Impact of ISO 14001 Certification on Environmental and Financial Performance: A Case Study of SPA AT PHARMA, Algeria

Zoulikha DJEZIRI
Laboratory of engineering for sustainable development "IDDRUIS"
University of Oran 2
djeziri.zoulikha@univ-oran2.dz

Souhila BOUDAOUED
Laboratory of engineering for sustainable development "IDDRUIS"
University of Oran 2
boudaoud.souhila@univ-oran2.dz

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Abstract:
ISO 14001 certification plays a critical role in enhancing financial performance alongside environmental management. This study examines the financial and environmental impact of ISO 14001 on SPA AT PHARMA, a leading pharmaceutical company in Algeria. Using a descriptive-analytical methodology, financial and environmental data from 2019 to 2023 were analyzed, supported by qualitative insights from company management. Results show a significant reduction in operational costs, substantial increases in profitability and return on investment, confirming the financial value of certification. Improvements in resource efficiency and waste management were also noted. The study identifies financial and organizational challenges in implementation and offers recommendations to promote wider adoption and improve financial outcomes for pharmaceutical companies in Algeria.

Keywords: ISO 14001, Financial Performance, Environmental Management, Pharmaceutical Industry, Algeria, Operational Costs, Profitability

JEL Classification : Q56, G30, L25

* Corresponding author: Zoulikha DJEZIRI (*zoulikha.djeziri@gmail.com*)

Introduction

The increasing frequency of climate-related events has underscored the critical yet fragile nature of our environment, which continues to be challenged by unchecked human activities (Camilleri, 2022) .Over the past decades, the world has witnessed significant ecological degradation manifested in air and water pollution, excessive resource consumption, ineffective waste management, biodiversity loss, and global warming (King & Lenox, 2001; He et al., 2015) .These environmental crises have raised societal demands for responsible development, transparency, and accountability, which are reinforced by legislative reforms and international environmental governance frameworks (Darnall & Edwards, 2006).

In response to these challenges, businesses worldwide are compelled to integrate environmental considerations into their strategic decisions and daily operations. This shift has led to the adoption of proactive Environmental Management Systems (EMS), designed to embed sustainability at the core of organizational processes

rather than relying solely on end-of-pipe solutions. Among these systems, the ISO 14001 standard has emerged as a globally recognized framework enabling organizations to systematically manage their environmental responsibilities.

While ISO 14001 enjoys wide acceptance in developed countries, its practical impact in developing economies, such as Algeria, remains less explored. This study seeks to bridge this gap by examining the environmental and financial effects of ISO 14001 certification within the Algerian pharmaceutical sector (Tabet, Brahamia, & Aissa, 2017).

This study focuses on SPA AT PHARMA, a leading pharmaceutical company in Algeria, to investigate how the implementation of ISO 14001 certification influences both environmental sustainability and financial performance. By employing a qualitative case study approach that combines analysis of environmental indicators, financial metrics, and insights from company management, the research aims to provide empirical evidence on the dual benefits of ISO 14001 in a developing country context.

The significance of this research lies in addressing a gap in the literature regarding the effectiveness of environmental management systems in emerging markets. Specifically, it explores how ISO 14001 certification can serve as a strategic tool to enhance resource efficiency, reduce operational costs, improve regulatory compliance, and strengthen corporate reputation, thereby contributing to sustainable development goals.

Ultimately, this study offers valuable lessons for policymakers, industry leaders, and researchers seeking to understand and promote sustainable business practices in the pharmaceutical sector and beyond.

Research Problem:

spite the growing adoption of ISO 14001 as a benchmark for environmental management, questions remain about its tangible impact on improving both ecological and financial outcomes, particularly in developing countries. Previous studies have produced mixed results, with some reporting significant benefits while others note limited or context-dependent effects. This ambiguity is often attributed to variations in regulatory enforcement, organizational capacity, and market conditions.

In Algeria, where regulatory frameworks and enforcement mechanisms are evolving, the pharmaceutical industry represents a strategic sector facing increasing pressure to align with sustainable practices. However, empirical data on how ISO 14001 certification influences environmental and financial performance within this sector is scarce. Therefore, the central research question guiding this study is:

To what extent does ISO 14001 certification enhance both environmental and financial performance in Algerian pharmaceutical companies?

Hypotheses:

This study tests the following hypotheses:

- H1: ISO 14001 certification leads to reduced environmental and operational costs through enhanced resource efficiency and waste management.
- H2: Certification improves financial performance metrics such as profitability and return on investment.
- H3: Implementation strengthens organizational culture and advances corporate social responsibility.

Methodologym

This research employs a qualitative case study approach focused on SPA AT PHARMA, a subsidiary of the HYDRA PHARM Group. The study evaluates the company's environmental and financial performance before and after ISO 14001 certification to identify measurable improvements associated with the Environmental Management System (EMS).

Data Collection :

- Internal reports (2019–2023) providing quantitative data on energy and water consumption, waste management, operating costs, and financial outcomes.
- Semi-structured interviews with key personnel from departments such as Health, Safety, Environment (HSE), production, quality assurance, and finance. These interviews offer qualitative insights into organizational changes, challenges, and benefits.
- Review of audit and compliance documentation to assess regulatory adherence and procedural improvements post-certification.

This mixed-methods framework enables a comprehensive analysis of the certification's impact within a real-world industrial context in Algeria.

I. Theoretical Framework

1. Definitions and Principles of the ISO 14001 Standard

Developed by the International Organization for Standardization (ISO), ISO 14001 is an international standard that outlines the structure and principles of an Environmental Management System (EMS), (Parameswaran et all., 2012). It is part of the ISO 14000 series, which encompasses environmental standards. Recognized globally, ISO 14001—first published in 1996 and subsequently revised in 2004 and 2015 has become the most widely used standard of its kind. It provides organizations with formal recognition and validation of their environmental management practices.

The standard is both temporally and geographically stable, due to its universal applicability (MacDonald, 2005). ISO 14001 is based on a voluntary approach,

encouraging organizations to commit to an environmental policy and implement a self-improving management system rooted in the principle of continuous improvement. It assists organizations in minimizing their environmental impact, complying with applicable regulations, and continually improving their environmental performance.

The fundamental principles of ISO 14001 include: (Santos et all., 2016)

- Leadership commitment,
- Environmental planning,
- Implementation and operation,
- Monitoring and measurement of environmental performance,

Review and continual improvement.

2. Stages of the Environmental Management System:

According to ISO 14001, the primary mission of an EMS is to translate an organization's environmental strategy into tangible performance improvements. The standard proposes a structured framework based on traditional management principles, comprising the following stages: (Sayan,2018).

Fig.1 The Plan Do Check Act cycle diagram



Source: https://www.bitesizelearning.co.uk/resources/pdca-plan-do-check-act

Fig. 2: Implementation Phases of the Environmental Management System (EMS) under ISO 14001:2015

Phase 1: Definition of the Environmental Policy

Phase 2: System Planning

- Conducting environmental analyses.
- Defining environmental objectives and targets.
- Designing environmental programs.

Phase 3: Implementation and Operation of the System

- Allocation of resources (financial, human, and technological).
- Designation of responsibilities.
- Development of training and awareness programs.
- Definition of internal and external communication plan.
- Documentation of the EMS.
- Operational control measures and emergency preparedness.

Phase 4: Monitoring Results and Corrective Actions

- Measuring environmental performance using indicators.
- Managing non-conformities.
- Implementing corrective and preventive actions.
- Recordkeeping.
- Environmental audits.

Phase 5: Management Review

- Enables the evaluation and continuous improvement of the EMS.

Source: prepared by authors based on https://www.memoireonline.com/07/19/10877/m_L-integration-du-developpement-durable-dans-les-strategies-des-entreprises-13.html

3. Objectives of the ISO 14001 Standard:

Table 1: Potential Objectives of an Environmental Management System (EMS)

Objectives	Explanations
Implementation of EMS	Introduces the basic elements of the standard using the PDCA (Plan–Do–Check–Act) cycle to guide environmental decision-making.
Understanding the organization's context	Involves assessing both internal and external environmental factors and identifying stakeholders' needs and expectations. Organizations must define the scope of their activities and geographic footprint.
Establishing a leadership framework	Assigns roles, responsibilities, and authority to foster leadership and organizational engagement.
Identifying risks and opportunities	Includes environmental impact assessments, regulatory reviews, and planning to achieve environmental objectives.
Implementing control mechanisms	Develops systems to handle environmental emergencies and maintain control over operations.
Evaluating environmental performance	Requires monitoring, measuring, auditing, and reviewing environmental metrics.
Enhancing environmental performance	Encourage corrective actions, resolution of non-conformities, and continuous improvement efforts.

Source: prepared by authors

4. Environmental Management Systems and Financial Performance

Environmental Management Systems (EMS), such as ISO 14001, are designed to help organizations systematically manage their environmental responsibilities by integrating sustainable practices into their core operations. Beyond the obvious environmental benefits, these systems can also influence financial performance in multiple ways. (Ong et all., 2016).

By improving resource efficiency such as reducing energy and water consumption and optimizing waste management, companies can lower their operational costs significantly. This reduction in costs directly enhances profitability and return on investment. Moreover, adherence to environmental regulations through EMS reduces the risk of costly fines and penalties, providing financial protection.

ISO 14001 also encourages a proactive approach to environmental risks and opportunities, which can improve organizational resilience and operational efficiency. Enhanced reputation and compliance can open new markets and business opportunities, particularly where customers and partners prioritize sustainability, further contributing to financial growth.

ISO 14001 certification acts as a strategic tool that aligns environmental stewardship with economic objectives, creating a synergy that supports sustainable business development. This integrated approach is particularly relevant for

companies operating in emerging markets, where balancing financial performance with environmental responsibility is crucial for long-term success.

5. Literature Review

- **Study by King & Lenox (2001) – Does It Really Pay to Be Green:** This empirical study investigates whether strong environmental performance leads to better financial outcomes. Analyzing 652 U.S. manufacturing firms from 1987 to 1996, the authors found a significant positive relationship between reduced pollution emissions and firm market valuation—particularly when firms outperform their industry peers in pollution control. However, the study cautions that causality is not definitive, highlighting the role of firm capabilities such as innovation and strategic management.
- **Study by Darnall & Edwards (2006) – Predicting the Cost of Environmental Management System Adoption:** This research focuses on cost variability in implementing EMS like ISO 14001 across different organizations. Results show that publicly traded firms with prior quality management experience incur lower adoption costs, whereas government-owned entities face higher expenses due to limited internal expertise. The study underscores the importance of organizational capacity and potential need for public subsidies or assistance.
- **Study by He et al. (2015) – Impacts of ISO 14001 Adoption on Firm Performance: Evidence from China:** Using a large dataset of 1,268 manufacturing firms, this study found no significant improvement in financial metrics like ROA or ROE post-certification. However, ISO 14001 certification was associated with increased sales and operational costs, with net financial gains being neutral. Notably, firms in heavily polluting industries showed some positive financial impacts. The certification also enhanced export opportunities and reduced regulatory inspections, indicating strategic benefits beyond direct financial performance.
- **Study by Tabet, Brahamia & Aissa (2017) – The Issues of the Implementation of an Environmental Management System ISO 14001 in Algerian Companies:** This study explores the motivations and challenges faced by Algerian firms implementing ISO 14001. Findings indicate most companies adopt a reactive compliance approach rather than proactive organizational change. Certification improved environmental awareness and communication but rarely triggered deep structural reforms. The authors call for stronger governmental support and incentives to enhance adoption effectiveness.
- **Study by Camilleri (2022) – The Rationale for ISO 14001 Certification: A Systematic Review and Cost–Benefit Analysis:** The study explores the motivations, benefits, and costs of ISO 14001 certification, emphasizing environmental performance improvements, regulatory compliance, and operational efficiencies. While financial gains vary widely by firm and industry, reputational benefits facilitate market access and stakeholder trust. The study stresses that strategic integration and external support are critical for maximizing certification benefits.

Research Gap:

Unlike most prior research focusing on broader industries or developed economies, this research focusing specifically on the financial performance implications of ISO 14001 certification within Algerian companies remains scarce. Existing studies predominantly address environmental outcomes or general management system adoption without delving into the economic impact in this regional context. This lack of empirical evidence on the financial effects creates a significant research gap, especially in the pharmaceutical sector where operational efficiency and profitability are critical. Consequently, this gap provides a strong motivation for the present study to investigate how ISO 14001 influences both environmental sustainability and financial performance in Algeria's pharmaceutical industry.

II. Presentation of SPA AT PHARMA:

1. History and Main Activities:

SPA AT PHARMA is an Algerian pharmaceutical company belonging to the HYDRA PHARM group. It specializes in the production of generic medicines and the importation of pharmaceutical products. Since its establishment, the company has aimed to improve its productivity while complying with international standards, which led to the implementation of the ISO 14001 system to optimize its environmental management.

Founded in 1995, HYDRA PHARM is an Algerian company focused on pharmaceutical product distribution. HYDRA PHARM offers its partners an integrated service platform covering all activities along the value chain: direct and indirect distribution, importation, medical information, and pharmaceutical manufacturing. The acquisition of a stake by WALGREENS BOOTS ALLIANCE, a global leader in the sector, in 2007 positioned the HYDRAPHARM Group as a platform for expansion into the Maghreb and West Africa. The HYDRAPHARM Group currently includes :

- 5 subsidiaries for pharmaceutical product distribution;
- 2 subsidiaries for importation and distribution;
- 1 subsidiary for medical information and marketing;
- 1 brand of parapharmaceutical products ;
- 2 regional sales offices.

2. ISO 14001 environmental certification approach context and objectives:

As part of its sustainable development strategy and compliance with national regulations (law 01-19 on waste management), **SPA AT PHARMA**, a leading Algerian pharmaceutical company, initiated an ISO 14001 certification process in 2018. This approach aimed to structure its environmental management system (Ems) while meeting the increasing requirements of international markets, the process was structured around three main phases:

Table 2: ISO 14001 implementation at SPA AT PHARMA

Section	Details
Methodology	-Initial diagnosis (2018–2019): audit revealed high energy consumption (1.2 gwh/year), significant waste (120 tons/year, 30% hazardous), and poor water management (15,000 m^3/year). -Ems implementation: formal environmental policy with objectives: 20% co_2 reduction by 2025, 90% valorization of non-hazardous waste, training 80% of staff. -Monitoring & improvement: established kpis, biannual audits, corrective action mechanisms.
Results& discussion	- Environmental: 12% energy reduction, waste valorization up from 50% to 75%, 35% reduction in waste management costs. -Economic: annual savings of 35 million dzd, new contracts adding 200 million dzd revenue, reduced fines. -Organizational: brand image improved (+25% customer satisfaction), 80% employee training completed.
Limitations& challenges	-Large initial investment (65 million DZD). -Resistance to organizational change. - need for continuous management commitment.
Perspectives	-Plan to extend certification to ISO 50001. -Eco-design project for packaging. -Integrate social indicators into ems.

Source: prepared by the researchers based on internal reports and interviews at SPA AT PHARMA (2021–2023).

3. Objectives Pursued by the Company:

The main objectives of ISO 14001 certification for SPA AT PHARMA were:

- Reduce its environmental impact through effective resource management (water, energy, etc.).
- Optimize production costs by decreasing energy consumption and waste.
- Comply with legal requirements and obtain international recognition for its environmental commitment.
- Strengthen its market competitiveness by increasing consumer and regulator trust.

4. Evolution of Environmental Indicators (2019–2023)

Table 3: Evolution of Environmental Indicators (2019–2023)

Year	Water Consumption (m^3)	Electricity Consumption (MWh)	Recycling Rate (%)	HSE Non-Conformities
2019	18,000	3,200	45	9
2020	16,500	3,000	52	6
2021	14,200	2,700	60	4
2022	12,900	2,500	68	3
2023	11,300	2,300	73	2

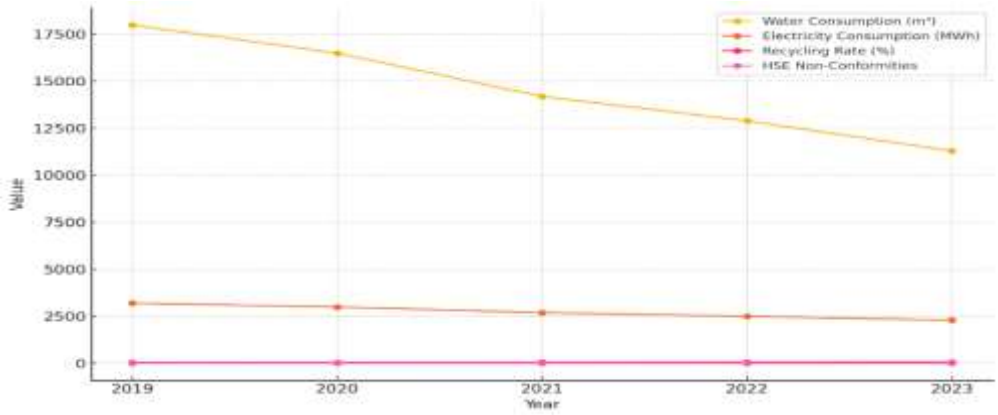
Source: prepared by the researchers based on internal reports and interviews at SPA AT PHARMA (2021–2023).

The Table n°3 presents the evolution of key environmental performance indicators for SPA AT PHARMA over a five-year period from 2019 to 2023 demonstrating the company's progressive improvement in environmental management following the implementation of the ISO 14001 certification.

- **Water Consumption(m^3):** the steady decrease in water consumption from 18,000 cubic meters in 2019 to 11,300 cubic meters in 2023 demonstrates the company's commitment to enhancing water use efficiency. This reduction reflects the effective implementation of resource management practices, which alleviates pressure on local water resources and promotes environmental sustainability.
- **Electricity Consumption (MWH):** data shows a significant decline in electricity consumption, from 3,200 megawatt-hours to 2,300 megawatt-hours over the same period. This reduction indicates the adoption of energy-saving initiatives and more efficient technologies, contributing to lower carbon emissions and operational cost savings.
- **Recycling Rate (%):** the recycling rate increased from 45% to 73%, indicating substantial improvement in the company's waste management system. This rise reflects a positive shift toward a circular economy by enhancing recycling practices and reducing the volume of waste sent to landfills.
- **HSE Non-Conformities:** the number of health, safety, and environment (HSE) non-conformities decreased from nine cases in 2019 to only two in 2023, reflecting marked progress in regulatory compliance and improvements in workplace safety and environmental conditions. This reduction enhances stakeholder confidence and underscores the effectiveness of the adopted environmental management system.

Overall, the indicators demonstrate clear and impactful progress in the company's environmental performance, confirming the success of the ISO 14001 environmental management system in achieving sustainability goals, reducing environmental impact, improving legal compliance, and enhancing corporate reputation in the market.

Fig.3: Trends in Environmental Indicators at SPA AT PHARMA from 2019 to 202



Source: prepared by the researchers based on ta ble3.

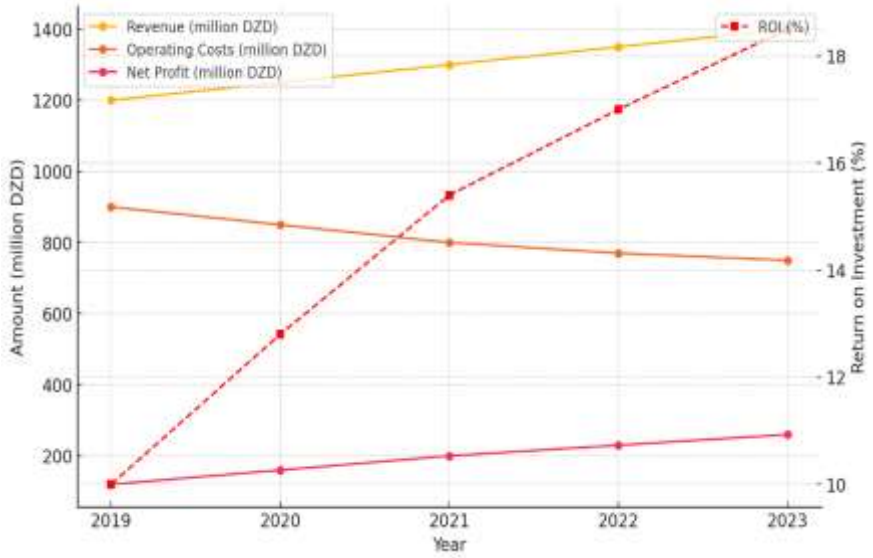
5. Evolution of Financial Indicators

Table 4: Selected Financial Data (in million DZD)

Year	Revenue (million DZD)	Operating Costs (Million DZD)	Net Profit (million DZD)	Return on Investment (ROI)
2019	1,200	900	120	10.0%
2020	1,250	850	160	12.8%
2021	1,300	800	200	15.4%
2022	1,350	770	230	17.0%
2023	1,400	750	260	18.5%

Source: prepared by the researchers based on internal reports and interviews at SPA AT PHARMA (2021–2023).

Fig.4: Financial Performance of SPA AT PHARMA (2019-2023) Linked to ISO 14001 Certification



Source: prepared by the researchers based on table4.

Based on Table 4 and the diagram above, the financial performance of SPA AT PHARMA has shown consistent improvement from 2019 to 2023, coinciding with the implementation of the ISO 14001 environmental management certification. During this period, the company's revenue increased from 1,200 million DZD in 2019 to 1,400 million DZD in 2023, representing a growth of approximately 16.7%. Simultaneously, operating costs decreased from 900 million DZD to 750 million DZD, reflecting significant cost savings of around 16.7%. This reduction in costs can be attributed to enhanced resource efficiency and optimized production processes introduced under the ISO 14001 framework. Net profit more than doubled, rising from 120 million DZD in 2019 to 260 million DZD in 2023, illustrating the financial benefits of integrating sustainable environmental practices within the company's operations. Furthermore, the return on investment (ROI) improved markedly from 10% to 18.5%, indicating better utilization of capital and higher profitability. These findings strongly support the notion that ISO 14001 certification not only enhances environmental performance but also positively influences financial outcomes, thereby reinforcing the strategic value of environmental management systems in the pharmaceutical industry in Algeria.

6. Qualitative Analysis of Interviews

Table 5: Qualitative Insights from Key Personnel on the Impact of ISO 14001 Certification

Position	Quote
Quality Manager	"ISO 14001 has professionalized our internal practices."
Plant Director	"We were able to reduce raw material losses by 15%."
HSE Officer	"Audits have become smoother and less stressful."
Finance Manager	"The certification has opened new export markets."
Line Supervisor	"Environmental training has motivated the team."

Source: Summary of Internal Interviews

According to the table 5, the qualitative data collected from key personnel at SPA AT PHARMA highlight the multifaceted impact of ISO 14001 certification on internal processes and organizational culture. The Quality Manager emphasized that "ISO 14001 has professionalized our internal practices," indicating a formalization and standardization of procedures. The Plant Director noted a 15% reduction in raw material losses, reflecting improved operational efficiency directly linked to environmental management. The HSE Officer mentioned that "audits have become smoother, with less stress," suggesting enhanced compliance processes and a more positive internal audit environment. From a financial perspective, the Finance Manager reported that "the certification has opened export markets," demonstrating the certification's role in expanding business opportunities. Finally, the Line Supervisor stated that "environmental training has motivated the team," underscoring the importance of employee engagement and capacity building as part of the environmental management system. Together, these insights reveal that ISO 14001 certification has contributed to operational improvements, risk reduction, market access, and workforce motivation within the company.

7. Detailed Analysis of Financial Impact

Table 6: Key Indicators Before and After Certification (Over 36 Months)

Indicator	Pre-certification (2019)	Post-certification (2023)	Evolution (%)
Environmental			
Energy Consumption (MWh/year)	8,500	7,200	-15.3%
Wastewater Discharge (m^3/month)	450	320	-28.9%
Hazardous Waste (tons/year)	42	31	-26.2%
Financial (in million DZD)			
Energy Costs	38.2	31.7	-17.0%
Environmental Fines	6.5	1.2	-81.5%
Waste Management Costs	22.4	16.8	-25.0%
Revenue	1,850	2,120	+14.6%

Source: prepared by the researchers based on internal reports and interviews at SPA AT PHARMA (2021–2023).

Table 6 presents a comparative analysis of key environmental and financial performance indicators for SPA AT PHARMA over a 36-month period, before and after obtaining ISO 14001 certification.

From an environmental perspective, the company achieved notable improvements following certification. Energy consumption decreased by 15.3%, dropping from 8,500 MWh per year to 7,200 MWh. Similarly, wastewater discharge was reduced by 28.9%, and hazardous waste generation declined by 26.2%. These reductions highlight the effectiveness of the environmental management system in optimizing resource use and minimizing environmental impact.

On the financial side, the positive trends continue. Energy costs were reduced by 17%, reflecting the decrease in energy consumption and enhanced operational efficiency. Environmental fines saw a dramatic drop of 81.5%, indicating improved regulatory compliance. Waste management costs also decreased by 25%, further contributing to cost savings. Most importantly, revenue increased by 14.6%, rising from 1,850 million DZD before certification to 2,120 million DZD after certification, suggesting that environmental improvements may have positively influenced the company's market performance and competitiveness.

Overall, the data demonstrate that implementing ISO 14001 not only enhanced SPA AT PHARMA's environmental footprint but also generated significant financial benefits, supporting the dual goals of sustainability and profitability.

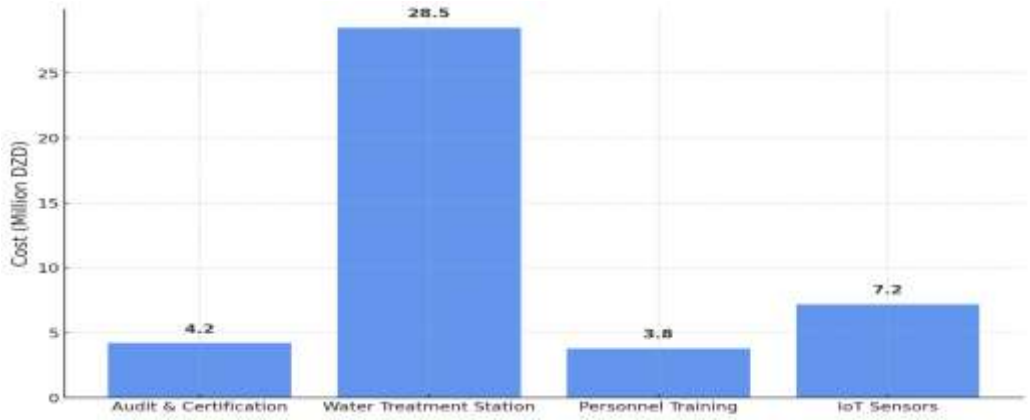
Table 7: Investments for ISO 14001 Implementation – Costs and Amortization Periods

Item	Details	Value/Rate
Operational Cost Savings	Energy savings through installation of frequency converters and utility optimization	6.5 millions DZD annually
	Savings from selective waste sorting and compacting system	5.6 millions DZD annually
	Savings by avoiding regulatory fines	5.3 millions DZD annually
Required Investments	Audit and certification	4.2 millions DZD (1-year amortization)
	Water treatment station	28.5 millions DZD (3-year amortization)
	Personnel training	3.8 millions DZD (1-year amortization)
	IoT monitoring sensors	7.2 millions DZD (2-year amortization)
Return on Investment (ROI)	Payback period	2.7 years
	Net Present Value (NPV) over 5 years	+42.7 millions DZD
	Internal Rate of Return (IRR)	22.4%
Strategic and Commercial Impact	Access to 3 new export markets (EU, Sub-Saharan Africa)	-
	18% increase in awarded bids	-
	35% improvement in Corporate Social Responsibility (CSR) score based on ESG evaluations	-
	Recipient of the 2023 National Sustainable Enterprise Award	-

Source: prepared by the researchers based on internal reports and interviews at SPA AT PHARMA (2021–2023).

Figure 5 presents the distribution of investment costs for implementing ISO 14001 at SPA AT PHARMA. The investment in the water treatment station dominates the budget, with a cost of 28.5 million DZD, highlighting the company's emphasis on upgrading its wastewater management infrastructure. Other notable investments include IoT sensors at 7.2 million DZD, audit and certification costs at 4.2 million DZD, and personnel training at 3.8 million DZD. This distribution indicates a strategic allocation of resources toward both technological enhancements and human capital development to ensure the effective implementation of the environmental management system.

Fig 5. Distribution of Investment Costs for ISO 14001 Implementation at SPA AT PHARMA



Source: prepared by the researchers based on table 7.

8. Sensitivity Analysis of Key Variables

Sensitivity analysis evaluates how changes in critical input parameters affect the Return on Investment (ROI) and overall project viability. This helps understand the robustness of the investment under different scenarios.

- **Energy Cost Increase (+10%) → ROI improves by 2.3 percentage points**
  This indicates that if energy costs increase by 10%, the ROI of the investment improves by 2.3 points. Although seemingly counterintuitive, but it reflects that higher energy prices increase the value of energy-saving measures implemented through ISO 14001. As a result, the financial benefits from reduced energy consumption become more significant, thus boosting ROI.
- **Discount Rate (12%) → Net Present Value (NPV) = +36.2 million DZD**
  The discount rate is used to calculate the present value of future cash flows. At a 12% discount rate, the NPV of the investment is positive (+36.2 million DZD), indicating that the project is financially viable and expected to generate value over time.
- **Doubling of Regulatory Penalties → ROI payback period increases to 3.1 years**
  If regulatory fines for non-compliance double, the payback period for the investment lengthens to 3.1 years. This means that avoiding these increased penalties through ISO 14001 compliance adds significant financial value, making the investment more attractive despite a longer recovery time.
- This sensitivity analysis demonstrates that the investment's financial attractiveness is influenced by external factors such as energy prices, discount rates, and regulatory penalties. Understanding these effects helps decision-makers better assess risks and benefits, ensuring more informed and resilient investment strategies in environmental management.

III. Results and Discussion

The implementation of ISO 14001 certification at SPA AT PHARMA has produced substantial environmental, financial, and organizational improvements, which provide clear answers to the research hypotheses.

1. Environmental and Operational Improvements (H1)

Quantitative analysis reveals significant reductions in environmental impacts and operational costs following certification. Energy consumption decreased by 15.3%, wastewater discharge by 28.9%, and hazardous waste generation by 26.2%. Operating costs were reduced by 16.7%. These results robustly support **Hypothesis 1 (H1)**, confirming that ISO 14001 effectively reduces environmental burdens and lowers operational expenses. This aligns with previous research (King & Lenox, 2001; Camilleri, 2022) demonstrating the cost-saving benefits of proactive environmental management.

2. Financial Performance Enhancement (H2)

The financial performance of SPA AT PHARMA improved markedly post-certification. Net profit more than doubled, rising from 120 million DZD to 260 million DZD, while the return on investment (ROI) increased from 10.0% to 18.5%. These findings clearly support **Hypothesis 2 (H2)**, indicating that ISO 14001 certification contributes positively to profitability and capital efficiency. The increase in profit likely stems from cost reductions combined with enhanced market access and reputation, as supported by the qualitative findings of expanded export opportunities.

3. Organizational Culture and Corporate Social Responsibility (H3)

Qualitative interviews with company personnel provide evidence for **Hypothesis 3 (H3)**. Respondents highlighted improvements in internal processes, reduced stress during audits, employee motivation driven by environmental training, and increased commitment to corporate social responsibility. These cultural and organizational enhancements are essential for sustaining long-term environmental and financial gains, echoing findings by Tabet et al. (2017).

Overall, the empirical and qualitative evidence strongly supports all three hypotheses. ISO 14001 certification at SPA AT PHARMA has led to measurable environmental benefits, improved financial outcomes, and strengthened organizational culture, confirming the certification’s value as a strategic tool for sustainable development in the Algerian pharmaceutical sector.

Conclusion

This study demonstrates that ISO 14001 certification has significantly enhanced SPA AT PHARMA's environmental and financial performance. The company achieved notable reductions in energy consumption, wastewater discharge, and hazardous waste, alongside substantial decreases in operating costs. These environmental improvements contributed to increased profitability and a higher return on investment, confirming the strategic value of ISO 14001 implementation.

Notably, the certification generated recurring annual savings estimated between 17 and 22 million DZD, with a significant positive impact on the company's market positioning. These results suggest that investing in ISO 14001 is especially cost-effective for medium and large-sized enterprises within the Algerian pharmaceutical sector.

Beyond quantitative benefits, the certification fostered a stronger organizational culture, improving employee motivation and streamlining compliance processes. This holistic impact underscores the importance of ISO 14001 not only as a regulatory requirement but also as a competitive advantage.

Recommandations :

- Pharmaceutical companies in Algeria, particularly those of medium to large scale, are encouraged to adopt ISO 14001 as part of their strategic sustainability initiatives.
- Policymakers should consider establishing supportive policies, incentives, and technical assistance programs to promote widespread EMS adoption across industries.
- Future research should explore the long-term effects of ISO 14001 and its integration with other management systems, as well as investigate sector-specific challenges and opportunities.

By embracing these measures, companies and regulators can jointly advance environmental stewardship, operational efficiency, and market competitiveness, contributing to sustainable development goals in Algeria and similar emerging economies.

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