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Cloud-based Documental Management System applied to the Supply Chain area: A Bibliometric Review Analysis

Duarte Miguel Pereira da Silva

Masters in Computer Science and Business Management

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PhD Carlos Eduardo Dias Coutinho, Assistant Professor,
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September, 2024

TECHNOLOGY
AND ARCHITECTURE

Department of Information Science and Technology

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Things are either devolving toward, or evolving from, nothingness.

- Leonard Koren

Agradecimento

A elaboração de uma tese de final de curso remete-nos inevitavelmente a pensar em todo o percurso universitário até ao último dia. É, por isso, um processo de aprendizagem contínua, onde procuramos sempre o melhor sucesso escolar e profissional possível. Dito isto, gostaria de agradecer de forma geral a todos os que, de certa forma, me permitiram crescer, não só como profissional, mas também como pessoa, durante este percurso.

Aos meus familiares, amigos, pelo constante apoio, paciência e passar de conhecimentos, apesar da distância física ao longo destes 3 anos. Nem sempre foi fácil conciliar a minha vida pessoal, com a profissional e com a vida universitária, mas todos eles me ajudaram e permitiram-me cumprir os meus objetivos e sonhos.

Ao ISCTE e todos os funcionários, colegas e docentes pela partilha de informação e ensinamentos a cada dia e pela disponibilidade, flexibilidade e simpatia mostrada. Em especial, ao meu Orientador de tese, o Professor Carlos Coutinho, que me indicou ao longo desta última fase, o melhor caminho a seguir, mesmo quando do meu lado não existiam novidades tão constantes como deveriam. Sem dúvida que esta instituição de excelência teria consigo os melhores profissionais que me deram ferramentas para poder chegar ao fim de mais uma etapa.

Todos foram extremamente importantes durante esta última difícil fase, marcada não só pela pandemia nunca vivida por ninguém, mas por acontecimentos que, no final, nos fizeram crescer, aprender e sonhar que é possível concretizar os nossos sonhos.

A todos, o meu muito Obrigado!

Resumo

Este documento apresenta uma revisão bibliométrica sobre a implementação e impacto de uma implementação de um Sistema de Gestão Documental (DMS) baseado em soluções na *Cloud* no setor da cadeia de abastecimento. O estudo foca-se na análise da literatura académica de 2010 a 2024, destacando o papel crescente das tecnologias na *Cloud* na melhoria da eficiência da cadeia de abastecimento, redução de custos, promoção da sustentabilidade e integração com outras novas tecnologias, promovendo todas as vantagens que cada uma proporciona quando implementadas individualmente. Refere também a implementação de soluções baseadas em *Cloud* em outros setores e os respetivos impactos que estas tiveram nas organizações. Através de uma revisão sistemática de artigos científicos da base de dados *Elsevier Scopus*, este documento explora detalhadamente os benefícios das soluções de DMS baseadas na *Cloud*, como a melhoria no acesso a documentos, redução da pegada de carbono e aumento da segurança de dados e conformidade com as regulamentações internacionais. Além disso, o estudo investiga como estes sistemas contribuem para a otimização de processos ao longo da cadeia de abastecimento, incluindo a redução de papel físico e de processos administrativos, levando a significativas vantagens ambientais e operacionais. Esta análise bibliométrica identifica tendências chave, autores relevantes e lacunas emergentes na pesquisa, oferecendo *insights* sobre o desenvolvimento futuro de soluções de DMS baseadas na *Cloud* no setor da cadeia de abastecimento, através de um ecossistema mais desmaterializado.

Palavras-chave: Soluções *Cloud*; Cadeia de Abastecimento; Sustentabilidade; Sistema de Gestão Documental (SGD); ISO; Novas Tecnologias

Abstract

This document presents a bibliometric review of the implementation and impact of Cloud-based solution Document Management Systems (DMS) in the supply chain sector. The study is focused on analyse academic literature from 2010 to 2024, focusing on the growing role of Cloud technologies in enhancing supply chain efficiency, reducing costs, promoting sustainability and integration with other new technologies that promote all the advantages that each one provides when implemented solo. It also refers of implementations of Cloud-based solutions in other sectors and what impacts did they had in the organizations. Through a systematic review of research papers from the Elsevier Scopus database, this document explores in detail the benefits of Cloud-based DMS solutions, such as improved document accessibility, reduced carbon footprint, and enhanced data security and compliance with international regulations. Furthermore, the study investigates how these systems contribute to optimizing processes across the supply chain, including the reduction of physical paperwork and administrative processes, leading to significant environmental and operational advantages. This bibliometric analysis identifies key trends, prominent authors, and emerging research gaps, offering insights into the future development of Cloud-based DMS solutions in the supply chain industry through a more dematerialized ecosystem.

Keywords: Cloud Solutions; Supply Chain; Sustainability; Document Management System (DMS); ISO; New Technologies

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Index of Acronyms

AI - Artificial Intelligence

CBML – Cloud-Based Machine Learning

CeFi – Centralized Service

CMfg – Cloud Manufacturing

CMHS - Cloud Material Handling Systems

CPS - Cyber-Physical Systems

DESI - Digital Economy and Society Index

DIS - Digital Information Sharing

DMS – Document Management

DSADV – Dispatch Advice

EDI - Electronic Data Interchange

EHR - Electronic Medical Records

FinTech – Financial Technology

GDPR - General Data Protection Regulation

ICT - Information and Communication Technologies

InsurTech – Insurance Technology

IoT – Internet of Things

ISO – International Organization for Standardization

ML - Machine Learning

PHR - Personal Health Records

RBAC – Role-based access control

RCM – Remote Container Management

RECADV – Receiving Advice Message

RFID – Radio Frequency Identification

SBTs – Soulbound Tokens

SCM – Supply Chain Management

SLA – Service Level Agreement

SMB – Small and medium Businesses

SME - Small and Medium-sized Enterprises

CHAPTER 1

1. Introduction

According to Wang et al. (2018), the existing logistics solutions suffer from several problems that can directly impact all the supply chain effectiveness. It also says that one of the major areas of concern is how to treat documentation that passes through various and different stakeholders. This process where the administration and processing of documents, in traditional document management based in physical paper, costs related to lost or delayed documents can account for as much as 20% of total transportation expenses.

Despite the effort to increase the use of new technologies to promote securable and reliable information, the shared documentation is still a major factor that can promote those best practices, since there is still a huge difficulty to share all the legal information between all nodes and/or stakeholders of supply chain. This also has an enormous impact when considering the carbon footprint in all supply chains. This dependency on paper documentation results in catastrophic effects for every stakeholder that need to waste a lot of resources to pass all the vital information for the next stakeholder in the chain, sometimes duplicating or triplicating the information necessary.

With the growing development of the information flow importance in an organization and the need to have that information always available, stored, secured, and tracked, the companies saw in Document Management System (DMS) a good opportunity to have all important files in these solutions. A DMS is a digital platform for organizing, storing, and managing documents securely and efficiently. The industrial companies looked to this as a strategic implementation, more concretely inside the Supply Chain area that looked to these solutions to improve warehouse and processes productivity, reduce all the costs, and optimize transportation costs and automatize processes. The Document Management System (DMS) also developed a solution to share all the documents needed between organizations, giving a huge opportunity to standardize all documentation required in every organization process and promote the use of digital information and not physical documents. With these solutions, it was also possible to understand that it can reduce the Supply Chain carbon footprint, promoting with that a paperless thinking between all stakeholders, estimating that DMS can help reduce the carbon footprint by more than 1400 $kgCO^2$/day [2]. This topic will describe the main objective that wants to be accomplished during the dissertation.

A Document Management System implementation can improve not only the carbon footprint from an organization, but also directly reduce administrative costs, providing better storage, security and traceability of documentation needed for each stakeholder, sharable any time for specific people. Cloud systems are in line with this necessity to store, share and give secure space to each user, having different solutions for each type of user needs.

By examining citation patterns and linked networks, this study aims to identify highly cited articles and eminent writers who have significantly influenced the field of Cloud computing and resource-based views. The analysis seeks to contribute to a thorough assessment of the current state of knowledge, indicate research gaps, and reveal viable avenues for future exploration in this quickly evolving subject by revealing connections between study topics and indicating emerging areas of interest. With that, the main objective of this project is to correlate the importance to have a Cloud service implemented to store the DMS information, with the importance in supply chain to have reliable and secured information available for every user, studying the impact to have a solution based in Cloud comparing to other solutions on the market. With this study, it would be possible to understand how a Cloud service solution can impact all supply chain end-to-end processes and how it can be used to reduce administrative costs and the carbon footprint related to those processes, not only in Supply Chain, but also comparing with different industries.

Chapter one introduces the theme and motivations. Chapter 2 presents a Literature Review on the topics researched. Chapter 3 presents the architecture of the proposed solution and the relevant data synthesis. Chapter 4 presents the discussion of the results. And finally, Chapter 5 presents the Conclusions and Future Work.

CHAPTER 2

2. Research Methodology

2.1. Research Strategy

For this review, a Systematic Literature Review (SLR) research strategy was employed to maximize the benefit of the articles related to the topic under study. Initially, the essential elements for the research were identified: the research questions that would be the focus, the database to search for keywords, the strings which are the terms to be searched in the database, and the criteria established to filter the results [3].

2.2. Research Questions

The current research is focused on exploring how a Cloud-based Document Management System (DMS) can be incorporated into Supply Chain Management (SCM), with focus on sustainability developments from these implementations. The study is guided by the following research questions:

Q1: What does the existing literature from 2010 to 2024 say about the use of Cloud-based solutions, more concretely in Supply Chain Management?

Q2: How can a Cloud-based Document Management System impact the organization results, in terms of efficiency, cost savings, productivity and sustainability?

Q3: How the regulatory frameworks in terms of data security and compliance, can enhance the design and implementation of a Cloud-based DMS solution in the Supply Chain?

2.3. Literature review

This section describes how the literature review for the topic under study was carried out, identifying initially the research strategy, the databases used, their keywords used and the quality criteria. In the end, it will be shown the results of this research as well as the threats to the validation of the review performed.

2.3.1. Identification of the Research

The objective of this study is to explore and analyse the contemporary literature on Cloud solutions and their role in enhancing resource-based strategies through the application of a bibliometric analysis methodology. Utilizing quantitative and qualitative techniques, this methodology allowed us a systematic examination of databases to identify prominent authors that discuss this topic, uncover emerging trends, assess citation patterns, and map the accumulation of scientific knowledge within the field [4].

This research aimed identifying highly cited publications and important authors who have significantly shaped the discourse on Cloud solutions and resource-based strategies by analysing citation patterns and related networks. By uncovering these connections between research topics and

highlighting emerging areas of interest, this analysis seeks to provide a comprehensive overview of the current state of knowledge by identifying gaps in the literature and suggest potential avenues for future exploration in this rapidly developing domain. Moreover, this bibliometric analysis will contribute to the existing body of knowledge, serving as a valuable resource for researchers, professionals, and students seeking to deepen their understanding of Cloud and Document Management solutions and their strategic applications in organizations, while also guiding future advancements in both theory and practice.

2.3.2. Articles Selection

The Elsevier Scopus online database was used to find the papers for this study, which followed the quality standards for analysis that were previously set and are listed in the Data criteria section. To start, it was used a procedure to compile pertinent articles. Prior, a more detailed review and selection process, based on predefined criteria, was used to identify articles that were pertinent and contributory to the research. The EBSCO Discovery Service from ISCTE was also used to conduct and maintain the integrity of the articles used from Scopus database. This methodical approach was designed and constructed to ensure that only the most significant articles were included.

2.3.3. Keywords

The keywords used for this literature review were combined with the logical operators "OR" and "AND". These operators help identify specific topics within broad fields of knowledge and find all relevant information about the subjects studied. Only one set of keywords was used in the search:

("Document Management System" OR *"DMS")* AND *"Cloud"* AND ("*Logistics"* OR *"Supply Chain"*) AND *"Sustainability"*.

2.3.4. Data criteria

In this research, it was used inclusion and exclusion data criteria which allowed us to find the most pertinent publications for the subjects of the study. In Table 2.1 - Inclusion Criteria and Table 2.2 - Exclusion Criteria is possible to check the criteria used in this research.

Table 2.1 - Inclusion Criteria

Inclusion Criteria	**Description**
IC1	English academic articles, journals, conference papers, conference reviews and book chapters
IC2	Articles between 2010 and 2024

Table 2.2 - Exclusion Criteria

Exclusion Criteria	Description
EC1	Articles not in English
EC2	Articles before 2010
EC3	Limited to specific study areas: Computer Science; Business Management and Accounting; Environmental Science; Engineering; Economics, Econometrics and Finance

Following the selection of data criteria already shown, the set of keyword search was conducted in the Elsevier Scopus database, focusing on "Cloud". To refine the research scope and enhance clarity, different filters were applied, as illustrated in the Table 2.3 - Filters applied, including the inclusion and exclusion criteria. Each filter progressively restricted the search, facilitating a more comprehensive understanding of the problem under study:

Table 2.3 - Filters applied

Filter Number	Description
Filter 1	Full Text
Filter 2	“Cloud” in Article title, Abstract and Keywords. The rest in Full Text
Filter 3	Inclusion and Exclusion criteria: Only English articles
Filter 4	Inclusion and Exclusion criteria: Articles between 2010 and 2024
Filter 5	Inclusion and Exclusion criteria: Articles in specific study areas

Following a search in the relevant database, the respective filters were applied. This was the final query used in Elsevier Scopus:

(ALL ((document AND management AND system) OR dms) AND TITLE-ABS-KEY (Cloud) AND ALL ((logistic) OR (supply AND chain)) AND ALL (sustainability)) AND PUBYEAR > 2009 AND PUBYEAR < 2025 AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (SUBJAREA , "COMP") OR LIMIT-TO (SUBJAREA , "ENGI") OR LIMIT-TO (SUBJAREA , "BUSI") OR LIMIT-TO (SUBJAREA , "ENVI") OR LIMIT-TO (SUBJAREA , "ECON"))

The outcome of this search is displayed in Table 2.4 - Number of articles in each filter stage:

Table 2.4 - Number of articles in each filter stage

Filter Number	Number of articles
Filter 1	5116
Filter 2	558
Filter 3	553
Filter 4	552
Filter 5	494

As shown in the upper table, the usage of the respective filters resulted in a total of 494 documents that this study will focus on.

2.3.5. Documents per year

The Figure 2.1 – Documents per year, illustrates the steady increase in document publications between 2010 and 2024. More pertinent documents have been published since 2019, having a huge contribution from then, and have continued to grow until today, indicating the growing popularity of these research areas. With 126 documents released, 2023 was the year with the most publications during the period studied.

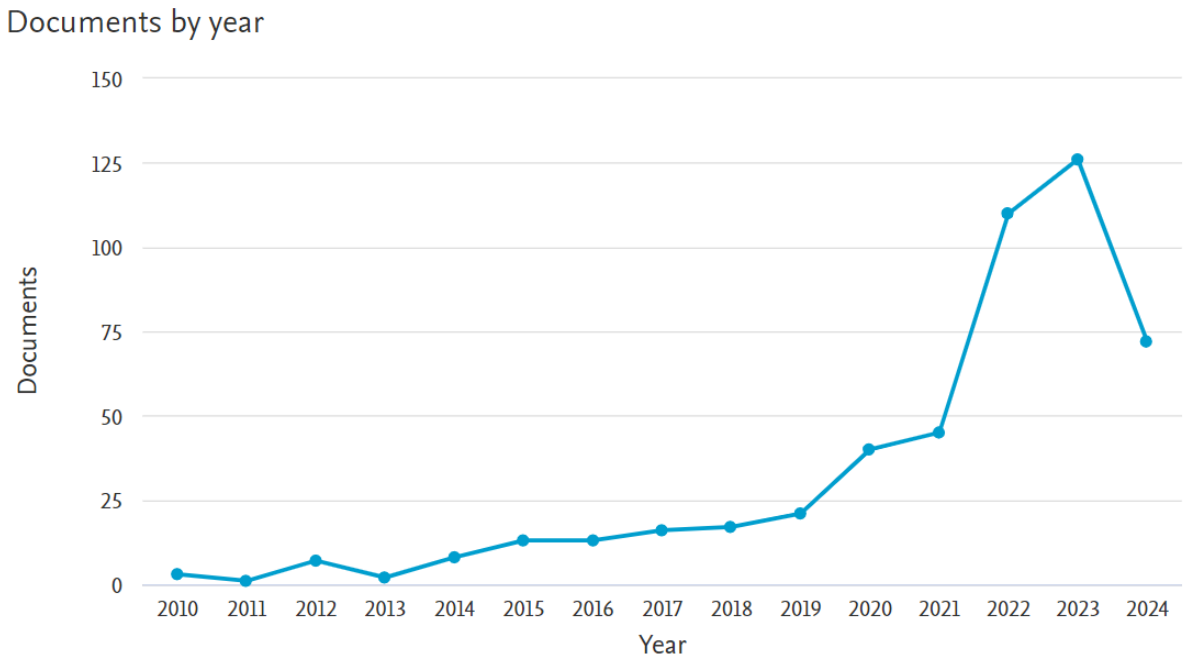

Figure 2.1- Documents per year

The significant increase in articles focused on Supply Chain Management and DMS, with focus on Cloud solutions highlights the recognition of their interconnected roles in improving organizational efficiency and reducing costs, with also an environmental thinking to promote the best sustainable

practices. The growing research documents offer valuable insights into how these areas collectively shape the strategic and economic landscape of businesses nowadays.

2.3.6. Top publishing Sources

During the last 14 years, the source with the most documents published about this study area has been Sustainability Switzerland, a source very correlated with the sustainability and Environmental Sciences study fields. This can be explained by the fact that the use of Cloud-based solutions and other new technologies has been directly explored to improve the usage of natural resources and correlate with current trends such as climate change and environmental issues. Since the Documentation Management Systems used in most organizations are still attached to physical documents, there is also a commitment to research and work into the best practices in this area with the objective of improving and reducing the use of paper.

In the Figure 2.2 - Documents per year by source., it is also possible to note that there is a diverse distribution of sources, which can imply not only that these topics are studies in application to several areas of business but also that they are important areas of study for future implementations in different types of organizations.

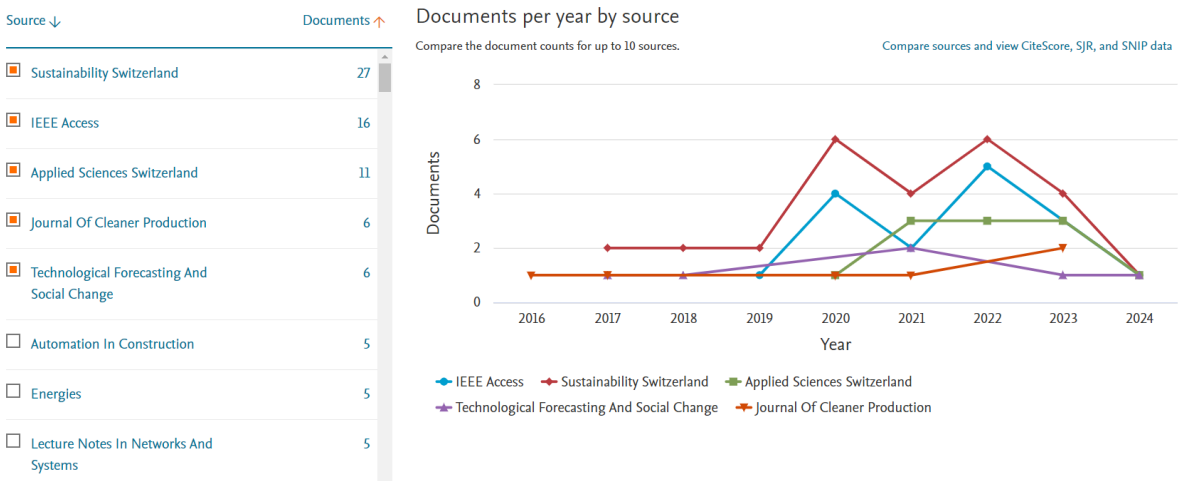

Figure 2.2 - Documents per year by source.

2.3.7. Total by subject area

Of the 494 documents studied, as shown in Figure 2.3 - Documents by subject area., the largest share (24.1%, corresponding to 277 documents) belongs to the Computer Science subject area, followed by Engineering (19.2%) and Business, Management, and Accounting (12.4%). As discussed previously, this distribution highlights the diverse areas to which this study applies, suggesting that new technology usage can be correlated with various specific business domains, providing new insights and solutions.

Subject area	Documents
Computer Science	277
Engineering	220
Business, Management and Accounting	142
Social Sciences	85
Environmental Science	81
Energy	54
Decision Sciences	51
Economics, Econometrics and Finance	51
Mathematics	38

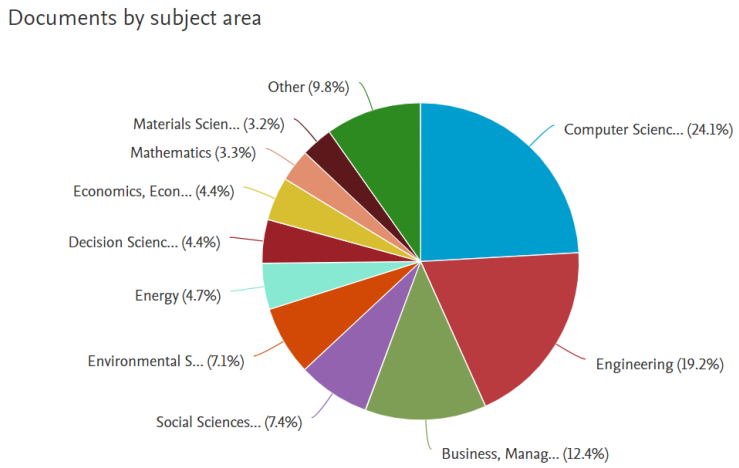

Figure 2.3 - Documents by subject area.

2.3.8. Geographics and funding sponsors

In Figure 2.4 - Documents by country or territory., it is possible to analyse from which are the most of publications studied. Most publications are based in India, China, United Kingdom and United States. Most of the documents are from Asia or Europe. In the next figure, it is possible to analyse the geographical origins of the publications studied. Most publications come from India, China, the United Kingdom, and the United States, with most documents originating from Asia or Europe. This distribution indicates that the world's leading economic and technological powers, including those that are major polluters, as well as environmentally conscious countries, are increasingly aware of the significance of Cloud technology and sustainability, reflecting their commitment to advancing these fields and studying its impact.

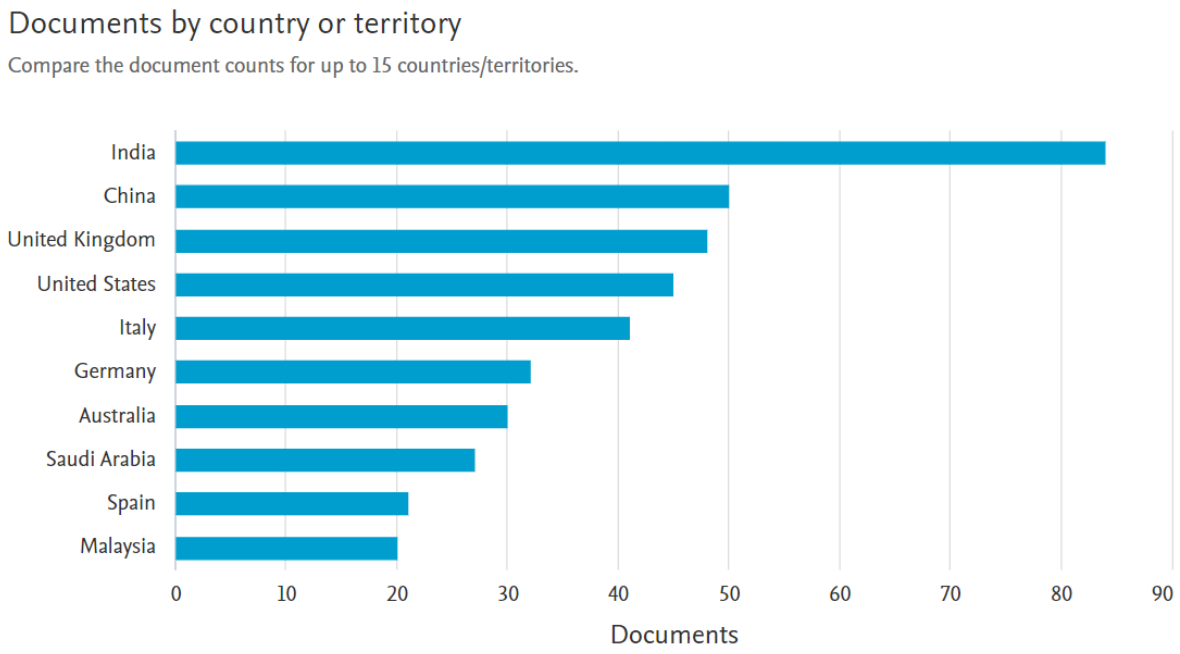

Figure 2.4 - Documents by country or territory.

This is also correlated to the funding sponsors, with the National Natural Science Foundation of China sponsoring 20 publications, followed by four European associations that, cumulatively, have sponsored 36 publications, as seen in Figure 2.5 - Documents by funding sponsor.. In other words, these regions have invested in financing studies on how to positively impact the environment, reduce organizational costs and enhance the studies of innovative technologies.

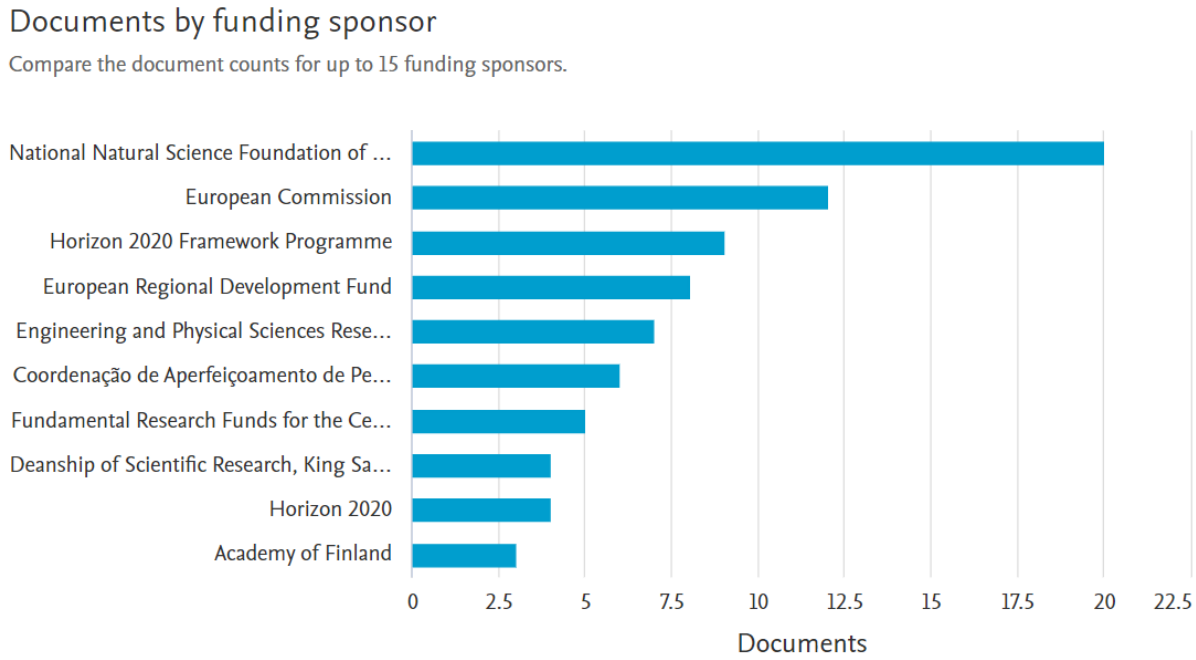

Figure 2.5 - Documents by funding sponsor.

2.3.9. Types of documents

As shown in Figure 2.6 - Documents by type, from the 494 documents, most of them are articles (55.7%), which is the primary form of scholarly research, contributing to advancing the knowledge in this topic.

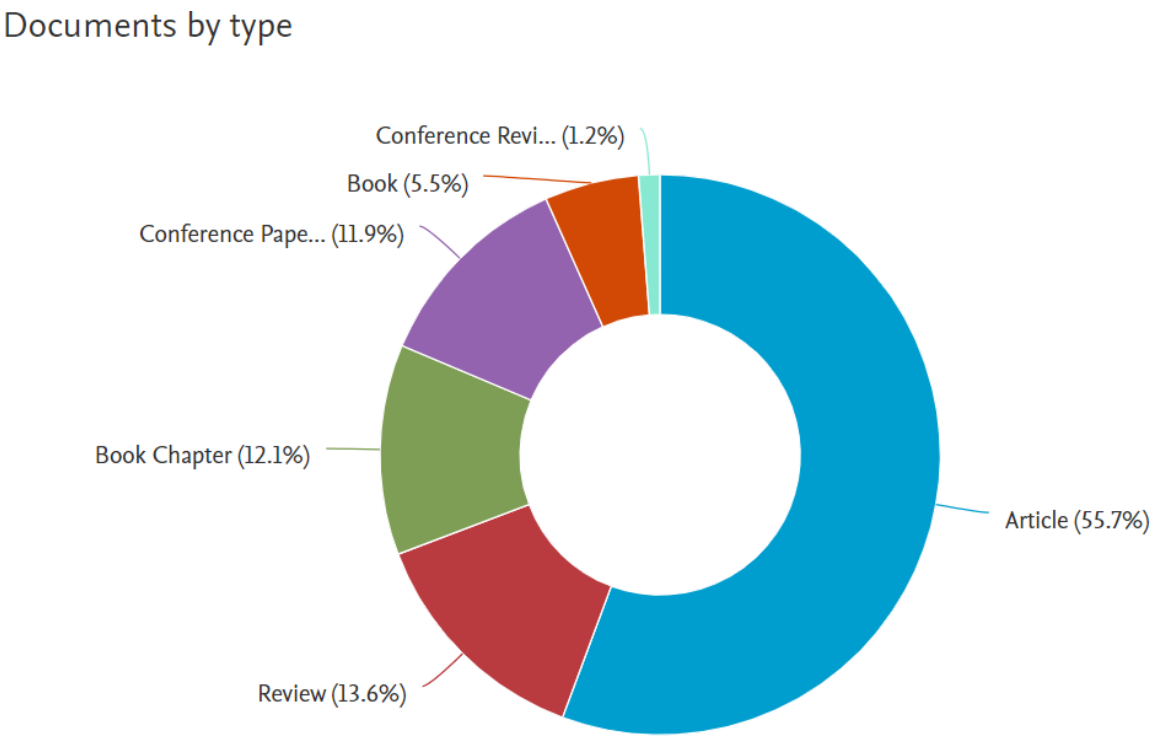

Figure 2.6 - Documents by type

2.4. Key Concepts, Structures and Findings

As previously referenced, during this research, it was used the Elsevier Scopus search engine, retrieving, and extracting information from a total of 494 documents. To better understand and analyse, it was also used a program called VOSviewer, a software tool for constructing and visualizing bibliometric networks in a specific dataframe. This program permits to have a co-occurrence analysis for the keywords used in every document, providing a visual representation of a network between the most significant keywords in the dataframe. For this study, it was used a threshold of minimum of 12 occurrences of a keyword, leading to 48 keywords that meet this requirement out of 3685, as shown in Figure 2.7 - Threshold selection in VOSviewer.

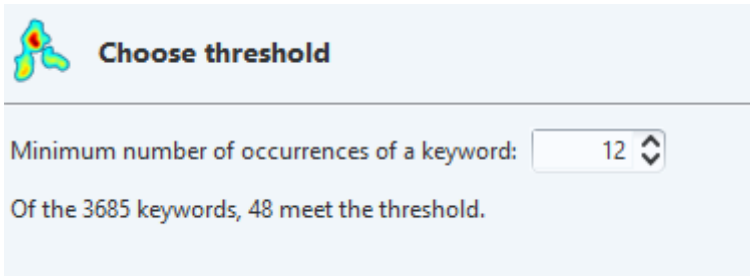

Figure 2.7 - Threshold selection in VOSviewer.

After this first co-occurrence junction, the program gave a graphic visualization of the top keywords used, that permitted to make a comprehensive analysis between them, as shown in Figure 2.8 - Network Visualization of Keyword and Co-occurrence in VOSviewer.

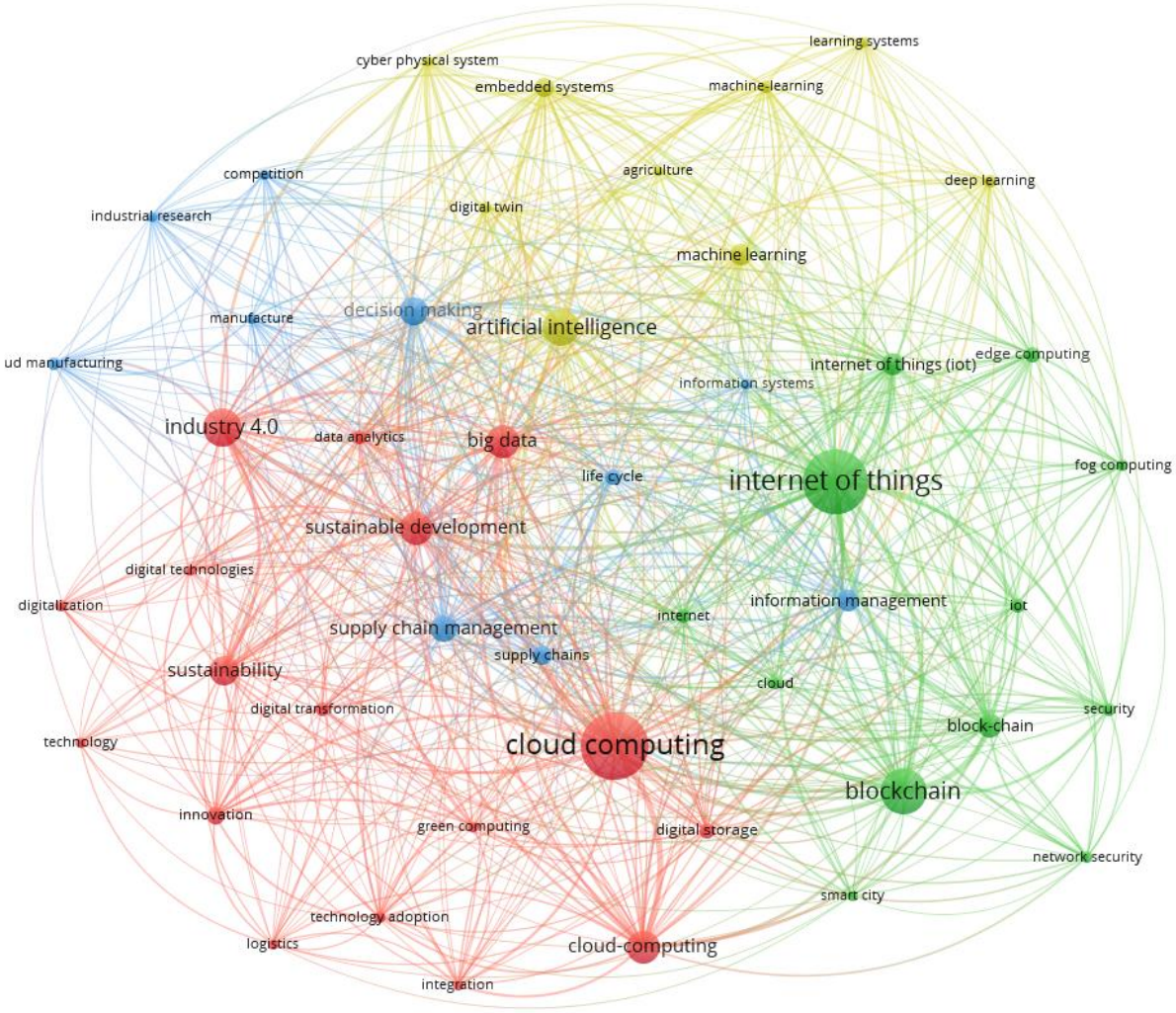

Figure 2.8 - Network Visualization of Keyword and Co-occurrence in VOSviewer.

Subsequently, these keywords were grouped into distinct clusters, enabling an exploration of the interconnected themes within the dataset. It was possible to identify 4 main clusters of keywords, as shown in Table 2.5 - Cluster division, each highlighting distinct yet interconnected areas of research and application. This analysis highlights how different areas are interconnected, demonstrating how innovations in one can have a substantial impact and stimulate innovation in other domains. This method reflects the multifaceted and integrated approach required for contemporary research and application.

Table 2.5 - Cluster division

New Technology	Supply Chain
Blockchain; Security; Smart City; Internet of Things; Digital Transformation; Technology; Innovation; Industry 4.0; Artificial Intelligence; Machine Learning; Deep Learning; Big Data; Embedded Systems; Learning Systems	Logistics; Decision Making; Manufacture; Competition; Industrial Research; Information Management; Network Security: Life Cycle; Information Systems; Data Analytics
Sustainability	**Cloud Computing**
Green Computing; Technology Adoption; Sustainable Development; Digitalization; Agriculture	Fog Computing; Edge Computing; Digital Storage; Cyber Physical System; Cloud Manufacturing

- **New Technologies**: Represent the modern technologies that drive innovation across various sectors in the last years.
- **Supply Chain**: Highlight the integration of advanced technologies in optimizing supply chain processes, enhancing decision-making, and improving overall efficiency and reduced costs.
- **Sustainability**: Emphasizes the role of technology in promoting sustainable practices and development, reducing the use of resources in different areas.
- **Cloud Computing**: Reflect the understanding and evolution of Cloud technologies and their applications in enhancing computing capabilities, storage solutions, and manufacturing processes.

It is also important to refer that, the keywords across these clusters are not isolated, which means that often overlap and influence each other. These interconnections can be made, for example, between these terms:

- **Blockchain and Supply Chain**: Blockchain technology is crucial for enhancing security and transparency in supply chains.
- **Big Data and Sustainability**: Big data analytics are vital for sustainable development by optimizing resource usage and reducing waste.
- **Edge Computing and Internet of things (IoT):** Edge computing supports IoT applications by processing data closer to the source, reducing latency and bandwidth use.
- **AI and Digital Transformation:** Artificial intelligence drives digital transformation by automating processes and providing deep insights through data analytics.

- **Cyber Physical Systems and Manufacturing**: In Cloud manufacturing, cyber-physical systems integrate physical processes with digital technologies, enhancing efficiency, cost reduction and flexibility.

CHAPTER 3

3. Data synthesis

After a rigorous analysis of each cluster and concentration of the documents divided by their area of study, it was possible to make a qualitative approach of each document, focusing on the content relevant for this project. The best related articles were then selected to ensure that only the best related were referenced to the research topics. This selection of articles can be seen in the table below.

Table 3.1 - Resume of the documents analysed

Year	Authors	Title	Keywords
2012	Yacine Rezgui, Thomas Beach, Omer Rana	A governance approach for BIM management across lifecycle and supply chains using mixed-modes of information delivery	BIM; governance; supply chain; lifecycle; data storage;
2018	Mahmoud Maqableh; Mutaz M; Al-Debei; Omar Al Hujran; Enas Al-Lozi	Challenges of Cloud Computing Adoption From the TOE Framework Perspective	Adoption; Cloud Computing; Jordan; TOE Framework
2023	Diana Teresa Parra-Sánchez; Leonardo Hernán Talero-Sarmiento	Digital transformation in small and medium enterprises: a scientometric analysis	Digital transformation; Digital transformation strategy; Digital technologies adoption; Scientometric analysis; Small and medium enterprises
2024	Ebru Surucu-Balci, Çagatay Iris, Gokcay Balci	Digital information in maritime supply chains with blockchain and Cloud platforms: Supply chain capabilities, barriers, and research opportunities	Digital platforms Dynamic capabilities Blockchain technology adoption Supply chain 4.0 Digital transformation in maritime Systematic literature review
2024	Claudia Durán, Christian Fernández-Campusano, Raúl Carrasco, Eduardo Carrillo	DMLBC: Dependable machine learning for seaports using blockchain technology	Blockchain Machine learning Logistic management Dependable system Smart port
2024	Hao Zhong; Dong Yang; Shengdong Shi; Lai Wei, Yanyan Wang	From data to insights: the application and challenges of knowledge graphs in intelligent audit	Knowledge graph; Electricity; Audit; Artificial intelligence
2023	Shitharth Selvarajan; Achyut Shankar; Mueen Uddin; Abdullah Saleh Alqahtani; Taher Al-Shehari;	A smart decentralized identifiable distributed ledger technology-based blockchain (DIDLT-BC) model for Cloud-iot security	Blockchain; Cloud; distributed ledger technology (DLT); security; internet of things (iot); Rabin digital signature generation; Decentralized Systems

	Wattana Viriyasitavat		
2021	Maitha Al Ketbi; Khaled Shuaib; Ezedin Barka; Marton Gergely	Establishing a security control framework for blockchain technology	Blockchain technology; standards; security controls; information security; secu-rity governance
2023	Claudiu George Bocean; Anca Antoaneta Vărzaru	EU countries' digital transformation, economic performance, and sustainability analysis	
2023	Awni Rawashdeh; Badi Salem Rawashdeh; Esam Shehadeh	The Determinants of Cloud Computing Vision and Its Impact on Cloud Accounting Adoption in smbs	
2023	Chiara Cimini; Alexandra Lagorio; Roberto Pinto; Giuditta Pezzotta; Federico Adrodegari; Sergio Cavalieri	5G supporting digital servitization in manufacturing: An exploratory survey	5G; digital servitization; smart pss; wireless communication networks
2019	Sara Rouhani; Ralph Deters	Security, Performance, and Applications of Smart Contracts: A Systematic Survey	Smart contracts; Blockchain; Peer-to-peer computing; Systematics; Bitcoin
2023	Martin Polívka; Lilia Dvořáková	The importance of Industry 4.0 technologies when selecting an ERP system – An empirical study	AIDC; big data; Cloud technologies; ERP system selection; system integration
2021	Martin Liebenberg; Matthias Jarke	Information systems engineering with Digital Shadows: Concept and use cases in the Internet of Production	Digital Shadow Internet of Production (iop) Database views World Wide Lab (WWL) Cooperative information systems Digital twin Informed machine learning Knowledge pipeline
2024	Raza Nowrozy; Khandakar Ahmed, A; S; M; Kayes; Hua Wang; Timothy R; Mcintosh	Privacy Preservation of Electronic Health Records in the Modern Era: A Systematic Survey	Block chain; data sharing; confidentiality; electronic health records; privacy; security
2023	Xubo Ye; Mababa Jonilo	Unleashing the Power of Big Data: Designing a Robust Business Intelligence Framework for E-commerce Data Analytics	E-Commerce; Big Data; Business Intelligence; Security Safeguards; Risk Assessment Models

2023	Saeed Banaeian Far; Azadeh Imani Rad, Maryam Rajabzadeh Asaar	Blockchain and its derived technologies shape the future generation of digital businesses: a focus on decentralized finance and the Metaverse	Artificial intelligence Cryptocurrency Decentralized autonomous organization Digital twin Non-fungible token
2023	A;P; Amadi-Echendu	A framework for asset transfers	Supply chain; Supply chain management; Land administration; Risk management; Payments systems; Information technology; Records management; Dematerialisation
2023	Chunyan Li; Jiaji Wang; Shuihua Wang; Yudong Zhang	A review of iot applications in healthcare	Iot Healthcare Remote monitoring
2023	Saadat M; Alhashmi, Ibrahim Abaker Targio Hashem, Islam Al-Qudah	Artificial Intelligence applications in healthcare: A bibliometric and topic model-based analysis	Healthcare Artificial Intelligence Analysis Bibliometric
2023	Ashish Khanna , Yogesh Sharma , Devansh Singh , Ria Monga , Tarun Kumar	Automated Medical Document Verification on Cloud Computing Platform: Blockchain-Based Soulbound Tokens	Blockchain; Soulbound token; Cloud computing; Medical document verification; Deep learning;
2023	Piotr Łasak; Sławomir Wyciślak	Blockchain and Cloud platforms in banking services- A paradox perspective	Banking services; banking sector transformation; blockchain-based platforms; Cloud-based platforms; paradox theory; blockchain; Cloud
2023	Simon Wong; John Kun-Woon Yeung; Yui-Yip Lau; Tomoya Kawasaki	A Case Study of How Maersk Adopts Cloud-Based Blockchain Integrated with Machine Learning for Sustainable Practices	Blockchain; Cloud; machine learning; supply chain; technical sustainability; environmental sustainability; economic sustainability; social sustainability
2023	Ebru Surucu-Balci; Çagatay Iris; Gokcay Balci	Digital information in maritime supply chains with blockchain and Cloud platforms: Supply chain capabilities, barriers, and research opportunities	Digital platforms Dynamic capabilities Blockchain technology adoption Supply chain 4.0 Digital transformation in maritime Systematic literature review
2023	Xinxiang Jia, Shiva Abdolia	Challenges and Opportunities in Product Life Cycle Management in the Context of Industry 4.0	Product-system; Lifecycle Management; Industry 4.0; Digital Twin
2023	Cosmin Aron; Fabio Sgarbossa; Eric Ballot; Dmitry Ivanov	Cloud material handling systems: a cyber-physical system to enable dynamic resource allocation and digital interoperability	Cyber-physical systems; Material handling systems; Resilience; Sustainability; Digital interoperability; Deep reinforcement learning

2023	Ahsan Waqar; Muhammad Husin Gultom, Abdul Hannan Qureshi, Liza Evianti Tanjung, Hamad R; Almujibah	Complexities to the deployment of Cloud computing for sustainability of small construction projects: Evidence from Pakistan	Cloud-computing Sustainable construction Construction industry Barriers Amos-SEM
2022	Irfan Custovic;Jianpeng Cao; Daniel M; Hall	Cloud manufacturing for industrialized construction: Opportunities and challenges for a new manufacturing model	Cloud manufacturing Industrialized construction Off-site construction AEC Industry 4.0
2023	Truong Van Nguyen, Hiep Cong Pham, Minh Nhat Nguyen, Li Zhou & Mohammadreza Akbari	Data-driven review of blockchain applications in supply chain management: key research themes and future directions	Supply chain; blockchain; text mining; data driven review; topic modelling
2017	Kazimierz Worwa, Maciej Kiedrowicz, Tadeusz Nowicki, Robert Waszkowski	Evaluating the impact of testing document management system with RFID tags software on the level of its reliability	RFID documents; worflow; software; realiability testing
2023	Yousaf Murtaza Rind, Muhammad Haseeb Raza, Muhammad Zubair , Muhammad Qasim Mehmood and Yehia Massoud	Smart Energy Meters for Smart Grids, an Internet of Things Perspective	Smart meters; smart energy; iot; sensing; metrology; 5G
2022	Dojanah Mohammad Kadri Badera; Nisreen Innabb; Ibrahim Atoumb; Farah faisal Alathamnehc	The influence of the Internet of things on pharmaceutical inventory management	Internet of Things Inventory management Pharmaceutical Companies Jordan
2024	Natalia Chaplynska; Olena Lytvyn; Volodymyr Kudin; Andrii Onyshchenko; Mykyta Nikolaiev	Integration of digital means in the financial sphere: the potential of Cloud computing, blockchain, big data and ai	Financial industry; innovations in the financial sector; innovations in finance; digital transformation of finance; integration of technologies

2024	Teijo Palander; Timo Tokola; Stelian Alexandru Borz; Peter Rauch	Forest Supply Chains During Digitalization: Current Implementations and Prospects in Near Future	Data-driven optimization; Dynamics; Logistics; Simulation; Technology
2022	Sulaiman Rajab, Mohamed Afy-Shararah, Konstantinos Salonitis	Using Industry 4.0 Capabilities for Identifying and Eliminating Lean Wastes	Lean Manufacturing; Industry 4.0; Wastes; Operations Management
2023	Buyung Adi Dharma; Madziatul Churiyah;I Nyoman Suputra; Andi Basuki	The effect of Cloud tracking-based integrated supply chain learning devices on critical thinking skills, learning behavior, student career development with variable moderation learning media	Export Platform; Critical Thinking Skills; Learning Behavior; Career Development; Learning Media;
2018	Ziyuan Wang, Dain Yap Liffman, Dileban Karunamoorthy, Ermyas Abebe	Distributed Ledger Technology for Document and Workflow Management in Trade and Logistics	Blockchain; DLT; Workflow management; Supply chain
2023	Showmick Guha Paul; Arpa Saha; Mohammad Shamsul Arefin; Touhid Bhuiyan; Al Amin Biswas; Ahmed Wasif Reza; Naif M; Alotaibi; Salem A; Alyami; Mohammad Ali Moni	A Comprehensive Review of Green Computing: Past, Present, and Future Research	Carbon emissions; eco-friendly computing; energy efficiency; green computing; green computing area; sustainable development;
2024	Verónica Bolón-Canedo, Laura Morán-Fernández, Brais Cancela, Amparo Alonso-Betanzos	A review of green artificial intelligence: Towards a more sustainable future	Green machine learning Sustainability Green-by AI Green-in AI
2023	Alice Elizabeth Matenga; Khumbulani Mpofu	Africa and Industry 5.0: Challenges and Opportunities in the Future of Manufacturing	Africa; Industry 5;0; CPPS; digital economy; industrialisation
2023	Paula Bajdor	Cloud Computing in Terms of Sustainable Development - Evaluation and Mutual Relations	Cloud computing; sustainable development; ecologic; economic; social
2024	Virginia Hernández; Antonio Revilla; Alicia Rodríguez	Digital data-driven technologies and the environmental sustainability of micro, small, and medium enterprises: Does size matter?	Digital technologies; digitalization; micro-business; small and medium-sized enterprises; sustainability

2023	Daniel J; Veit; Jason B; Thatcher	Digitalization as a problem or solution? Charting the path for research on sustainable information systems	Digitalization; Sustainability; Sustainable development; Environmental sustainability; Social sustainability; Economic sustainability; Green IT; Green IS
2023	Yali Chen, Xiaozi Wang, Zhen Liu; Jia Cui, Mohamed Osmani; Peter Demian	Exploring Building Information Modeling (BIM) and Internet of Things (iot) Integration for Sustainable Building	Building Information Modeling (BIM); Internet of Things (iot); sustainable building; smart cities; information management; building metaverse; life cycle; bibliometric
2017	Mahendra K; Ugale; Shweta J; Patil; Dr; Vijaya B; Musande	Document Management System:A Notion Towards Paperless Office	Paperless; Document Management System; OCR; Tagging; Indexing; Information Retrieval
2015	Shyamalesh Khan; B V N Prasad; S Selvi; Usha Rani; A K Srivastava; D K Gautam	Document Management System: An Explicit Knowledge Management System	DMS: Document Management System; DSS: Decision Support System; ECM: Enterprise Content Management; HRIS: Human Resource Information System; KMS: Knowledge Management System; PO: Personnel Officer; RDCIS: Research & Development Centre for Iron & Steel; SAIL: Steel Authority of India Limited
2015	Tongjin Lee; Jun Iio	Document Management System Based on ISAD(G)	
2015	Srikant Krishnan; Nary Subramanian	Evaluating Carbon-Reducing Impact of Document Management Systems	Document; management; system; evaluation; carbon
2023	Zubaida Rehman; Noshina Tariq; Syed Atif Moqurra; Joon Yoo; Gautam Srivastava	Machine learning and internet of things applications in enterprise architectures: Solutions, challenges, and open issues	Enterprise architectures; expert systems; intelligent infrastructures; internet of things; machine learning applications
2024	Teijo Palander; Timo Tokol; Stelian Alexandru Borz; Peter Rauch	Forest Supply Chains During Digitalization: Current Implementations and Prospects in Near Future	Data-driven optimization; Dynamics; Logistics; Simulation; Technology
2023	Federica Costa, Stefano Frecassetti, Matteo Rossini; Alberto Portioli-Staudacher	Industry 4.0 digital technologies enhancing sustainability: Applications and barriers from the agricultural industry in an emerging economy	Industry 4.0 Emerging economies Barriers Agricultural industry Sustainability
2018	Mariagrazia Fugini, Jacopo Finocchi	Innovative Big Data Analytics: A System for Document Management	Big Data architecture; document and content management; metadata

			extraction; machine learning for document classification
2015	Marcin Hernes	Information Extraction Methods for Text Documents in a Cognitive Integrated Management Information System	Information extraction; cognitive agents; integrated management information systems
2024	Josselyne Ricárdez-Estrada; Claudia Lizette Garay-Rondero; David Romero, Thorsten Wuest; Roberto Pinto	Identifying Digital Supply Chain Capabilities	Digital Supply Chain; Digital Integration; Digital Capabilities; Digital Technologies; Digital Transformation
2022	Mihai Andronie, George Lazaroiu, Oana Ludmila Karabolevski, Roxana Stefanescu, Iulian Hurloiu, Adrian Dijmarescu ; Irina Dijmarescu	Remote Big Data Management Tools, Sensing and Computing Technologies, and Visual Perception and Environment Mapping Algorithms in the Internet of Robotic Things	Internet of Robotic Things; remote big data management tools; sensing and computing technologies; visual perception and environment mapping algorithms
2022	Neil J; Rowan	The role of digital technologies in supporting and improving fishery and aquaculture across the supply chain – Quo Vadis?	Digital transformation Sustainability End-to-end monitoring Food processing Disruptive innovation
2024	Prashnna Ghimire; Kyungki Kim; Manoj Acharya	Opportunities and Challenges of Generative AI in Construction Industry: Focusing on Adoption of Text-Based Models	Generative AI; implementation framework; construction; AEC; GPT; LLM; palm; Llama; fine-tuning
2023	Timur Omarov, Gulnura Taikulakova	Using of digital applications to transform project management processes and manage data in the oil and gas industry	Cloud-based data digital platforms; Project management; New technologies; Oil and gas enterprises; Personnel safety; Process optimization; Turnarounds.

CHAPTER 4

4. Discussion & findings

In this chapter, the main objective delves into the key findings from the analysis made after the literature review and focuses on the three fundamental research questions. By addressing these questions, the chapter aims to provide a comprehensive discussion on the current state of research in this field, the tangible benefits of Cloud-based DMS solutions for supply chain operations, and the implications of regulatory standards on their successful deployment. The findings presented not only contribute to the academic sector but also offer practical insights for organizations seeking to leverage and implement Cloud technologies and document management systems.

4.1. Q1: What does the existing literature from 2010 to 2024 say about the use of Cloud-based solutions, more concretely in Supply Chain Management?

4.1.1. Cloud-Based solutions implementations in different areas

Cloud computing plays a crucial role in different sectors and organizations. Accordingly, to [5], it facilitates real-time data management, improves collaboration among stakeholders and enhances decision-making processes through the processing of large datasets and guarantees more securable and trustworthy information. Cloud computing has become one of the most used technology due to its advantages and flexibility to implement in every organization in the most structural and important business areas [6].

Manufacturing and Construction sectors

In the manufacturing and constructions sectors, the use of Cloud solutions is associated with the growing development of the industry 4.0 in the last few years. [7] refers that the capabilities and application of the industry 4.0 had a significant and growing role in the successful implementation of waste reduction techniques. With the Cloud solution in this sector, it was possible to reduce product inventory, compared to traditional software downloads on personalized computers, increasing the cost-effectiveness of stock handling by eliminating the need for servers and human-related services. Also, in the emergence of Industry 5.0 these implementations in the manufacturing industry, driven by the integration of technologies like artificial intelligence, and the Internet of Thing revolutionized traditional manufacturing by enabling instantaneous data sharing, optimizing resource management, and enhancing collaboration throughout the supply chain of a manufacturing process. Cloud Manufacturing plays a crucial role in this transformation, offering a flexible, scalable, and efficient production model. This move towards more digital and interconnected systems is not only improving operational efficiency but also advancing sustainability efforts by reducing waste and enhancing

energy efficiency [8]. The manufacturing area took advantage of the scalability and mobility of this implementation, which allowed cost reduction compared to traditional software technologies. The mobility methods to check the inventory became a huge tool for stock managers to more accurately compare the need of inventory, saving time on updating computer software and systems that were previously used to estimate these needs. Global accessibility from Cloud computing also allowed manufacturers to centralize every management activity into one software, providing a unique database of processes integrated with every stakeholder.

Despite these advantages on using Cloud platforms in the manufacturing and construction areas, since these industries are still very dependable in human and inadequate data-structures, implementing a Cloud Manufacturing system could not be possible without structural change in an organization [9]. However, this change also has challenges, particularly for small-to-medium enterprises (SMEs), which may face difficulties with the financial and infrastructural requirements needed to adopt these technologies. To fully capitalize on the advantages of Industry 5.0, industries must prioritize investments in digital infrastructure, workforce development, and innovation, creating a more resilient and sustainable global manufacturing sector [8]. The integration of several different systems from every stakeholder could also be a challenge in the first place due to this lack of data structure. Custovic (2023) also refers that these sectors could not be ready to a drastic change since the facilities of SME's do not seem ready for real-time monitoring via a platform such as Cloud Manufacturing (CMfg) implementation. The geography of the organization could also be a variable to consider when implementing a new technology solution, since the region or country could have a lack of infrastructure and services available in the zone. Waqar et al. (2023) gave a complete overview of the challenges that can be considered when implementing a Cloud based solution in the manufacturing and construction areas based in zona and small and medium enterprises implementations:

Table 4.1 - Challenges when deploying Cloud Computing in Manufacturing and Construction industries.

Category	Challenges	Details
Technological and Operational	Infrastructure Limitations	Small projects frequently lack sophisticated IT infrastructure, which leads to problems with integration with current systems and performance.
	Compatibility Issues	Making sure Cloud solutions work with the different technologies used in construction can be difficult and lead to more expenses and delays.
Risk and Privacy	Data Security Concerns	Protecting sensitive data is critical, requiring robust security measures to prevent breaches and unauthorized access that could not be possible and ready in specific countries/areas
	Compliance with Regulations	Complying with various, regionally specific data protection laws.
Cultural and Behavioral	Resistance to Change	Specially in small firms, to adopt new technologies due to familiarity with traditional methods.
	Skills Gap	A lack of skilled employees in Cloud technologies requires significant investment in training and upskilling.
Uncertainty and Resource	Financial Constraints	Tight budgets make it difficult for small projects to afford the initial investment in Cloud computing infrastructure and services.
	Unpredictable Demand	Fluctuating demand in the construction industry resource planning, can potentially lead to underutilization or overspending on Cloud services.
Privacy and Legal	Intellectual Property Risks	Concerns about protecting intellectual property when using shared Cloud platforms.
	Liability Issues	Determining liability in cases of data breaches or service failures, especially when multiple parties are involved.

Health sector

With the advance of new technologies, the healthcare and medicinal areas were one of the sectors that flourished and provided more developments to enhance the use and implementation of innovation. Artificial Intelligence based algorithms have been widely used in healthcare research, utilizing associated technologies, like Cloud computing and IoT, thing that transformed the industry about operational procedures and patient care [10]. Alhashmi et al. (2024) confirmed that, in recent

years, publications about Cloud computing in healthcare services have emerged, more when we discuss the implementation of this technology integrated with IoT, which led to a cumulative growth in about 50% comparing to articles before 2017. The implementation of Cloud technology was used in the sector to store and process medical data, thereby ensuring reduced costs in processing data, improved security and flexibility on sharing information about the patients across different organizations and systems. It is also used for monitoring and controlling data from wearable devices and other devices that could have integration of IoT technology, allowing providers to detect and treat more effectively specific diseases, giving more detailed real-time information for better decision-making, improving the patient outcome [11]. One of the technologies that are also incorporated with IoT and used to help managing stores and inventory in the pharmacy sector is the implementation of Radio Frequency Identification (RFID) in products. This implementation permits to identify every merchandise using radio waves by tagging them, which contains every relevant information about the specific product, sending the information via Internet of the host system, receiving all the information from the IoT application program used in the companies. This data, such as temperature, vibration, pressure, humidity, light, pollution, give important traceability to the supplier and the pharmacies of all the conditions that the medicines went through before leaving to the client, which permits them to have the knowledge that, if a particular defect occur in a specific node of the chain, allow the chance to address it before it aggravates. The RFID system guarantee the reliability in software test phase, which enriches to a more efficient and cost-effective testing strategies when also implemented in Document Management System [12]. In this context, the Cloud computing is an important element of implementation by providing services, applications and data storage spaces, allowing the employees to access every information of the product location and maintenance, anytime and anywhere, which becomes a huge tool when managing stores, facilitating every task of stock management and quality control [13].

The implementations of blockchain integrated with Cloud computing are also discussed in the articles about this area. Khanna et al. (2023) have worked with the implementation of automated document verification on Cloud computing, using blockchain SBTs (Soulbound tokens), which guaranteed verification and authenticity of the documents from the decentralized database. The use of Cloud computing reduced the administrative time used to guarantee the verification of the documents, simplifying with both technologies the processes and easy access to the database. This implementation also reduces the risk of fraud and improves efficiency, revolutionizing the sector by ensuring that the documents are secured and cannot be altered during time from the blockchain technology. The use of Cloud suggests a change for a decentralized and distributed trust architecture, to improve the traceability and integrity of transactions, conducting the verification of the documents with powerful deep learning algorithms, which also were stored in the Cloud system [14].

In resume, the implementation of Cloud Based systems in the healthcare sector are becoming a crucial technology, guaranteeing storage, security, real-time monitoring through all the process. The synergy of using other new technologies like IoT and Blockchain with Cloud is also common, improving even more the optimization of processes inherent to the sector. The table below resumes the articles advantages and challenges identified when implementing Cloud solutions in the health sector.

Table 4.2 - Benefits and Challenges of implementation of Cloud based solutions in the healthcare area.

Category	Challenges	Benefits
Data Security & Privacy	Concerns about data breaches and ensuring compliance with regulations across different regions.	Enhanced security using blockchain technologies
Technological Integration	Integration with existing legacy systems can be complex and costly.	Cloud computing enables scalable, on-demand resources that reduce the need for large upfront investments.
Operational Efficiency	Potential latency and performance issues in Cloud environments, especially with large datasets.	Real-time data processing and analysis, improving decision-making and operational efficiency.
Cost	High initial setup and ongoing costs associated with Cloud infrastructure.	Reduces operational costs by optimizing resource use and enabling pay-as-you-go models.
Scalability	Challenges in managing large-scale deployments, especially in IoT environments.	Supports scalability, allowing for flexible resource allocation based on demand.
Innovation & Adoption	Resistance to adopting new technologies within traditional sectors.	Facilitates innovation by enabling the use of advanced technologies such as AI and IoT.
Regulatory Compliance	Complex compliance requirements across different regions, especially concerning data protection.	Assists in maintaining regulatory compliance through enhanced data management and security features.

Financial sector

The financial sector has also had a significant adjustment with the increasing growing of the digital economy. The way that this sector area work has changed dramatically in the last decades, not only for the companies that are in the area but also for its customers, with the implementation of new process payments, new ways of transactions and the use of e-banking for managing and monitoring every aspect of a financial account [15]. This digital transformation has developed the concepts of Financial Technology (FinTech) and Insurance Technology (InsurTech) companies as the basis of several banking services that work under a centralized finance (CeFI) [16]. Digitalization has become the main tool for the financial sector to improve the efficiency, accessibility, and quality of financial services and processes. Lytvyn et al. [15] have summarized the main implementations of digital technologies in the area, correlating with each financial activity or service solutions.

Table 4.3 - Application of digital technologies in the field of financial services (Source: [15])

	Payment services	Counselling, maintenance, and planning	Investment & Trade	Lending & Financing	Insurance	Security	Operating activities	Communication
Blockchain	X	X	X	X	X	X	X	X
Big Data	X	X	X	X	X	X	X	X
Internet of Things (IoT)					X			X
Cloud Computing				X			X	
Artificial Intelligence	X	X	X		X			X
Biometric Technology	X				X	X		
Augmented/ Virtual Reality		X	X					X

In this context, the use of blockchain has become the emerging technology implemented but, with that, the integration of blockchain with Cloud computing, underscores the growing importance of secure, scalable, and decentralized digital infrastructures. The Cloud technology has supported the use of blockchain to manage large-scale data while maintaining its decentralized nature [16]. The blockchain and Cloud integrated platforms have improved interconnectivity, security, and simplicity of transactions, providing lower data protection costs, technology implementation advantages, and a higher number of transactions supported [17].

The implementation of a Document Management System in this sector is also crucial since there are security and legal procedures that have include informational flow between the financial

chains. The use of traditional informational flows such as the use of physical paper documents can cause an enormous impact in financial trade process, since they can be easily misplaced, destroyed, or fraudulently copied [18]. Associated to these problems, it is also possible to add the lack of visibility and shareability of each financial trading process since when a document needs to be redirected to another person/employee, the physical document needs to be physically provided, which can lead to breach in the security measures and increased lead time in every process. The implementation of a Cloud-based solution for document storage is the best practice in terms of centralized database for financial transfer partners to enhance transparency, reduce turnaround times, and improve security while minimizing risks and costs. In this sense, the main advantages of a Cloud implementation in this sector provides enormous structural benefits throughout all chain, which can be resumed in seven primary areas [15]:

- **Reduced IT costs:** Avoid making large investments in hardware and data centers by using Cloud services for computing and data storage. This can boost productivity and reduce costs.
- **Scalability:** Immediately scale their computing resources as needed thanks to Cloud platforms. This is particularly crucial when managing heavy workloads or when carrying out complex financial computations.
- **Availability and Reliability:** Cloud providers typically give high levels of service availability (SLA) and dependability. This promotes the prevention of system malfunctions and guarantees the continuous provision of financial services.
- **Data storage and analysis:** Companies can store and analyse large volumes of data in real time thanks to Cloud computing. This can be applied to the creation of analytical tools, trend prediction, and fraud detection.
- **Data Security:** Cloud providers are making investments in the safety and security of data. They offer a range of monitoring, authentication, and encryption tools to assist financial institutions in safeguarding private client information as well as company information.
- **Deployment Speed:** Cloud solutions can be implemented more rapidly than traditional IT infrastructures, enabling financial institutions to adapt swiftly to market shifts and roll out new products and services with greater speed.
- **Ubiquitous and interoperability:** Cloud computing allows professionals to access data and applications from anywhere and on any device, enhancing their mobility and productivity.

By examining the interplay between blockchain, Cloud computing, and other advanced technologies, these innovations represent the future for digital financial enterprises.

4.1.2. Application of Cloud-Based solutions in Supply Chain

Digital transformation is becoming crucial for enhancing information sharing and processing in supply chains, which involves extensive data and document exchanges. The potential benefits of digital information sharing (DIS) have led to increased research on Cloud-based platforms [19]. This increasing importance of information in supply chain is correlated with the complex series of processes involving numerous activities, from acquisition of raw materials, manufacture, distribution, and product delivery to end users, that are becoming more overflowed with information, due to technological developments and the necessity of globalization that transformed this sector into a very strategic aspect in all industrial operations [20]. With this demand, the implementation of Cloud-based platform in supply chains has emphasized their role in managing and optimizing data flows and have also increased due to the benefits of this kind of solutions [21]. Furthermore, the idea of Cloud-based material handling systems (CMHS) has become a major development in the field of Supply Chain, improving the robustness and efficiency of material handling procedures. Cyber-physical systems (CPS) and Cloud computing are integrated by a Cloud Material Handling System (CMHS) to provide real-time data processing and dynamic resource allocation, both of which are critical to the continuity and responsiveness of logistical networks. In addition to boosting operational effectiveness, this strategy helps supply chains remain sustainable and flexible, especially in the face of growing complexity and worldwide disruptions [22]. The way in which these newly developed Cloud-based tools complement established supply chain procedures highlights how digital technology revolutionized contemporary logistics. Palander et al. [23] have defined these six different qualitative benefits when implementing a Cloud solution in supply chain:

Table 4.4 - Benefits of Cloud solution implementation in Supply Chain

Benefits	Description
Integration and Standardization	Cloud platforms enable easier integration and standardization of data elements, which is crucial for efficient for supply chain management and procurement chains.
Data-Driven Decision Making	Cloud platforms support data-driven decisions by providing a centralized repository for data collection and analysis, optimizing supply chain operations.
Enhanced Connectivity and Collaboration	Cloud platforms facilitate real-time data sharing and collaboration among stakeholders, synchronizing operations and giving visibility in each supply chain node.

Support for Big Data Analytics	Due to big data generated in supply chains, Cloud solutions facilitate storage, processing, and analysis of large datasets to provide better insights and management of complex operations
Modeling and Optimization	These implementations permit an integration of modeling and optimizing operations, supporting dynamic and complex modeling approaches with the application of optimization.
Scalability and Flexibility	Scalability and flexibility are an essential tool for managing fluctuating demands and changing conditions in supply chains, maintaining efficiency and responsiveness.

Cloud solutions are normally linked with the implementation of other new technologies such as Blockchain, Artificial Intelligence, Machine Learning and IoT. In the study of Wong et al. (2023), it is possible to investigate what specific benefits that a Cloud-Based Machine Learning solution has in a Supply Chain in different quadrants, such as economic, security, sustainability, and technical areas. In this study, it was also implemented a P2P network with blockchain technology for traceability and transparent records in every operation. The following table presents a summary of the key sustainable practices implemented by an organization through its Cloud Based Machine Learning (CBML) system. These practices demonstrate how the integration of cutting-edge technologies can contribute to a more sustainable and efficient supply chain, thereby setting a benchmark for industry-wide adoption.

Table 4.5 - Summary of Sustainable Practices Implemented with Cloud-Based Blockchain Integrated with Machine Learning System.

Category	Use Cases/Features	Sustainable Practices
Technical Sustainability	Microsoft Azure Cloud technology's scalability	Solve issues related to availability, storage capacity, latency, and throughput.
	Machine learning integrated into Microsoft Azure Cloud technology	Perform big data analytics. Learn from big data for better supply chain management.
Environmental Sustainability	CBML processes for tracking and sharing shipment risk records	Reduce paperwork. Reduce carbon emissions.
	Guiding a ship to safe zones via machine learning in CBML	Prevent damage. Avoid waste.
	Immutability of shipment risk records in CBML for claims assessment and payment	Reduce energy consumption.
	Allocation of on-demand computing resources by CBML	Optimize energy consumption.
Economic Sustainability	Efficient processing of claims assessment and payment by CBML	Reduce costs and improve operational efficiency.
		Optimize shipment routes.

	Computation by machine learning on geolocation data from GPS sensors	Reduce costs of tracing and tracking.
	Remote Container Management (RCM) system for customers to keep track of container conditions	Obtain operational efficiency.
	Operational expenditure for CBML	Lower upfront investment. Improve business agility. Reduce management costs.
Social Sustainability	Location of safe zones for shipments by CBML	Provide safe working conditions.
	Immutability of shipment route records generated by CBML	Render trust. Reduce fraud.
	RCM control for monitoring conditions of products	Ensure and maintain product safety and health.

After the implementation, it was possible to identify that the adoption of a CBML solution had a significant impact across all Supply Chain, which can be grouped into five main outputs:

1. **Cost reduction:** The increased efficiency management led to lower fraud risk and improved data transparency and accuracy. With this, was possible to reduce administrative, operational, and legal costs.
2. **Energy efficiency:** This integration optimized the routing and scheduling of the study case, which resulted in a decrease in fuel consumption. The integration resulted from the use of machine learning algorithms and GPS sensors, based on historical data.
3. **Operational efficiency:** The Machine Learning implementation for predictive maintenance and real-time monitoring improved the overall efficiency in the operations, resulting in a reduction in turnaround times.
4. **Economic benefits:** CBML enabled more precise demand forecasting and inventory management, leading to a reduction in inventory holding costs, with an increase in revenue due to better customer satisfaction and reduced stockouts.
5. **Environmental impact:** With the optimized and more efficient routes already identified, it was possible to reduce CO2 emissions through all logistics chains.

The Dispatch Advice and Receiving Advice Message (DSADV and RECADV) implementations are examples of how the sector is aware of the necessity of electronic and faster data communication between every stakeholder. The implementation of Dispatch Advice and Receiving Advice Message in the supply chain guarantees the communication of Electronic Data Interchange (EDI) messages, especially in retail operations. This includes information such as the merchandise sent to the retailer and when confirmation of the reception of the order back to the supplier, all this electronically. As expected, this kind of implementations also resulted in a more transparent, securable and traceable

information from every stakeholder, improving its trust in each operation since the blockchain technology provides us clear, immutable records that can be shareable with regulatory entities [25].

4.2. Q2: How can a Cloud-based Document Management System impact the organization results, in terms of efficiency, cost savings, productivity and sustainability?

4.2.1. Document Management System in Cloud-based solutions

A Document Management System can be described as a system used by organizations to store, search, track, share and retrieve documents that are relevant to archive for certain purposes [26]. These purposes can vary between legal or procedural requests, whereby the main objective when implementing a DMS was to centralize the storage of those documents, ensuring a unique physical or virtual location to search for them when needed. This also guarantees that those documents are secured, and their integrity can be maintained [27]. Khan et al. (2015) also refers that, with the increasing demand for documentation in each transaction, the Document Management System have increased its importance during time, serving as an important tool for explicit knowledge management, support decision making processes and organizational efficiency, and guarantee legal obligations. With this growing necessity of storing documents, the physical archives have become challengeable to manage, even for small and medium-sized enterprises, since the number of transactions of documents have increased, as said previously [21]. There are multiple solutions depending on each organization necessity, even for small enterprises that can use Open Source Softwares do become digital in this sense [28]. This resulted in companies searching for best practices that can improve this process, implementing digital solutions [29] that provide strategic methods that reduce operational efforts, while guaranteeing security and governance of the processes [30]. Due to its easy integration with DMS, the most common technology used to store documents are the Cloud solutions, that provide a help when storing huge amounts of data [27] conducting this implementation for a paperless and dematerialization framework. Most of the documents analysed refence the opportunities when using Cloud-based solutions. In the Research Question One, it was already referenced the general benefits of this technology. In the next table, it is possible to correlate those advantages and integrate them in the DMS implementations.

Table 4.6 - Main documents that refence advantages of using Cloud-based solutions in DMS

Advantage	Definition	Documents that refer the advantage
Energy Efficiency	The ability to reduce energy consumption through optimized processes, technologies, and practices, leading to lower environmental impact and operational costs.	[2], [31]
Resource Optimization	Efficient use of resources such as materials, energy, and time to maximize output while minimizing waste and environmental impact.	[21], [31]
Carbon Footprint Reduction	The process of reducing the total greenhouse gas emissions caused by an organization, event, product, or individual, typically measured in units of carbon dioxide equivalent.	[2], [23]
Waste Reduction	Minimize the amount of waste generated through efficient processes, recycling, and reusing paper, thereby reducing the environmental impact.	[29], [31], [32]
Environmental Sustainability	The ongoing effort to integrate environmental considerations into business operations, focusing on reducing the ecological footprint and promoting a paperless framework	[2], [24], [32], [33]
Economic Efficiency	Achieving the best possible economic outcomes with the least amount of resources, waste, and effort, often through the use of digital technologies to streamline operations.	[31], [33]
Scalability and Flexibility	Ability to dynamically adjust resources (such as computing power, storage, and bandwidth) to meet the changing demands of an organization	[21], [33]
Cost Reduction	Lowering expenses associated with business operations, by reducing the need for physical infrastructure and maintenance for document storage and reduce administrative operations from traditional document systems	[21], [31]

Overall Efficiency	The general improvement in organizational processes and outputs achieved by leveraging Cloud computing to optimize performance, reduce downtime, and streamline workflows.	[2], [29], [34]
Security	Ensuring the protection of data and IT systems from unauthorized access, breaches, and other security threats, typically enhanced by Cloud providers' advanced security measures.	[27], [35], [36]
Centralized Repository	A single, unified location for storing, managing, and easy to access documents and data, which improves monitoring operations, accessibility, and information management across the organizations.	[19], [27], [35], [37], [38]
Interconnection with other new technologies	Integration and interaction of Cloud systems with other emerging technologies such as Artificial Intelligence (AI), Internet of Things (IoT), Blockchain, and Big Data Analytics	[1], [7], [8], [24], [31], [33], [39], [40], [41]

As expected, we can conclude that the organizational results benefit significantly from the implementation of a Cloud-based solution for a Document Management System (DMS), as it contributes to the dematerialization of processes. This shift from traditional paper-based methods to digital platforms not only enhances operational efficiency but also aligns with broader organizational goals of sustainability, scalability, and innovation. The adoption of Cloud-based DMS offers numerous advantages that collectively transform the way organizations manage their information and processes, ultimately leading to improved productivity, reduced costs, and greater flexibility.

Enhanced Efficiency and Productivity

One of the most immediate benefits of implementing a Cloud-based DMS is the significant improvement in organizational efficiency. The digitalization of document management processes eliminates the time-consuming tasks associated with handling physical documents, such as filing, retrieving, and archiving. With Cloud-based systems, documents are easily accessible from any location, allowing employees to retrieve information quickly and efficiently. This accessibility reduces downtime, minimizes errors associated with manual document handling, and accelerates decision-making processes [26]. Furthermore, Cloud-based DMS platforms often come with advanced search capabilities, enabling users to locate specific documents or information immediately. This feature is particularly valuable in environments where time is of the essence. By streamlining document retrieval

and management, organizations can allocate their resources more effectively, focusing on core business activities rather than administrative tasks [37].

Cost Reduction and Economic Efficiency

Another critical advantage of Cloud-based DMS is the reduction in operational costs. Traditional document management systems require significant investments in physical infrastructure, including storage spaces, filing cabinets, and security measures [42]. Additionally, the costs associated with maintaining and updating these physical systems can be substantial. By contrast, Cloud-based solutions eliminate the need for physical storage, as all documents are stored digitally in secure Cloud environments. The cost savings extend beyond the elimination of physical infrastructure. Cloud-based DMS operates on a pay-as-you-go model, allowing organizations to pay only for the resources they use. Secure and immutable electronic records replace traditional paper-based systems, streamlining processes and reducing waste. This model offers greater economic efficiency, particularly for small and medium-sized enterprises (SMEs) that may not have the financial resources to invest in large-scale IT infrastructure. Moreover, the scalability of Cloud solutions means that organizations can easily adjust their resource usage based on demand, further optimizing costs [34]. The reduction of investment risk is another economic benefit of Cloud-based DMS. Traditional IT investments often involve significant upfront costs, with no guarantee of return on investment. In contrast, Cloud-based solutions offer a lower-risk alternative, as they require minimal upfront investment and can be scaled up or down as needed. This flexibility allows organizations to adapt quickly to changing market conditions without the risk associated costs [23].

Scalability and Flexibility

Scalability is one of the most compelling features of Cloud-based DMS. Organizations must be able to respond quickly to fluctuations in demand. Cloud solutions offer the ability to scale IT resources up or down in real-time, ensuring that organizations can meet their needs without over-committing resources [31]. This scalability is particularly important for growing businesses or those operating in industries with seasonal demand fluctuations. The flexibility of Cloud-based DMS extends beyond scalability [33]. These systems can be accessed from any location with an internet connection, enabling remote work and collaboration across geographies. This capability is especially relevant in the current global context, where remote work has become the norm for many organizations. By facilitating remote access, Cloud-based DMS supports the creation of more agile and resilient business operations, capable of withstanding disruptions [21].

Environmental Sustainability

The implementation of a Cloud-based DMS contributes to an organization's sustainability goals by reducing the environmental impact of document management processes. Traditional paper-based systems are resource-intensive, requiring large amounts of paper, ink, and energy for printing, storing,

and retrieving documents [29]. Additionally, the disposal of paper documents contributes to environmental degradation, as paper waste often ends up in landfills. By transitioning to a Cloud-based solution, organizations can significantly reduce their reliance on paper, leading to a decrease in deforestation and other environmental impacts associated with paper production [26]. Furthermore, Cloud data centers are typically more energy-efficient than on-premises servers, as they utilize advanced cooling systems and renewable energy sources to power their operations. This reduction in energy consumption translates to lower carbon emissions, contributing to the fight against climate change. The environmental benefits of Cloud-based DMS extend beyond paperless framework and energy efficiency. By enabling remote work and reducing the need for physical travel, these systems help to lower the organization's overall carbon footprint [2]. For example, employees can collaborate on documents in real-time without the need for in-person meetings, reducing the emissions associated with business travel. The digitization of documents reduces the need for physical storage space, which in turn reduces the energy and resources required to maintain these facilities [24].

Improved Security and Compliance

Security is a critical concern for any organization, particularly when it comes to managing sensitive documents and information. Document Management System offers robust security features that help to protect documents from unauthorized access, data breaches, and other cyber threats. These systems typically include encryption, multi-factor authentication, and access controls, ensuring that only authorized personnel can access sensitive information [27]. This solution providers often invest heavily in security infrastructure and protocols, ensuring that their systems are compliant with industry standards and regulations. This level of security is often beyond the reach of individual organizations, particularly SMEs, which may not have the resources to implement such measures on their own. By leveraging the security capabilities of Cloud-based DMS, organizations can enhance the protection of their documents while maintaining compliance with regulatory requirements. In addition to security, this supports better accountability and control over document management processes. These systems provide detailed audit trails that track document access, modifications, and transfers, allowing organizations to monitor and verify compliance with internal policies and external regulations [1]. This level of oversight is particularly valuable in industries with stringent regulatory requirements.

Centralized Repository and Knowledge Management

This serves as a centralized repository for all organizational documents, providing a single source of truth for information management. This centralization improves the organization's ability to manage and retrieve documents, as all information is stored in a unified location that is easily accessible to authorized users. This approach reduces the risk of document loss or duplication and ensures that all employees are working with the most up-to-date information [19]. The centralized nature of Cloud-based DMS also enhances knowledge management within the organization. By

providing a unified platform for storing and sharing information, these systems facilitate the dissemination of knowledge across departments and teams. [35], [37], [38]. This improved knowledge sharing supports better decision-making and innovation, as employees can access the information they need to perform their tasks effectively. Moreover, the centralized repository of a Cloud-based solution enables organizations to implement advanced search and retrieval capabilities, such as full-text search and metadata tagging [41]. These features allow users to locate specific documents quickly, improving productivity and reducing the time spent on document-related tasks. The ability to categorize and tag documents enhances the organization's ability to manage large volumes of information, making it easier to organize and retrieve documents based on specific criteria [27].

Interconnection with Other New Technologies

One of the key advantages of a Cloud-based DMS is its ability to integrate seamlessly with other emerging technologies[36]. This interconnection allows organizations to leverage the strengths of various technologies to enhance their document management processes. For example, the integration of Artificial Intelligence (AI) and Machine Learning (ML) with Cloud-based DMS enables automated document classification, predictive analytics, and intelligent search capabilities. These features not only improve efficiency but also provide valuable insights that can inform strategic decision-making [27], [37]. Additionally, the integration of Blockchain technology with Cloud-based DMS enhances the security and transparency of document management processes [14]. Blockchain's decentralized and immutable ledger provides a tamper-proof record of document transactions, ensuring that documents are secure and verifiable [1]. Moreover, the interconnection of Cloud-based DMS with the Internet of Things (IoT) allows organizations to automate and optimize document-related workflows [31]. For example, IoT devices can automatically capture and upload documents to the Cloud, where they can be processed and stored without manual intervention. This automation reduces the time and effort required for document management, freeing up resources for other value-added activities [41]

4.2.2. Sustainability in new technologies

Sustainability is referenced in most of the articles about digitalization, due to its impact on sustainable sociotechnical systems and regulatory goals that are strictly becoming referenced in most of the countries, topic that it will be on focus in the research question three. The systems and the technologies used to work on sustainability have also been developing during the last years to support structural changes in a organization. For example, green computing, also known as sustainable computing, was aimed to focus on reducing carbon footprint of computing systems by reducing energy consumption, minimizing e-waste, and promoting the use of renewable energy sources while

maintaining and improving their performance [43]. In the table below is possible to understand the gas emissions reduction throughout the years [44].

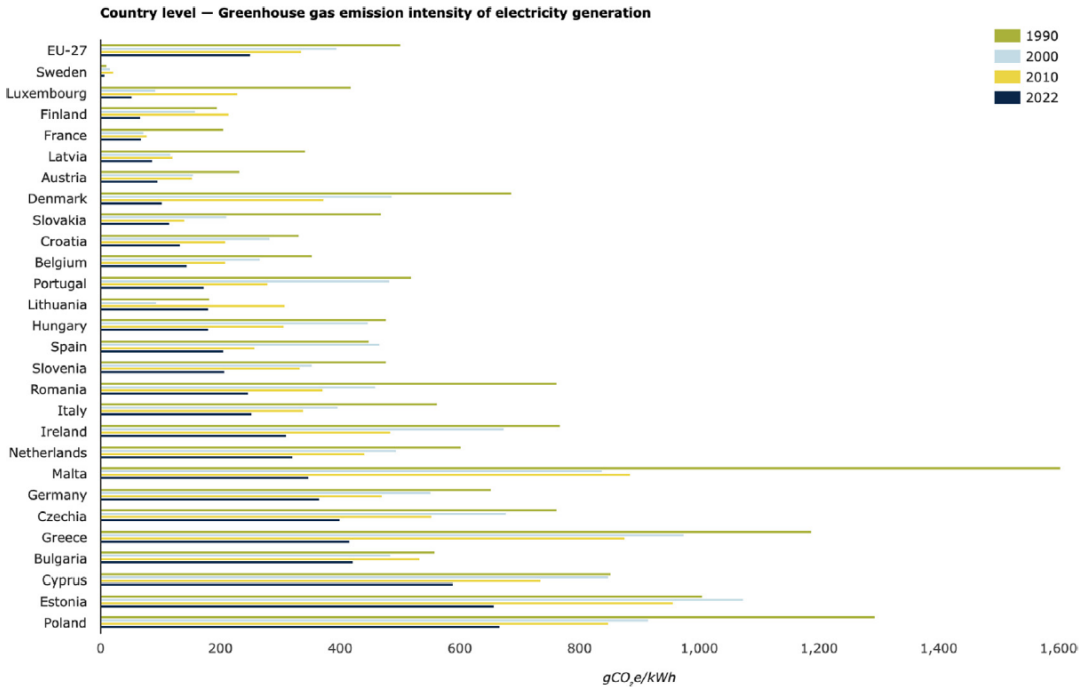

Figure 4.1 - How is the evolution of gas emissions in EU improving (Source: [44]).

Blockchain, despite many of the research practices discuss are focused on economic or social benefits, its environmental impact is mentioned, not only mentioning the opportunities that this technology has but also its challenges due to the necessity of electricity usage [29]. Using blockchain for documentation reduces the need for physical paperwork, decreasing the environmental impact associated with paper production, printing, and disposal.

In Artificial Intelligence, it is also referenced its impacts, more concretely how its implementation can improve company algorithms in two ways [44]:

- Used to find solutions to climate change and environmental degradation (**green-by AI**). This definition refers to how AI promotes sustainability in other fields, including optimizing energy efficiency in different sectors but also improving processes and decision making, which can contribute to broader sustainable goals.
- Work on environmentally friendly manner (**green-in AI**) creating value in the chain, from data collection, storage, and processing to algorithm training that minimize computational costs and reduces environmental impacts of AI training and deployments. This framework also defines strategies to optimize hardware, improve algorithm efficiency and work with renewable energy sources for data centers.

Rowan (2023) also focus on how sustainability is a central tool for growing companies in a specific sector, particularly in how digital technologies can help meet global demands while addressing

environmental challenges. It examines the impact of these technologies on reducing environmental pollution, enhancing resource management, and ensuring the traceability and safety of products. IoT, AI, Cloud computing, machine learning and blockchain are the most used technologies to improve operational efficiency, reduce waste and combat fraudulent activities or prevent security breaches.

The digital Document Management Systems are not an outlier to this evolution, since they can reduce not only the carbon footprint [2], but also provide crucial tools which will lead companies adapt a paperless framework in its processes [23]. An implementation of a DMS can reduce more than 33% of used paper in an organization and reduce the carbon footprint by 1400 $KgCO^2e$ per day [2].

Since the use of Cloud solutions are the best practice in terms of storing documents, Bajdor (2023) have resumed the main benefits on using Cloud computing when working in a sustainable development context:

Table 4.7 - Cloud Computing advantages in a Sustainable context (Adapted from [31])

Sectors	Benefits
Economic	• Increased economic efficiency with reduced investment expenditures. • Decreased costs associated with IT maintenance and development (e.g., paying only for utilized resources, favorable cost-to-computing power ratio). • Improved predictability and stability of IT-related expenses. • Lowered investment risk within the IT sector. • Greater flexibility and scalability of IT solutions (adapting IT resources dynamically to the company's evolving needs). • Enhanced oversight and management of IT resources.
Ecologic	• Accelerated implementation of eco-friendly innovations. • Environmental conservation through reduced electricity usage. • Protection of the environment by cutting down harmful emissions (e.g., lowering carbon dioxide emissions from conventional power plants). • Conservation of natural resources (e.g., by minimizing the need for IT infrastructure purchases). • Decreased levels of radiation, noise, and other disturbances related to IT equipment usage. • Reduced waste generation.
Social	• Improved collaboration with customers and partners. • Expansion of knowledge and employee engagement in the deeper and broader application of IT technologies (enhancing educational levels). • Strengthened relationships and enhanced human interaction. • Better understanding of the social environment. • Inducing changes in the labor market • Ability to include and empower various professional groups

	• Easiness on interoperability

4.2.3. Main solutions for DMS data storage in Cloud

There are multiple platforms that provide a document storage solution in their Cloud services. Each of them brings distinct strengths to the table and have similarities, which enable organizations to choose the platform that best aligns with their operational needs, budget constraints, and strategic goals. Whether prioritizing scalability, security, cost-efficiency, or integration with existing IT infrastructure, the leading Cloud storage providers that will be shown, offer comprehensive solutions that support the complex demands of modern businesses when searching for a trustable platform to upload their documents. The most prominent and commonly used in every sector are: Amazon Web Services (AWS) with Amazon S3 (Simple Storage Service); Microsoft Azure's Blob Storage; Google Cloud Storage; IBM Cloud Object Storage; and Oracle Cloud Object Storage [45].

Amazon S3, offers a highly scalable object storage service known for its remarkable durability and availability. Designed to store and retrieve virtually unlimited amounts of data, Amazon S3 is widely utilized across industries for applications ranging from data backup and archival to content storage and big data analytics. Its durability ensures that data is protected against loss, making it a reliable choice for securing DMS storage needs. Amazon S3 integrates with every AWS services, enabling organizations to build comprehensive, scalable solutions that align with their specific needs [46].

Microsoft Azure Blob Storage provides a robust object storage solution within the Azure ecosystem, designed specifically for handling large volumes of unstructured data such as images, videos, and backups. Azure Blob Storage offers tiered storage options, including hot, cool, and archive tiers, allowing organizations to optimize costs by aligning storage expenses with data access patterns. The flexibility of Azure Blob Storage, combined with its deep integration with other Azure services, makes it an ideal choice for enterprises that rely on Microsoft's suite of Cloud solutions and, for that, be the best solution tool for a Cloud-based DMS solution. Its advanced data protection features further ensure that data remains secure and compliant with regulatory requirements [47].

Google Cloud Storage is also recognized for its high performance, low latency and high throughput, making it an optimal choice for data-intensive applications such as integration with big data analytics and machine learning. Google Cloud Storage offers multi-regional storage, ensuring that data is redundantly stored across multiple locations to enhance availability and resilience. The service's strong lifecycle management capabilities enable organizations to automate data retention policies, thereby optimizing storage costs while maintaining compliance with data governance standards.

Google Cloud Storage's integrates with Google's other Cloud services provides organizations with a powerful platform for building data-driven applications [48].

IBM Cloud Object Storage offers a scalable and secure solution tailored for both structured and unstructured data, commonly used for data archiving, backup, and disaster recovery. IBM's solution is distinguished by its high resiliency, ensuring data integrity and availability even in the face of hardware failures. This makes it particularly well-suited for hybrid Cloud environments where data must be securely managed across on-premises and Cloud-based systems, which is the case for most of the Small and Medium-sized enterprises (SME). The cost-effectiveness of IBM Cloud Object Storage, combined with its strong security features and integration with IBM's broader Cloud services, positions it as a key player for enterprises seeking reliable and flexible storage solutions [49].

Oracle Object Storage is a critical component of Oracle's extensive Cloud infrastructure, offering highly durable and scalable object storage that integrates with Oracle's Cloud and on-premises applications. This solution is particularly advantageous for enterprises already using Oracle's suite of products, as it provides a consistent and integrated environment for managing data across the organization. Oracle Object Storage's cost-effective storage tiers enable organizations to optimize their storage expenditure, while its robust security features ensure that data remains protected against unauthorized access. Additionally, Oracle's support for hybrid Cloud deployments allows organizations to maintain a consistent IT environment that can has the flexibility to work with both Cloud and on-premises resources [50].

4.3. Q3: How the regulatory frameworks in terms of data security and compliance, can enhance the design and implementation of a Cloud-based DMS solution in the Supply Chain?

One of the most important challenges of the digital society has during through the last years was to maintain data privacy and security in different databases [36]. With the increasing use of data storage Cloud-based solutions and because these implementations are used to store large relevant amounts of data it makes them a target for hackers to explore security breaches [51]. To control this situation, Cloud providers have developed different tools for its users to prevent these attacks from happening in different circumstances, providing services that integrates security measures such as encryption, anonymization, multi-authentication and role-based access control (RBAC) which are considered essential to mitigate these risks of attacks [52].

4.3.1. Frameworks and International Organization for Standardization (ISO) certifications

Organizations have also focused their efforts to enhance data security best practices from its employees, not only by using these security protections but also providing training to reduce the risk of this situation to happen. Rawashdeh et al. (2023) focus their work on explaining how data security is important when implementing Cloud solutions, highlighting the main concerns of Small and medium Businesses (SMBs), focusing on robust data security measures, encryption, and strong access control systems. One of the frameworks that was discussed in this paper was the TOE framework – Technology-Organization-Environment. The technology sector highlights that, including the security advantages of Cloud computing, play a critical role in Cloud accounting adoption, while compatibility with existing security protocols and the perceived complexity of implementing robust security measures can negatively affect adoption decisions. This framework is also identified by Al-Hujran et al. (2018) which have defined 7 main security challenges when implementing a Cloud computing solution:

Table 4.8 - Security challenges when adopting a Cloud computing solution from the TOE framework (source:[54])

Challenge	Description
Lack of Regulations	Cloud computing regulations remain unclear, leaving Cloud customers uncertain about their legal status and jurisdiction.
Lack of Standards	There is a lack of open standards among Cloud providers, making it difficult to switch between providers.
Lock-in	Customers can become locked into a specific service provided, limiting their freedom.
Loss of Control	Organizations risk losing control over their IT environments, as they depend on Cloud service providers and service-level agreements (SLA).
Privacy Concerns	Customers need assurance about how their data is handled by Cloud operators, especially concerning third-party access.
Reliability	Depending on the internet, can make them vulnerable to bottlenecks, latency, and connection issues.

Security Concerns	Exposure to data to public networks, increasing vulnerabilities, especially with geographically dispersed resources.

Rouhani & Deters (2019) also underscores the importance of employing strong security measures, such as encryption and access controls, to mitigate risks of unauthorized access and data breaches. Furthermore, it highlights the necessity of compliance with data protection regulations, including GDPR, to ensure that Cloud-based systems adhere to required security standards.

Another framework that is discussed is the implementation of security control based in Blockchain, due to its construction as a Distributed Ledger Technology. The main objective of this framework is to reinforce the ISO certifications about data security and privacy which mitigate blockchain-specific risks related to data privacy, integrity, and access control. ISO is an organization responsible for developing standard processes in different areas and sectors, which permits organizations to understand and follow important guidelines given by experts globally [56]. This is especially relevant, as the rapid adoption of new technologies across various sectors and environments demands comprehensive guidelines to assist companies in their successful implementation. Such guidelines will be crucial for ensuring that businesses can easily integrate these technologies while maintaining efficiency, security, and compliance with industry standards [57]. This framework establishing a robust security control for new technologies, by addressing critical security vulnerabilities and governance gaps, ensuring that implementations not only maintain their core benefits of decentralization and transparency but also adhere to the highest standards of data integrity, confidentiality, and compliance [56]. In the table below, there's a resume of the elements of this framework and each ISO certification that approaches and aligns organizations to better implement security compliance measures:

Table 4.9 - ISO certification for each framework element (Sources: [56], [58])

Framework Element	Description	ISO Certification
Encryption	Data encryption protects sensitive information both in transit and at rest to prevent unauthorized access.	**ISO 27001:** Information Security Management; **ISO 27017:** Cloud Security; **ISO 28000:** Security Management for Supply Chains
Access Control	Implement robust access control mechanisms such as multi-factor authentication and role-based access control (RBAC).	**ISO 27001:** Information Security Management; **ISO 27017:** Cloud Security; **ISO 28000:** Security Management
Compliance with Standards	Ensure compliance with regulatory standards like General Data	**ISO 27701:** Privacy Information Management; **ISO 28000:** Security Management

	Protection Regulation (GDPR) to maintain user privacy and avoid legal consequences.	
Data Segmentation	Proper data segmentation prevents data leaks between different clients using shared Cloud infrastructure.	**ISO 27018:** Protection of Personal Data in Cloud; **ISO 28000:** Security Management
Regular Auditing and Monitoring	Continuous auditing and monitoring to detect and mitigate security breaches in real time, with logs for review.	**ISO 27002**: Security Controls; **ISO 22301:** Business Continuity Management
Incident Response	A detailed incident response plan to handle breaches, notify affected parties, and restore system security.	**ISO 27035:** Incident Management; **ISO 22301:** Business Continuity Management

These ISO are the most referenced and most Cloud providers have those certifications which gives extra confidence for its clients that the best security measures are being followed. Specific areas can have different and more focused ISO certifications about security and privacy measures, which developed different frameworks for these cases. For example, for the health sector, the frameworks EHR (Electronic Medical Records) and PHR (Personal Health Records) have been developed for organizations that need to comply with the ISO 27999 that focuses specifically on the information security management of health records. This provides extensive models of Privacy, confidentiality and security measures when managing sensitive data as this [59].

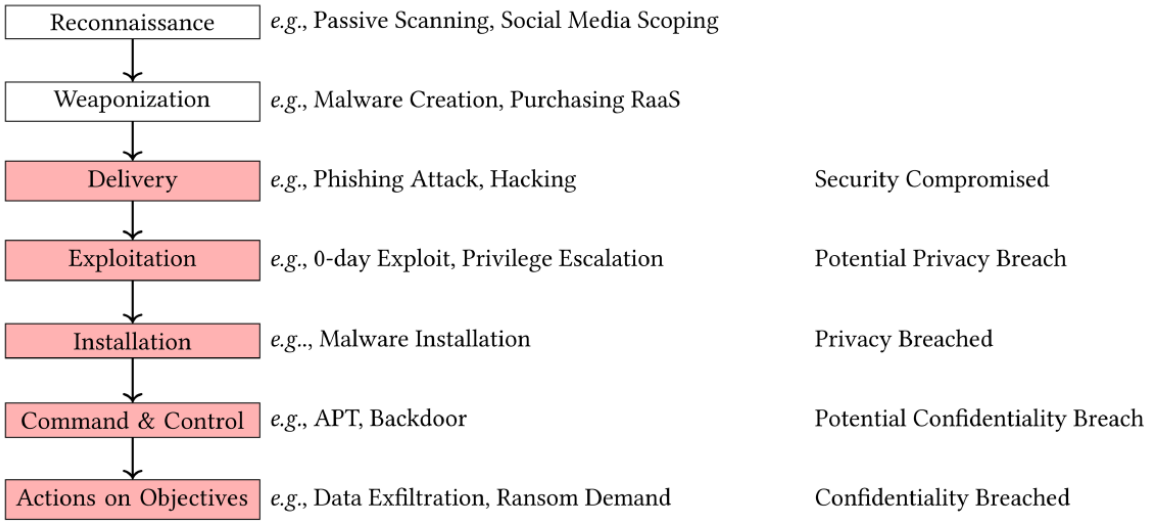

Figure 4.2 - Example of a kill chain in EHR Systems (source: [59]).

4.3.2. Data security and compliance from Cloud platforms in Supply Chain DMS

The successful adoption of Cloud computing in SMBs depends on integrating these security considerations into both technological and organizational frameworks. According to Parra-Sánchez & Talero-Sarmiento (2024), SMBs must address key security and privacy issues, ensuring that their digital

transformation aligns with robust data protection protocols. The adoption of technologies like the ones already mentioned, is essential for enhancing competitiveness and operational efficiency, but these advancements require a clear strategy that mitigates security risks and ensures compliance with relevant regulations. Despite this initial effort and alignment that needs to exist, Cloud computing is still the best option to implement when storing huge volumes of data [54]. When implementing a DM System, that's the case. As already discussed, traditional DMS presents several risks, including data fragmentation across different stakeholders, which leads to inconsistencies and errors in complex supply chains. These systems are also prone to data loss, due to their necessity of having physical paper, putting intellectual property at risk. Access control is often insufficient, leaving sensitive data vulnerable to unauthorized access, while security measures are inadequate, even in systems managed by third parties [60]. Additionally, these systems are inefficient, slower, and more prone to human errors, particularly in industries like maritime, where large volumes of documents must be shared across multiple stakeholders [19]. These challenges highlight the need for secure, modern Cloud-based platforms. As discussed previously, the implementation of Cloud services in supply chain organizations enhances digital information management across all the supply chain nodes and stakeholders, due to its support's scalability, flexibility, and real-time access, Cloud technology facilitates better decision-making and efficiency when monitoring supply chain data. The implementation of a DMS in Cloud computing contributes to creating a clever and effective security model by reduce time consuming measures and processes about security and computational expenses. The modules of this system create digital signatures impossible to override or fake, trustable transaction of information and authentication and validation [36]. The need for compliance with legal requirements imposed by many countries in terms of digital transformation and sustainability initiatives enhance the use of digital transformation technologies like Cloud computing for data storage. In the European Union, where the policies and regulations about data security, sustainability and economic growth are very strict, it has highlighted in the recent years the need for organizations to change from traditional systems to a digital economy. These legal frameworks are part of broader EU policies aimed at fostering innovation, economic competitiveness, and environmental responsibility. Digital transformation is a central pillar of the EU's strategy to ensure long-term economic growth while meeting its sustainability objectives, particularly those outlined in the Sustainable Development Goals (SDGs). One of the key areas where the EU's legal requirements influence digital transformation is through its Digital Economy and Society Index (DESI). This index tracks the progress of digital transformation in areas such as digital skills and the integration of digital technologies into business models. EU policies emphasize the importance of information and communication technologies (ICT), such as Cloud computing, as essential drivers of innovation and sustainability. The EU has recognized Cloud computing as a critical driver of digital transformation, and its adoption is encouraged as part of the region's broader economic and

sustainability goals. By integrating Cloud computing with other digital technologies, such as artificial intelligence, Blockchain or IoT, businesses are better equipped to innovate and remain competitive in the global market. Moreover, Cloud computing helps businesses comply with the EU's sustainability initiatives, as it often supports greener IT practices by optimizing resource usage and reducing carbon footprints associated with traditional IT infrastructure, promoting dematerialization and paperless frameworks [61]. The Supply Chain in this context has also been one of sectors that most was revolutionized in recent years, due not only to globalization but also to the regulations previously discussed. With the transition to the industry 4.0, it is important that every stakeholder adapt to its transformative effects [62]. The growing need to modernize information and communication systems, which are vital for efficiently managing traffic flow, has driven the necessity for collaborative efforts among all the supply chain to implement the use of new technologies to substitute traditional systems such as Document Management systems [63]. The focus is on swift, secure, and transparent data processing to ensure prompt delivery to end customers, substituting document systems outdated [64].

CHAPTER 5

5. Conclusions

The growth of digitalization has been seen as a revolutionary transformation in how companies and organizations manage their resources, processes and costs. With the introduction of new technologies such as blockchain, IoT, AI and Cloud, businesses have embraced these solutions to manage their day-to-day tasks, improving their relations with its customers, reduce costs from reviewing internal processes, and enhance overall operational efficiency. These technologies have not only streamlined workflows but have also provided greater transparency, security, and real-time data insights, allowing companies to make more informed decisions, optimize resource allocation, and drive innovation in every sector. As a result, digitalization has become a critical factor in maintaining competitiveness and provides sustainable advantages in today's rapidly evolving business sectors. The social and environmental impacts have also gained relevance in the last decade in the management sector. The digitalization and the use of these new technologies had a profound impact on sustainability. By reducing the reliance on physical resources, such as paper and energy on-premises servers, businesses can significantly lower their carbon footprint. Cloud-based solutions, for instance, promote energy efficiency by consolidating data storage in optimized data centers, while the shift to digital documentation reduces waste and deforestation. AI. Blockchain and IoT also contribute to sustainable practices by enabling predictive maintenance, optimizing processes, and reducing waste across various areas. These developments not only contribute to environmental preservation but also align with the global push for more sustainable business models. The Supply Chain is considered a vital sector in the globalized economy, due to our necessity to transport, store, and deliver goods in every part of the world. With, it is possible to understand that this sector has a high impact in the carbon footprint worldwide, which could be minimized with these new technologies with optimized routes for, maximized resources and automized processes that could prevent as much waste as possible. One important factor in the supply chain is the use of physical paper throughout every step of the stakeholders. The process of still using physical paper can signify more than 20% of the total transportation cost due to the administrative tasks implied to the management of those documents and the high risk of delayed or lost files through all the nodes of a supply chain.

The present study has conducted a comprehensive analysis of how a Cloud-based solution can be implemented in a high-pressure area like supply chain to manage their documents, with an integrated Document Management System. As the technological landscape rapidly advances, its research must keep pace. This study provides a contribution by shedding light on the current state of the art in Cloud computing and its impact on improving as a competitive advantage and the Resource Based-View, one of the strategic management main frameworks.

Moreover, it discussed how similar implementations of Cloud-based solutions in different areas have resulted, more specifically, in the supply chain sector. After that, the study was focused on how a Cloud-based solution for a Document Management System can impact the organization results while becoming a strategic advantage in organizations in terms of sustainability, security and operational efficiency and productivity, giving some examples of the most common Cloud solutions used. Lastly, it analysed how the implementation of a Cloud-based DMS solution can be enhanced by regulations in terms of data security and compliance.

After a careful and profound discussion of the topics described above, it was possible to conclude that the implementation of a Cloud Document Management System can help organizations to better optimize their documentation archive, becoming as a useful and strategic advantage to improve transparency throughout all the supply chain nodes, increase data security of the information shared between each stakeholder by having an integrated, single and ubiquitous system that can only be accessed by people authorized. It ensures compliance with various regulatory frameworks, such as the General Data Protection Regulation (GDPR) in Europe, which adds an additional layer of complexity to the implementation process. This also resulted in improved efficiency of administrative tasks that were secured by company employees, frequently with manual processes, which contributed to employee happiness and cost and time savings. Sustainability was also a predominant factor of this research, since that, with this digital transformation and dematerialization, the reduce of paper usage was possible and that this paperless framework could implicate contributions for companies to focus on environmental and social responsibilities, which can be seen as a strategic advantage to an organization. It was also analysed that Cloud solutions can be integrated with other new technologies like AI, IoT and Blockchain, which reinforces the powerful tool that could be, and that this synergy can have a transformative impact on supply chain operations. The integration of those technologies with a Cloud-based Document Management Systems not only enhances automation and real-time data processing but also improves decision-making and overall process optimization. This synergy provides greater visibility and traceability across the supply chain, fosters innovation, and further strengthens security by ensuring data immutability and transparency.

Throughout the study, and despite all these advantages and the fact that the use of new technologies is in a *crescendo* tendency, it was also noted that this kind of implementation cannot be the best, depending on the sector, region or size of an organisation. In certain regions, it is still possible to have legal restrictions to this DMS solution or even the country not having the necessary technological infrastructure to support Cloud-based solutions effectively. Additionally, smaller organizations, especially in less developed regions or certain business areas, may face financial and operational challenges in adopting such advanced technologies. The initial costs of implementation, despite being lower than an on-premises infrastructure, the need for skilled personnel, and the

integration with existing systems can cause constraints for some companies. While Cloud solutions offer significant benefits, certain sectors with stringent regulatory requirements or those dealing with highly sensitive data may encounter limitations regarding data sovereignty, privacy concerns, and compliance with local laws. In the end, organizations must measure and plan if, with this transition, they are aligned with their needs and expectations and legal laws that can exist in specific cases.

Although this study provides valuable insights, it also encompasses its limitations. As the landscape of digital technologies is constantly changing and taking into consideration that the use of these new technologies, it is most likely that this research could be outdated in a short time, compromising the study's currency and comprehensive understanding of how was made this approach linking the DMS and Cloud solutions. Despite the limitations, this research provides a systematic review on Cloud and Document Management Systems, providing updated and relevant information on the current state of this topic. The positive impact of an improvement with DMS Cloud services in Supply Chain is clearly visible, which allows managers and companies to improve the management of their resources and processes, leading to sustained competitive advantage, by giving data-drive insights and, with that improving decision-making while being in mind sustainability and paperless practices.

Future Work

For future work, multiple approaches of research and practical exploration can be proposed based on the findings of this thesis. While the study has provided a comprehensive analysis of not only the impact of Cloud-based Document Management Systems (DMS) on the supply chain, but also in other areas, there are still many sectors that warrant further investigation and experimentation. The study is also a theoretical approach based on practical studies in different environments which does not guarantee that its implementation would be a perfect match of the topics discussed. For that, it is suggested to conduct a longitudinal study to track the long-term impacts of Cloud-based DMS on organizations. This includes monitoring changes in efficiency, security, and sustainability over time, providing deeper insights into how these systems evolve within companies, and how employees would adapt to a change like the one studied. The human factor is always the conditioning that can vary since it depends on ow users interact with the system, what challenges they face, and how usability can be improved will help in designing more user-friendly platforms. Incorporating user feedback could lead to more efficient training programs and greater employee satisfaction of the tool, ensuring smoother transitions during implementation.

This kind of solution could also explore the ongoing challenges and benefits organizations experience after full integration of the system. Despite this research have discovered that Cloud computing can be integrated with other new technologies, it would be recommendable to investigate further this kind of integrations and if, in the meantime, the advantages keep enhancing document security and compliance in more complex, multi-stakeholder supply chains. By addressing those areas

in future research, it will be possible to provide a more complete understanding of Cloud-based DMS solution and its transformative potential across various industries and regions, further solidifying its role in driving digital innovation and sustainability in business operations.

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