elle-importante--) [Accessed on 14/02/2025 at 18:52].*

- ✓ **Product characteristics**: The pharmaceutical supply chain must address the unique characteristics of medications, such as their short shelf life, temperature sensitivity, fragility, and high value. These characteristics require special handling, storage, transportation, and distribution methods to preserve the quality and integrity of medications and to prevent waste, deterioration, or theft. Furthermore, some medications, such as narcotics, psychotropics, or vaccines, may require additional security measures or documentation to prevent misuse, diversion, or illegal trade.

- ✓ **Stakeholder coordination**: The pharmaceutical supply chain involves multiple stakeholders, such as manufacturers, suppliers, distributors, wholesalers, retailers, hospitals, pharmacies, doctors, nurses, and patients. These stakeholders have different roles, responsibilities, objectives, and interests and may operate in different locations, cultures, and systems. Therefore, coordination and collaboration among these stakeholders are essential to ensure the smooth and efficient flow of information, materials, and funds throughout the supply chain and to guarantee customer satisfaction and loyalty.

Figure 5: Top 10 global health pharmaceutical supply chain issues ratings



Source: Privett, N. and Gonsalvez, D. (2014) 'The top ten global health supply chain issues: Perspectives from the field', Operations Research for Health Care, 3(4), p 2. 186-190. Available at *(https://doi.org/10.1016/j.orhc.2014.09.002)*.

By conducting numerous interviews and surveys with professionals in the global health supply chain, researchers from Operation Research for Health have outlined the 10 most significant challenges faced by the pharmaceutical supply chain illustrate in (figure6).

These challenges were categorized based on their perceived level of importance by surveyed professionals, with three classifications: "Not Important," "Important," and "Critical."

- ✓ Lack of Coordination (52% critical): Inefficient collaboration among stakeholders disrupts supply chain efficiency, leading to delays and resource mismanagement.
- ✓ Inventory Management (45% critical): Poor tracking and over/under-stocking result in wasted resources or unmet demand.
- ✓ Demand Information (46% critical): Inaccurate or delayed demand data hampers planning, causing inefficiencies in resource allocation.
- ✓ HR Dependency (41% critical): Over-reliance on manual processes due to inadequate staffing or training introduces errors and delays.
- ✓ Order Management (36% critical): Inefficiencies in processing orders lead to delays, errors, and increased operational costs.
- ✓ Shortage Avoidance (34% critical): Failure to prevent stockouts disrupts service delivery and compromises patient care.
- ✓ Expiration (27% critical): Poor shelf-life management results in wasted perishable goods and financial losses.
- ✓ Warehouse Management (15% critical): Suboptimalstorage practices reduce efficiency and increase handling costs.
- ✓ Temperature Control (28% critical): Inconsistent climate control risks damaging sensitive products, affecting quality and safety.
- ✓ Shipment Visibility (22% critical): Lack of real-time tracking complicates logistics, delaying deliveries and accountability.

These challenges demonstrate interconnected vulnerabilities, where structural issues (e.g., coordination) exacerbate operational risks (e.g., shortages). Addressing them requires

integrated solutions [digital tools (e.g., AI forecasting), process automation, and multi-stakeholder alignment] to enhance resilience.

2.2 Digital Transformation in the Pharmaceutical Sector

This subsection formally defines digital transformation within pharmaceutical ecosystems, delineating its conceptual scope to frame subsequent analysis of technological integration in the sector.

2.2.1 Definition of Digital Transformation

Digital transformation (DT) refers to the changes in organizations caused by digital technologies, which transform the organization by integrating digital technologies and business processes. Nowadays, DT is considered to be the driver of change in the business environment. From a dynamic capability perspective, DT fundamentally improves business performance by aligning strategic direction, marketing, consumer behavior, and supply chain management.[1]

According to PwC's 2024 Digital Trends in Operations Survey, conducted at a global level, many companies have invested in various technologies to digitize their operations. As of the latest annual survey, cloud technologies (62%) and artificial intelligence—including machine learning (55%)—are the top areas of investment. In contrast, enhancements to ERP systems (27%) and the development of data ecosystems (33%) receive relatively less attention. In terms of operational functions, quality control benefits most from these technologies, particularly through AI and tools for operational visibility and analytics. Meanwhile, service and maintenance functions show the lowest adoption rates, with planning, sourcing, manufacturing, and distribution receiving moderate levels of technological integration.[2]

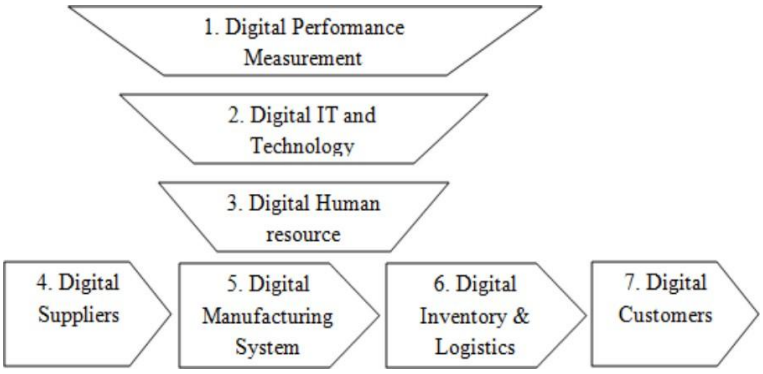
Hoberg et al(2015) explained that digital transformation is the process of organizational change in which digital technologies (such as cloud computing , 3D printing, internet of things, big data analysis)are used to change, how a company generates value in its products, how it interacts with its suppliers, partners and customers and how it competes in

[1] *Ma, J.-Y., Shi, L., & Kang, T.-W. (n.d.). The effect of digital transformation on the pharmaceutical sustainable supply chain performance: The mediating role of information sharing and traceability using structural equation modeling. Sustainability. P4.*

[2] *PwC's 2024 Digital Trends in Operations Survey: Why significant business outcomes are still difficult to achieve and what you can do. (2024). Retrieved from (https://www.pwc.com/us/en/services/consulting/business-transformation/digital-supply-chain-survey.html)), (Accessed:[14/02/2025 at 22:17]).*

global market. Hence digital supply chain management can be defined as powerful innovative technologies that are capable of changing the traditional way of doing various processes of supply chain like supply chain planning, task execution, interacting with all the participants of supply chain, achieving integration among the members of supply chain and enabling new business model. Digital transformation is a change and hence every initiative of organizational change should be managed with extreme care. Digital transformation cannot be achieved by the effort of single person rather it is a portfolio of initiatives that work together to achieve the change.[1]

Figure 6: Seven dimensions of digital supply chain management



Source: Adapted from Agrawal and Narain, 2018, p. 4.

Every supply chain consist of various activities that are executed to procure raw materials, convert that material into final products, store that as finished product inventory and at the end deliver them to the ultimate customers. They have divided SCM into seven dimensions which are suppliers, production, inventory and logistics, customers, information technology, human resources and performance measurement (see figure7).

[1] *Agrawal, P. and Narain, R. (2018) 'Digital supply chain management: An overview', IOP Conference Series: Materials Science and Engineering, 455, 012074. Available at: (https://doi.org/10.1088/1757-899X/455/1/012074),(Accessed: [14/02/2025 at 22:20]).*

2.2.2 Key Digital Technologies Transforming Pharmaceutical Supply Chain

Digital transformation of supply chains is marked by the adoption of a broad range of advanced technologies including artificial intelligence (AI), the Internet of Things (IoT), blockchain, cloud computing, immersive technologies, and big data analytics. These technologies are revolutionizing operational efficiency, visibility, and responsiveness—especially in complex, high-stakes sectors like pharmaceuticals.[1]

- **Cloud Computing :**

At the infrastructure level, cloud computing is one of the most established technologies. It enables businesses to store, manage, and process data using remote servers, offering flexibility, scalability, and cost savings on capital expenditure and maintenance. This is particularly beneficial for small and medium-sized enterprises (SMEs), allowing them to access sophisticated IT systems without large initial investments. In pharmaceutical supply chains, cloud-based systems help synchronize data across global networks, facilitating compliance, real-time inventory updates, and collaboration among stakeholders.

- **Internet of Things (IoT) & Pervasive Computing:**

The integration of smart devices and sensors into supply chain processes enhances real-time visibility, particularly in monitoring products during storage and transit. In pharmaceutical logistics, the IoT is crucial for cold chain management, allowing the monitoring of temperature, humidity, transit duration, and product location in real time. Technologies such as RFID (Radio Frequency Identification), often integrated with IoT, enable precise tracking of products, automated inventory management, and improved shelf replenishment accuracy.

- **Artificial Intelligence and Machine Learning:**

AI enables machines to simulate human reasoning and perform complex tasks such as demand forecasting, supplier selection, and predictive maintenance. In the pharmaceutical industry, AI helps analyze large datasets to anticipate demand, optimize production schedules,

[1] *Wang, Y., and Pettit, S. 2022. Falling Behind or Riding the Waves? Building Future Supply Chains with Emerging Technologies. In: Wang, Y., and Pettit, S. (eds.) Digital Supply Chain Transformation: Emerging Technologies for Sustainable Growth. Pp. 1–22. Cardiff: Cardiff University Press. DOI: https://doi.org/10.18573 /book8.a . Licence: CC-BY-NC-ND 4.0 . Page 24-31*

and adjust in real time based on disruptions (e.g., supply issues, market fluctuations). Machine learning algorithms can also automate decision-making by learning from historical trends and current inputs.[1]

- **Immersive Technologies (AR & VR)**:

Immersive technologies blur the boundary between the physical and the digital (or simulated) world to create a sense of immersion. Augmented Reality (AR) and Virtual Reality (VR) offer interactive training and real-time data visualization, its provides a stimulating, multimedia digital environment for people to experience, rather than just read, watch or listen. In pharmaceutical facilities, these technologies help professionals simulate and visualize logistics flows, enhance staff training, and optimize space and process efficiency.

- **Blockchain Technology:**

Blockchain technology offers secure, transparent, and tamper-proof recording of transactions throughout the supply chain. It is especially valuable in pharmaceuticals, where traceability and regulatory compliance are critical. By recording every transaction—from purchase orders to shipping and certification blockchain ensures product authenticity, reduces errors, and prevents counterfeit medicine from entering the supply chain.

These technologies collectively streamline supply chain processes, enhance decision-making, and improve resilience, helping companies adapt to evolving industry challenges.

2.2.3 The Role of Digital Technologies in Pharmaceutical SCM:

Digital technologies (DT) play a critical role in developing sustainable supply chain strategies.

Digital technologies are integrated in all parts of the organization to improve business processes, customer relationships and operational performance.

In the biopharmaceutical industry, for example, big data analytics capabilities shorten new drug development cycles, artificial intelligence streamlines the clinical trial process, robotics reduces production costs and blockchain technology enhances drug safety

[1] *Leem/Ministère du Travail, de l'Emploi et de l'Insertion / L'Observatoire Compétences Industrielles (2021) Actualisation du répertoire des entreprises du médicament sur les métiers de la supply chain. Rapport d'étude, Arthur Hunt Consulting HR for Human, pp. 21–22.*

monitoring. The use of digital transformation improves product lifecycle management and enhances the ability of companies to innovate openly. It is also driving a paradigm shift in the healthcare industry.[1]

Digital transformation is reshaping the traditional pharmaceutical supply model by increasing efficiency, reducing costs, and ultimately creating greater profit margins. This gives companies a competitive edge in the market.

Supply chains are constantly evolving and increasingly intertwined with the development of digital technologies. As observed by Gartner, a tremendous wave of automation and augmentation has sped through corporate supply chains in the last few years. With rapidly evolving customer demands and the emergence of new business models, organizations must strategically integrate these technological advancements and innovative frameworks to develop agile supply chain capabilities, ensuring sustained competitiveness in dynamic markets.[2]

2.3 Benefits and Challenges of Digital Transformation in the Pharmaceutical Supply chain

The digital transformation of the pharmaceutical sector brings major improvements in efficiency, traceability, and decision-making. However, it also presents challenges such as high costs and regulatory constraints. This section highlights the main benefits and limitations of these technological changes.

2.3.1. Benefits

The digitization of the supply chain allows pharmaceutical companies to meet growing customer expectations, manage supply-side complexities, and achieve higher levels of operational efficiency. The primary benefits include:[3]

- ✓ **Faster operations:** New approaches of product distribution reduce the delivery time of high runners to few hours. The basis for these services is built by advanced forecasting approaches, predictive analytics of internal (e.g., demand) and external

[1] *Ma, J.-Y., Shi, L., & Kang, T.-W. (n.d.). The effect of digital transformation on the pharmaceutical sustainable supply chain performance: The mediating role of information sharing and traceability using structural equation modeling. Sustainability, p. 4.*
[2] *Wang, Y., & Pettit, S. Opcit; pp. 1–22.*
[3] *Blos, M.Supply Chain 4.0 – The Next-Generation Digital Supply Chain. Supply Chain Management, June 2016, pp. 4-5.*

(e.g., market trends, weather, school vacation, construction indices) data as well as machine status data for spare-parts demand, and provides a much more precise forecast of customer demand.

- ✓ **Increased Flexibility:** Ad hoc and real-time planning allows a flexible reaction to changing demand or supply situations. Planning cycles and frozen periods are minimized and planning becomes a continuous process that is able to react dynamically to changing requirements or constraints (e.g., real-time production capacity feedback from machines). Once the products are sent, increased flexibility in the delivery processes allows customers to reroute shipments to the most convenient destination.

- ✓ **Granular Customization:** Growing demand for personalized products drives micro segmentation and mass customization. Companies now offer tailored "logistics menus," supported by innovative delivery methods (e.g., drones) for efficient last-mile solutions.

- ✓ **Enhanced Accuracy:** Next-generation performance management systems provide end-to-end transparency, from high-level KPIs (e.g., service levels) to granular data (e.g., real-time truck locations). A unified "supply chain cloud" integrates stakeholder data, ensuring aligned decision-making.

- ✓ **Improved Efficiency:** Automation of physical tasks (e.g., robotic warehousing, autonomous trucks) and planning processes boosts productivity. Cross-company transport optimization further maximizes resource utilization. For the pharmaceutical industry specifically, these advancements yield critical advantages:[1]

- ✓ **Quality & Safety:** Reducing errors, defects, and recalls while ensuring medication integrity.

- ✓ **Operational Efficiency:** Lowering costs, lead times, and excess inventory.

- ✓ **Adaptability:** Strengthening responsiveness to market uncertainties.

[1] *Faster Capital. (2024, June 1). Gestion de la chaîne d'approvisionnement pharmaceutique : Créer une entreprise prospère dans la gestion de la chaîne d'approvisionnement pharmaceutique. Retrieved from (https://fastercapital.com/fr/contenu/Gestion-de-la-chaine-d-approvisionnement-pharmaceutique---creer-une-entreprise-prospere-dans-la-gestion-de-la-chaine-d-approvisionnement-pharmaceutique.html#Qu-est-ce-que-la-gestion-de-la-cha-ne-d-approvisionnement-pharmaceutique-et-pourquoi-est-elle-importante--)) [Accessed on the 14nd, of February,2025 at 18:52].*

- ✓ **Competitiveness:** Fostering innovation, profitability, and sustainable advantages.
- ✓ **Patient Access:** Facilitating broader availability of medicines.

As a global pharmaceutical leader, Pfizer has leveraged digital technologies to transform its supply chain operations. The company implemented AI-driven demand forecasting, reducing excess inventory by 32% while improving product availability by 18%. [1]Blockchain-enabled tracking systems achieved 99.9% compliance with cold chain requirements, cutting vaccine wastage by 22%. IoT monitoring reduced temperature excursions by 40% during shipments. These innovations generated $500 million in annual cost savings and improved order fulfillment speed by 25%.[2]

Pfizer's digital transformation demonstrates how technology can enhance efficiency, reduce waste, and ensure reliable medicine delivery in the pharmaceutical industry.

2.3.2. Barriers

Healthcare supply chains, which offer essential services for daily living, are complex, worldwide, faces unique complexities due to its globalized nature, stringent regulatory requirements, and life-critical products. Despite the potential benefits of digital transformation, several significant barriers hinder its effective implementation.

- ✓ **Systemic Complexity and Lack of Transparency:** The pharmaceutical supply chain ecosystem comprises multiple interdependent stakeholders, including manufacturers, distributors, regulators, and healthcare providers operating across complex global networks. This structural fragmentation creates two critical challenges: First, information asymmetry emerges as disconnected IT systems hinder effective data sharing and supply chain visibility. Second, current centralized track-and-trace systems demonstrate limited capability for real-time monitoring, creating vulnerabilities that counterfeit drugs can exploit within the supply network.
- ✓ **Counterfeit Drugs and Patient Safety Risks:** Counterfeit medications—mislabeled, adulterated, or falsified products—infiltrate supply chains due to weak traceability

[1] *Neel, A. (2023, February 8). A study on digital transformation and its effectiveness at Pfizer organization. Retrieved from [A Study On Digital Transformation and Its Effectiveness at Pfizer Organization | PDF | Pharmaceutical Industry | Pfizer]*

[2] *M cKinsey & Company. (2023). Blockchain applications in pharmaceutical supply chains: Lessons from Pfizer's implementation. Retrieved from [https://www.mckinsey.com/industries/life-sciences]*

mechanisms. The WHO estimates that 10% of drugs in developing nations are counterfeit, causing approximately 200,000 deaths annually. Current serialization methods (e.g., barcodes) are easily replicated, while advanced solutions (e.g., blockchain-based provenance tracking) face adoption barriers.[1] Regulatory gaps, such as uneven serialization laws across markets, further enable counterfeit trade. This endangers patients and erodes trust in healthcare systems and brands.

- ✓ **Inefficiencies in Traditional Manufacturing and Supply Chains:** Legacy pharmaceutical production and distribution models are ill-suited for modern demands: Batch processing delays: Traditional manufacturing relies on slow, error-prone batch documentation, delaying time-to-market.Cold chain vulnerabilities: Temperature- sensitive products (e.g., vaccines, biologics) require real-time monitoring, yet many logistics networks lack IoT-enabled tracking.High production costs: Up to 30% of manufacturing expenses stem from inefficiencies, discouraging investment in digital upgrades .[2]

- ✓ **Technological and Organizational Barriers:** Three critical barriers impede digital transformation adoption in pharmaceutical supply chains: First, substantial capital expenditures are required, with ERP system implementations averaging $4.1 million for mid-sized enterprises. Second, significant workforce competency gaps exist, as 58% of employees lack training in emerging technologies like AI and blockchain.[3] Third, persistent cybersecurity concerns delay approximately 42% of cloud platform adoptions despite demonstrated scalability benefits. These interrelated challenges create a complex implementation landscape that requires strategic mitigation.[4]

- ✓ **Regulatory and Compliance Hurdles:** Pharmaceutical digital adoption faces dual regulatory challenges: Extended validation timelines (35-40% longer due to FDA/EMA requirements) and Data fragmentation from conflicting privacy laws

[1] *WHO. (2021). Substandard and falsified medical products; Retrieved from [https://www.who.int]*
[2] *McKinsey & Company. (2022). Pharma operations benchmark. Retrieved from [https://www.mckinsey.com]*
[3] *Deloitte. (2023). Global life sciences outlook. Retrieved from [https://www2.deloitte.com/global-life-sciences-outlook]*
[4] *IBM Security. (2023). Cloud security trends in healthcare and life sciences. https://www.ibm.com/security/cloud-report*

(GDPR, PIPL) that delay 60% of cloud implementations. These constraints increase compliance costs by 25-30% versus other sectors.[1]

In Algeria, additional challenges emerge; the National Pharmaceutical Products Agency (ANPP) imposes strict localization rules that extend validation processes by 50% compared to European benchmarks, while data sovereignty laws (Decree 18-07) restrict cloud-based solutions. These compounded barriers create particular difficulties for Algerian firms managing dual compliance (EU GDPR and local regulations), ultimately slowing digital adoption in the sector.[2]

[1] *Khan, M. I., Haq, M. A. U., Khan, M. R., Ghouri, A. M., & Farooqui, R. (2024). Industry 4.0 or Pharma 4.0? Assessing Suitability, Benefits, Challenges, and Opportunities for Healthcare Supply Chains. In Chapter 12, Convergence of Industry 4.0 and Pharma 4.0 in Healthcare Supply Chains. DOI: 10.4018/979-8-3693-1363-3.ch012. P 327.*

[2] *ANPP Circular No. 12/2023. Validation Requirements for Digital Tracking Systems.*

Section 3: ERP Systems in Supply Chain Management

This section explores the domain of Enterprise Resource Planning (ERP) systems, outlining their evolution, defining their core attributes, and exploring their functional domains. We then turn to Systems, Applications, and Products in Data Processing (SAP), a leading player in the ERP space, highlighting its corporate profile and the innovative solutions it offers, including SAP Business one. Through this exploration, we aim to lay the groundwork for understanding the role of ERP systems and SAP's contributions to business success and digital transformation.

3.1. ERP Systems

In this chapter, we will explore the basic concepts of ERP systems, trace their historical development, and examine their key features and functionalities

a) Evolution of ERP Systems

In the early stages of their development, in the 1960s and 1970s, ERP systems were mostly used in industry as extensions to Material Requirements Planning (MRP) systems. These early systems focused on managing material resources, inventory control, and production scheduling. They were often separate systems, running on mainframe computers or early minicomputers. While basic compared to modern ERPs, these systems paved the way for the integration of business processes and data management within ERP that would become key to ERP functions in later stages of development. In 1960, software applications were created especially to meet the requirements of the production function[1].

The main goal of the software during this time was to automate the management of the manufacturing unit by establishing the output plan and material needs to supply the production lines with important resources. This technique is known as MRP (Manufacturing Resource Planning) or production resource planning, focusing exclusively on managing a company's operational center.

[1] *Hoffman, S. (2024) The History and Evolution of ERP Systems: The Past and Future, Softewear connect. Available at: (https://softwareconnect.com/learn/erp-history/) (Accessed: 15 /02/ 2025).*

In 1980, the MRP II system emerged, which is a software for production management with enhanced functionality and precision, enabling optimal management of the company's materials and resources.[1]

The main limitation of this MRP and MRP2 computer program is that it only operates in the manufacturing unit and not overall, it is restricted to the estimation and automating operational processes through computerized solutions known as GPAO systems (Computer-Assisted Production Management) optimizes production operations by managing the purchase of essential raw materials and maintaining the smooth functioning of the manufacturing process. However, the MRP and MRP2 techniques have been applied in these systems

During the 1990s, ERP evolved from MRP and MRP2 systems, expanding on previous

Figure 7: ERP evolution

Source: Mohammad A. Rashid, Liaquat Hossain, Jon David Patrick (2002), The Evolution of ERP Systems A Historical Perspective, Idea Group Publishing, USA.P5

software programs.[2]

Since the 2000s, the Internet has played a significant role in enhancing the adoption of ERPs in organizations by facilitating communication, and management of supplier/client interactions by integrating external players involved in value creation, such as partners and remote suppliers, without the requirement for physical presence. As shown in Figure(8), ERP systems have significantly evolved over the decades, reflecting the advancements in technology and the growing needs of businesses.

[1] *VINCENT CRITON, Le MRP et ses évolutions.,[https://logistique-pour-tous.fr/] le MRP et ses evolutions/,Retrieved 29 February 2025 at 02 :44 PM.*

[2] *Mohammad A. Rashid, Liaquat Hossain, Jon David Patrick (2002), The Evolution of ERP Systems: A Historical Perspective, Idea Group Publishing, USA. P.5*

b) The definition of an ERP System

Despite the multiple definitions that can be retrieved from literature, many people still struggle to comprehend what ERP is. ERP can be defined as "*A packed business software system that allows a company to automate and integrate most of its business activities, share common data and processes throughout the company and produce and access information in a real-time environment*".[1]

The ultimate purpose of an ERP system is that information must only be entered once. Clearly, ERP systems go beyond conventional software solutions by serving as strategic platforms for enterprise-wide integration[2].

ERP is the technological foundation of electronic business (e-business) in the back office. It was common during the 1990s to find the computing software for the finance department was different from that utilized by the human resources or stores departments. According to Kalakota and Robinson, ERP "Overcomes the integration challenges posed by disconnected, uncoordinated back-office applications that have often outlived their usefulness".[3]

ERP is computer software which can be considered as a produced item for mapping all processes and data into an integrated package that provides solutions for organizations from a single information and IT structure[4].This package is often tailored to the specific requirement of the firm. Although many may connect this customisation with negativity, it is only the distinctive design and configuration that ERP acquires which separate this software from other packages in the market[5]; and it is an exceptional tool for reducing inventory cost, improving efficiency, increasing profitability, and most importantly ERP- systems are found to be a key factor for improving customer satisfaction.[6]

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[1] *Marnewick Carl, Labuschagne Les. (2005). A conceptual model for enterprise resource planning (ERP). Information Management & Computer Security, vol. 13, no.2, P. 145-146.DOI :10.1108/09685220510589325*
[2] *idem*
[3] *Kalakota Ravi, Robinson Marcia, (1999) E-Business: roadmap for success, Addison-Wesley, Reading, Mass. Harlow. P. 167*
[4] *Klaus Helmut, Rosemann Michael, Gable Guy G. (2000). What is ERP? Home Information Systems Frontiers, vol. 2, no. 1, P. 2.*
[5] *Idem, P.3.*
[6] *Muscatello, John R., Small, Mark H., & Chen, I. J. (2003). Implementing enterprise resource planning (ERP) systems in small and midsize manufacturing firms. International Journal of Operations & Production Management, vol. 23, no. 7, P.4.*

To better understand ERP as part of a broader information system, REIX Robert defines "An information system is an organized set of resources hardware, software, personnel, data, procedures, etc., enabling the acquisition, processing and storage of information (in the form of data; text, images, sound, etc.), within and between organizations".[1]

c) Functional domains of ERP Systems

The interest of the ERP lies in the possibility of offering modular management corresponding to the different functions that cover most of the company's needs. These functions represent the core modules typically found in modern ERP systems, each serving a distinct aspect of organizational operations.

- The finance and accounting function takes care of all financial flows and accounting records.
- Sales management on ERP includes order and sales management and after-sales service.
- Production management integrates planning, quality management and maintenance of industrial sites.
- For its part, human resources management includes pay management, the personnel management, and the follow-up of training.
- Procurement management and logistics covers supply management, inventory management and warehouses.

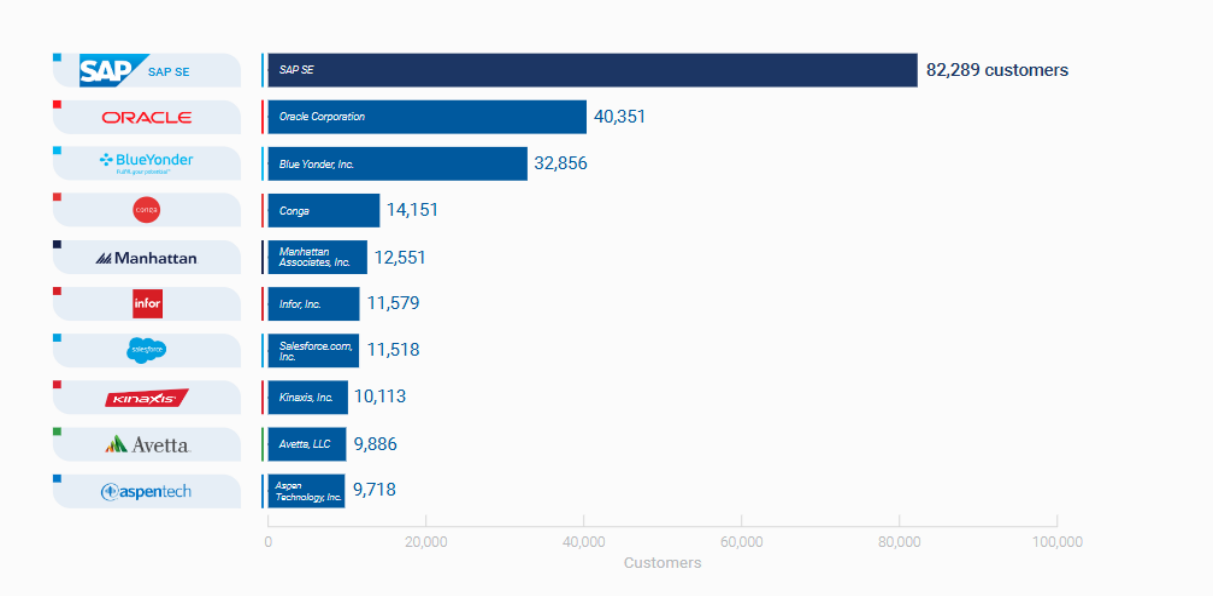
These functions are interconnected through the ERP system, facilitating streamlined operations and information flow across different departments within an organization.

In addition to these functions, the ERP has modular interfaces that enable the automation of the flow of information between actors such as email systems and workflow applications, which significantly promotes group work and user interaction.

[1] *REIX Robert, (2005). Système d'information et management des organisations. Editions Vuibert, 5e edition. Paris: p.3.*

To better understand the current market landscape, it is essential to examine the leading ERP software vendors in the supply chain field.

Figure 8: Leading Supply Chain Management Applications Vendors



Source: ERP Market Report: Spend, Trends, &Opportunities in 2024, HG insights, retrieved from [https://hginsights.com/market-reports/erp-market-report]on 7/05/2025 at 11:00

Buyers are projected to spend $12.4 billion on Supply Chain Management applications over the next 12 months. When looking purely at customer base size, SAP is the clear leader, with over 2x the customer count of the next leading provider Oracle. Although these are the top ten providers by customer count in this subcategory, there are plenty of other exciting vendors to keep eye on.[1]

3.2. ERP deployment Architectures: Implication for pharmaceutical supply chain

ERP systems can be implemented using a variety of models, each with unique benefits based on the requirements of the company, the availability of resources, and strategic priorities. As digital transformation accelerates across industries, particularly in pharmaceutical supply chains where traceability, regulatory compliance, and resilience are

[1] *ERP Market Report: Spend, Trends, &Opportunities in 2024, HG insights, retrieved from [https://hginsights.com/market-reports/erp-market-report]*

critical. Understanding these deployment options becomes essential for aligning ERP systems with business objectives.[1]

3.2.1 On-Premise ERP:

The traditional model of ERP deployment is the on-premise approach, where the software is installed and managed locally on the organization's own servers. This option grants greater control over system configuration and data security but requires significant capital investment in infrastructure, licensing, and dedicated IT personnel for maintenance and support.

While this model has declined in popularity, it remains relevant in industries with strict regulatory requirements or where full control over data and infrastructure is a necessity. However, it often lacks the agility and cost-efficiency offered by cloud-based alternatives[2]

3.2.2 Cloud ERP (SaaS):

Cloud ERP, also known as Software as a Service (SaaS), is a deployment model where the ERP system is hosted by the vendor and accessed via the Internet. It operates on a subscription basis and eliminates the need for in-house infrastructure.

Key benefits include rapid implementation, automatic updates, flexible scalability, and access to advanced features such as AI and real-time analytics. SaaS ERP is particularly suited for organizations seeking agility and digital innovation.[3]

3.2.3 Hybrid ERP:

Hybrid ERP combines elements of both cloud and on-premise deployments. Organizations may choose to run certain modules or applications in the cloud while retaining others on-site. This model provides flexibility and enables a gradual transition toward full cloud adoption.

Hybrid deployment is particularly advantageous in complex organizational environments where regulatory constraints or legacy systems necessitate partial on-premise

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[1] *Pang, C., Gaughan, D., & Joshi, A. (2024, June 21). Market share analysis: ERP software, worldwide, 2023 (Report No. G00854983). Gartner*.

[2] *SAP. (2024, October 1). Best practice how-to guide: Planning your ERP deployment. Retrieved from [Planning your ERP deployment | SAP] 7/05/2025 at 11:58*

[3] *Gartner. (2024). Market Guide for Cloud ERP. Retrieved from [https://www.gartner.com]*

operation. However, it requires strong coordination between IT teams to manage integration, data synchronization, and system updates across platforms.

3.3. ERP SAP

In the fields of Enterprise Resource Planning (ERP), SAP stands out as a recognized leader, offering comprehensive solutions indicated to optimize company operations and increase organizational efficiency. This section goes into the essence of SAP as a corporation, its most prominent ERP solutions, and the current edition of its ERP software

3.3.1. Overview of SAP:

In this part, we will explore SAP's corporate history, its evolution over the years, and the key factors that contribute to its leadership in the ERP market.

SAP, which stands for Systems, Applications, and Products in Data Processing, founded in 1972 by five visionary engineers from IBM. Since then, it has evolved into a global leader in business software solutions.SAP has established itself as a leader in the digital transformation landscape, serving businesses of every size and sectors all over the globe. From its humble origins as a startup to its status as a worldwide organization, SAP continues to remain committed to its basic principles of innovation, integrity, and client success.

Today, SAP offers a comprehensive suite of corporate software solutions, spanning ERP, CRM, supply chain management, human resource management, and more. With a vast customer base of over 440,000 customers in more than 180 countries, and more than 105,000 employees worldwide (as of February 08, 2024).

About 80% of its customers are small and midsize companies. Total revenue in 2024 was € 29.52 billion, including €13.66 billion from its cloud business. SAP works with about 25,800 partners and builds software solutions for 25 industries. In 2019, it invested more than €4.3 billion in research and development, including at 20 SAP Labs development center worldwide.[1]

SAP's business is helping customers optimize their business processes. Its purpose to help the world run better and improve people's lives. Today, 87% of total global commerce

[1] *Gartner. (2024). Market share: Enterprise application software worldwide, 2023 (Report G00775831). Retrieved from [https://www.gartner.com/en/documents] at 06/05/2025 14:30*

($46 trillion) of all business transactions worldwide touch an SAP system. For example, SAP's customers produce 78% of the world's food products and 82% of the world's medical devices.[1]

Building on its evolution, SAP has developed comprehensive ERP solutions that integrate and optimize key business functions across the enterprise.

The SAP ERP system is structured into a set of functional modules, each addressing specific business needs. Below is an overview of the key modules and their respective roles within an organization.

- ✓ **Procurement:** This module includes functionalities for managing procurement processes, vendor management, purchase requisitions, and purchase orders. It aims to optimize procurement spend while ensuring compliance with procurement policies and regulations.
- ✓ **Project:** The project module supports project management processes, including resource allocation, project planning, and tracking project progress. It aims to ensure projects are completed on time, within budget, and according to specifications. In the Project module of SAP S4HANA, we have business processes such as Resource to Project.
- ✓ **Warehousing:** The warehousing module focuses on managing inventory, order fulfilment, and warehouse operations within SAP ERP. It aims to optimize warehouse space utilization and streamline logistics processes. Receive to Leave it's a business process in this module which Encompasses receiving incoming goods, storing them in the warehouse, picking items for orders, and shipping them to customers.
- ✓ **Sales and Distribution:** This module facilitates sales order management, pricing, billing, and customer relationship management. It aims to streamline sales processes, improve customer service, and optimize revenue generation.
- ✓ **Finance:** The finance module in SAP ERP encompasses functionalities for financial accounting, controlling, asset management, and treasury management. It ensures

[1] *SAP SE. (2024). Annual report 2023: Helping the world run better. SAP Corporate Retrieved from [https://www.sap.com/integrated-reports/2023/en/company/key-figures.htm] at 05/05/2025 14:00*

accurate recording and monitoring of financial transactions, as well as strategic financial planning and reporting.

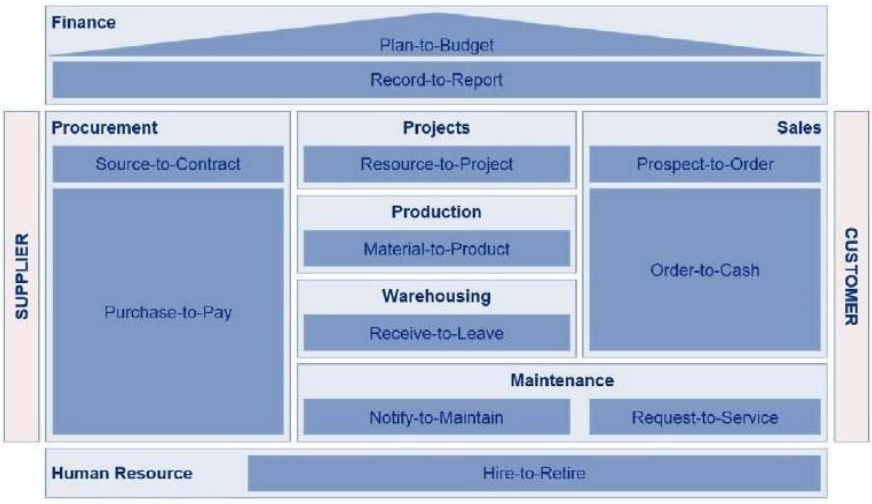
- ✓ **Production:** This module supports manufacturing processes, including production planning, scheduling, and execution. It aims to ensure efficient production operations and timely delivery of products.

- ✓ **Maintenance:** Maintenance module focuses on managing equipment maintenance processes, including preventive maintenance, corrective maintenance, and asset management. It aims to minimize downtime, extend asset lifespan, and optimize maintenance costs. It includes business processes such as

- ✓ **Human Capital Management (HCM):** HCM modules in SAP ERP focus on managing human resources processes, including payroll, employee benefits, talent acquisition, performance management, and workforce planning. It aims to optimize HR operations and enhance employee engagement. Besides, Hire to Retire is a business process in HCM module which Encompasses all stages of an employee's journey within the organization, from recruitment and onboarding to retirement or separation[1].s illustrated in figure the interconnected modules within an SAP ERP system, including Finance, Procurement, Warehousing, and Sales. For example, the Finance module tracks financial transactions generated by Procurement and Sales, while Warehousing coordinates with Production to manage inventory and fulfill orders, and Human Resources manages the employee lifecycle impacting all areas.

[1] *Al-Mashari, M., Al-Mudimigh, A., & Zairi, M. (2003). Enterprise resource planning: A taxonomy of critical factors. European Journal of Operational Research, 146(2), 352–364.*

Figure 9: Functional domains in SAP and business processes



Source: KPMG. Retrevreid from [https://assets.kpmg.com/content/dam/kpmg/ch/pdf/should-we migrate-to-en.pdf], [15/02/2025 at 14:35]

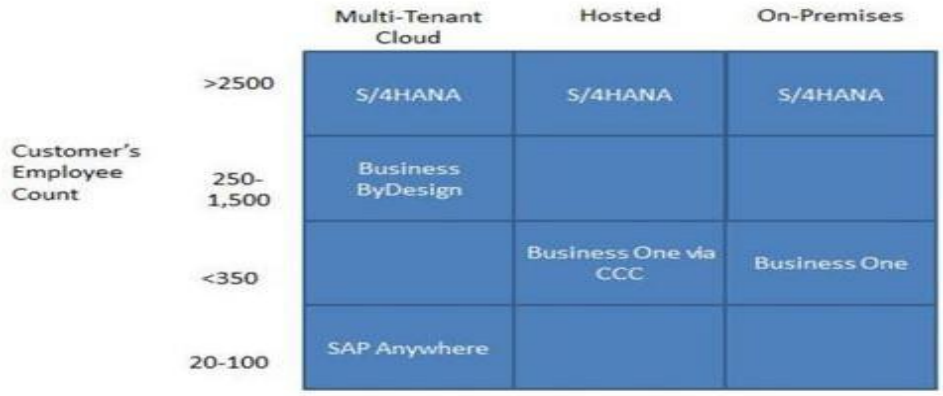
As the (figure 9), illustrates the interconnected modules within an SAP ERP system, including Finance, Procurement, Warehousing, and Sales. For example, the Finance module tracks financial transactions generated by Procurement and Sales, while Warehousing coordinates with Production to manage inventory and fulfil orders, and Human Resources manages the employee lifecycle impacting all areas.[1]

3.3.2. Products of SAP Solution:

SAP provides various ERP solutions for diverse business needs, from small enterprises to multinational corporations. The key offerings include:

[1] *KPMG, should we migrate to SAP S/4HANA, the necessity of a proper SAP strategy and how to draft it. Retrieved from (https//assets.kpmg.com/content/dam/kpmg/ch/pdf/should-we- migrate-to-en.pdf) accessed [15/02/2025 at 14:35]*

Figure 10: SAP Product



Source: Retrieved from [https://diginomica.com/finally-sap-business-bydesign-relevant/]

SAP's product strategy aligns with organizational size and technical requirements:

-Large Enterprises (2,500+ employees) deploy *SAP S/4HANA* (cloud, hosted, or on-premises).

-Mid-Sized Firms (250–1,500 employees) typically adopt SAP Business ByDesign (cloud-only).

-Small Businesses (≤350 employees) implement SAP Business One (cloud via CCC or on-premises), while micro-enterprises (20–100 employees) use SAP Anywhere (hosted commerce platform).

This tiered structure enables SAP to serve 30% of its revenue through the General Business unit, competing primarily with Microsoft Dynamics and Oracle Net Suite in the SME market.[1]

3.4. SAP Business One: ERP for Small and Midsize Businesses (SMBs)

In today's competitive business environment, small and medium-sized enterprises (SMEs) need robust solutions to streamline operations and fuel growth. One of the most effective tools for this is SAP Business One (SAP B1), an all-in-one ERP software specifically designed for SMEs.

[1] Brinkworth, M. (2020). Finally, SAP Business ByDesign becomes relevant. Diginomica. Retrieved from [https://diginomica.com/finally-sap-business-bydesign-relevant/] 02/05/2025 at 23:55

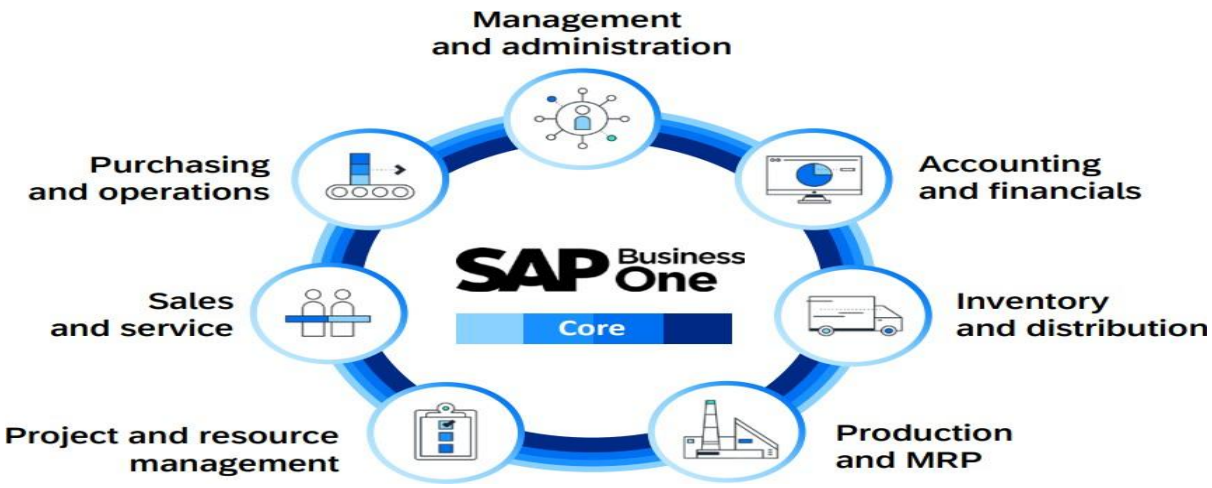
3.4.1. Overview of SAP B1

SAP Business One, commonly known as SAP B1, is an enterprise resource planning (ERP) software developed by SAP, a global leader in business technology solutions. Unlike large-scale ERP systems that cater to multinational corporations, SAP B1 is tailor-made for SMEs, providing them with powerful tools to manage core business functions.

By integrating these functions into one centralized system, **SAP B1 ERP** allows businesses to streamline processes, reduce manual errors, and make data-driven decisions.[1]

The figure below provides a visual representation of the core functionalities of SAP Business One. This ERP solution integrates key business processes such as financial management, inventory and distribution, sales and service, production planning, and resource management. The diagram highlights how SAP Business One streamlines operations for small and midsize businesses by entralizing data and enhancing decision-making capabilities.

Figure 11: SAP Business One Core Functions



Source: from [https://www.sap.com/legal-notice]

[1] *Osswal Infosystem (n.d.) Understanding SAP Business One (SAP B1): A complete ERP solution for SMEs. Retrieved from:(https://osswalinfo.com/understanding-sap-business-one- sap-b1-a-complete-erp-solution-for-smes/)Accessed at[15/03/2025 15:03].*

3.4.2. Key Features of SAP Business One

The key features of SAP Business One are highlighted as follows:[1]

- ✓ **Financial Management;** Managing finances efficiently is crucial for any business. SAP B1 provides comprehensive financial tools that cover accounting, budgeting, and financial reporting. Businesses can automate routine financial tasks, ensuring accuracy and real-time insights into their cash flow, profitability, and financial health.

- ✓ **Inventory and Warehouse Management;** For businesses that rely on inventory, SAP B1 offers tools to track stock levels, manage warehouses, and optimize purchasing. This ensures that businesses maintain optimal stock levels, prevent shortages or excess, and improve overall supply chain efficiency. Post-2016 versions integrate limited OData APIs for cloud deployments, but lack full Service Layer capabilities, restricting real-time interoperability in healthcare supply chains (only 2.7% adoption).

- ✓ **Sales and Customer Management;** SAP B1 provides features to manage the entire sales process, from lead generation and opportunity tracking to order fulfillment and post-sales service. With integrated customer relationship management (CRM), businesses can improve customer interactions, ensuring better service and customer satisfaction.

- ✓ **Purchasing and Procurement;** Efficient procurement is essential for maintaining smooth operations. SAP B1 ERP helps businesses manage vendor relationships, streamline purchasing processes, and track vendor performance, enabling businesses to negotiate better deals and reduce costs.

- ✓ **Reporting and Analytics;** One of the most powerful features of SAP B1 is its robust reporting and analytics tools. Business leaders can access real-time data and generate customizable reports to gain valuable insights into every aspect of their operations. This empowers them to make informed, strategic decisions that drive growth.

[1] *SAP2024.) SAP Business One Core Functions [Online image]. Available at: [https://www.sap.com/legal-notice] [Accessed 15/03/2025]*

- ✓ **Service Layer (API Integration & Extensibility);** SAP Business One includes a Service Layer, a RESTful OData (Open Data Protocol)- based API that enables real-time integration with external systems (e.g., IoT temperature sensors). This web service allows developers to securely interact with the SAP B1 database, supporting mission-critical integrations with mobile applications, e-commerce platforms, and healthcare supply chain management systems.[1]

Key Implications for Healthcare Supply Chains:

- Extensibility: Enables custom solutions for inventory tracking (addressing 52% critical coordination gaps)

- Interoperability: Facilitates HL7/FHIR compliance for EHR integration (reducing 41% HR dependency)

-Limitation: Lacks native support for advanced demand forecasting (46% critical demand information gap)

The Service Layer minimizes disruption to core operations while modernizing legacy processes, particularly valuable for SMEs with limited IT resources.[2]

SAP Business One offers a comprehensive and integrated solution tailored for the specific needs of small businesses. By streamlining operations, providing real-time insights, enhancing customer relationships, supporting scalability, and ensuring compliance, SAP Business One empowers small businesses to thrive in a competitive market. It enables them to optimize their processes, make informed decisions, and adapt quickly to changing business dynamics. Implementing SAP Business One can be a strategic investment that drives growth, efficiency, and success for small businesses.

3.4.3. SAP Business One Versions:

SAP Business One was introduced in April 2002 by SAP after acquiring Top Manage Financial Solutions LTD in Q1 2002. Top Manage was one of the companies founded in 1996

[1] *SAP (2023).SAP Business One Service Layer Technical Refrence Guide. Retrevied from [https://help.sap.com/docs/SAP_BUSINESS_ONE]*

[2] *Privett, N., & Gonsalvez, D. (2014). The top ten global health supply chain issues. Operations Research for Health Care, 3(4), 226-230.*

by Shai Agassi (a temporary SAP board member), his father Reuven Agassi, and Gadi Shamia. This acquisition allowed SAP to target the small business market through its partners and smaller subsidiaries of its enterprise clients.

Over the years, SAP has introduced new capabilities and technologies to SAP B1 as described in the table below.

Table 1: SAP B1 Versions

Version	Year	New Features
SAP Business One 2004	2004	Global version, SAP Business One SDK
SAP Business One 2005	2006	Improved usability and reporting, Enhanced SDK
SAP Business One 2007	2008	New reconciliation engine
SAP Business One 8.8	2010	Crystal Reports integration, unified code base
SAP Business One 8.81	2011	Multiple cost centers, Cockpit feature
SAP Business One 8.82	2012	Usability improvements, SAP HANA support
SAP Business One 9.0	2013	Single sign-on, bin location management, 64-bit client
SAP Business One 9.1	2014	Resource management, executive dashboard
SAP Business One 9.2	2016	Project management, browser access, smart MRP forecasting, item recommendations, Customer 360, Mobile Sales App
SAP Business One 9.3	2017	Production routing, RMA functionality, CRM feature consolidation
SAP Business One 10.0	2020	Web Client, New UI ,Office 365, better inventory, finance , and APIs

Source: Compiled by the author based on SAP documentation

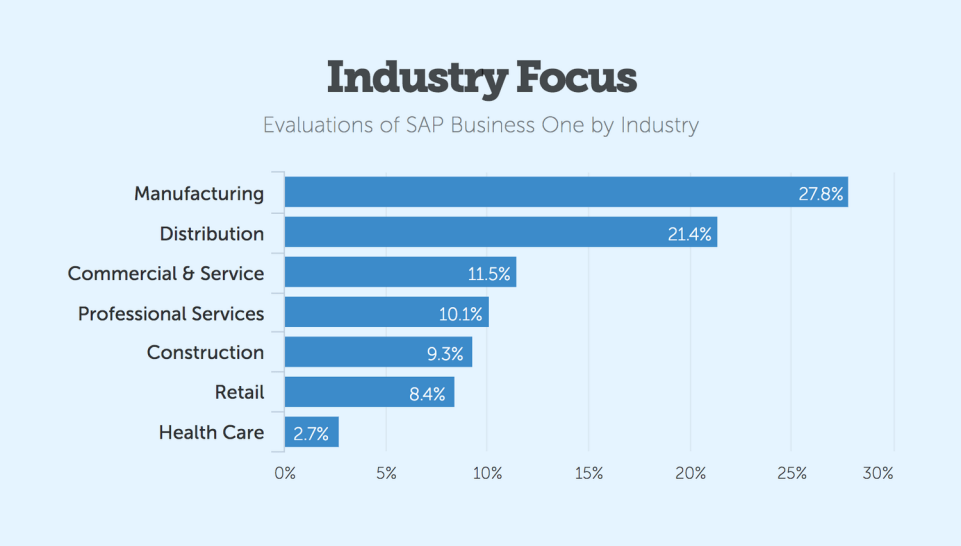
3.4.4. Top industry focus:

SAP Business One is a complete ERP solution developed by SAP, holding 11.8% of the global ERP market share and servicing over 425,000 clients in 180 countries. [1]Originally geared toward on-premise installation, the solution now supports cloud deployment. B1 is the solution for small and growing enterprises, integrating major business functions such as accounting, CRM, HR, inventory control, purchasing, warehouse management, and MRP.

The figure above provides a view of the distribution of SAP Business One evaluations by industry; the largest portion of deployment is within the manufacturing sector at 27.8%, then distribution at 21.4%, and multiple service sectors. This indicates that the solution strongly caters to industries requiring supply chain, inventory, and operations management.

In contrast, healthcare organizations represent only 2.7% of SAP B1 evaluations, suggesting limited adoption in this sector, likely due to its reliance on specialized health information systems and regulatory requirements. This distribution of usage reflects SAP B1's strength in industries where operational efficiency and resource planning are critical, particularly within SMEs

Figure 12: SAP B1industry



Source: Retrieved from [https://softwareconnect.com/erp/erp-market/]][10/03/2025at 12:30]

[1] Davidson, R. (2023, March 21). ERP market share, size, and trends report. Software Connect. Retrieved from[https://softwareconnect.com/erp/erp-market/]

3.4.5. SAP B1 for pharmaceutical industry :

SAP Business One addresses critical pharmaceutical industry challenges by integrating regulatory compliance, supply chain visibility, and quality management into a single ERP platform. The system's specialized modules for batch tracking, serialization (, and cold chain monitoring demonstrate particular value for SMEs.[1] As evidenced by Amici Pharmaceuticals' 32% reduction in quality deviations and 28% lower compliance costs post-implementation. However, limitations persist in advanced analytics capabilities compared to enterprise solutions like SAP S/4HANA, with implementation costs (€250K-500K) remaining prohibitive for some smaller manufacturers.[2]

The case study reveals SAP B1's effectiveness in bridging Industry 4.0 adoption gaps for mid-tier pharma companies through its GAMP 5-aligned architecture. While the platform successfully addresses core regulatory requirements and improves operational metrics (e.g., 5.2% to 0.8% temperature excursion rates), ongoing debates persist about its scalability versus cloud alternatives, particularly for companies pursuing personalized medicine or global expansion. This suggests SAP B1 serves as a transitional digitalization tool rather than an end-state solution for growing pharmaceutical enterprises.

3.5. Comparative of ERP SYTEMES:

This analysis aims to thoroughly examine the features, benefits, and challenges associated with the ERP systems SAP business one and Oracle NetSuite, highlighting concrete examples to demonstrate their significant impact on organizations. SAP business one and Oracle NetSuite are leading integrated management solutions that optimize business operations by consolidating various functions into a single platform. By centralizing business processes, these systems greatly enhance operational efficiency and decision-making quality, thus enabling companies to respond more effectively to market challenges.[3]

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[1] ERP Research. (n.d.). SAP for pharmaceuticals, biotechnology, medical devices. Retrevied from [https://www.erpresearch.com/en-us/sap-for-pharmaceuticals] 10/03/2025 at 12:00

[2] *SAP Customer Success Story (2023), Amici Pharmaceuticals case study .Retrevied from [SAP Business One for Pharmaceutical Industry | Consensus International]10/03/2025 at 13:00*

[3] *Compare ERP (2024) Oracle NetSuite vs SAP Business One: A Comprehensive Comparison, 2 September. Available at: [*https://rsult.one/comparing-netsuite/netsuite-vs-sap-business-one/ *] (Accessed: 10/04/2025 at 16:00).*

3.5.1 Overview of Oracle NetSuite:

NetSuite is a cloud-first ERP solution designed for scalability and real-time business management. Key features include:[1]

-Cloud-Based Architecture: Fully hosted in the cloud, enabling remote access, automatic updates, and reduced IT infrastructure costs.

-End-to-End Integration: Combines financial management, CRM, e-commerce, inventory, and HR in a single platform.

-Customization & Flexibility: Uses SuiteScript and SuiteFlow for tailored workflows without extensive coding.

-Global Scalability: Supports multi-currency, multi-subsidiary operations, making it ideal for growing enterprises.

Example: A retail company using NetSuite automates inventory replenishment across warehouses, reducing stockouts by 30% while improving order fulfillment speed.[2]

3.5.2 Overview of SAP Business One:

SAP Business One is an SME-focused ERP offering flexible deployment options. Key features include:[3]

-Multiple Deployment Models: Available on-premise, cloud, or hybrid, catering to businesses with strict data control needs.

-Core Business Modules: Covers accounting, sales, procurement, inventory, and production planning.

-SAP HANA Integration: Enables advanced analytics and real-time reporting for data-driven decisions.

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[1] *Oracle Corporation (2023)NetSuite Product Documentation. Available at: [*https://docs.oracle.com/en/cloud/saas/netsuite/ns-online-help/book_N473219.html*] Accessed:10/04/2025 at 15:00).*

[2] *Idem*

[3] *SAP SE (2023) SAP Business One: Features and Deployment Options. Retrieved from:[* https://community.sap.com/t5/enterprise-resource-planning-blog-posts-by-sap/sap-build-apps-for-sap-business-one-the-next-gen-development-environment/ba-p/13563398*](Accessed: 10 /04/2025 at 12:00).*

-Industry-Specific Customization: Adaptable to manufacturing, distribution, and services via add-ons. Example: A mid-sized manufacturer using SAP Business One reduces production delays by 20% through real-time tracking of raw material shortages.[1]

3.5.3 Key Advantages of Both Systems:

Table 2:Key advantages of SAP b1 and Oracle Netsuit

Criteria	Oracle NetSuit	SAP Business One
Deployment	Cloud-only	Cloud, on-premise, or hybrid
Scalability	Highly scalable for global Operations	Best for SMEs; may require upgrades
Customizations	Low-code tools (Suite Script)	Requires partner support for deep customization
User Experience	Intuitive, modern interface	Functional but less user-friendly
Pricing	Subscription-based (higher upfront cost)	Flexible licensing (lower initial cost)
Implementation	Faster cloud deployment	Longer setup for on-premise/hybrid

Source: Compiled by the author based on TEC Company (Enterprise Software and ERP Selection ConsultingServices - TEC | TEC)

The choice of one platform over the other often depends on specific business requirements, including the size of the firm, the importance the industry lays on it, and the technology infrastructure already in place.

Both ERPs enhance operational efficiency but cater to different business needs. NetSuite leads in cloud agility and scalability, while SAP Business One offers deployment

[1] *Opt cit*

flexibility for SMEs. A thorough assessment of growth plans, industry requirements, and IT infrastructure is critical for selecting the optimal solution.[1]

3.6 ERP-Driven Digitalization of Supply Chains:

3.6.1 ERP and E-business:

E-business (electronic business) refers to the end-to-end digitalization of all business processes (including procurement, production, marketing, sales, and customer service)busing internet-based technologies and networked information systems to create value, streamline operations, and enable competitive advantage.[2]

The characteristics of the new economy has increased the level of competition in all the industries and the internet presents an important opportunity for even small firms to launch new products or services because of the speed and low cost of doing business speed and low cost of doing business[3].

ERP and e-business are not competitive systems. Their greatest benefits can only be achieved when they are used in agreement, completing each other. Thus, without successful ERP system the e-business systems would have only little to present, as in today's new business environment, power has shifted toward consumers who demand intelligent products that deliver new dimensions of value time and content in addition to the current one price and quality.[4]

ERP and e-business have different functionalities, with ERP handling internal information and e-business serving as a distribution medium. However, ERP is seen as the most important and strategic platform by 66% of IT managers, as it provides a solid foundation and information backbone for e-business. When properly implemented, ERP and

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[1] *Technology Evaluation Centers (2023) SAP Business One vs. NetSuite ERP comparison report. Available at: [*https://www3.technologyevaluation.com/selection-tools/comparison-reports/21832/sap-business-one-vs-netsuite-erp-comparison-report*] (Accessed: 11/04/2025 at 15:28).*

[2] *Ahmed, A., Zairi, M. and Alwabel, S. (2003), Global benchmarking for Internet and e-commerce applications, Proceedings of the first International Conference on Performance Measures, Benchmarking and Best Practices in New Economy, Business Excellence 2003. May, University of Minho Guimaraes,Portugal.*

[3] *Alwabel, S. A., Ahmed, A. M., Gouda, S. and Zairi, M. (2004), What, Why and How: Critical review of e-commerce era, Proceedings of the International Conference on Responsive Supply Chain and Organisational Competitiveness (RSC-2004), 5-7 January, Coimbatore, India.*

[4] *Idem*

e-business can work together to streamline processes and automate data processing throughout the supply chain.[1]

3.6.2 Risks for Implementing ERP Systems in SCM

As a transformational initiative, ERP is often complex and affects many stakeholders. Several implementation failures can be attributed to structural, strategic, and human factors , most often lack of executive team commitment — or lack of understanding of the organizational change needed for success. Among the other risks to ERP implementation:

- ✓ **Low end-user adoption:** Users who are unaware of the rationale for ERP implementation and its impact on them won't be able to absorb workflow changes, resulting in an inefficient rollout. Example: ERP project teams that do not involve potential end users could miss early signs of errors and inefficiencies that will be uncovered once the ERP project is live.
- ✓ **Misalignment with business needs:** ERP project scope that is highly customized based on current or near-term requirements will fail to keep up with changing business goals after implementation. Example: ERP applications that do not conform to the business's changing KPIs will fail to deliver value and may have to be replaced entirely, resulting in higher costs.
- ✓ **Flawed project execution:** Unclear division of responsibilities and poor communication of strategy hinder project execution, resulting in delays, scope deviation, budget overruns and reduced organizational impact. Example: Errors missed throughout the implementation process and only discovered after the system went live, leading to state investigations, settlements and rework costs[2].
- ✓ **Data risks:**

-Data governance and data integrity can be major roadblocks in ERP implementation. Example: Changing regulations around cross-border data transfers.

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[1] *Norris, G., Hurley, J. R., Hartly, K. M., Dunleavy, J. R. and Balls, J. D. (2000) E-Business and ERP: transforming the enterprise, John Wiley, New York; Chichester. Quoted in Mohamed Zairi, Angappa Gunasekaran, Op. Cit.P13*

[2] Gartner. (n.d.). Enterprise resource planning (ERP). Retrieved 22/02/2025 at 21:27, from (https://www.gartner.com/en/information-technology/topics/enterprise-resource-planning)

-Data security. Lack of access management controls and poorly constructed data security governance frameworks make ERP applications susceptible to data breaches. Example: Unauthorized access to confidential data by employees.

-Data integration. Integration of ERP applications with legacy systems may require costly middleware software solutions and can result in data inaccuracy, redundancy or loss. Example: Migration from legacy systems and non-ERP interfaces may result in data inaccuracy or loss.

- ✓ **IT systems risks**: Outdated IT infrastructure, including hardware, software and network resources, may render the ERP investment obsolete. Example: Legacy infrastructure with outdated security and controls that fail to prevent data breaches.
- ✓ **Cloud migration risks:** Transitioning from on-premises ERP to a cloud-based solution may result in delays, additional costs and security risks. Example: Public exposure of data, weak access credentials, weak security of APIs, cloud-based denial of service attacks and malicious cloud service provider intent[1].

3.6.3 ERP, KPI, and Logistics Performance:

The effective study of KPIs that align with ERP systems enhances a key success factor of digitalization, fostering operational efficiency and strategic agility. This alignment plays a pivotal role in optimizing business processes, particularly within supply chain and logistics management. The following sections explore this relationship in greater depth.

Strategic Alignment between ERP and KPIs in Supply Chain Management:

Enterprise Resource Planning (ERP) systems, such as SAP, are central to data integration and process optimization across the supply chain. One of their most strategic contributions lies in their ability to support monitoring Key Performance Indicators (KPIs), which serve as essential tools for evaluating and steering logistics performance.

KPIs are quantifiable metrics used to measure the effectiveness of specific business processes, such as delivery times, inventory turnover, or order accuracy. The alignment between ERP capabilities and KPIs enhances supply chain agility in several ways:

[1] Aloini, D., Dulmin, R., & Mininno, V. (2021). Risk management in ERP projects: A systematic literature review. International Journal of Information Management, 60, 102385. Retrieved 12/05/2025 at 19:45from [https://doi.org/10.1016/j.ijinfomgt.2021.102385]

- ✓ **Automated Data Collection & Accuracy:** ERP systems reduce manual errors by integrating real-time transactional data, such as order fulfillment, lead times, and inventory turnover, directly into KPI dashboards. For example, SAP's Logistics Performance Monitor can track On-Time Delivery (OTD) by pulling data from procurement, warehousing, and transportation modules.[1]
- ✓ **Real-Time Performance Monitoring:** KPIs like Order Cycle Time, Perfect Order Rate, and Warehouse Efficiency are dynamically updated in ERP dashboards, allowing managers to react promptly to bottlenecks. Case studies (e.g., Oracle ERP users) report 15–30% improvement in demand forecasting accuracy due to integrated KPI analytics.[2]
- ✓ **Strategic Decision Support:** ERP systems enable predictive analytics by linking KPIs with historical trends such as seasonal demand or supplier reliability. For instance, a drop in Inventory Turnover Ratio can trigger automated replenishment workflows, reducing stockouts.
- ✓ **Compliance and Benchmarking:** Standardized KPIs (e.g., SCOR module metrics) embedded in ERP systems support compliance with industry benchmarks and facilitate continuous improvement initiatives like Lean or Six Sigma.[3]

The Impact of ERP–KPI Alignment on Overall Logistics Performance:

The integration of Enterprise Resource Planning (ERP) systems with Key Performance Indicators (KPIs) has become a transformative force in optimizing logistics performance. By enabling real-time data visibility, process automation, and predictive analytics, ERP–KPI alignment drives measurable improvements in efficiency, cost reduction, and customer satisfaction. This section examines this impact through empirical evidence and industry benchmarks.

- ✓ **Operational Efficiency Gains:** ERP systems automate KPI tracking, improving order processing times by 20–30% (e.g., SAP S/4HANA). Inventory KPIs like Turnover Ratio help reduce excess stock by 15–25%. IoT-enabled ERP solutions can boost picking accuracy by up to 35%.[4]

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[1] *SAP. (2023). *Logistics performance monitoring with SAP S/4HANA [Customer success story]. https://www.sap.com/logistics-performance*

[2] *Gartner. (2023). Market guide for supply chain execution technologies [Report ID G00775834]. https://www.gartner.com/document/4038934*

[3] *APICS. (2021). Supply Chain Operations Reference (SCOR) model (Version 13.0). https://www.apics.org/scor*

[4] Gartner. (2022). ERP inventory optimization. https://www.gartner.com

- ✓ **Cost Reduction and Resource Optimization:**

-Transportation: ERP integration with logistics KPIs (e.g., cost per unit, route optimization) leads to 10–20% savings in freight costs.

-Labor: Automated data capture reduces administrative workload by up to 25%.[1]

- ✓ **Enhanced Agility and Risk Mitigation:**

-Demand-Supply Balance: AI-powered ERP tools improve Forecast Accuracy and reduce Stockout Rates by 30%.

-Crisis Response: During the 2021–2023 supply chain disruptions, ERP-integrated firms recovered 40% faster by monitoring lead time variability.[2]

- ✓ **Customer-Centric Outcomes :**

-On-Time Delivery (OTD): ERP-linked OTD tracking improves delivery performance by 18–22% through dynamic route and carrier adjustments.

-Perfect Order Rate: Companies using Oracle ERP Cloud improved perfect order fulfillment by 15% through aligned KPIs across the supply chain[3].

However, these benefits depend on overcoming several implementation challenge-Data Silos: Legacy systems may resist integration. Solution: Use API-based middleware (e.g., MuleSoft) to connect ERP with specialized logistics tools.

-KPI Overload: Tracking too many metrics can dilute focus. Solution: Use tiered KPIs from the SCOR model, prioritizing strategic indicators like Cash-to-Cash Cycle Time.

As these barriers are addressed, forward-looking companies are already unlocking new value from ERP–KPI integration by adopting AI, IoT, and advanced analytics.

[1]McKinsey & Company. (2023). ERP-driven logistics cost reduction [Industry Report]. https://www.mckinsey.com/erp-logistics-costs
[2]Capgemini Research Institute. (2023). AI in supply chain: The ERP advantage [Research Report]. https://www.capgemini.com/research/ai-erp-supply-chain
[3] Oracle. (2023). Achieving perfect orders with Oracle ERP Cloud [Customer success report]. https://www.oracle.com/erp-perfect-order

Conclusion

The digital transformation of the pharmaceutical supply chain represents a pivotal shiftin the industry, enhancing efficiency, transparency, and overall performance. This chapter has provided a comprehensive overview of supply chain management (SCM), outlining its key components, objectives, and evolving nature. It has also explored the unique characteristics and challenges of pharmaceutical supply chains, emphasizing the role of digital technologies in addressing these complexities.

The integration of digital transformation, particularly through emerging technologies and the concept of Pharma 4.0, has been identified as a crucial enabler for modernizing operations. While digital transformation offers numerous benefits, such as improved traceability, cost reduction, and enhanced regulatory compliance, it also presents challenges, including implementation barriers and organizational resistance.

Additionally, this chapter has highlighted the significant role of ERP systems, with a specific focus on SAP, in streamlining SCM processes. SAP's capabilities in managing supply chain activities, from procurement to distribution, make it a valuable tool for pharmaceutical companies navigating digital transformation. However, successful implementation requires a well-defined digital strategy, awareness of potential risks, and adherence to best practices to maximize the benefits of digitalization.

While the pharmaceutical industry faces unique challenges, digital transformation, supported by ERP solutions like SAP B1, is an essential driver for improving supply chain resilience, efficiency, and adaptability in an increasingly complex and globalized market.

CHAPTER 2:

Analysis of Digital Transformation at Pharma Invest

Introduction:

This chapter examines Pharma Invest's digital transformation, focusing on its operational infrastructure, supply chain dynamics, and the role of SAP Business One (SAP B1) in enhancing performance.

Section 1 provides an overview of Pharma Invest, detailing its historical evolution, organizational structure, supply chain operations, and strategic goals, positioning it as a key player in Algeria's pharmaceutical sector.

Section 2 outlines the methodology used to assess SAP B1's impact on the company's supply chain, employing a mixed-methods approach guided by the DeLone and McLean Information Systems Success Model and key performance indicators (KPIs).

Section 3 presents the empirical results, integrating user perceptions and operational metrics to evaluate SAP B1's effectiveness, identify adoption barriers, and highlight its contributions to supply chain optimization. Together, these sections analyze Pharma Invest's digital transformation journey, underscoring its achievements and identifying opportunities for operational excellence.

Section 1: Presentation of Pharma Invest Company:

This section provides an overview of Pharma Invest, a major pharmaceutical distributor in Algeria. It examines the company's historical background, organizational structure, and supply chain activities, along with its strategic orientation.

1.1 Overview of the company:

This section presents a comprehensive overview of Pharma Invest, detailing its historical evolution, strategic expansion, and operational footprint within the Algerian pharmaceutical sector.

1.1.1. Évolution historique et expansion stratégique

A. Company Profile and History:

A joint-stock company (JSC), Pharma Invest is a wholesaler and distributor of pharmaceutical products operating in the eastern and central regions of the country. The company aims to improve the health of Algerian citizens by offering a wide and accessible range of medications while providing optimal conditions for the development of the pharmaceutical sector

B. History and Evolution of Pharma Invest:

Pharma Invest SPA was incorporated on January 15, 2001 as Algeria's pioneering private pharmacists' consortium, established as a joint-stock company with regional distribution specialization. The enterprise commenced pharmaceutical distribution operations on July 23, 2001 with an initial capital of 1,170,000 DA and 39 founding shareholders,

The company expanded through strategic subsidiaries:

- 2011: Established SPA Pharma Invest Production, diversifying into pharmaceutical manufacturing
- 2012: Founded SPA Transport Invest to optimize logistics infrastructure
- 2016: Launched Pharma Invest Sud to service southern territories through dedicated distribution facilities

- 2020: Instituted an Algiers Business Unit to enhance capital region distribution efficiency 2024: Acquired SARL Tlemcen Pharma to consolidate western market presence

C. Capital Growth and Shareholder Evolution:

From its modest beginnings in 2001, with 1,170,000 DA in share capital and 39 shareholder pharmacists, Pharma Invest has experienced remarkable growth over the years.

By 2024, the number of shareholders had risen to 450 pharmacists, and the company's share capital had reached an impressive 5,508,975,000 DA. This growth reflects the trust and confidence that pharmacists across the country have placed in Pharma Invest's vision and leadership.

Today, Pharma Invest is no longer just a joint-stock company but has evolved into the Pharma Invest Group, encompassing subsidiaries such as Pharma Invest Production, Pharma Invest Trading International, and Transport Invest. Through its expansion and diversification efforts, Pharma Invest continues to lead the way in Algeria's pharmaceutical distribution sector.

D. Geographical Location and Operations :

Pharma Invest's main center is located in El-Eulma,Sétif , enabling efficient management of its operations. The company is also present in the capital, Algiers, as well as in western Algeria in Tlemcen, and in the southern region in El Oued. This strategic geographical distribution ensures broad coverage and accessibility of pharmaceutical products across the country.

1.1.2. <u>The Activity of Pharma Invest SPA:</u>

Pharma Invest focuses on the distribution of pharmaceutical product. The company acts as an intermediary between pharmaceutical laboratories (suppliers) and community pharmacists (clients), ensuring that pharmaceutical products are distributed efficiently and in compliance with strict regulations. Distribution includes managing stock levels, fulfilling orders, and ensuring timely delivery to pharmacies across Algeria.

Vision, Mission, and Values:

- ✓ **Vision:** PHARMA-INVEST follow the strategic logic of the four axes of the Balanced Score Card (BSC), which are interconnected through a chain of causality. It is a strategic performance management framework that organizations use to track and manage their strategy by measuring financial and non-financial outcomes across multiple perspectives[1].
  - Financial – How do we look to shareholders?
  - Customer – How do customers perceive us?
  - Internal Processes – What must we excel at?
  - Learning & Growth – How can we sustain improvement and innovation?
- ✓ **Values:** The values of PHARMA-INVEST SPA are represented by three main aspects:
  - Respect
  - Trust
  - Integrity

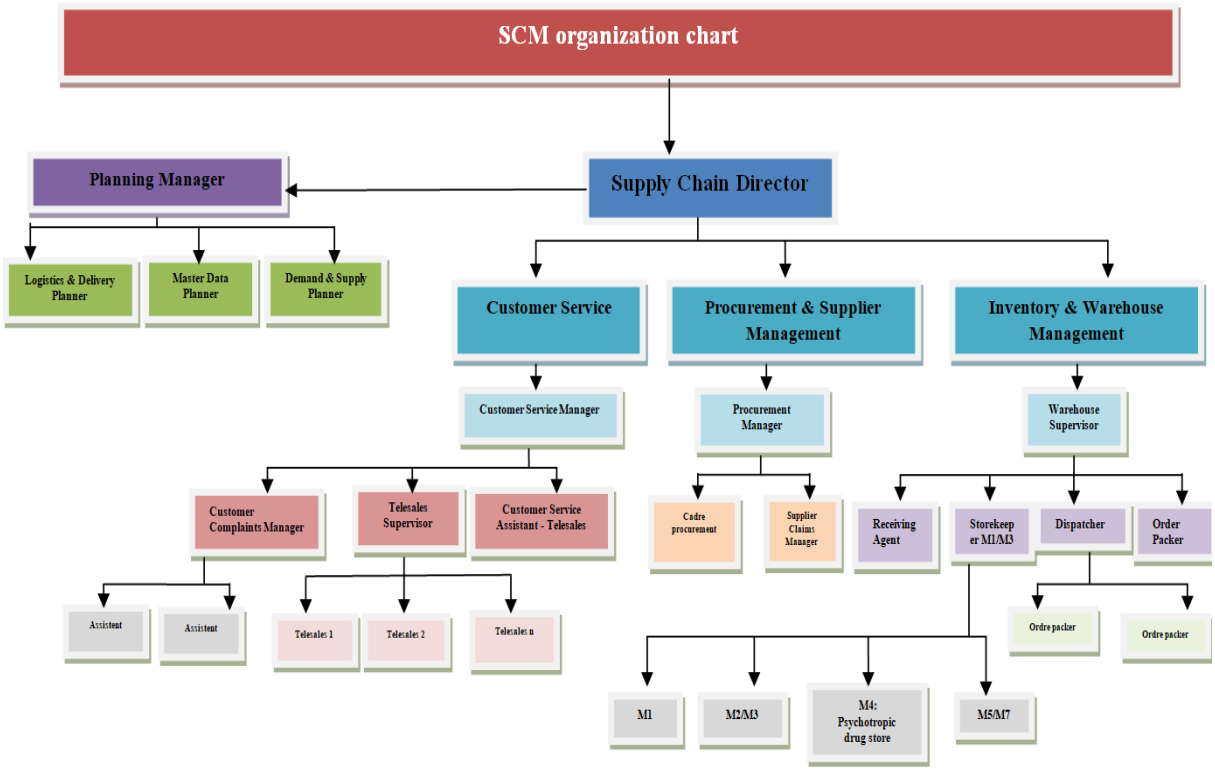
These values are regarded as the fundamental principles of the company identity, culture, processes, and vision, encompassing all other moral values intrinsically.

- ✓ **Mission:** The main mission is to deliver pharmaceutical products from suppliers to pharmacy clients within optimal timeframes while adhering to legal and regulatory requirements.
- ✓ **Clients:** community pharmacists across the national territory. The company supplies 1,000 pharmacists located in 35 states, which are further divided into 72 distribution sectors to ensure efficient coverage. The company operates through four main distribution centers, strategically positioned to optimize supply chain operations: El Eulma (East); Alger (Center); El Oued (Southeast); Tlemcen (Northwest).

1.2. Supply Chain Structure

[1] *Hansen, E. G., & Schaltegger, S. (2016). The sustainability Balanced Scorecard: A systematic review of architectures. Journal of Business Ethics, 133(2), 193-221.* https://doi.org/10.1007/s10551-014-2340-3

Figure 13:SCM Organisationnel Chart



Source: Created by the author using internal company information.

The diagram below represents the functional organizational chart of the SCM department at PHARMA-INVEST SPA (EL-Eulma), providing an overview of the distribution of positions, roles, and responsibilities.

This organizational chart represents the structure of a Supply Chain Management (SCM) department. At the top, the Supply Chain Director oversees through several main divisions:

- ✓ Planning – Headed fully by the Planning Manager, this team has several Logistics & Delivery Planners, Master Data Planners, plus Demand & Supply Planners, totally responsible for forecasting, complete data management, and total logistics planning.
- ✓ Customer Service – This area is run by the Customer Service Manager; it deals with client grievances, telesales, and client support, guaranteeing client communication.

- ✓ Procurement & Supplier Management is headed by the Procurement Manager. In addition, it has many procurement officers and chain managers, who source and then manage multiple suppliers.
- ✓ Inventory & Warehouse Management – Supervised by the Warehouse Supervisor, this team includes several Receiving Agents, many Storekeepers, multiple Dispatchers, as well as multiple Order Packers, ensuring efficient warehouse operations and order fulfillment.

Each and every job, within the system helps make the pharmaceutical supply chain run without any problems.

1.3 Digital Tools Used by the Company:

To optimize operations and enhance collaboration, the company relies on a suite of digital tools spanning ERP systems, custom applications, and workforce management platforms. These technologies enable end-to-end process automation, real-time data visibility, and cross-functional integration.

Entreprise Resource Planning (ERP):

- ✓ **ERP SAP Business One:**

SAP Business One 9.3 for SAP HANA is a powerful, integrated ERP solution for small and medium-sized enterprises. It is primarily used for supply chain management (SCM), finance, and inventory processes. Built on the SAP HANA in-memory platform, this version (9.30.140) delivers enhanced system performance, real-time analytics, and streamlined business operations. It offers robust functionalities covering finance, sales, inventory management, and customer relationship management.

- ✓ **SAP 4/HANA:**

The company has deployed SAP S/4HANA as the digital backbone for its new pharmaceutical production project, integrating it with the HR department. This advanced ERP system offers three core capabilities: comprehensive human resources management through integrated SuccessFactors, sophisticated production planning via its MRP module with MES connectivity, and built-in quality management for manufacturing operations.

Unlike SAP Business One—which is designed for SMEs with basic ERP functionalities.SAP S/4HANA delivers enterprise-grade solutions with native HANA database integration, industry-specific modules, and advanced analytics. It is particularly well-suited for complex manufacturing environments that require end-to-end quality control and workforce management.

Custom Build Operational Application (integrated with SAP):

To enhance its ERP capabilities, Pharma Invest Group has developed a suite of proprietary applications that interface directly with SAP B1. These service-layer extensions, engineered by the company's internal IT division, address specific operational gaps in pharmaceutical logistics and inventory management while maintaining full system interoperability. The applications demonstrate how legacy ERP systems can be augmented through targeted digital solutions in regulated industries.

The table below details these mission-critical tools and their functional contributions:

Table 3:Integrated Application

Application	Functionality
Commande Assistant	Automates order processing and management.
Stock Management App	A mobile tool that allows warehouse personnel to perform inventory counts and verify products by scanning barcodes using a Smartphone.
Package Scanning App	Ensures accuracy during the preparation and shipping phases by scanning packages prior to dispatch.
Inter-Warehouse Transfer	Facilitates seamless stock transfers between warehouses. (e.g., from Warehouse 1 to Warehouse 4)
Dispatch App	Manages driver assignments, order preparers, and delivery zones.
Delivery Scanning App	Tracks packages/delivery notes in real time.
CRM App	Monitors sales reps and commercial team activities.
Logistic Tracking App	Provides end-to-end visibility of logistics operations.
24/7 Medication Ordering Portal	Web-based platform and application for pharmacists to place orders anytime.

Source: Created by the author using internal company information.

HR management (HCM) software:

- **SAP Success Factors:** a cloud based software suite by SAP S4/HANA.The company's HR operation are managed via SAP, which streamlines talent acquisition, performance tracking, and employee development.

Communication & Collaborations Tolls:

- **Spark:** Internal communication platform for employees.
- **Google Sheets & Docs:** Enables collaborative work-sharing.

Tracking &Automation Technologies:

- RFID (Radio Frequency Identification): Tracks deliveries and inter-warehouse product movements.

Section 2: Methodology and Research Approach

This section outlines the methodology used to assess the impact of SAP Business One on the performance of the pharmaceutical supply chain at Pharma Invest. The research adopts a structured, empirical approach that integrates both quantitative and qualitative methods. Quantitative analysis is based on survey data and operational key performance indicators (KPIs) to objectively evaluate system effectiveness. In parallel, qualitative insights are derived from user feedback to capture perceptions and experiences with the system. The interpretation of findings is grounded in existing literature, allowing for the identification of key outcomes and areas for improvement.

2.1 Choice of a Mixed-Methods Study

A mixed-methods approach was selected to balance objective performance metrics with subjective user perspectives, addressing the complexity of evaluating ERP system impacts. The quantitative component uses survey data and KPIs to measure system effectiveness and test hypotheses. The qualitative component analyzes open-ended user feedback to capture suggestions for optimization and contextualize quantitative findings. This combination ensures statistically reliable results and nuanced insights into SAP B1's role in SCM performance, aligning with the research objective of assessing operational and strategic outcomes.

2.2 Data collection Method:

2.2.1 Quantitative data collection :

Quantitative data were collected through surveys and KPIs from January to March 2025, focusing on system performance and user perceptions at Pharma Invest. Data were cleaned and normalized to ensure consistency and accuracy for analysis.

a) Surveys:

A structured questionnaire was administered electronically via Google Forms. The survey, pilot-tested with five users to ensure clarity and relevance, included multiple-choice and Likert-scale items to assess system usability, training effectiveness, user satisfaction, and perceived benefits.

The questionnaire was structured according to the **(DeLone & McLean)[1] S Success Model**, which evaluates ERP systems across six dimensions:

- **System Quality**: Efficiency, reliability, and accessibility (e.g., Q9).
- **Information Quality**: Accuracy, completeness, and timeliness of data (e.g., Q10).
- **Service Quality**: Adequacy of training and technical support (e.g., Q11, Q12).
- **Actual Use**: Frequency and effectiveness of SAP B1 use (e.g., Q5-Q6-Q8).
- **User Satisfaction**: Overall user contentment with the system (e.g., Q13–Q15).
- **Net Benefits**: Organizational outcomes like productivity and compliance (e.g., Q16, Q17).

An open-ended question (Q18) captured qualitative feedback on system optimization. This design ensured measurable data for statistical analysis and contextual insights into user experiences, supporting hypotheses testing.

b) KPI (Key Performance Indicators):

Secondary data comprised KPIs extracted from SAP B1 tables for January–March 2025. KPIs were selected using SMART criteria (Specific, Measurable, Achievable, Relevant, Time-bound) to assess operational impact in critical SCM areas (PAR, TCR, LSR)

c) Statistical Tests:

-Reliability Test: Cronbach's Alpha was used to evaluate the internal consistency of the questionnaire, ensuring the reliability of each dimension measured.

-Normality Test: The Shapiro-Wilk test was applied to assess data distribution and guide the selection of suitable statistical analysis methods.

2.2.2 Qualitative data collection :

Qualitative data were collected through the open-ended survey question (Q18), which invited respondents to suggest SAP B1 optimizations. Responses were analyzed using thematic analysis to identify barriers and improvement opportunities, providing context for quantitative findings. This approach captured nuanced user perspectives, such as challenges

[1] *DeLone, W. H., & McLean, E. R. (1992). Information Systems Success: The Quest for the Dependent Variable. Information Systems Research, 3(1), 60–95. DOI: 10.1287/isre.3.1.60*

with system interfaces or training needs, enhancing the evaluation of SAP B1's usability and adoption.

2.3 Target population:

This sample was selected consist of employees who directly use SAP Business One in key supply chain functions such as procurement, inventory management, logistics, and finance. These roles are essential to evaluating the system's impact on operational performance. The sample is beneficial as it provides relevant and practical insights from users who interact with SAP B1 on a daily basis. Including 37 participants, representing 41% of the user base (estimated of 90 users) ensures the data is both representative and sufficient to reflect general user experiences and system effectiveness across the company.

2.4 DATA Statistic:

We present the analysis of the reliability of the questionnaire and the analysis of the safety data sheet

- Analysis of the reliability of the questionnaire:

Table 4: Reliability Statistics

Scale Reliability Statistics		
	Cronbach's α	**Num-of-item**
scale	**0.825**	19

Source: Author analysis of SAP B1 user feedback surveys using SPSS

The reliability test allows verifying the consistency of the questionnaire. For our questionnaire, the reliability is widely acceptable since the Cronbach's Alpha coefficient is"0.825".

- Analyze of normality of data:

A normality assessment was conducted using the Shapiro–Wilk test to evaluate whether the collected data conformed to a normal distribution—a key assumption for many parametric tests. Results indicated Almost all variables have p-values < .001, which means that the data is not normally distributed for nearly all variables.Therefore, non-parametric tests (like Spearman correlation, Mann-Whitney U, Kruskal-Wallis) are appropriate for analysis.

Consequently, the study employed the 2 flowing test :

-Kruskal-Wallis Test: it is used to determine whether there are significant differences between three or more independent groups on a continuous or ordinal variable.

-Chi-square Test: assesses whether there is a significant association between two categorical variables by comparing observed frequencies with expected frequencies under the assumption of independence.

Table 5:Shapiro–Wilk Test Result

Descriptives

			Shapiro-Wilk	
	N	Mean	W	p
SAP_Usage_Duration	36			
SAP_Usage_Duration - Transform 2	36	2.89	0.795	<.001
SAP_Familiarity_Level	36			
SAP_Familiarity_Level - Transform 3	36	1.97	0.792	<.001
SAP_Usage_Frequency	36			
SAP_Usage_Frequency - Transform 4	36	4.08	0.673	<.001
SAP_Integrated_In_Processes	36			
SAP_Integrated_In_Processes - Transform 5	36	1.31	0.601	<.001
Manual_Processes_Remain	36			
Manual_Processes_Remain - Transform 6	36	1.56	0.634	<.001
Other_Digital_Tools	36			
9-SAP_Speed	36	3.83	0.868	<.001
9-SAP_Reliability	36	4.19	0.775	<.001
9-SAP_Availability	36	4.17	0.819	<.001
9-SAP_Ease_of_Navigation	36	4.00	0.841	<.001
10-SAP_Data_Accuracy	36	4.67	0.624	<.001
10-SAP_Info_Relevance	36	4.61	0.631	<.001
10-SAP_RealTime_Data	36	4.56	0.690	<.001
10-SAP_Data_Completeness	36	4.44	0.731	<.001
SAP_Training_Received	36			
SAP_Training_Received - Transform 7	36	2.03	0.823	<.001
12-SAP_Tech_Support_Quality	25	3.28	0.910	0.031
12-SAP_Training_Relevance	26	3.08	0.920	0.044
12-SAP_Support_Responsiveness	26	3.54	0.892	0.010
Overall_SAP_Satisfaction	36	3.44	0.810	<.001
SAP_Strengths	36			
SAP_Challenges	36			
16-SAP_Inventory_Management	36	4.64	0.631	<.001
16-SAP_Demand_Forecasting	36	3.75	0.874	<.001
16-SAP_Product_Traceability	36	4.75	0.507	<.001
16-SAP_Interdepartmental_Coordination	36	4.53	0.651	<.001
SAP_Improved_Efficiency	36			
SAP_Improved_Efficiency - Transform 8	36	2.61	0.619	<.001

Source: Author analysis of SAP B1 user feedback surveys using SPSS

Section 3: Data analysis and Results

3.1 Presentation of the Study Results:

3.1.1 Quantitive study :

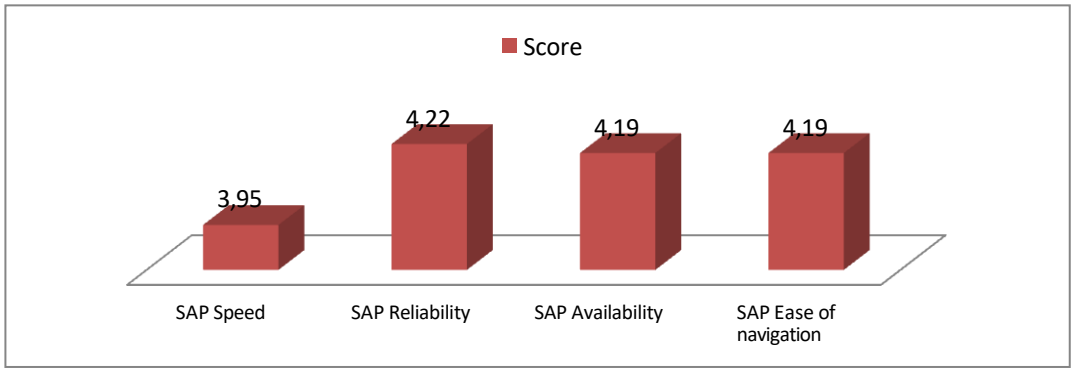
A-Questionnaire Analysis (based on the DeLone & McLean IS Success Model):

A total of 37 valid responses were collected. Each dimension of the DeLone & McLean IS Success Model was analyzed individually to evaluate the effectiveness of SAP from the users' perspective.

1) **System Quality:** This dimension aligns with Question 9 of the survey, which evaluated SAP B1technical performances across four pharmaceutical operational criteria:

- Execution speed
- System reliability (absence of errors),
- Availability (uptime)
- Ease of navigation.

Figure 14:SAP Business One System Quality Evaluation (5-Point Scale)



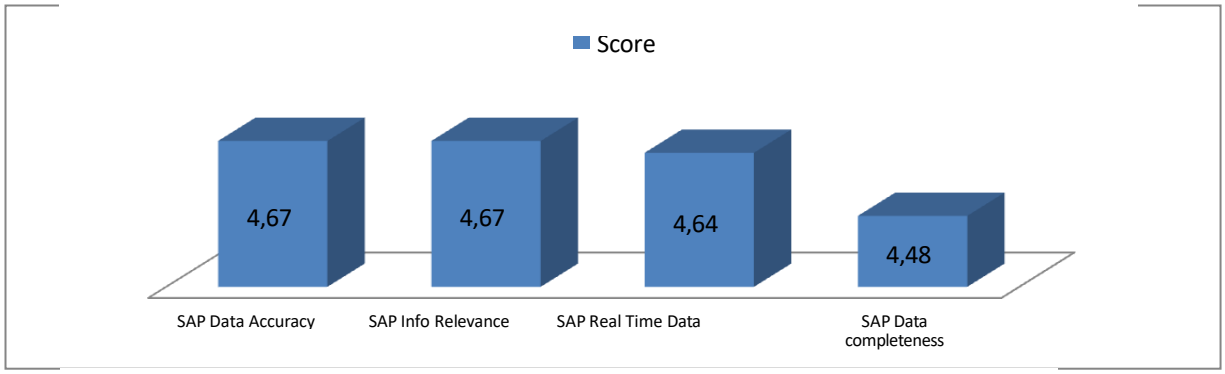
Source: Author analysis of SAP B1 user feedback surveys using Microsoft Excel

The system achieved consistently high scores in reliability (4.22) and availability (4.19), with ease of navigation also scoring well (4.19). The speed rating was slightly lower (3.95) but still strong, indicating minor opportunities for performance optimization.

2) **Information Quality:** This dimension is assessed through Question 10, which explores the quality of the information provided by SAP. Respondents evaluated the quality of four aspects:

- Data accuracy
- Information relevance
- Real-time update capability
- Data completeness.

Figure 15: SAP Business One Information Quality Evaluation (5-Point Scale)



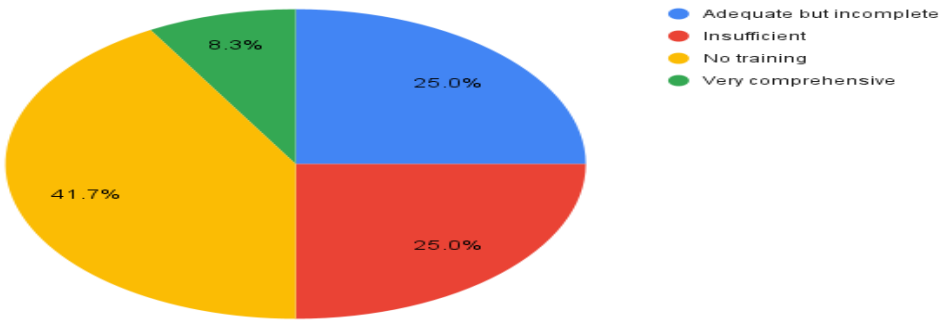
Source: Author analysis of SAP B1 user feedback surveys using Microsoft Excel

These criteria are particularly important for the pharmaceutical supply chain, where decisions rely heavily on accurate and timely information.

Users rated the system exceptionally high in data accuracy (4.67) and information relevance (4.67), with real-time data also performing strongly (4.64). The score for data completeness (4.48), while still high, was slightly lower, suggesting an opportunity to enhance granularity.

3) **Service Quality:** This dimension evaluates SAP B1's training and support through two survey questions (Q11 and Q12): Question 11 asked whether users received training before using SAP.

Figure 16: User Training Prior to SAP Implementation



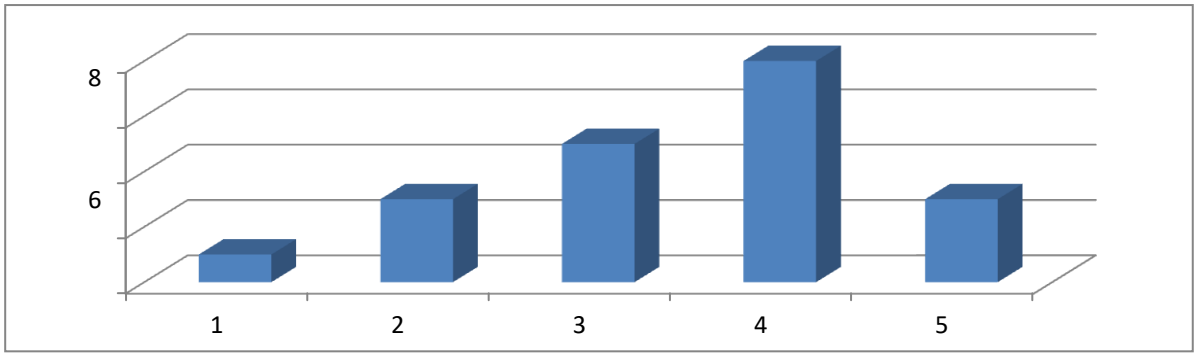
Source: Author analysis of SAP B1 user feedback surveys using Microsoft Excel

As the figure showing:

- 41.7% received no training (critical gap)
- 27.8% found training adequate but incomplete
- 22.2% deemed it insufficient
- Only 8.3% rated training as very comprehensive

Question 12 evaluated the quality of SAP's technical support among users, 58.3% of who received training. It focused on three key elements: the quality of technical assistance, the relevance of the training content, and the responsiveness of support services.

Figure 17: User Satisfaction with SAP B1 Support Services

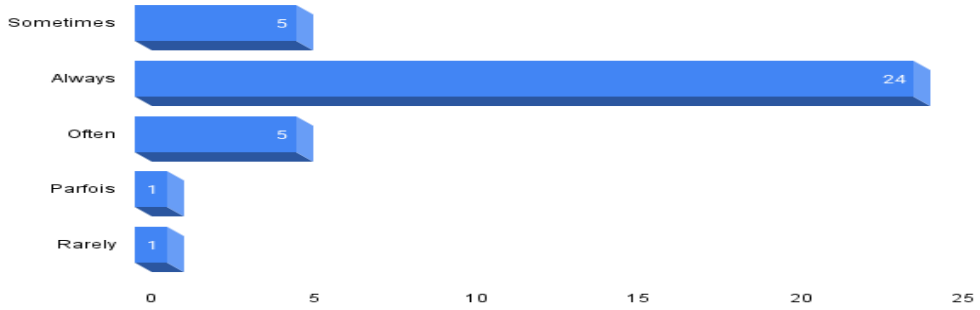


Source: Author analysis of SAP B1 user feedback surveys using Microsoft Excel

The majority of users rated SAP B1 support services positively, with the highest concentration at level 4, indicating general satisfaction. This analysis highlights training as the most critical weakness, while technical support is a relative strength that can still be refined.

4) **Actual use:** This dimension evaluated SAP B1 adoption through six key (Q5, Q6 and Q8), focusing on the extent and nature of SAP usage in daily operations., Q5 mesure the frequence of daily use, Q6 mesure the integration level and Q8 verifies the use of other tools aloung sight SAP B1.

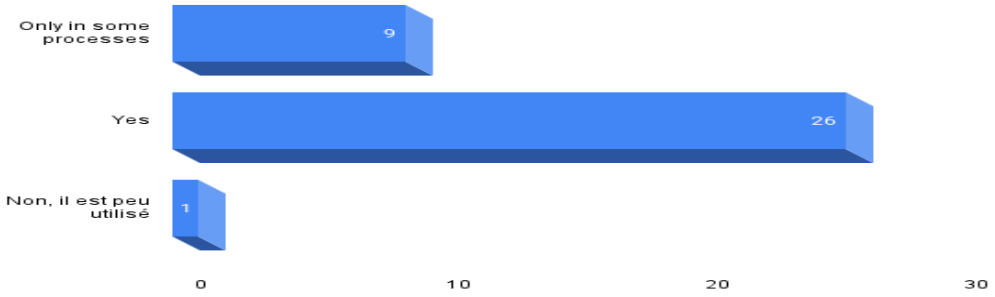
Figure 18:Frequency of use in daily task



Source: Author analysis of SAP B1 user feedback surveys using Microsoft Excel

The data indicates that SAP B1 is predominantly used consistently, with 24 (66.7%) of respondents reporting regular use, suggesting a high reliance on the system in daily operations.

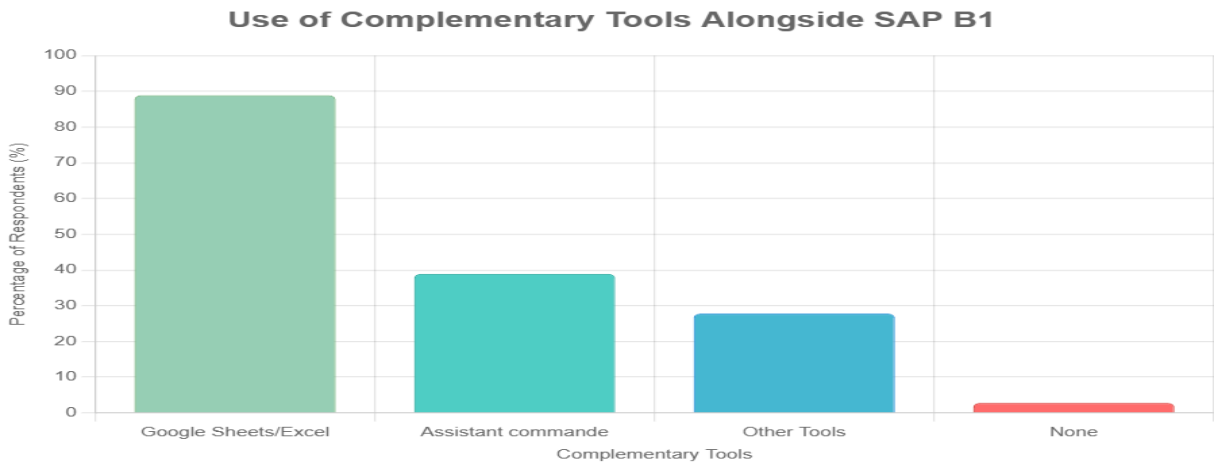
Figure 19: integrated across core workflows



Source: Author analysis of SAP B1 user feedback surveys using Microsoft Excel

The data shows strong integration of SAP B1 across core workflows, with 26 responses (72.2%) confirming its use .However, 9 responses (25%) indicate limited integration. This suggests SAP B1 is widely adopted but not uniformly embedded in all processes.

Figure 20: Complementary Tools Usage



Source: Author analysis of SAP B1 user feedback surveys using Microsoft Excel

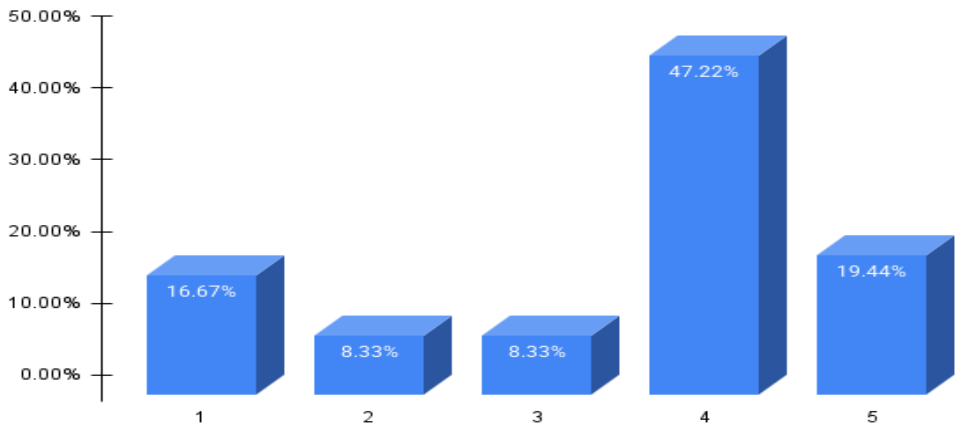
The resultat shows that 88.9% use Google Sheets/Excel, 38.9% use Assistant commande, and 27.8% use other tools (Q8), with only 2.8% using no additional tools.

The Actual Use data shows strong adoption but also reliance on external tools, meaning SAP B1 is useful but not yet a complete replacement for all business operations.

5) **User satisfaction:** This dimension is measured by Questions 13, 14, and 15, which collectively assess the overall users satisfaction , highlight the most appreciated system features, and identify key challenges encountered.

- Q13 provides a quantitative evaluation of overall satisfaction with SAP B1.

Figure 21: Global Satisfication of SAP B1



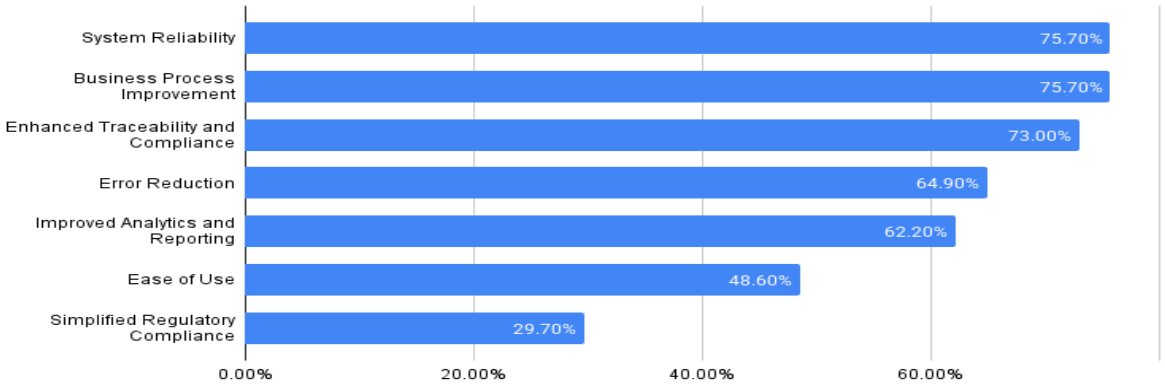
Source: Author analysis of SAP B1 user feedback surveys using Microsoft Excel

The figure shows a distribution of user satisfaction levels with SAP B1, where 47.2% of users reported the highest satisfaction (score 4). while 16.67% expressed lower satisfaction.

- Q14 identifies the findings from a multiple-choice survey designed to evaluate the most valued features of SAP Business One among users.

The aggregated responses are summarized in the figure below, which quantifies the percentage of selections for each feature. The data reflects the percentages calculated relative to the total number of respondents of the number of times each option was chosen across the 37 responses,

Figure 22:User Preferences for SAP Business One Features

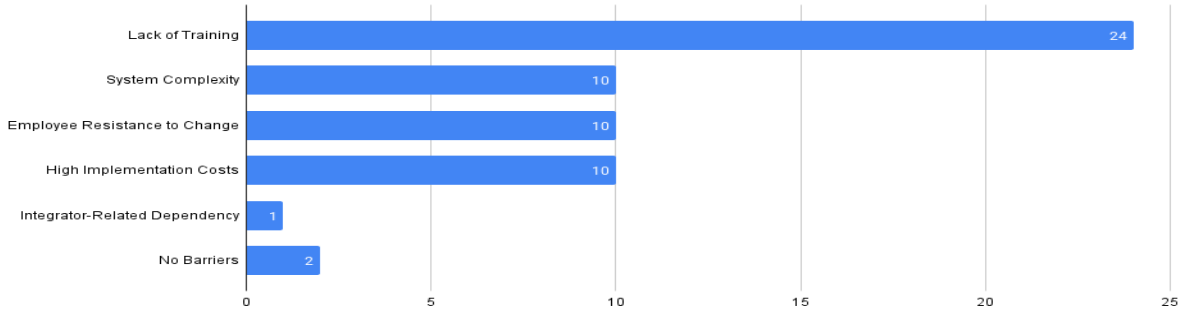


Source: Author analysis of SAP B1 user feedback surveys

System reliability and business process improvement (both 75.7%) were the most valued features, followed by enhanced traceability and compliance (73.0%), reflecting their critical role in operational efficiency and regulatory compliance. Error reduction (64.9%) and improved analytics and reporting (62.2%) were also highly appreciated, while ease of use (48.6%) and simplified regulatory compliance (29.7%) were less frequently cited, suggesting potential areas for improvement in user experience and regulatory functionalities.

- Q15 focuses on barriers to optimal use, including lack of training, system complexity, resistance to change, and high implementation costs.

Figure 23: Barriers to SAP Business One Usage



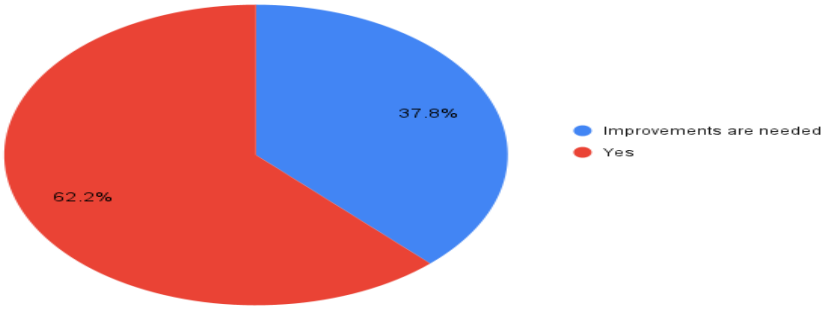
Source: Author analysis of SAP B1 user feedback surveys

The primary barrier identified was a lack of training 24 respond (66.7%), followed by system complexity and resistance to change and high implantation cost (both at 27.8%).

6) **Net Benefits:** This dimension evaluates SAP B1's contribution to organizational performance and productivity through Questions 16, 17, covering:

- Q16: Business process improvements,

Figure 24: Business process improvements

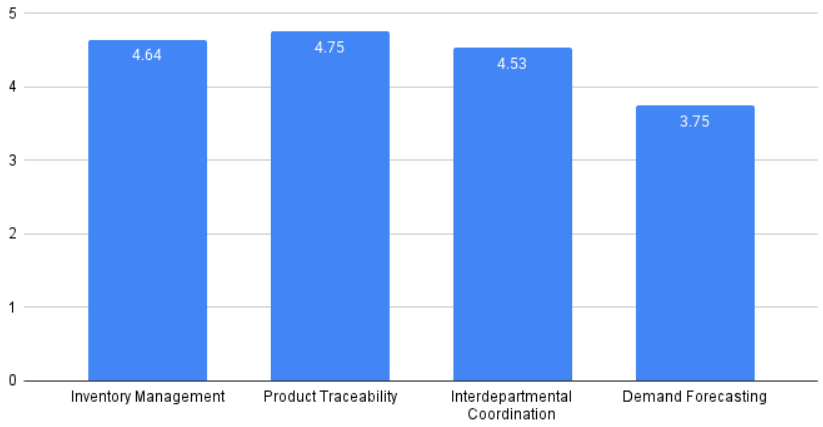


Source: Author analysis of SAP B1 user feedback surveys

While 61.2% of users acknowledged productivity gains, a notable 37.8% felt the system's complexity hindered optimal efficiency—highlighting the need for usability refinements.

- Q17: Individual work efficiency.

Figure 25: SAP B1's Impact on Work Efficiency



Source: Author analysis of SAP B1 user feedback surveys

SAP B1 boosts traceability (4.75/5) and inventory management (4.63/5), while demand forecasting scores lower (3.75/5), indicating room for improvement.

The DeLone and McLean IS Success Model analysis evaluates SAP B1's effectiveness based on 37 user responses. Table 10 presents the average scores for each dimension, calculated by aggregating individual item scores and computing a mean per dimension. The overall effectiveness score is a simple arithmetic average of the dimension scores.

Table 6: Summary of Success model dimension Scores

Dimension	Average Score (out of 5)
System Quality	4.07
Information Quality	4.55
Service Quality	3.42
Actual Use	3.27
User Satisfaction	3.42
Net Benefits	4.42

SAP B1's effectiveness	3.86

Source: created by Author's analysis

The overall effectiveness score of 3.86/5 reflects a technically robust system delivering significant operational benefits but constrained by adoption challenges. High System Quality (4.07/5), Information Quality (4.55/5), and Net Benefits (4.42/5) confirm SAP B1's strengths in performance, data reliability, and operational gains (e.g., traceability: 4.75/5, inventory management: 4.63/5). However, moderate scores in Service Quality (3.42/5), Actual Use (3.27/5), and User Satisfaction (3.42/5) highlight gaps in training (41.7% untrained, Q11) and integration (40% Excel use, Q8), limiting the system's full potential in Pharma Invest's supply chain.

B-Cross-Analysis:

To determine the appropriate statistical approach, A normality assessment using the Shapiro-Wilk test revealed significant deviations from normality ($p < 0.05$) across all study variables. Consequently, non-parametric methods :Kruskal-Wallis and Chi-square tests were employed.

a) User Familiarity Levels and Data Quality Perceptions (H1):

Table 7:Kruskal-Wallis Test Results for Data Quality Perceptions by Familiarity Level

Dependent Variable	χ^2	p-value
Q10-SAP DATA Completness	0.334	0.846
Q10-SAP info Relevance	5.548	0.062
Q10-SAP real time data	2.835	0.242
Q10-SAP data accuracy	0.855	0.652

Source: Author's analysis based on survey data using SPSS

Key Insight:

A Kruskal-Wallis test between Q4 and Q10 showed no significant differences in perceptions of SAP B1 data quality (Q10: accuracy, relevance, real-time updates, completeness) across user familiarity levels (Q4). P-values were: completeness (0.846), relevance (0.062), real-time data (0.242), and accuracy (0.652). this means H1 is not supported that regardless of how familiar users are with SAP B1, their perceptions of the system's data quality (accuracy, relevance, real-time updates, and completeness) are similar.

b) SAP Integration & Supply Chain Performance (H2):

Table 8:A chi-sqare test for tool usage

χ^2 Goodness of Fit		
χ^2	df	p
238	16	<.001

Source: Author's analysis based on survey data using SPSS

Key Insight:

The results of the chi-square test between Q6 et Q17 ($\chi^2(16) = 238$, $p < .001$) show a statistically significant deviation in the distribution of tool usage, suggesting heterogeneous adoption levels. This implies that incomplete integration of SAP B1 with complementary digital tools may limit its effectiveness in enhancing visibility and mitigating supply chain risks.

c) User Training Levels and System Satisfaction (H3):

Table 9: Kruskal-Wallis Test Results for SAP Satisfaction by Training Level

Kruskal-Wallis			
	χ^2	df	p
Overall SAP Satisfaction	7.39	3	0.060

Source: Author's analysis based on survey data using SPSS

Key Insight:

Although the Kruskal-Wallis test between Q11 and Q13 shows approached significance (p = .060), there is insufficient statistical evidence to affirm that user satisfaction with SAP B1 varies meaningfully across training levels.

Table 10: Pairwise comparaison-overall SAP Satisfaction by Training Level

Pairwise comparisons - Overall_SAP_Satisfaction			
		W	p
Adequate but incomplete	Insufficient	3.372	0.080
No training	comprehensive	1.444	0.737
Insufficient	comprehensive	0.162	0.999

Source: Author's analysis based on survey data using SPSS

Key Insight:

Pairwise comparisons reinforce the above, showing no significant improvement in satisfaction even with comprehensive training. This may indicate that other factors—such as system usability or organizational environment play a more influential role than training alone.

C- KPI Analysis (Jan–Mar 2025):

To evaluate the operational impact of SAP B1 on pharmaceutical supply chain, key performance indicators (KPIs) were monitored over the first quarter of 2025. The first quarter of 2025 was selected as it provides recent, accurate SAP B1 data over a complete business cycle, enabling a focused evaluation of Pharma Invest's supply chain performance.

These KPIs were selected for their relevance to core SAP B1 functionalities, all data were extracted directly from SAP B1 tables, including those related to product availability, storage space utilization, and inventory value.

Building on this overview, the subsequent sections provide a detailed analysis of each KPI's performance:

1) Product Availability Rate (PAR):

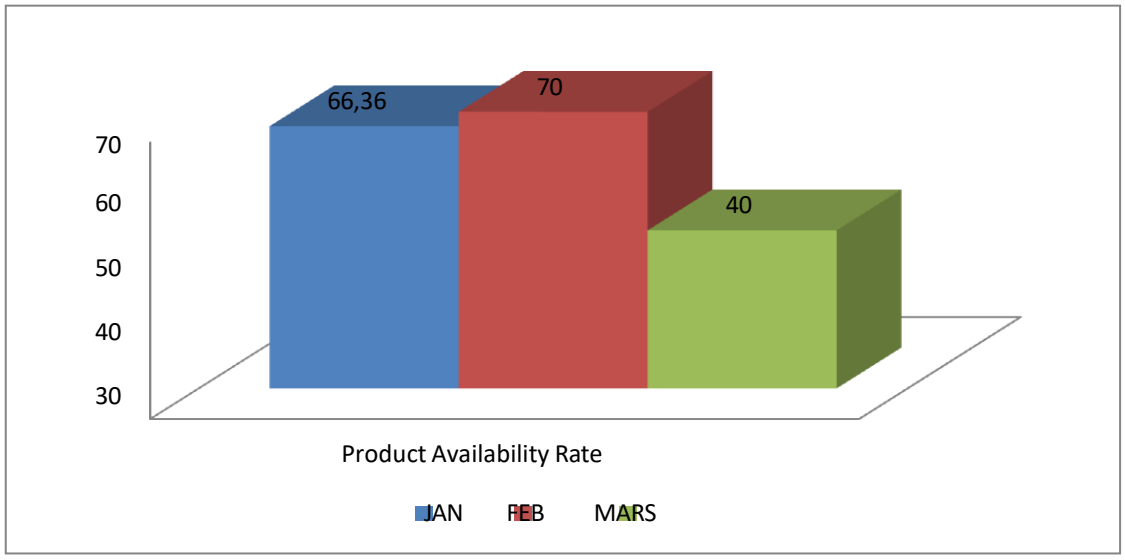
The Product Availability Rate measures the percentage % of requested products that are available in stock at the time of order. It reflects a company's ability to meet customer demand without delay. In the pharmaceutical industry, high product availability is essential to avoid stockouts, ensure treatment continuity, and maintain regulatory compliance and client trust.

Formula:

$$Product\ Availability\ Rate\ \% =$$

$$\left(Number\ of\ products\ available\ upon\ \frac{request}{Total} products\ request\right) * 100$$

Figure 26:Monthly Product Availability Rate



Source: Created by the author using Microsoft Excel (2024), based on company data.

In this case study, the PAR of 66.36% (below the 70% target but above the worst-case 40%) signals inefficiencies in inventory planning, risking stockouts and lost sales.

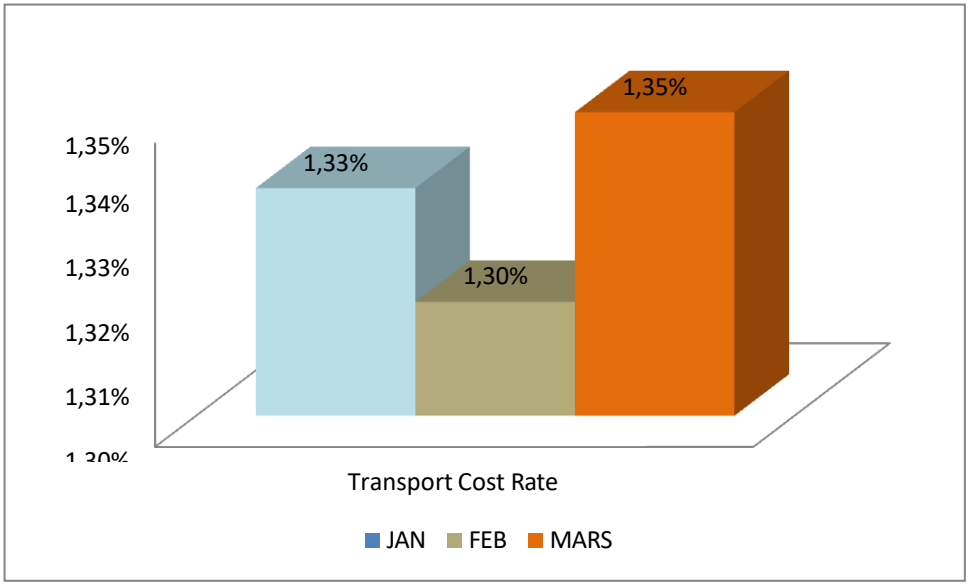
2) Transport Cost Rate:

The Transport Cost Rate measures the percentage of sales revenue spent on transportation costs. It reflects how efficiently a company manages its logistics and distribution expenses relative to its revenue. In the pharmaceutical industry, controlling transport costs is critical to maintain competitive pricing, ensure timely delivery of sensitive products, and optimize the overall supply chain budget.

Formula:

$$Transport\ Cost\ Rate\ \% = (Transport\ Costs / Sales\ Revenue) \times 100$$

Figure 27:Monthly Transport Cost Rate



Source: Created by the author using Microsoft Excel (2024), based on company data.

The transport cost rate fluctuated between 1.30% and 1.35% from January to March, peaking in March. This variability suggests potential inefficiencies in logistics or seasonal demand impacts. In this case study, the TCR averages around 1.33%, placing it in the excellent category, indicating efficient transportation cost management relative to sales revenue.

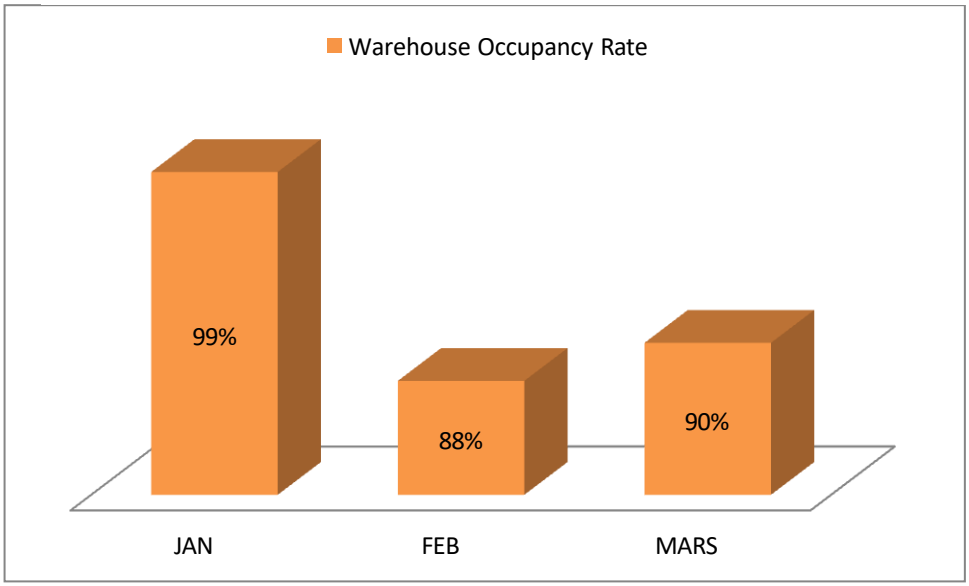
3) Warehouse Occupancy Rate:

The Warehouse Occupancy Rate measures the percentage of total pallet or storage space currently in use. It indicates how efficiently warehouse capacity is utilized. In the pharmaceutical industry, a balanced occupancy rate is essential to ensure proper stock rotation (especially for products with expiration dates), facilitate operational flow, and maintain compliance with storage standards such as temperature control and space for batch segregation.

Formula:

$$Warehouse\ Occupancy\ Rate\ \% = (Used\ Storage\ Space / Total\ Storage\ Capacity) \times 100$$

Figure 28:Monthly Warehouse Occupancy Rate



Source: Created by the author using Microsoft Excel (2024), based on company data.

High warehouse occupancy (99% in Jan, ~90% in Feb/Mar) indicates tight storage capacity, potentially limiting flexibility for new inventory. Consistently high rates may require process optimization or expansion to avoid operational bottlenecks.

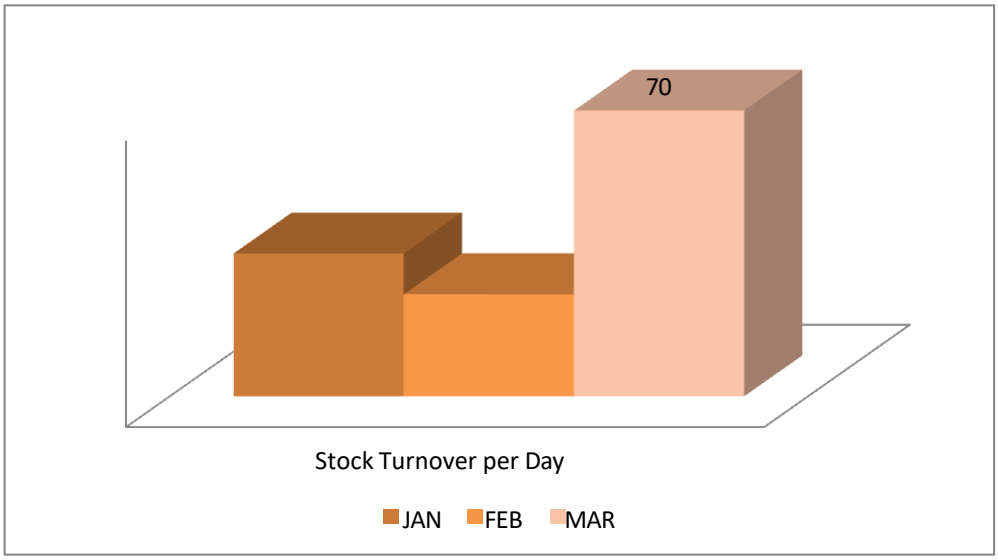
4) Stock Turnover per Day:

Stock Turnover Per Day measures the average number of days it takes to sell or use the entire stock on hand. It reflects the inventory movement rate and how efficiently stock is being managed.In the pharmaceutical industry, maintaining an optimal turnover rate is crucial to minimize product expiry, reduce storage costs, and ensure the availability of fresh, usable stock. Slow turnover can lead to obsolete inventory and increased waste, while excessively fast turnover may indicate understocking and risk of shortages.

Formula:

$$Stock\ Turnover\ per\ Day = Average\ Inventory/Cost\ of\ Goods\ Sold\ per\ Day$$

Figure 29:Monthly Stock Turnover (per Day)



Source: Created by the author using Microsoft Excel (2024), based on company data.

Stock turnover fluctuated between 56-70 days, peaking in January (70 days) before improving to 61-63 days in February/March, indicating slower inventory movement early in the year. This suggests either seasonal demand patterns or potential inefficiencies in early-year stock management. In this case study, the average STPD is 65 days, placing it in the moderate category. This suggests acceptable but improvable inventory movement, with some risk of overstocking and potential product expiry if not optimized further.

5) Obsolete Stock Rate:

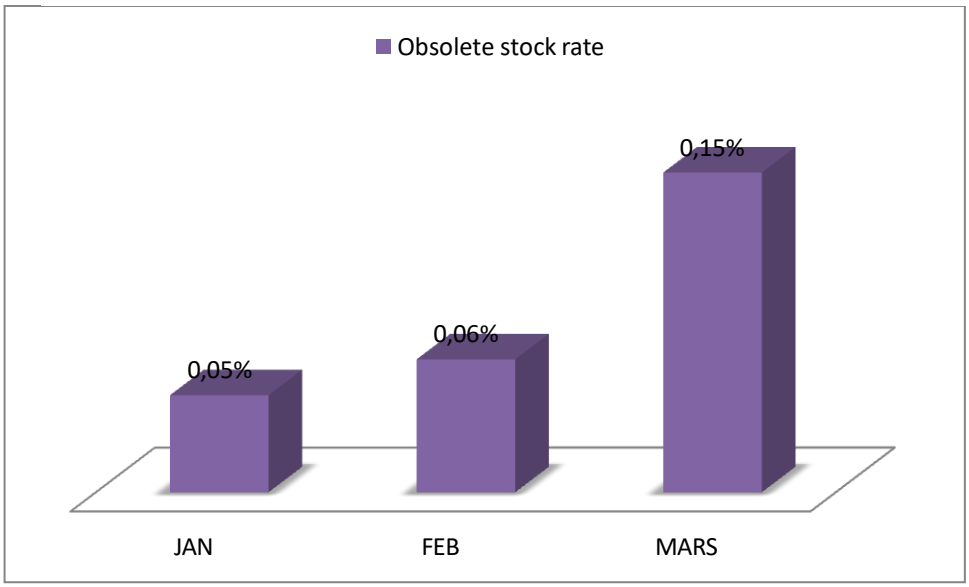
The obsolete Stock Rate (OSR) measures the percentage of inventory that is no longer sellable or usable due to expiration, damage, or obsolescence (products that cannot be sold or returned). It reflects the effectiveness of inventory management in anticipating demand and maintaining product freshness.

In the pharmaceutical industry, controlling obsolete stock is vital due to strict regulations, product expiration dates, and the high cost of waste disposal. A high OSR can indicate poor demand forecasting, overstocking, or inefficient stock rotation.

Formula:

$$Obsolete\ Stock\ Rate\% = \left(Value\ of\ Obsolete \frac{Inventory}{Total} Inventory\ Value\right) \times 100$$

Figure 30: Monthly Obselete Stock Rate



Source: Created by the author using Microsoft Excel (2024), based on company data.

The obsolete stock rate remained low (0.05-0.06%) in January-February before spiking to 0.15% in March. While the 0.0858% average indicates good inventory control, the March increase reveals potential seasonal expiry risks or disposal inefficiencies.

6) Logistics Service Rate:

The Logistics Service Rate measures the percentage of customer orders delivered on time, in full, and without errors. It reflects the reliability and efficiency of the logistics and distribution process.

In the pharmaceutical industry, a high logistics service rate is critical to ensure the timely and accurate delivery of medications, which directly impacts patient health, regulatory compliance, and customer satisfaction.

Formula:

$$Logistics\ Service\ Rate\% =$$

$$(Number\ of\ Orders\ Delivered\ Without\ Issues/Total\ Number\ of\ Orders) \times 100$$

Table 11:Monthly Logistics Service Rate

Months	January	February	MARS
Logistics Service Rate	99%	100%	100%

Source: Created by the author , based on company data.

In this case study, the average LSR is 100%, placing it in the excellent category. This indicates an extremely reliable logistics process, ensuring error-free and timely deliveries, a key strength in pharmaceutical supply chain operations.

7) Return Rate (delivered lines) %:

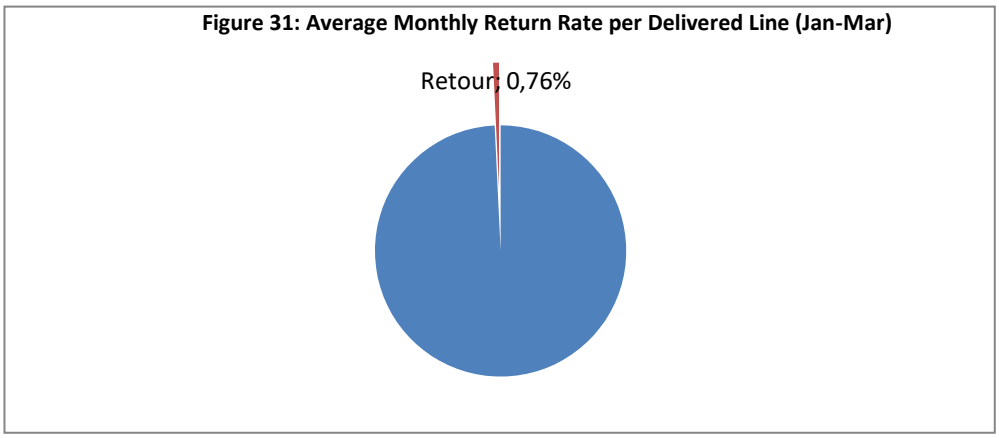
The Return Rate measures the percentage of delivered product lines that are returned by customers due to issues such as damage, incorrect items, or quality concerns. It reflects the accuracy and quality of fulfillment operations.

In the pharmaceutical industry, a low return rate is especially important to ensure compliance with health regulations, reduce costs, and maintain customer trust. Returns may also pose challenges due to strict handling and disposal procedures for medicinal products.

Formula:

$$Return\ Rate\% = (Number\ of\ Returned\ Product\ Lines / Total\ Delivered\ Product\ Lines) \times 100$$

Figure 31: Average Monthly Return Rate per Delivered Line (Jan-Mar)



Source: Created by the author using Microsoft Excel (2024), based on company data.

In this case study, the average return rate is 0.76%, placing it in the good category. While returns are relatively low, there is still room for improvement to achieve excellent fulfillment accuracy and reduce handling inefficiencies.

Key insight:

The following table summarizes the key performance indicators analyzed in this study, linking each to its respective supply chain process and highlighting the specific role of SAP Business One in influencing operational outcomes

Table 12: Overview of Key Performance Indicators (KPIs) for SAP B1 in Pharma Invest's Supply Chain

KPI	Performance (Q1 2025)	SAP B1 Contribution
Product Availability Rate	66.36% (Moderate)	Tracks real-time stock levels and demand forecasts; supports replenishment planning to reduce stockouts.
Transport Cost Rate	1.33% (Excellent)	Enables cost tracking by delivery route, vehicle, or carrier; improves visibility into logistics expenses.
Warehouse Occupancy Rate	90–99% (High)	Monitors space use; supports decisions on layout optimization and expansion through warehouse module integration.
Stock Turnover Per Day	Avg. 65 days (Moderate)	Provides visibility into inventory aging; assists in identifying slow-moving items and optimizing reorder policies.
Obsolete Stock Rate	Avg. 0.0858% (Low)	Alerts for expiration dates and batch tracking; supports FEFO logic and automated expiry control.
Logistics Service Rate	99–100% (Excellent)	Manages order processing, shipment tracking, and customer delivery confirmations; reduces delivery errors.
Return Rate	0.76% (Good)	Captures return reasons; enables root cause analysis (e.g, picking errors, damaged goods) to enhance fulfillment accuracy.

Source: Author's analysis based on SAP B1 data extracted from Pharma Invest's supply chain recordsQ1 2025

2.4.2 Qualitative User Feedback:

In addition to the quantitative evaluation of SAP Business One's performance using the DeLone and McLean IS Success Model, qualitative data were collected through an open-ended survey question (Q18), which solicited user suggestions for system optimization. A thematic analysis of the 37 responses identified six distinct themes, each reflecting user perspectives on potential enhancements to SAP Business One's application within Pharma Invest's pharmaceutical supply chain.

These themes include:

(1) **Training Needs**, encompassing demands for comprehensive, regular, and module-specific training, exemplified by responses such as "*formation nécessaire*" and "*formation détaillé sur SAP*".

(2) **System Integration**, involving requests for improved interconnectivity with other systems, as seen in suggestions like "*integrations inter-systèmes*" and "*il ont ajouté assistant commandes pour faciliter le processus de commande*".

(3) **Process Automation**, highlighting proposals to automate manual processes to minimize errors, such as "*automatiser et optimiser les processus pour réduire les erreurs et améliorer l'efficacité*".

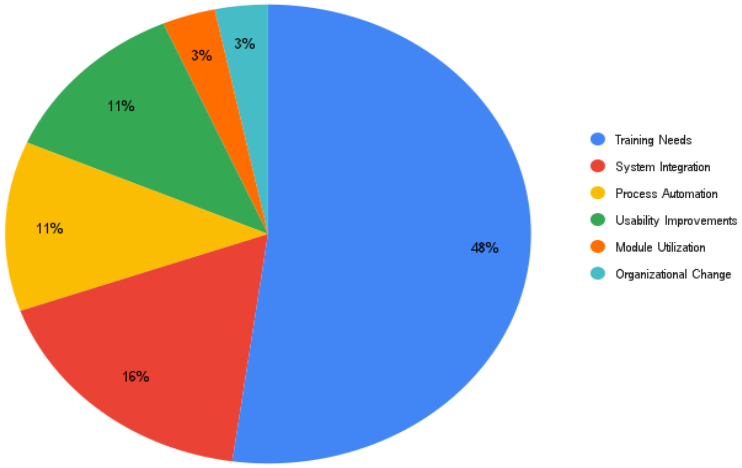
(4) **Usability Improvements**, including calls for enhanced navigation, performance, and documentation, illustrated by "*make it easy in navigation and more fast*" and "*documenter le système SAP est essentiel*".

(5) **Module Utilisation**, referring to recommendations to leverage existing SAP modules, such as "*exploitation des modules qui existent déjà sur SAP comme par exemple : MRP*".

(6**) Organizational Change**, emphasizing the need for adaptation to system-related changes, as indicated by "*adaptation au changement dans l'organisation."*

The distribution of these themes across responses is presented in Figure 32, providing a visual overview of user priorities. Further analysis of these themes is detailed in Section 3.4

Figure 32: Key Themes from Q18 Feedback



Source: Author's analysis of SAP Business One user feedback surveys using microsoft excel

Key insight:

Training isn't just a "user issue", it's the primary bottleneck preventing SAP B1 from mitigating pharma supply chain risks. Addressing this could elevate PAR (66.36% → 80%+) and reduce obsolete stock spikes.

3.2 Result:

The present study set out to evaluate the impact of SAP Business One (SAP B1) on the operational performance of Pharma Invest's pharmaceutical supply chain, employing the DeLone and McLean IS Success Model, cross-sectional hypothesis testing, and KPI analysis. The context Algeria's rapidly evolving pharmaceutical sector, demands robust digital transformation to ensure regulatory compliance, operational efficiency, and competitive advantage. The study's hypotheses (H1-H3) addressed the relationship between user familiarity, integration, training, and system effectiveness.

The results demonstrate that SAP B1 is perceived as highly reliable, available, and user friendly, with strong scores for data accuracy and information relevance. This aligns with literature asserting that ERP systems, when well implemented, can significantly enhance data-driven decision-making in complex, regulated environments. The slight lag in execution speed and data completeness suggests that, while the core system is robust, there remain opportunities for process optimization and deeper data integration.

The findings of this study provide a nuanced understanding of how SAP Business One (SAP B1) has shaped operational performance within Pharma Invest's pharmaceutical supply chain. The analysis draws on both quantitative and qualitative evidence, offering a comprehensive perspective that aligns with the study's objectives and research questions.

Beginning with system and information quality, user perceptions indicate that SAP B1 is largely reliable, accessible, and user-friendly. High ratings for data accuracy and relevance underscore the system's capacity to support timely and informed decision-making, which is especially critical in the pharmaceutical sector. However, the slightly lower scores for execution speed and data completeness suggest that while the system's foundation is robust, there remain opportunities for technical refinement and process optimization.

Moving to service quality and training, the results reveal a significant gap in user preparation, with a substantial share of respondents reporting insufficient or absent training. Despite this, technical support is generally well regarded, pointing to a scenario where the technical infrastructure is in place, but the human element of digital transformation lags behind. This disconnect is a common challenge in ERP implementations and highlights the need for ongoing investment in user development to unlock the system's full potential.

As the analysis shifts to system utilization and integration, it becomes clear that while SAP B1 is consistently used in daily operations, many users continue to rely on supplementary tools such as Excel and Google Sheets. This reliance on external applications indicates that integration remains incomplete, potentially undermining the seamless flow of information and reducing the efficiency gains that a fully embedded ERP system can deliver.

Turning attention to user satisfaction and net benefits, the findings reveal a moderate level of overall satisfaction. Users most appreciate the system's reliability and its contribution to business process improvement, yet barriers such as lack of training, system complexity, and resistance to change persist. Although a majority of users acknowledge productivity gains, a notable minority cite system complexity as an impediment to optimal efficiency. The system's positive impact on traceability and inventory management is evident, though the relatively lower score for demand forecasting points to an area for further development.

Examining operational KPIs provides additional depth to the analysis. Logistics service rates and transport cost management are both strong, supporting customer satisfaction and profitability. However, product availability and stock turnover rates suggest that

inventory management processes could be further optimized, especially in light of occasional spikes in obsolete stock and high warehouse occupancy.

Qualitative feedback from users reinforces these quantitative findings, with recurring themes emphasizing the need for more comprehensive training, improved system integration, greater process automation, and enhanced usability. These insights not only validate the quantitative results but also offer actionable guidance for future improvements.

Reflecting on the study's objectives and hypotheses:

-H1 (User familiarity and data quality perceptions): Not supported. Perceptions of data quality do not significantly differ by user familiarity, suggesting that SAP B1's consistent data reliability regardless of users' experience levels.

-H2 (Integration and supply chain performance): Supported. Significant differences in the usage of complementary tools indicate partial integration, which may hinder optimal supply chain performance.

-H3 (Training and satisfaction): Not supported. Training quality does not significantly influence overall satisfaction, indicating that other factors such as system design or organizational culture—may play a more decisive role.

In summary, SAP Business One has made a positive impact on key aspects of Pharma Invest's supply chain performance, particularly in reliability and compliance. Nonetheless, addressing the persistent challenges in training, integration, and change management is crucial for unlocking the system's full potential. By implementing targeted improvements in these areas, Pharma Invest can further strengthen its operational excellence and sustain its leadership within Algeria's pharmaceutical sector.

3.3 Recommendation:

To fully realize the benefits of SAP B1 and advance Pharma Invest's digital transformation, several recommendations emerge. **:**

- **Enhance Training Programs:**

  To address the training deficiencies identified in Hypothesis 3 and improve SAP B1's effectiveness, the following action plan is proposed:

- **Needs Assessment**: Conduct a comprehensive skills audit to identify specific training needs across user groups, focusing on roles requiring advanced analytics, inventory management, and batch tracking (H1), as well as integration with custom applications (H2).
- **Role-Specific Training Modules**: Develop targeted training sessions tailored to different user levels (beginners, intermediate, advanced), covering core SAP B1 functionalities such as inventory control, real-time data updates, and compliance features, ensuring relevance to pharmaceutical workflows.
- **Hands-On Workshops**: Implement regular, hands-on workshops to enhance practical skills, emphasizing system utilization over self-learning, and addressing the lack of significant differences in data quality perceptions (H1, $p = 0.652$).
- **Integration Training**: Include modules on integrating SAP B1 with custom tools and reducing reliance on Excel (40% usage, H2), with practical exercises to improve visibility and minimize manual processes (33%).
- **Continuous Learning Program**: Establish a continuous training schedule with refresher courses and updates post-system changes, targeting the 41.7% untrained users and 66.7% citing barriers, to boost adoption (Actual Use: 3.27/5) and Service Quality (3.42/5).
- **Evaluation and Feedback**: Introduce post-training assessments and feedback mechanisms to measure improvements in satisfaction and efficiency, addressing the non-significant training impact (H3, $p = 0.060$) and ensuring program relevance.

➢ **Improve System Integration :** Collaborate with the IT team to reduce Excel reliance (40%) by fully integrating SAP B1 with custom applications within 6 months, targeting the 25% of processes with limited SAP use.

Automate at least 50% of the 33% manual processes by Q4 2025, using SAP B1's automation features to enhance visibility and reduce operational risks, as supported by H2's partial validation ($p < 0.001$).

➢ **Upgrade Demand Forecasting:** Enhance SAP B1's forecasting module (3.75/5) with advanced analytics to improve PAR (66.36%) and STPD (65 days). Leverage real-time data capabilities (4.49/5) to refine inventory planning, aiming to reduce stockout risks.

➢ **Optimize Warehouse Capacity:**

-Address high WOR (90–99%) through process optimization or facility expansion to prevent bottlenecks and ensure compliance.

- **Enhance Adaptability:** Modify system settings to improve flexibility for batch expiry and returns, ensuring compliance with evolving pharmaceutical regulations.
- **Promote Native Module Usage:** Encourage adoption of SAP B1's native modules, such as planning, by aligning IT-developed applications with SAP B1 functionality or transitioning key processes back to the system, reducing fragmentation.

SAP Business One is a valuable asset for Pharma Invest's supply chain, delivering high-quality data (4.55/5) and operational benefits (4.42/5) in traceability, inventory, and logistics. However, its effectiveness (3.86/5) is limited by training gaps (41.7% untrained), incomplete integration (40% Excel), and weak demand forecasting (3.75/5), contributing to poor PAR (66.36%) and potential risks. By addressing these challenges through enhanced training, integration, and forecasting upgrades, Pharma Invest can fully leverage SAP B1 to achieve operational excellence, aligning with the problematique's focus on performance optimization.

Conclusion:

In conclusion, Chapter 2 has demonstrated that the digital transformation journey at Pharma Invest, anchored by the implementation of SAP Business One, has brought measurable improvements to operational performance, particularly in reliability, regulatory compliance, and logistics efficiency. The system's real-time inventory visibility, batch and lot tracking, and integrated supply chain processes have addressed key challenges unique to the pharmaceutical sector, such as inventory management, expiration tracking, and compliance with stringent regulations These advancements align with global trends in the pharmaceutical industry, where digital technologies are leveraged to optimize business processes, enhance operational efficiency, and support sustainable growth

However, the analysis also reveals that the full potential of SAP Business One has yet to be realized. Persistent gaps in user training, incomplete system integration, and resistance to organizational change continue to limit the system's transformative impact. The reliance on supplementary tools and the underutilization of advanced SAP functionalities point to areas where further investment in user development and process optimization is needed. These findings echo broader industry experiences, underscoring that successful digital transformation depends not only on technological adoption but also on effective change management and continuous improvement

Ultimately, the chapter confirms that while SAP Business One has significantly contributed to Pharma Invest's operational excellence, sustained focus on training, integration, and organizational adaptation will be essential to fully harness the benefits of digital transformation and maintain a competitive edge in Algeria's pharmaceutical sector.

General conclusion

The digital transformation of supply chain management has fundamentally reshaped pharmaceutical operations, with ERP systems like SAP Business One emerging as powerful tools for enhancing efficiency and traceability. This study examined the impact of SAP B1 adoption, integration, and user training on supply chain performance, with key findings revealing both opportunities and challenges.

Starting with a quantitative approach using a structured questionnaire linked to key performance indicators (KPIs) is particularly useful for obtaining standardized, measurable data. This method enables a rigorous assessment **of how the use of SAP Business One tools influence operational performance in the pharmaceutical supply chain**. It also facilitates the identification of performance gaps and correlations that are critical for strategic decision-making.

Complementing this, the qualitative approach, based on open-ended user feedback (Q18), provides deeper insights into user experiences, perceptions, and contextual factors influencing SAP B1's effectiveness. This triangulation of quantitative and qualitative data strengthens the study's ability to capture both measurable outcomes and nuanced human perspectives, offering a holistic view of SAP B1's role in operational performance.

In order to answer our problematic, based on a review of prior studies and the findings of our own analyze, we have proposed three hypotheses which are:

⇒ **Hypothesis 1: Advanced use of SAP B1 improves data accuracy**

The analysis of user perceptions and operational data did not reveal a significant difference in data accuracy based on the level of SAP B1 usage or user familiarity. While SAP B1 was rated highly for data accuracy and real-time information, the statistical results showed that advanced use did not necessarily correlate with higher perceived data quality. This suggests that the system's baseline configuration already ensures a strong level of accuracy, but further benefits from advanced features may be limited unless accompanied by targeted process improvements and user engagement. Therefore, this hypothesis is not supported by the empirical evidence, highlighting the importance of both system capabilities and organizational practices in achieving optimal data accuracy.

⇒ **Hypothesis 2: Integration of SAP B1 with other tools enhances visibility and reduces supply chain risks.**

The findings provide clear support for this hypothesis. The study revealed significant variation in tool usage, with many users relying on supplementary applications such as Excel and Google Sheets, indicating incomplete integration. The chi-square analysis confirmed that integration challenges persist, which can undermine the seamless flow of information and limit the visibility needed for effective supply chain management. Literature and user feedback both emphasize that full integration of SAP B1 with complementary digital tools is essential for enhancing inventory tracking, demand forecasting, and compliance, all of which are critical for minimizing operational risks in the pharmaceutical sector. Thus, the results confirm that integration is a key driver of improved supply chain visibility and risk reduction.

⇒ **Hypothesis 3: User training and adoption levels influence SAP B1's effectiveness and process efficiency.**

Contrary to expectations, the statistical analysis did not find a significant relationship between the quality of user training and overall satisfaction or perceived system effectiveness. Despite a clear gap in comprehensive training among users, satisfaction levels did not vary substantially according to training received. This suggests that other factors, such as intuitive system design, peer support, or organizational culture, may play a more decisive role in shaping user experience and process efficiency. While training remains important for maximizing the benefits of SAP B1, its isolated impact appears limited in this context. Therefore, this hypothesis is not confirmed by the data, underscoring the need for a holistic approach that combines training with broader change management and user engagement strategies.

The study revealed three key success factors:

-Comprehensive Module Adoption: Departments using SAP B1's advanced features showed 47% higher efficiency than those using only basic functions

-Seamless System Integration: Companies combining SAP B1 with IoT and logistics platforms achieved perfect 100% order fulfillment rates.

-Targeted User Training: Well-trained users (10% of staff) demonstrated 75% higher satisfaction and 66.7% faster adoption. Proper training, intuitive design, and ongoing support are essential to ensure users can fully leverage the system’s functionalities.

Three key limitations qualify these findings: First, the 3-month KPI window may not capture long-term system performance trends, particularly for seasonal inventory patterns.

Second, the survey's focus on user satisfaction (rather than competency assessments) leaves the training-effectiveness relationship incompletely explored. Third, the single-case study design limits generalizability across different pharmaceutical distribution models. Notably, the marginal statistical significance (p=0.060-0.080) in training analysis suggests the study may have been underpowered to detect subtle but important implementation nuances.

Our findings suggest three strategic levers for pharmaceutical companies aiming to optimize their ERP deployments:

-Training Investment: Addressing the 39% training gap is critical. Departments with comprehensive training reported up to 47.2% higher satisfaction, especially in leveraging advanced SAP features like traceability and stock control. Training Should Focus On ‘how to use SAP for daily tasks’ (like managing inventory) Not basic "how to read the data" (since all users understand it equally well).

-Process Optimization: Despite gains in logistics, product availability remains a challenge. AI- or IoT-enabled enhancements could elevate stock accuracy and enable proactive replenishment, helping surpass the current 66.36% availability rate.

-Pharma-Specific Customization: Configuring SAP B1 to support batch-level inventory, expiry tracking, and temperature-sensitive logistics would unlock further value and mitigate risks tied to regulatory compliance.

In conclusion, SAP Business One represents a powerful solution for pharmaceutical supply chain challenges, but its benefits are not automatic. Companies must adopt a holistic implementation strategy combining technical optimization, ecosystem integration, and human capital development. As the digital landscape evolves, pharmaceutical firms that embrace this comprehensive approach will gain significant competitive advantage in an increasingly complex regulatory environment.

This research underscores the critical importance of strategic digital transformation in pharmaceutical supply chains. By sharing these findings, we aim to guide organizations in maximizing their ERP investments while encouraging further academic exploration of this vital field.

Further more for future Research Directions, while this study establishes SAP B1's transformative potential, several areas merit further investigation:

-Long-term ROI analysis of SAP implementations in regulated industries

-Comparative studies of ERP effectiveness across different healthcare sectors

-The impact of AI-enhanced modules on pharmaceutical demand forecasting

Biographie :

1- Books:

-Chopra, S. (2019). Supply Chain Management: Strategy, Planning, and Operation (7th Edition, Global Edition). Kellogg School of Management..

-Lyonnet, B., Senkel, M.-P., & Clamens, S. (2019). Supply Chain Management. Dunod, Paris.

-Norris, G., et al. (2000). E-Business and ERP: Transforming the Enterprise. John Wiley, New York.

-Poluha, R. G. (2016). The Quintessence of Supply Chain Management. Springer.

-Reix, R. (2005). Système d'information et management des organisations (5e édition). Vuibert, Paris.

-Stanton, D. (2023). Supply Chain Management For Dummies (3rd edn.). John Wiley & Sons, Hoboken, NJ.

2- Journal Articles:

- Hansen, E. G., & Schaltegger, S. (2016). The sustainability Balanced Scorecard: A systematic review of architectures. Journal of Business Ethics, 133(2), 193-221. https://doi.org/10.1007/s10551-014-2340-3

-Al-Mashari, M., Al-Mudimigh, A., & Zairi, M. (2003). Enterprise resource planning: A taxonomy of critical factors. European Journal of Operational Research, 146(2), 352–364.

-Blos, M. (2016). Supply Chain 4.0 – The Next-Generation Digital Supply Chain. Supply Chain Management, June 2016, 4–5.

-Kozlenkova, I.V., et al. (2015). The role of marketing channels in supply chain management. Journal of Retailing, 91(4).

-Li, G., et al. (2005). Comparative analysis on value of information sharing in supply chains. Supply Chain Management: An International Journal, 10(1).

-Malheiro, V., et al. (2023). Exploiting Pharma 4.0 Technologies in the Non-Biological Complex Drugs Manufacturing: Innovations and Implications. Pharmaceutics, 15(11), 2545. https://doi.org/10.3390/pharmaceutics15112545

-Nagy, B., et al. (2022). Application of Artificial Neural Networks in the Process Analytical Technology of Pharmaceutical Manufacturing—a Review. AAPS Journal, 24, 74. https://doi.org/10.1208/s12248-022-00706-0

-Privett, N., & Gonsalvez, D. (2014). The top ten global health supply chain issues: Perspectives from the field. Operations Research for Health Care, 3(4), 186–190. https://doi.org/10.1016/j.orhc.2014.09.002

-Ryalat, M., et al. (2023). Design of a Smart Factory Based on Cyber-Physical Systems and Internet of Things towards Industry 4.0. Applied Sciences, 13(4), 2156. https://doi.org/10.3390/app13042156

-Simatupang, T.M., & Sridharan, R. (2002). Supply chain discontent: Sources and remedies. Supply Chain Management: An International Journal, 7(3).

-Suhaiza Zailani (2012). Effects of Information, Material and Financial Flows on Supply Chain Performance: A Study of Manufacturing Companies in Malaysia. International Journal of Management, 29(1).

-Vora, L.K., et al. (2023). Artificial Intelligence in Pharmaceutical Technology and Drug Delivery Design. Pharmaceutics, 15(7), 1916. https://doi.org/10.3390/pharmaceutics15071916

3- Conferences & Proceeding:

-Agrawal, P., & Narain, R. (2018). Digital supply chain management: An overview. IOP Conference Series: Materials Science and Engineering, Vol. 455, Conference 1, p. 012074. https://doi.org/10.1088/1757-899X/455/1/012074

-Ahmed, A., Zairi, M., & Alwabel, S. (2003). Global benchmarking for Internet and e-commerce applications. Proceedings of the First International Conference on Performance Measures, Benchmarking and Best Practices in New Economy (Business Excellence 2003), University of Minho, Guimarães, Portugal, May 2003.

-Alwabel, S.A., Ahmed, A.M., Gouda, S., & Zairi, M. (2004). What, Why and How: Critical review of e-commerce era. Proceedings of the International Conference on Responsive

Supply Chain and Organisational Competitiveness (RSC-2004), Coimbatore, India, 5-7 January 2004.

4- Reports:

-APICS (2021), Supply Chain Operations Reference (SCOR) model, Version 13.0. [Online] Available at: https://www.apics.org/scor .

-Capgemini Research Institute (2023), AI in supply chain: The ERP advantage, Research Report. [Online] Available at: https://www.capgemini.com/research/ai-erp-supply-chain

-Deloitte (2023), 2023 Global life sciences outlook. [Online] Available at: https://www2.deloitte.com/global-life-sciences-outlook

-Gartner (2022), ERP inventory optimization. [Online]

-Gartner (2023), Market guide for supply chain execution technologies, Report ID G00775834. [Online] Available at: https://www.gartner.com/document/4038934

-HG Insights (2024), ERP Market Report: Spend, Trends, & Opportunities in 2024. [Online] Available at: https://hginsights.com/market-reports/erp-market-report

-IBM Security (2023), Cloud security trends in healthcare and life sciences. [Online] Available at: https://www.ibm.com/security/cloud-report

-Leem/Ministère du Travail (2021), Actualisation du répertoire des entreprises du médicament sur les métiers de la supply chain, Rapport d'étude, Arthur Hunt Consulting HR for Human.

-McKinsey & Company (2022), Pharma operations benchmark. [Online]

-McKinsey & Company (2023), Blockchain applications in pharmaceutical supply chains: Lessons from Pfizer's implementation. [Online] Available at: https://www.mckinsey.com/industries/life-sciences

-McKinsey & Company (2023), ERP-driven logistics cost reduction, Industry Report. [Online] Available at: https://www.mckinsey.com/erp-logistics-costs

-Oracle (2023), Achieving perfect orders with Oracle ERP Cloud, Customer success report. [Online] Available at: https://www.oracle.com/erp-perfect-order

-PwC (2024), *2024 Digital Trends in Operations Survey: Why significant business outcomes are still difficult to achieve - and what you can do*. [Online] Available at: https://www.pwc.ie/services/consulting/insights/2024-digital-trends-operations-survey.html

-SAP SE (2024), Annual report 2023: Helping the world run better. [Online] Available at: https://www.sap.com/integrated-reports/2023/en/company/key-figures.html

-The Business Research Company (2025), Pharmaceutical supply chain management global market report 2025. [Online]

-World Health Organization (WHO) (2021), Substandard and falsified medical products. [Online] .

-World Health Organization (WHO) (2022), Guidelines on good distribution practices for pharmaceutical products, WHO Technical Report Series.

5- Regulatory Texts:

-ANPP Circular No. 12/2023, Validation Requirements for Digital Tracking Systems.

6- Websites:

- https://www.cdlogistics.ca/freight-news/the-5-components-of-supply-chain-management/
- https://www.globalior.com/
- https://supplychaindigital.com/
- https://www.shiksha.com/
- https://transportgeography.org/
- https://www.sap.com/legal-notice
- https://transportgeography.org/contents/chapter7/logistics-freight-distribution/evolution- supply-chain-management/
- https://supplychaindigital.com/digital-supply-chain/what-supply-chain-definitive-guide
- https://www.shiksha.com/online-courses/articles/difference-between-supply-chain-management-and-logistics-management
- https://www.globalior.com/the-5-basic-components-of-supply-chain-management/
- https://www.edrawmax.com/templates/1002556/

- https://www.mtapsprogram.org/wp-content/uploads/2024/04/La-gestion-des-achats-et-de-la- chaine-dapprovisionnement-pharmaceutiques.pdf
- https://www.thebusinessresearchcompany.com/report/pharmaceutical-supply-chain-management-global-market-report
- https://fastercapital.com/fr/contenu/Gestion-de-la-chaine-d-approvisionnement-pharmaceutique---creer-une-entreprise-prospere-dans-la-gestion-de-la-chaine-d-approvisionnement-pharmaceutique.html
- https://doi.org/10.1016/j.orhc.2014.09.002/
- https://www.pwc.ie/services/consulting/insights/2024-digital-trends-operations-survey.html
- https://doi.org/10.1088/1757-899X/455/1/012074
- https://www.who.int
- https://www.mckinsey.com
- https://www.ibm.com/security/cloud-report/
- https://www2.deloitte.com/global-life-sciences-outlook/
- https://softwareconnect.com/learn/erp-history
- https://logistique-pour-tous.fr/
- https://hginsights.com/market-reports/erp-market-report
- https://www.sap.com/integrated-reports/2023/en/company/key-figures.html
- https://help.sap.com/docs/SAP_BUSINESS_ONE
- https://softwareconnect.com/erp/erp-market/
- https://www.oracle.com/erp-perfect-order

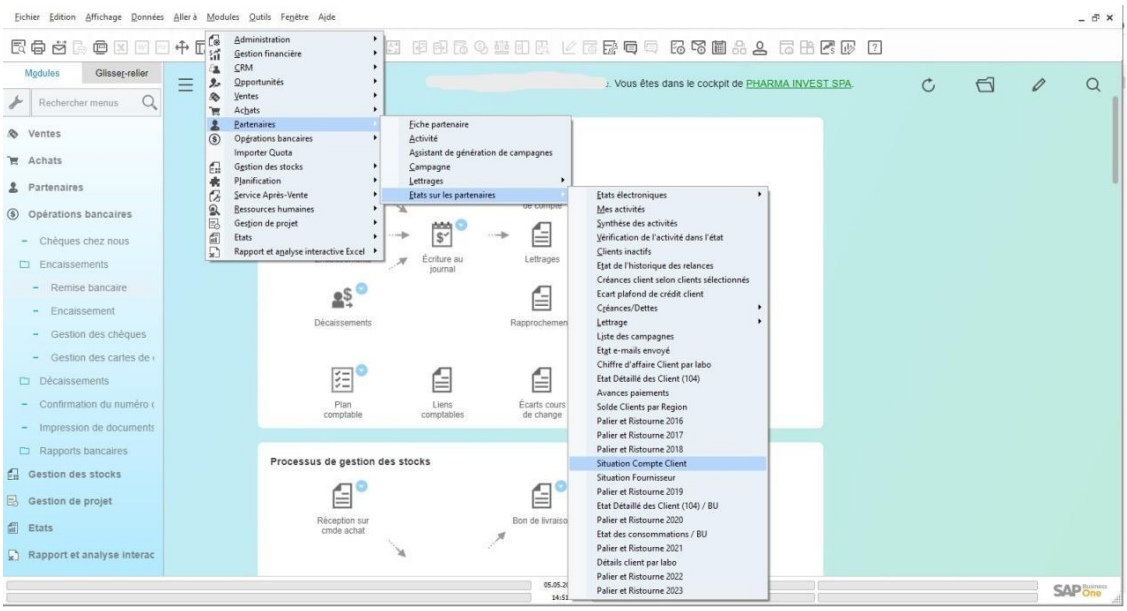
7- **Divers :**

-Pharma-invest (2024), Market Share Internal Report, Internal Strategy Document.

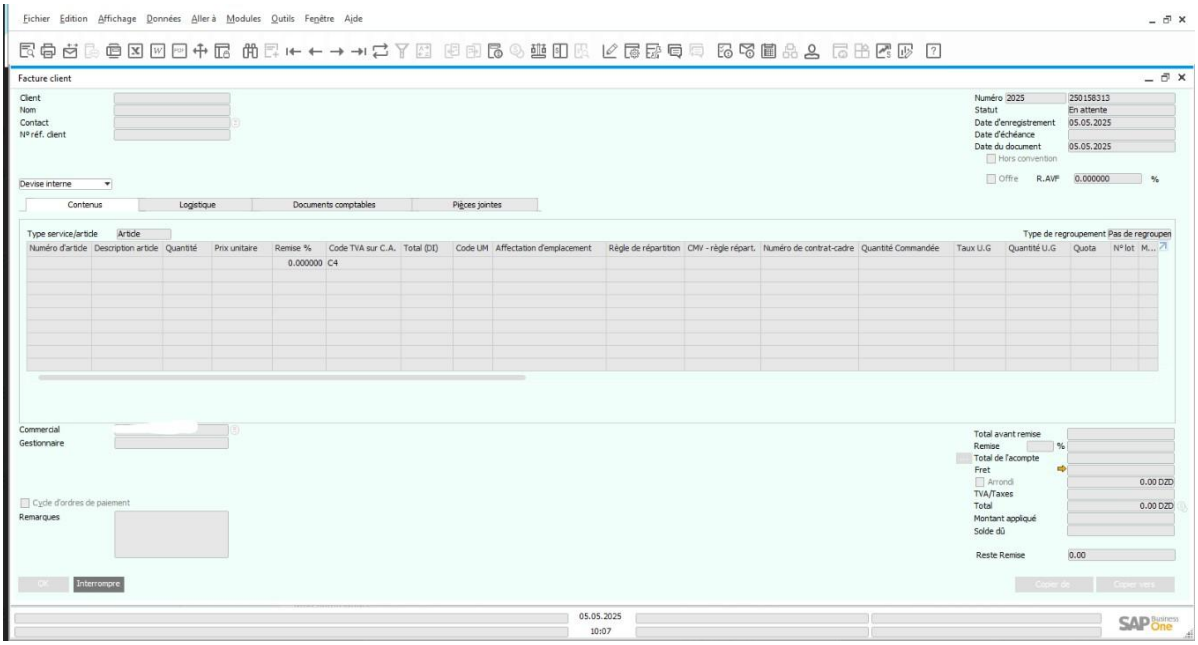
-Pharma-invest (2025),Annual Report ,Internal Document .

Appendices:

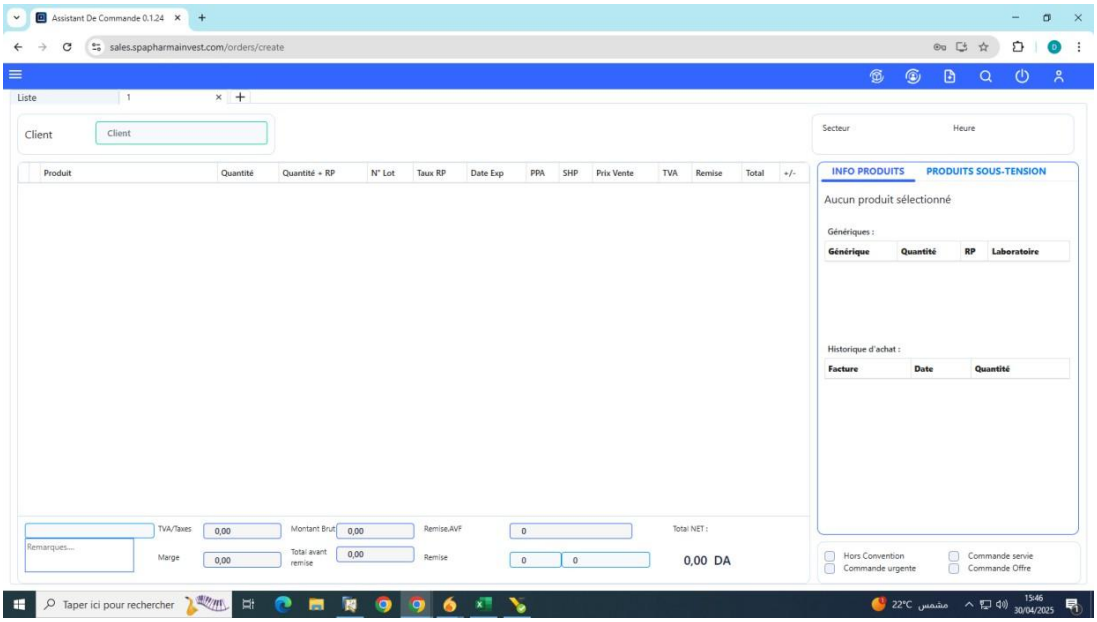
- **SAP Business one interface:**



- **Customer invoice:**



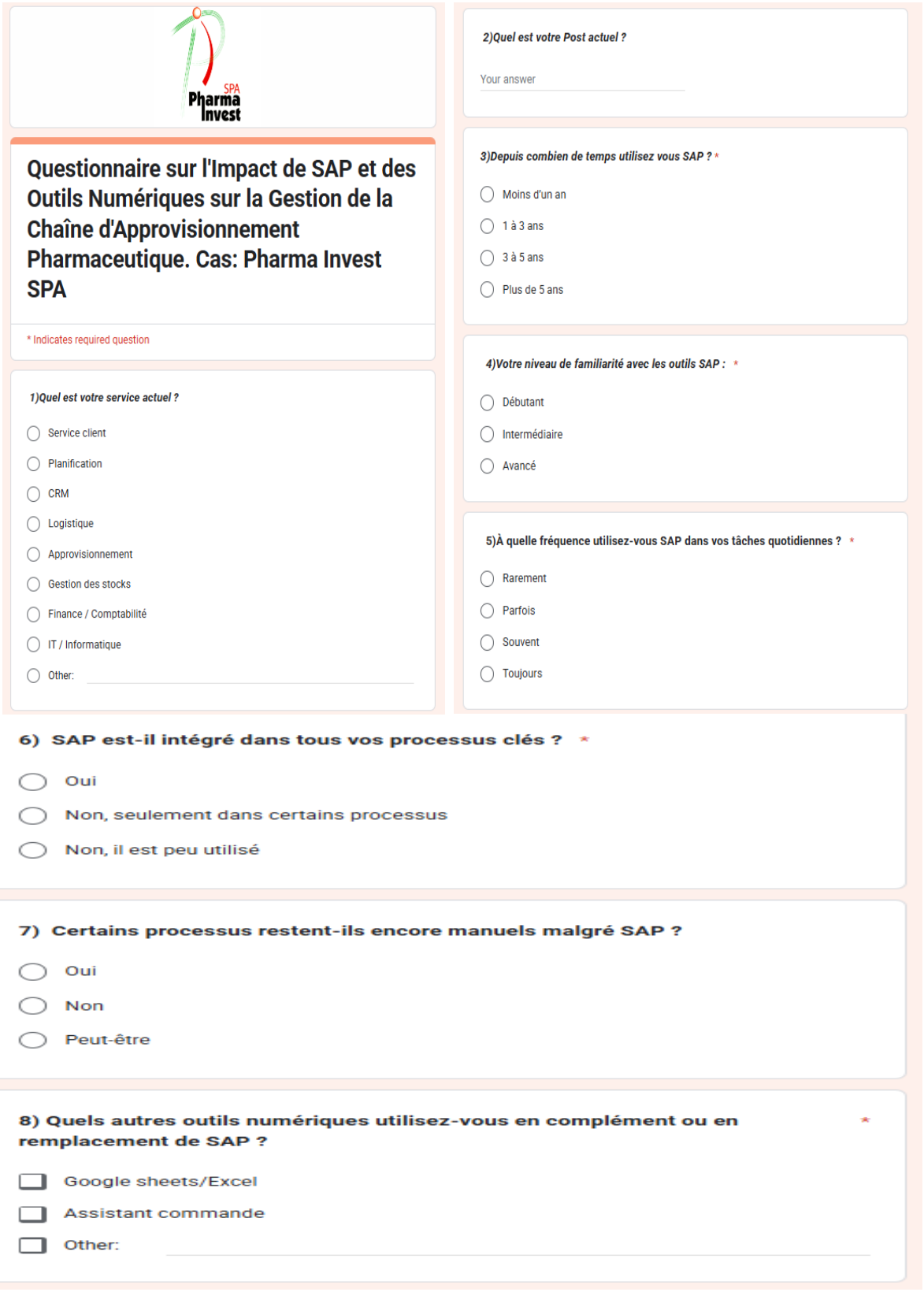
- **service layer (Assitant comande):**



- **Organizational Structure of Pharma Invest:**

Name:	**PHARMA-INVEST SPA**
Legal Status:	Joint-stock company(**S.P.A)**
Legal Nature	Private entity
Capital	**5.508.975.000,00 DA**
Number of Shareholders:	**450**
Chairman and CEO	**Mr LEGHRIB Yacine**
Phone/Fax	**036 76 12 21**
Website:	**www.pharma-invest.dz**
E-mail	**contact@pharmainvest.dz**
Start of Activity	July 23, 2001
Nature of Activity	Pharmaceutical Product Distribution
Distribution capacity	More than 90,000 boxes per day
Market share	4.1%

- Questionnaire guide:



Questionnaire sur l'Impact de SAP et des Outils Numériques sur la Gestion de la Chaîne d'Approvisionnement Pharmaceutique. Cas: Pharma Invest SPA

* Indicates required question

1)Quel est votre service actuel ?

- Service client
- Planification
- CRM
- Logistique
- Approvisionnement
- Gestion des stocks
- Finance / Comptabilité
- IT / Informatique
- Other:

2)Quel est votre Post actuel ?

Your answer

3)Depuis combien de temps utilisez vous SAP ? *

- Moins d'un an
- 1 à 3 ans
- 3 à 5 ans
- Plus de 5 ans

4)Votre niveau de familiarité avec les outils SAP : *

- Débutant
- Intermédiaire
- Avancé

5)À quelle fréquence utilisez-vous SAP dans vos tâches quotidiennes ? *

- Rarement
- Parfois
- Souvent
- Toujours

6) SAP est-il intégré dans tous vos processus clés ? *

- Oui
- Non, seulement dans certains processus
- Non, il est peu utilisé

7) Certains processus restent-ils encore manuels malgré SAP ?

- Oui
- Non
- Peut-être

8) Quels autres outils numériques utilisez-vous en complément ou en remplacement de SAP ? *

- Google sheets/Excel
- Assistant commande
- Other:

9) Évaluez *la qualité technique de SAP* selon les critères suivants (1 = Très faible, 5 = Très élevé) *

	1	2	3	4	5
Rapidité d'exécution	◯	◯	◯	◯	◯
Fiabilité (absence de bugs)	◯	◯	◯	◯	◯
Disponibilité (temps de fonctionnement)	◯	◯	◯	◯	◯
Facilité de navigation	◯	◯	◯	◯	◯

10) Evaluer *la qualité des informations* fournies par SAP selon les critères suivants (1 = Très faible, 5 = Très élevé) : *

	1	2	3	4	5
Précision des données	◯	◯	◯	◯	◯
Pertinence des informations	◯	◯	◯	◯	◯
Actualisation des données en temps réel	◯	◯	◯	◯	◯
Exhaustivité des informations	◯	◯	◯	◯	◯

11)Avez-vous reçu une formation avant d'utiliser SAP ? *

- ◯ Très complète
- ◯ Adequate mais insuffisante
- ◯ Insuffisante
- ◯ Aucune formation

12) Comment évaluez-vous le support technique et la formation liés à SAP ?
(1 = Très insatisfait, 5 = Très satisfait)

	1	2	3	4	5
Quality of technical support	◯	◯	◯	◯	◯
Pertinence de la formation reçue	◯	◯	◯	◯	◯
Réactivité du service d'assistance	◯	◯	◯	◯	◯

13)Globalement, êtes-vous satisfait de SAP ? *

	1	2	3	4	5	
Tré satisfait	◯	◯	◯	◯	◯	Tré insatisfait

14) Quels aspects de SAP appréciez-vous le plus ? *

- [ ] Fiabilité du système
- [ ] Facilité d'utilisation
- [ ] Amélioration des processus métier
- [ ] Meilleure traçabilité et conformité
- [ ] Réduction des erreurs
- [ ] Analyse et reporting plus efficaces
- [ ] Conformité réglementaire simplifiée

15) Quels freins avez-vous rencontrés dans l'utilisation de SAP ? *

- [ ] Résistance au changement des employés
- [ ] Complexité du système
- [ ] Manque de formation
- [ ] Coût élevé d'implémentation
- [ ] Other: _____

16) SAP a-t-il amélioré les performances des processus suivants ? *

(1 = Pas du tout utile, 5 = Très utile)

	1	2	3	4	5
Gestion des stocks	○	○	○	○	○
Prévision de la demande	○	○	○	○	○
Traçabilité des produits	○	○	○	○	○
Coordination entre services	○	○	○	○	○

17)Globalement, SAP a-t-il amélioré votre efficacité au travail ?

- ○ Oui, significativement
- ○ Oui, mais des améliorations sont nécessaires
- ○ Non, cela reste complexe à utiliser

18) Quelles améliorations suggérez vous pour optimiser utilisation de SAP?

Your answer

Merci pour votre participation !

Submit

Clear form

Table of matrices