Implementation of Artificial Intelligence in Quality Management in SMEs: Benefits and Challenges

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Abstract

The adoption of artificial intelligence (AI) in small and medium-sized enterprises (SMBs) has emerged as a key strategy for improving quality management. This article discusses the main benefits and challenges of implementing AI in this context. A systematic review of the academic literature and relevant business reports was carried out, in order to collect and analyze empirical evidence on the application of AI in the quality management of SMEs, obtaining as results that the main benefits of the implementation of AI in the quality management of SMEs include: Improved data-driven decision-making, process automation and error reduction, early detection of quality issues, customization of products and services, and resource optimization and cost reduction. On the other hand, the main challenges were: Lack of knowledge and skills in AI, high implementation costs, concerns about data security and privacy, resistance to cultural change, and integration of AI with existing systems and processes, concluding that the implementation of AI in SMB quality management offers significant benefits, but it also entails challenges that must be addressed strategically. SMEs that manage to overcome these challenges will be able to take advantage of the competitive advantages offered by AI, improving their efficiency, quality and adaptability in an increasingly dynamic business environment.

Keywords: Artificial intelligence, quality management, SMEs, benefits, challenges.

1. Introduction

Business artificial intelligence refers to the application of artificial intelligence techniques and algorithms in the business context, it consists of the use of intelligent systems and software that can simulate and automate human cognitive activities, such as reasoning, learning, and decision-making. These systems can analyze large volumes of data, extract relevant information, and generate actionable insights to improve operations and decision-making in businesses. Throughout these times, the impact that these tools can have on the productivity of workers has been studied, as well as the benefits and possible risks of using them without the due care and responsibility they deserve.

The insertion of AIs in SMEs is changing the world in which we live in a deeper way, even than we are sometimes able to feel, in this way, it is possible to automate tasks that until recently were only reserved for humans, significantly improving the quality and usefulness of processes.

Thus, companies have opportunities for growth and structural development through the intensive use of artificial intelligence, but, thinking from the perspective of SMEs, there are some that are clearly remarkable and that, in addition, require an investment of resources, both money and otherwise, that is increasingly less.

Artificial Intelligence and SMEs

The main argument of Artificial Intelligence managers is its cost, but the truth is that there are entities, apps and software products that can be contracted at affordable prices today. In addition, one of the advantages of betting on it is that its results from an accounting point of view are almost immediate, as it allows the digitization of many processes, a better structuring of human capital capabilities and a greater segmentation of marketing actions. However, in many small and medium-sized companies, it is more the feeling of fear among their managers that is the main cause of not using artificial intelligence than the understanding that it will not be useful.

The integration of artificial intelligence in organizations is essential, which implies training both the management team and the heads of areas and departments on its advantages. It also favours explanatory artificial intelligence, relying on success stories of companies of similar size or even direct competitors that have improved their performance ratios at different levels thanks to the commitment to AI.

How to implement Artificial Intelligence in companies?

The implementation of artificial intelligence in companies requires a strategic and planned approach. Key steps to consider:

1. Identify application opportunities

2. Assess your business processes and identify areas where artificial intelligence can deliver significant improvements. This could be in task automation, data analysis, customer service, or supply chain optimization, among others.

3. Collect and prepare data

4. Artificial intelligence relies on high-quality data to generate accurate results. Make sure to collect and prepare the data needed to train and feed AI models.

5. Developing AI models

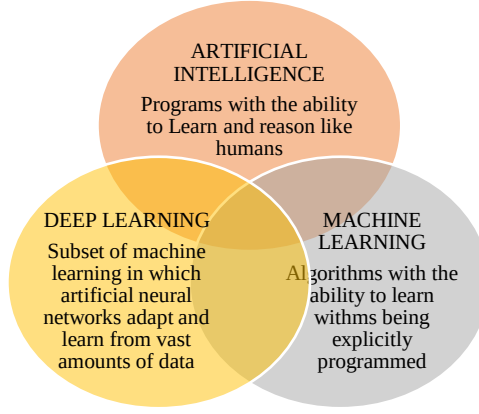
6. Hire or collaborate with AI experts to develop custom models and algorithms that fit your specific business needs. These models can be trained using machine learning or deep learning techniques.

Governance of Artificial Intelligence at the international level

Beyond definitions, different international organizations and countries have developed approaches in recent years on how to regulate, promote or implement algorithms and Artificial Intelligence (AI) from and in governments and public administrations. To begin this journey, it is necessary to know the proposals made by different international and multilateral organizations (1). Among them, we highlight the Organisation for Economic Co-operation and Development (OECD), the United Nations (UN) and some of its system bodies or the Council of Europe (CoE). All these approaches offer key concepts and points that guide or establish a framework of reference for the member countries of these bodies, hence their key role from the perspective of the framework of AI policies to be promoted by governments and public administrations (from the public sector outwards), but also by governments and public administrations (within the public sector itself) (2).

In this case, emphasis is also placed on the importance of knowledge about AI, that is, the skills and resources, such as data, code, algorithms, models, research, know-how, training programs, governance, processes and best practices that are required to understand and participate in the AI life cycle, as well as the actors and parties (organizations and people) interested in or affected by AI systems.

Figure 1. AI shaping



Note. Adapted from differences between Artificial Intelligence and Machine Learning, by ExperiencIA Oracle (3)

Artificial intelligence (AI) spans a broader spectrum than machine learning. When a machine performs tasks in an 'intelligent' way, mimicking human cognitive functions, it is considered AI. On the other hand, machine learning is a specific subset of AI. It is defined as the ability of machines to receive data and learn on their own, adjusting algorithms as they process information and become familiar with their environment.

Specifically, the OECD has proposed principles for reliable AI governance. The principles are: inclusive growth, sustainable development and well-being; human-centered values and justice; transparency and explainability; robustness and safety; and accountability. Along with the above, he has also raised a series of recommendations to be incorporated into national policies and international collaboration for trustworthy AI: such as investing in AI research and development; promoting a digital ecosystem for AI; facilitate and shape a public policy environment for AI; building human capacities and preparing for the transformation of the labour market; and international cooperation for trustworthy AI (4).

United Nations (UN). International Telecommunication Union (ITU). From a different perspective, ITU has promoted since 2017 a global summit with the slogan: "AI for good", with a clear technical orientation within the purpose of this organization, very focused on collaboration with national ministries of science and telecommunications. One of ITU's differentiating elements is the link between AI and the UN's 17 Sustainable Development Goals (SDGs), so that it aims to identify related projects, initiatives and organizations that will enable them to accelerate (3).

Table 1. Artificial Intelligence Implementations in Organizations.

Industria	Transformación
Bless you	Robotic-assisted surgery and virtual nursing assistants
Tourism	Check-in via facial recognition
Transport	Autonomous vehicles, aircraft, and pilotless ships
Commerce	Stores and supermarkets without cashiers would be a reality
Education	Facial recognition to analyze the effectiveness of teaching and obtain feedback directly from students
Agriculture	Agricultural drones and autonomous tractors
Government	Public safety by facial recognition and data analysis

Fuente: Elaboración propia en base a la literatura

These are some of the examples that are a reality in organizations today, having said the above, large companies specialize in congruent processes due to their organizational structure and the power of being able to implement almost any system they are forced to implement, which is why they effectively implemented artificial intelligence in their organizations. On the other hand, it does not mean that an SME does not manage to establish itself in the market with this type of method, successful SMEs seek to position themselves in the market and achieve its development. SMEs in their constant growth seek to implement new systems that make processes as competitive as those that exist in the market in which they are developed.

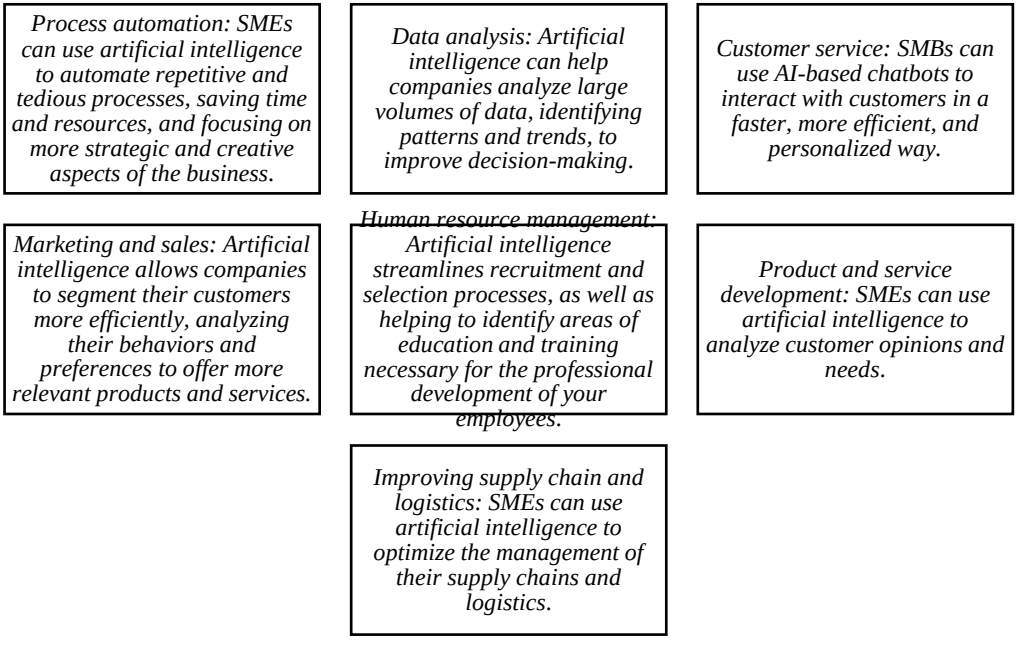
Artificial intelligence (AI) not only contributes to the implementation of new processes and the internal improvement of organizations, but also offers significant opportunities for the growth of SME companies. Beyond increasing sales or improving perception, AI can drive sustainable

development by generating employment and encouraging specialization in various job areas, although there are successful examples of AI applications, it is important for SMEs to conduct thorough research to understand the specific costs and benefits before implementation.

Proceeds

Small and medium-sized businesses (SMBs) can also benefit from artificial intelligence in a number of ways, such as:

Figure 2. Benefits in the implementation of AI in SMEs



Note: Literature Review

Main risks that an SME may face when using Artificial Intelligence:

Costs: AI adoption and implementation can be costly, especially for SMBs with limited resources. In addition to the costs of acquiring and developing AI systems, the company may need to train its employees and acquire additional hardware or software.

Data security and privacy: AI, like any other technology, can be vulnerable to cyberattacks or security breaches. Companies must consider data protection and privacy both in their own operations and in interactions with customers.

Unemployment and job displacement: Automating tasks and processes using AI can lead to the displacement of employees in certain roles.

Reliance on technology: As a business begins to rely on AI, problems could arise if the system fails or encounters technical difficulties.

Lack of personalization and human focus: While AI systems can improve efficiency in customer service and other areas, there is also a risk of losing the human touch in customer interactions, which could lead to dissatisfaction or lower loyalty.

Accountability and regulations: Implementing AI comes with issues of legal liability and compliance that are still under development. SMBs need to stay informed about how laws and regulations affect their implementation of these technologies.

Challenges:

1. Lack of understanding of the opportunities and benefits that AI offers.
2. Lack of adequate information.
3. Lack of an adequate strategy on artificial intelligence.
4. Lack of data.
5. Difficulty integrating AI projects with existing systems.

However, given the challenges that SMEs face for implementation, there are more benefits that they would encompass for the organization. If SMEs were to implement the technologies, which is feasible for the organization, since we are immersed in the fact that this could be very expensive but the truth is that it is not so, for example, the implementation of an app or a chat Bot is something that even SMEs can implement and pay for its low cost. On the contrary, instead of representing additional value, they could reduce costs and increase productivity without neglecting human talent.

2. Methodology

The article is based on the PRISMA methodology (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). Research questions were raised: How does the incorporation of artificial intelligence influence consumer satisfaction? and How is artificial intelligence transforming the way companies are designed and developed?

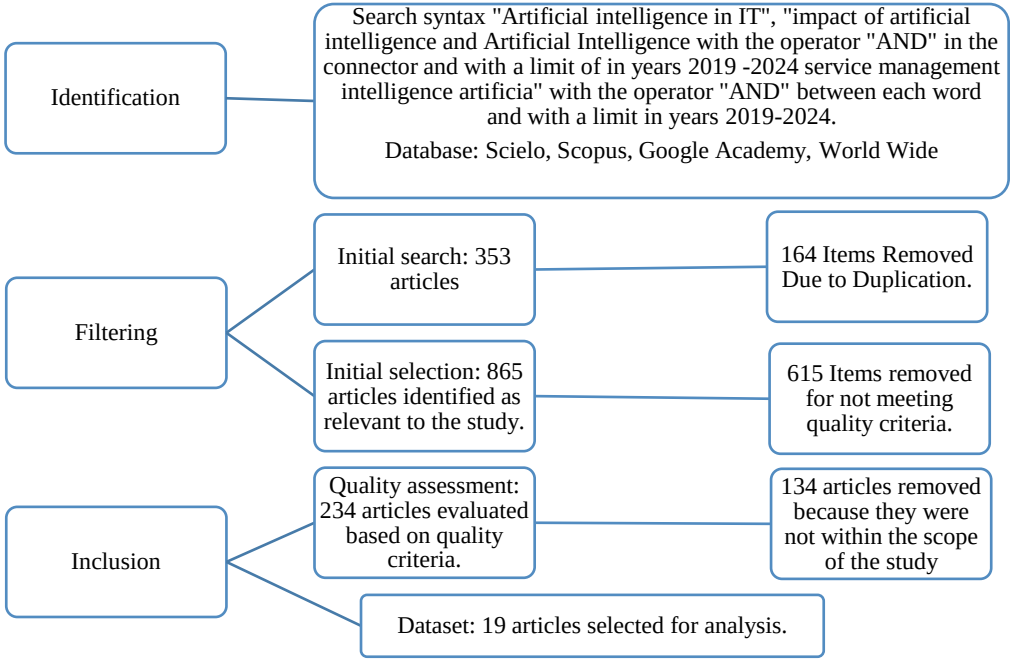
To do this, we use an exhaustive analysis of the scientific literature following the PRISMA methodology, as described by Beal (2021). This methodology allows a structured study of information supported by other authors, in order to answer the questions posed. Beltrán and Oscar (2005) point out that systematic reviews are an observational and retrospective research design that synthesizes the results of multiple primary studies. These reviews are fundamental in evidence-based medicine due to their rigorous methodology, which allows us to identify relevant studies to answer problem questions. This methodology can be applied to all types of systematic reviews, not only to meta-analyses of clinical trials. Taking into account these definitions, the following research steps will be detailed: design of the search strategy, selection of the relevant literature, recording of results and, finally, the interpretation of the results.

Inclusion, exclusion and quality criteria

The inclusion criteria established for this systematic review were as follows: information was sought in English and Spanish related to the impact of artificial intelligence (AI) on quality management in the last 4 years (2020-2024). On the other hand, in the exclusion criteria, information that had artificial intelligence in service management as its theme was not considered, nor that which did not contain the keyword "AI". In terms of quality criteria, temporal relevance due to the constant evolution of technology, consistency in the presentation of ideas, originality to avoid duplication, and a rigorous methodological approach to minimize biases, errors, and misinterpretations were taken into account. These quality criteria strengthen the validity of the results obtained.

The search and extraction of information was carried out individually and the discrepancies observed were resolved by consensus among the collaborators, with the aim of achieving a systematic review as shown in (Graph 2).

Figure 2. Reliable data extraction process.



Note: The detailed outline of the process used when applying the PRISMA methodology.

Data collection process

To begin to address the issue at hand, some key words and significant terms were first defined. These are: "Artificial Intelligence", "Structural Analysis", "Structural Management and Control",

"Structured System", "Data Flow Diagram", "Structured Design". On the other hand, the PRISMA methodology begins with the search for records or citations in various databases, followed by the elimination of duplicates and ends with qualitative and quantitative synthesis studies (systematic reviews and meta-analyses). The databases selected for this systematic review were chosen because of their widespread use in a variety of systematic studies and the abundance of scientific articles containing relevant information.

Table 2. Articles were obtained by searching academic search engines and their respective search engines.

Search Engine	Search Terms	Results	Selected
SciELO	(IT service) AND (artificial intelligence) AND year_cluster:("2022" OR "2021" OR "2020" OR "2019")	12	1
Scopus	(TITLE-ABS-KEY) (service AND management) AND TITLE-ABS-KEY (intelligence AND artificial) AND PUBYEAR > 2018 AND PUBYEAR < 2024 AND (LIMIT-TO (LANGUAGE , "English") OR LIMIT-TO (LANGUAGE , "Spanish") OR LIMIT-TO (LANGUAGE , "Portuguese") AND (EXCLUDE (SUBJAREA , "MEDI") OR EXCLUDE (SUBJAREA , "MATH") OR EXCLUDE (SUBJAREA , "ENER") OR EXCLUDE (SUBJAREA , "SOCI") OR EXCLUDE (SUBJAREA , "PHYS")) AND (LIMIT-TO EXACTKEYWORD, "Artificial Intelligence"	635	12
Google Academy	"IT service management" AND "impact of artificial intelligence" AND "finance" AND "Customer" -Medicine -Energy)	131	4
World Wide Science	(“IT service management with AI and impact of artificial intelligence in organization”)	96	1

Note: This table presents the different search engines used in this research. The search terms section shows the different keywords entered into each related academic search engine. The results show the number of articles found after applying relevant filters to ensure the certainty of the topics covered in our research. Finally, articles were selected using the PRISMA methodology.

3. Results

Influences given by the implementation of AI by companies, for customer satisfaction grouped by items.

Table 3. Advantages and disadvantages of AI in PYMES

Influences	Advantages	Disadvantages	Total
Several authors agree that artificial intelligence influences when a customer needs a query, so waiting time is a determining factor in satisfaction.	▪ Operational efficiency ▪ Decision-making ▪ Personalization and customer experience ▪ Resource optimization.	▪ Cost of implementation ▪ Distrust and resistance to change ▪ Technological dependence ▪ Privacy and security risk.	7
An essential factor in quality management, through the use of AI, is the ease of handling of intuitive	▪ More intuitive and user-friendly processes. ▪ Increased accuracy and consistency	▪ Technical complexity. ▪ Lack of trust and transparency.	5

processes and their ease of use.	▪ Process optimization. ▪ Decision-making.	1. Implementation and maintenance cost ▪ Resistance to change.	
Artificial intelligence has a significant impact on PYMES, in terms of security.	▪ Detection and prevention of Threats. ▪ Automated incident response. ▪ Adaptation and continuous improvement. ▪ Resource optimization.	▪ Vulnerability to targeted attacks. ▪ Over-reliance on technology. ▪ Privacy and compliance risks. ▪ Dependence on external suppliers.	5

Note: Literature review

AI-driven organizational transformations in SMBs

Table 3 shows important transformations in various areas, such as the generation of value for consumers, marketing, risk analysis and fraud detection, human resources management and organizational structure. These changes are motivated by the implementation of artificial intelligence and seek to optimize efficiency, personalization, and collaboration within companies.

Table 3. AI transformations in organization, design, and operation grouped by items.

Transformations	Article(s)	Total
There has been a shift in the way consumer value is generated through financial data analysis. Now, this data is used to predict patterns, trends, performance, and the evolution of financial markets. In contrast, they used to rely on traditional methods such as statistical analysis and financial modeling.	Webb, (2020) (5); Agrawal et al. (2019) (6); Priya (2021) (7); Jadli et al. (2023) (9); Li Xin et al. (2023) (8); Leo et al. (2020) (9); Meyer et. al, (2022) (10)	7
In the past, personalization in marketing focused on segmenting customers based on their age, gender, geographic location, and other criteria. However, today, personalization goes beyond these traditional categories and seeks to offer unique and relevant experiences to each individual.	Blut et al. (2021) (11); Stroessner y Benítez (2019) (12)	2
In the past, traditional approaches to detecting fraud and analyzing risks relied on manual methods, sometimes resulting in errors and omissions.	Raraz et, al (2023) (13); Villacorta et al. (2023) (14)	2
Human talent management has evolved thanks to the identification of employees' skills and talents. Previously, traditional methods relied on interviews and manual assessments, which sometimes resulted in biases and errors in identifying talents.	Raraz et, al (2023) (14); Santander et al. (2024) (16);	2
Changes in organizational structure, driven by the adoption of cross-functional and multidisciplinary teams, focus on the growing importance of digital and technological skills. These skills make it possible to address the challenges and opportunities related to artificial intelligence (AI). In this context, companies are increasingly opting for flat and collaborative structures instead of centralized hierarchies.	Cedeño et, al (2023) (17); Alvia et, al (2021) (18); De Tyler (2023) (21); Diestra et, al (2021) (22)	4

Note: Results obtained from the articles selected for the study

4. Discussion

Artificial intelligence systems require collaboration between humans and AI models to ensure high-quality data in training. This implies a structural change in organizations, with greater attention to technology and the formation of multidisciplinary teams, in addition, Robotic Process Automation (RPA) incorporates machine learning to improve efficiency in complex administrative processes of companies. On the other hand, removing bottlenecks in decision-making is crucial in the implementation of artificial intelligence, supported by statistical approaches such as propensity modeling.

Según, Li Mahei et al. (2023) (19), it should be noted that hybrid intelligence systems rely on human input to provide high-quality data with which to train their underlying AI models. Therefore, a structural change would occur within the organization, paying more attention to technology areas and forming cross-functional and multidisciplinary teams that can also help address the challenges and opportunities of AI. In addition, according to Tapia (20), el RPA Incorporate machine learning to improve administrative processes. These processes can be complicated and require a high degree of interpretation and judgment from decision-makers, which achieves greater operational efficiency in the organization.

As can be seen in the previous paragraph, although AI, being implemented both for the improvement of internal processes and focused purely on customers, already provides the possible risks of not being able to understand or control the decisions it makes. Therefore, future lines of research should be focused on the field of regulations and ethical frameworks that guide development, in order to improve transparency and achieve a better understanding and control of the decisions made by AI.

5. Conclusions

AI offers great potential to improve quality management in SMEs, but its implementation must be strategic, considering both the benefits and the challenges. It is important for companies to carefully assess their context and needs before adopting AI solutions in quality management for small and medium-sized businesses (PYMES) It presents both significant benefits and important challenges to consider.

On the other hand, the benefits of AI in this area are numerous. AI's ability to analyze large volumes of data, identify patterns and trends, and automate key processes can substantially improve the efficiency and accuracy of quality assurance and control activities. In addition, AI helps PYMES to anticipate and predict quality problems, allowing a more proactive and effective response. In an increasingly competitive environment, these improvements in quality management can represent an important strategic advantage for SMEs.

SMEs that manage to integrate AI strategically and responsibly into their quality processes will have an important opportunity to improve their competitiveness and better adapt to market demands. However, those that fail to address the associated challenges risk being left behind in an environment increasingly dominated by technological innovation.

Limitations

The present study is not without limitations, which opens up avenues for future research.

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