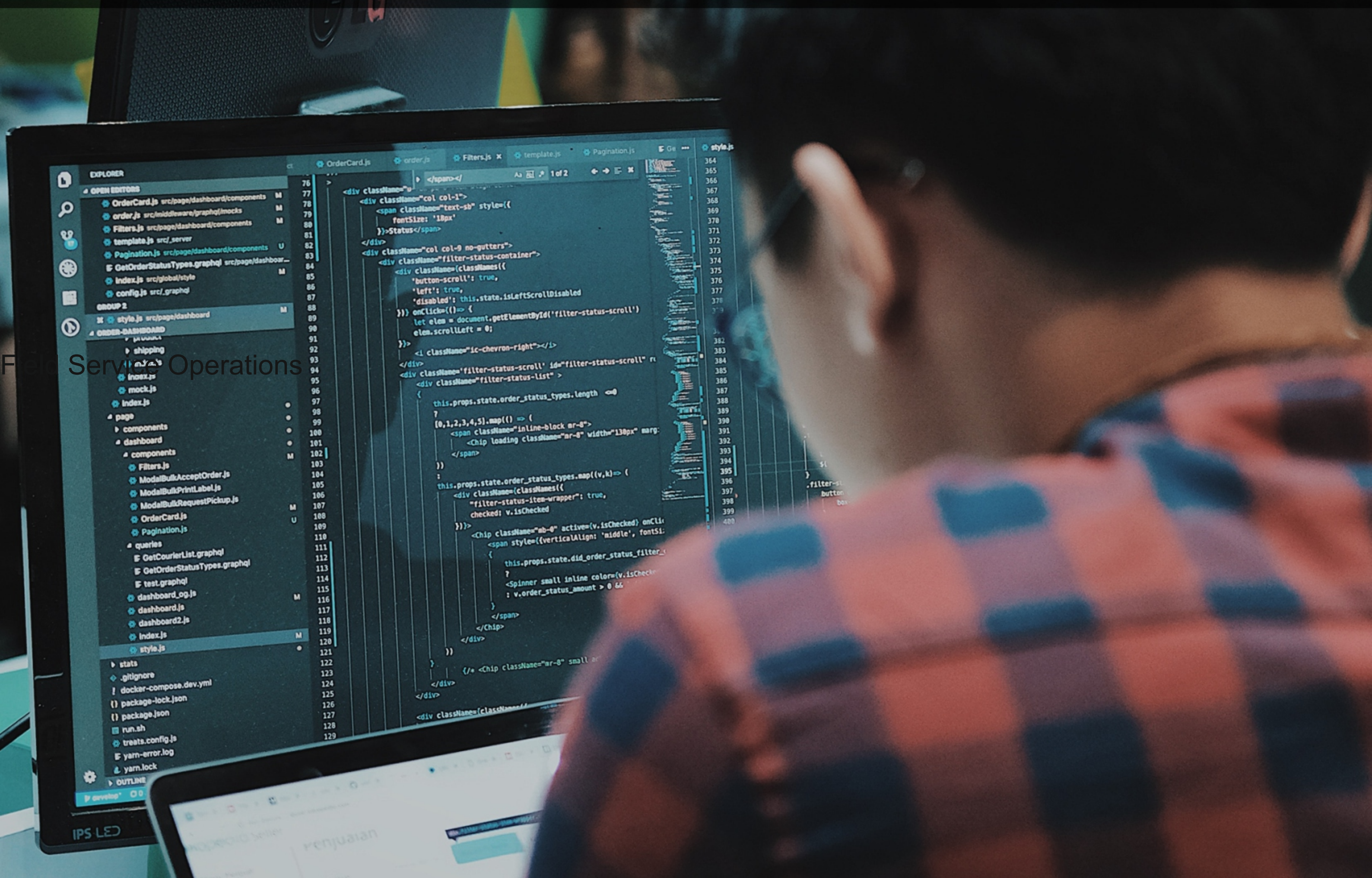
Online ISSN : 0975-4172
Print ISSN : 0975-4350
DOI : 10.17406/GJCST

Global Journal

of Computer Science and Technology: C

Software & Data Engineering



Highlights

- Proactive Supply Chain
- Trunk Stock Management
- Field Service Operations
- Data Systems for Healthcare

Discovering Thoughts, Inventing Future

VOLUME 25 ISSUE 1 VERSION 1.0

© 2001-2025 by Global Journal of Computer Science and Technology, USA

Global Journal of Computer Science and Technology: C
Software & Data Engineering

Global Journal of Computer Science and Technology: C
Software & Data Engineering

Volume 25 Issue 1 (Ver. 1.0)

Open Association of Research Society

© Global Journal of Computer Science and Technology. 2025

All rights reserved.

This is a special issue published in version 1.0 of "Global Journal of Computer Science and Technology "By Global Journals Inc.

All articles are open access articles distributedunder "Global Journal of Computer Science and Technology"

Reading License, which permits restricted use. Entire contents are copyright by of "Global Journal of Computer Science and Technology" unless otherwise noted on specific articles.

No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without written permission.

The opinions and statements made in this book are those of the authors concerned. Ultraculture has not verified and neither confirms nor denies any of the foregoing and no warranty or fitness is implied.

Engage with the contents herein at your own risk.

The use of this journal, and the terms and conditions for our providing information, is governed by our Disclaimer, Terms and Conditions and Privacy Policy given on our website http://globaljournals.us/terms-and-condition/menu-id-1463/

By referring / using / reading / any type of association / referencing this journal, this signifies and you acknowledge that you have read them and that you accept and will be bound by the terms thereof.

All information, journals, this journal, activities undertaken, materials, services and our website, terms and conditions, privacy policy, and this journal is subject to change anytime without any prior notice.

Incorporation No.: 0423089
License No.: 42125/022010/1186
Registration No.: 430374
Import-Export Code: 1109007027
Employer Identification Number (EIN):
USA Tax ID: 98-0673427

Global Journals Inc.

*(A Delaware USA Incorporation with "Good Standing"; **Reg. Number: 0423089**)*

Sponsors: *Open Association of Research Society*
Open Scientific Standards

Publisher's Headquarters office

Global Journals® Headquarters
945th Concord Streets,
Framingham Massachusetts Pin: 01701,
United States of America
USA Toll Free: +001-888-839-7392
USA Toll Free Fax: +001-888-839-7392

Offset Typesetting

Global Journals Incorporated
2nd, Lansdowne, Lansdowne Rd., Croydon-Surrey,
Pin: CR9 2ER, United Kingdom

Packaging & Continental Dispatching

Global Journals Pvt Ltd
E-3130 Sudama Nagar, Near Gopur Square,
Indore, M.P., Pin:452009, India

Find a correspondence nodal officer near you

To find nodal officer of your country, please email us at *local@globaljournals.org*

eContacts

Press Inquiries: *press@globaljournals.org*
Investor Inquiries: *investors@globaljournals.org*
Technical Support: *technology@globaljournals.org*
Media & Releases: *media@globaljournals.org*

Pricing (Excluding Air Parcel Charges):

Yearly Subscription (Personal & Institutional)
250 USD (B/W) & 350 USD (Color)

Editorial Board

Global Journal of Computer Science and Technology

Dr. Corina Sas

School of Computing and Communication Lancaster University Lancaster, UK

Dr. Jianyuan Min

Ph.D. in Computer Science, M.S. in Computer Science, B.S. in Computer Science, Texas A&M University, United States

Dr. Sotiris Kotsiantis

Ph.D. in Computer Science, Department of Mathematics, University of Patras, Greece

Dr. Kassim Mwitondi

M.Sc., PGCLT, Ph.D. Senior Lecturer Applied Statistics/ Data Mining, Sheffield Hallam University, UK

Dr. Diego Gonzalez-Aguilera

Ph.D. in Photogrammetry and Computer Vision Head of the Cartographic and Land Engineering Department University of Salamanca Spain

Dr. Kurt Maly

Ph.D. in Computer Networks, New York University, Department of Computer Science Old Dominion University, Norfolk, Virginia

Dr. Yuanyang Zhang

Ph.D. of Computer Science, B.S. of Electrical and Computer Engineering, University of California, Santa Barbara, United States

Dr. Zhengyu Yang

Ph.D. in Computer Engineering, M.Sc. in Telecommunications, B.Sc. in Communication Engineering, Northeastern University, Boston, United States

Dr. Osman Balci, Professor

Department of Computer Science Virginia Tech, Virginia University Ph.D. and M.S. Syracuse University, Syracuse, New York M.S. and B.S. Bogazici University, Istanbul, Turkey

Dr. Don. S

Ph.D in Computer, Information and Communication Engineering, M.Tech in Computer Cognition Technology, B.Sc in Computer Science, Konkuk Universtity, South Korea

Dr. Kwan Min Lee

Ph. D., Communication, MA, Telecommunication, Nanyang Technological University, Singapore

Dr. Ramadan Elaiess

Ph.D in Computer and Information Science, University of Benghazi, Libya

Dr. Khalid Nazim Abdul Sattar

Ph.D, B.E., M.Tech, MBA, Majmaah University, Saudi Arabia

Dr. Omar Ahmed Abed Alzubi

Ph.D in Computer and Network Security, Al-Balqa Applied University, Jordan

Dr. Stefano Berretti

Ph.D. in Computer Engineering and Telecommunications, University of Firenze Professor Department of Information Engineering, University of Firenze, Italy

Dr. Lamri Sayad

Ph.d in Computer science, University of BEJAIA, Algeria

Dr. Hazra Imran

Ph.D in Computer Science (Information Retrieval), Athabasca University, Canada

Dr. Nurul Akmar Binti Emran

Ph.D in Computer Science, MSc in Computer Science, Universiti Teknikal Malaysia Melaka, Malaysia

Dr. Anis Bey

Dept. of Computer Science, Badji Mokhtar-Annaba University, Annaba, Algeria

Dr. Rajesh Kumar Rolen

Ph.D in Computer Science, MCA & BCA - IGNOU, MCTS & MCP - MIcrosoft, SCJP - Sun Microsystems, Singhania University, India

Dr. Aziz M. Barbar

Ph.D. IEEE Senior Member Chairperson, Department of Computer Science AUST - American University of Science & Technology Alfred Naccash Avenue Ashrafieh, Lebanon

Dr. Chutisant Kerdvibulvech

Dept. of Inf. & Commun. Technol., Rangsit University Pathum Thani, Thailand Chulalongkorn University Ph.D. Thailand Keio University, Tokyo, Japan

Dr. Abdurrahman Arslanyilmaz

Computer Science & Information Systems Department Youngstown State University Ph.D., Texas A&M University University of Missouri, Columbia Gazi University, Turkey

Dr. Tauqeer Ahmad Usmani

Ph.D in Computer Science, Oman

Dr. Magdy Shayboub Ali

Ph.D in Computer Sciences, MSc in Computer Sciences and Engineering, BSc in Electronic Engineering, Suez Canal University, Egypt

Dr. Asim Sinan Yuksel

Ph.D in Computer Engineering, M.Sc., B.Eng., Suleyman Demirel University, Turkey

Alessandra Lumini

Associate Researcher Department of Computer Science and Engineering University of Bologna Italy

Dr. Rajneesh Kumar Gujral

Ph.D in Computer Science and Engineering, M.TECH in Information Technology, B. E. in Computer Science and Engineering, CCNA Certified Network Instructor, Diploma Course in Computer Servicing and Maintenance (DCS), Maharishi Markandeshwar University Mullana, India

Dr. Federico Tramarin

Ph.D., Computer Engineering and Networks Group, Institute of Electronics, Italy Department of Information Engineering of the University of Padova, Italy

Dr. Roheet Bhatnagar

Ph.D in Computer Science, B.Tech in Computer Science, M.Tech in Remote Sensing, Sikkim Manipal University, India

Contents of the Issue

Global Journal of Computer Science and Technology: C
Software & Data Engineering
Volume 25 Issue 1 Version 1.0 Year 2025
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Integrating AI and Machine Learning in Project Management for Proactive Supply Chain Disruption Mitigation

By Samuel Yaw Larbi, Emmanuel Opoku Manu, Samuel Donatus, Daniel Kweku Assumang, JohnPaul Adimonyemma & Tunmise Suliat Oyekola

Northeastern University

Abstract- The increasing unpredictability of global supply chains necessitate advanced technological solutions for disruption mitigation. It explored the integration of Artificial Intelligence (AI) and Machine Learning (ML) in project management to enhance supply chain resilience. AI-driven risk identification and forecasting enable organizations to anticipate disruptions and proactively manage risks, while machine learning models optimize supply chain operations through predictive analytics and anomaly detection. The application of AI in decision-making and real-time supply chain adaptation further enhances agility, leveraging scenario planning, digital twins, and AI-powered automation in logistics.

Keywords: *artificial intelligence, machine learning, supply chain management, project management, risk mitigation, blockchain, predictive analytics, digital twins, smart contracts, supply chain resilience.*

GJCST-C Classification: *LCC Code: HD38.5, QA76.9.A25*

INTEGRATINGAIANDMACHINELEARNINGINPROJECTMANAGEMENTFORPROACTIVESUPPLYCHAINDISRUPTIONMITIGATION

Strictly as per the compliance and regulations of:

© 2025. Samuel Yaw Larbi, Emmanuel Opoku Manu, Samuel Donatus, Daniel Kweku Assumang, JohnPaul Adimonyemma & Tunmise Suliat Oyekola. This research/review article is distributed under the terms of the Attribution-NonCommercial-NoDerivatives 4.0 International (CC BYNCND 4.0). You must give appropriate credit to authors and reference this article if parts of the article are reproduced in any manner. Applicable licensing terms are at https://creativecommons.org/licenses/by-nc-nd/4.0/.

Integrating AI and Machine Learning in Project Management for Proactive Supply Chain Disruption Mitigation

Samuel Yaw Larbi [α], Emmanuel Opoku Manu [σ], Samuel Donatus [ρ], Daniel Kweku Assumang [Ѡ], JohnPaul Adimonyemma [¥] & Tunmise Suliat Oyekola [§]

Abstract- The increasing unpredictability of global supply chains necessitate advanced technological solutions for disruption mitigation. It explored the integration of Artificial Intelligence (AI) and Machine Learning (ML) in project management to enhance supply chain resilience. AI-driven risk identification and forecasting enable organizations to anticipate disruptions and proactively manage risks, while machine learning models optimize supply chain operations through predictive analytics and anomaly detection. The application of AI in decision-making and real-time supply chain adaptation further enhances agility, leveraging scenario planning, digital twins, and AI-powered automation in logistics.

Additionally, the convergence of blockchain with AI and ML has introduced unprecedented transparency in supply chain operations. Blockchain-integrated AI enhances real-time tracking, while smart contracts automate compliance, ensuring greater accountability across global supply networks. However, despite these advancements, significant challenges persist. Issues such as data quality and bias in AI-based forecasting, high implementation costs, cybersecurity risks, ethical concerns, and resistance to AI adoption hinder widespread deployment.

Keywords: artificial intelligence, machine learning, supply chain management, project management, risk mitigation, blockchain, predictive analytics, digital twins, smart contracts, supply chain resilience.

I. Introduction

The global supply chain landscape has undergone significant transformations in recent years, with disruptions becoming more frequent, severe, and dynamic. Ordinarily, supply chain management (SCM) focused on optimizing operational efficiency, reducing costs, and ensuring timely delivery of goods and services [1]. However, the increasing prevalence of geopolitical instability, natural disasters, trade restrictions, cyber threats, and pandemics have heightened vulnerabilities across global supply networks. The COVID-19 pandemic, for instance, caused unprecedented disruptions, exposing weaknesses in supply chain resilience and forcing organizations to rethink their risk management strategies [2]. Additionally, geopolitical conflictssuch as the Russia-Ukraine warhave disrupted critical supply chains, particularly in agriculture, energy, and semiconductor industries, leading to price volatility and product shortages [3].

With supply chains extending across multiple continents and involving various organizations, disruptions no longer remain an isolated incidents but trigger ripple effects that impact entire industries and economies. These demand more proactive approaches that go beyond traditional risk assessment methods. Organizations must anticipate, identify, and mitigate risks in real-time, leveraging data-driven decision-making to ensure resilience, agility, and sustainability in their supply chain operations [4].

Project management plays a critical role in ensuring supply chain resilience by providing structured methodologies for managing uncertainties, risks, and disruptions [5]. Traditionally, supply chain managers rely on linear, sequential models that emphasize stability and efficiency [6]. However, in a volatile, uncertain, complex, and ambiguous (VUCA) world, these models often fail to address the dynamic nature of modern supply chains [7].

Integrating project management principles into SCM allows organizations to adopt a proactive approach by implementing agile methodologies, risk-based planning, and real-time monitoring of supply chain performance [5]. Project-based approaches enable firms to rapidly respond to unforeseen events, optimize resource allocation, and enhance collaboration among stakeholders. Agile methodologies such as Scrum and Kanban allow supply chain managers to iterate and refine processes continuously, while

Author α Ѡ: Northeastern University, Department of Project Management, College of Professional Studies.
e-mail: larbi.s@northeastern.edu
ORCID: http://orcid.org/0009-0001-4878-871x
ORCID: http://orcid.org/0009-0009-4227-5671
Author σ: University of Pittsburgh, Information System, Department of Informatics and Networked System.
ORCID: http://orcid.org/0009-0000-3713-0587
Author ρ: University of South Florida, College of Engineering, Mechanical.
ORCID: http://orcid.org/0009-0005-9912-8331
Author ¥: Florida A&M University, Department of Industrial Engineering, FAMU-FSU College of Engineering, Tallahassee.
ORCID: http://orcid.org/0000-0002-7125-6041
Author §: Independence Researcher, Software Engineer, Gloqal Inc.
e-mail: larbi.s@northeastern.edu
ORCID: http://orcid.org/0009-0009-6081-8035

Global Journal of Computer Science and Technology (C) XXV Issue I Version I Year 2025

© 2025 Global Journals

traditional project management techniques, such as Critical Path Method (CPM) and Work Breakdown Structures (WBS), help streamline complex supply chain projects [8,9]. Despite these advantages, current SCM practices still operate in siloed environments, with project management and supply chain operations being treated as distinct disciplines.

With the rapid advancements in Artificial Intelligence (AI) and Machine Learning (ML), organizations are now turning to data-driven approaches to mitigate supply chain risks and optimize operational performance. AI-powered solutions can predict disruptions, automate decision-making, and enhance real-time visibility, making supply chains more adaptive and resilient [10]. Although, while AI and ML provide unparalleled capabilities in supply chain risk management, their integration requires strategic planning, robust data infrastructure, and cross-functional collaboration.

Given the complexity of modern supply chains, combining AI/ML with project management methodologies presents a promising solution for proactive disruption mitigation. The structured approach of project management, when enhanced with AI-driven analytics and automation, can enhance risk prediction and prevention by integrating AI models into supply chain risk registers, improve real-time decision-making through leveraging AI-powered capability in project execution, optimize resource allocation and cost efficiency through ML-based supply chain simulations, and foster agile supply chain planning that adapts dynamically to market uncertainties [11,12].

Organizations that successfully integrate AI/ML with project management can build highly adaptive, self-learning supply chain ecosystems, reducing the impact of disruptions while driving cost savings and operational efficiency.

II. Literature Review

Supply chain disruptions refer to sudden or prolonged interruptions in the flow of goods, services, or information within a supply network, often leading to significant operational and financial repercussions [13]. Historically, major supply chain disruptions have shaped risk management strategies across industries. The COVID-19 pandemic was one of the most profound disruptions in recent history, exposing vulnerabilities in manufacturing, logistics, and inventory management. Border closures, labour shortages, and fluctuating demand created significant bottlenecks, delaying shipments worldwide [2]. Similarly, geopolitical tensions, such as the Russia-Ukraine conflict, have disrupted the supply of critical raw materials like wheat, crude oil, and semiconductor components [14]. Beyond these macroeconomic shocks, natural disasters have also played a major role in destabilizing supply chains. The 2011 Tōhoku earthquake and tsunami in Japan, for example, severely affected global electronics and automotive production, as the country was a hub for semiconductor manufacturing [15]. The 2011 Thailand floods further intensified disruptions, impacting companies reliant on hard disk drive manufacturing [16]. Cybersecurity threats, another growing risk, have also emerged as a critical concern. Ransomware attacks targeting shipping giants, such as the 2017 cyberattack on Maersk, resulted in financial losses exceeding $300 million and caused widespread delays in international freight operations [17].

Conventional supply chain risk management has largely relied on reactive strategies, often failing to anticipate and mitigate severe disruptions. Companies have long relied on maintaining inventory buffers, diversifying suppliers, and enforcing strict contractual agreements to reduce dependency on single sources [18]. Common risk assessment frameworks, such as Analytical Network Process (ANP) and Analytical Hierarchy Process (AHP), tend to be static, making them inadequate for addressing real-time volatility in global supply networks [19]. As supply chain risks grow more unpredictable, the need for dynamic, AI-driven predictive models has become increasingly evident.

III. AI and ML Implementation in Project Management for Supply Chain Disruption Mitigation

a) *AI-Powered Risk Identification and Forecasting*

The unpredictability nature of modern supply chains necessitates more sophisticated approaches to risk identification and forecasting. Traditional risk assessment models, which rely on historical data and rule-based decision-making, often struggle to capture the dynamic nature of global trade disruptions. Artificial Intelligence (AI) offers a paradigm shift by enabling real-time analysis and predictive insights, allowing companies to detect early signs of disruptions and implement proactive mitigation strategies [12].

One of the most transformative applications of AI in risk identification is its ability to analyse vast and diverse datasets to uncover hidden vulnerabilities within the supply chain. AI-powered predictive analytics leverage machine learning algorithms to detect anomalies, assess supplier reliability, and anticipate fluctuations in demand or supply constraints [20]. Big data analytics, particularly when integrated with AI, enhances predictive capabilities by processing real-time market signals, geopolitical developments, and environmental factors to assess potential risks. For instance, AI models trained on trade data and transportation trends can anticipate port congestion or shipping delays, enabling companies to reroute shipments before bottlenecks materialize [21].

© 2025 Global Journals

AI-driven demand forecasting is a crucial tool for preventing stock outs and overstocking, two common challenges in supply chain management [22]. Conventional forecasting methods, often reliant on static statistical models, fail to account for sudden shifts in consumer behaviour or external disruptions such as pandemics or geopolitical tensions. AI-enhanced forecasting systems continuously learn from new data sources, including customer purchasing trends, macroeconomic indicators, and even social media sentiment analysis. Companies such as Amazon and Walmart have successfully implemented AI-based forecasting models that dynamically adjust inventory levels based on real-time demand fluctuations [23]. This not only optimizes inventory management but also minimizes financial losses from excess stock or lost sales due to shortages.

Despite the advantages of AI in risk identification, there are challenges that remain in its implementation. Data quality and accessibility pose significant hurdles, as AI systems rely on large, high-quality datasets to generate accurate predictions. Many organizations face issues with fragmented data storage, siloed operations, and inconsistent data governance, which can compromise the effectiveness of AI models [24, 25]. Additionally, biases inherent in historical data can lead to inaccurate forecasts, reinforcing existing vulnerabilities rather than mitigating them [26].

Moreover, the integration of AI into supply chain risk management requires a fundamental shift in organizational culture and decision-making processes. Many firms still rely on manual or experience-based risk assessments, and transitioning to an AI-driven approach demands investment in digital infrastructure and workforce upskilling [27]. AI models must be continuously refined and adapted to evolving risk landscapes to ensure their reliability.

Fig. 3.1: AI-Powered Risk Identification and Forecasting

IV. Machine Learning Models for Proactive Disruption Mitigation

Machine learning (ML) has emerged as a critical tool in proactive disruption mitigation, offering the ability to analyse complex datasets, identify emerging risks, and optimize supply chain responses in real-time. Unlike traditional risk management approaches that focus on reactive strategies, ML-driven solutions enable predictive and adaptive decision-making, reducing the impact of disruptions before they escalate into crises [22].

Supervised and unsupervised learning models play a crucial role in supply chain optimization. Supervised learning algorithms, trained on labelled datasets, help predict supplier performance, transportation delays, and demand fluctuations with high accuracy [28]. These models analyse historical data, detecting recurring patterns and providing solutions into potential disruptions. For example, predictive analytics platforms powered by supervised learning have been employed to assess supplier risk by analysing financial stability, geopolitical factors, and

Global Journal of Computer Science and Technology (C) XXV Issue I Version I Year 2025

© 2025 Global Journals

past delivery performance [29]. Companies leveraging such models can proactively diversify their supplier base or renegotiate contracts to ensure continuity in operations.

On the other hand, unsupervised learning models, which operate without predefined labels, excel in anomaly detection within logistics, inventory management, and transportation networks [30]. These models identify deviations from expected patterns, flagging potential disruptions that may not be evident through conventional analysis. In logistics, for instance, unsupervised learning is used to detect irregularities in shipment movements, such as unexpected delays or route deviations, which could indicate potential supply chain risks such as theft, fraud, or unforeseen logistical constraints [31].

ML based anomaly detection also enhances the security and resilience of supply chain operations. Algorithms trained on vast datasets can identify cyber threats targeting logistics infrastructure, supplier networks, or digital transaction platforms [32]. With increasing cyber vulnerabilities in global supply chains, MLdriven security measures are essential in preventing data breaches and ensuring compliance with regulatory frameworks.

The application of predictive analytics in supplier risk management further highlights the strategic value of ML in disruption mitigation. Geopolitical developments, and environmental factors, ML models provide dynamic risk assessments through the analyses of real-time data on supplier operations, allowing businesses to make informed sourcing decisions. For example, during the COVID-19 pandemic, companies utilizing ML-driven supplier risk management systems were able to anticipate factory shutdowns in affected regions and shift procurement strategies accordingly [33]. This level of foresight was critical in maintaining production continuity and minimizing financial losses.

However, the implementation of ML-based proactive disruption mitigation strategies is not without challenges. One of the primary barriers is the need for highquality, integrated data across the supply chain ecosystem. Many organizations operate in siloed environments where data-sharing limitations hinder the effectiveness of ML models. Additionally, the computational complexity of ML algorithms necessitates substantial investments in cloud computing infrastructure and skilled data science expertise.

Moreover, reliance on ML for decision-making requires careful monitoring to ensure model accuracy and ethical considerations. The presence of bias in training datasets can lead to skewed risk assessments, disproportionately affecting certain suppliers or regions [34]. Transparency in ML driven decision-making processes is essential to maintain trust among stakeholders and avoid unintended consequences.

Nevertheless, the integration of ML into supply chain risk management offers significant advantages in enhancing resilience and responsiveness. As technological advancements continue to refine ML capabilities, businesses that embrace these tools will be better positioned to navigate disruptions and maintain competitive agility in an increasingly volatile global market.

© 2025 Global Journals

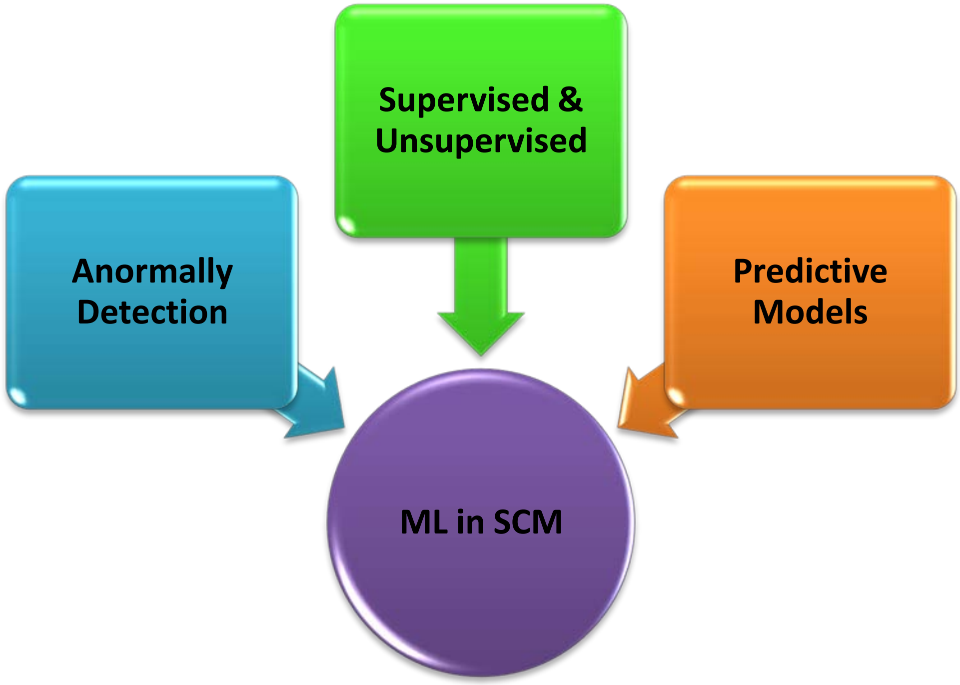


Fig. 3.2: Machine Learning Model for Proactive Model Disruption Mitigation

V. AI in Decision-Making and Real-Time Supply Chain Adaptation

AI driven tools such as scenario planning, simulation, automation, chatbots, and digital twins have become pivotal in enhancing operational efficiency and resilience.

AI-driven scenario planning and simulation have become indispensable in modern project management, particularly within supply chains through analysing vast datasets, AI can model various scenarios, predict potential disruptions, and assess their impacts on the supply chain. This enables managers to develop contingency plans and optimize decision-making processes [12].

AI-powered platforms can simulate the effects of geopolitical events, natural disasters, or market fluctuations on supply chains [35]. These simulations allow project managers to visualize potential outcomes and devise strategies to mitigate risks. The ability to anticipate and prepare for various scenarios enhances the agility and resilience of supply chains, ensuring continuity in operations despite uncertainties.

In addition, AI-driven simulations facilitate resource optimization by identifying bottlenecks and inefficiencies within the supply chain. It enables project managers to allocate resources more effectively, reduce operational costs, and improve overall performance by modelling different operational strategies. This data-driven approach replaces traditional trial and error methods, leading to more informed and efficient decision-making.

Automation, powered by AI, has transformed supply chain logistics by streamlining operations and reducing human intervention in routine tasks. AI algorithms can optimize routing, manage inventory levels, and forecast demand with high accuracy, leading to cost savings and improved service levels. For example, AI-driven automation in warehouses includes the use of robotics for sorting and packing, which accelerates order fulfilment and reduces errors. Companies like Amazon have invested heavily in robotics and AI to enhance their logistics operations. Amazon's advanced fulfillment centres utilize AI-powered robots to move goods efficiently, resulting in significant cost reductions and faster delivery times [36]. Also, AI-powered automation extends to transportation management. AI systems analyse traffic patterns, weather conditions, and delivery schedules to determine the most efficient routes for shipments [37, 38]. This optimization reduces fuel consumption, lowers transportation costs, and ensures timely deliveries, thereby enhancing customer satisfaction. Given an example, using AI Chatbots and Digital Twins in Predictive Supply Chain Management. These two represent innovative applications of AI in predictive supply chain management.

AI chatbots serve as virtual assistants, facilitating real-time communication between various stakeholders in the supply chain. They can handle inquiries, provide updates on shipment statuses, and assist in coordinating tasks among suppliers, manufacturers, and distributors [39]. This real-time

© 2025 Global Journals

interaction enhances transparency and responsiveness within the supply chain.

Conversely, digital twins are virtual reproductions of actual assets, processes, or entire supply chain networks. Digital twins, which combine real-time data with AI algorithms, enable continuous monitoring and modeling of supply chain operations. This technology enables businesses to anticipate potential disruptions, assess the impact of changes, and enhance processes before they are implemented in the real world. For example, in the manufacturing industry, digital twins can mimic production line changes to assess their impact on output and quality. This feature enables proactive decision-making, resulting in less downtime and increased operational efficiency. Similarly, in logistics, digital twins can simulate transportation networks to determine the best routing options, ultimately boosting delivery performance.

The integration of AI into decision-making and real-time supply chain adaptation offers substantial benefits, including enhanced predictive capabilities, operational efficiency, and resilience.As AI technologies continue to evolve, their applications in supply chain management are poised to become even more transformative, enabling businesses to navigate complexities and uncertainties with greater agility.

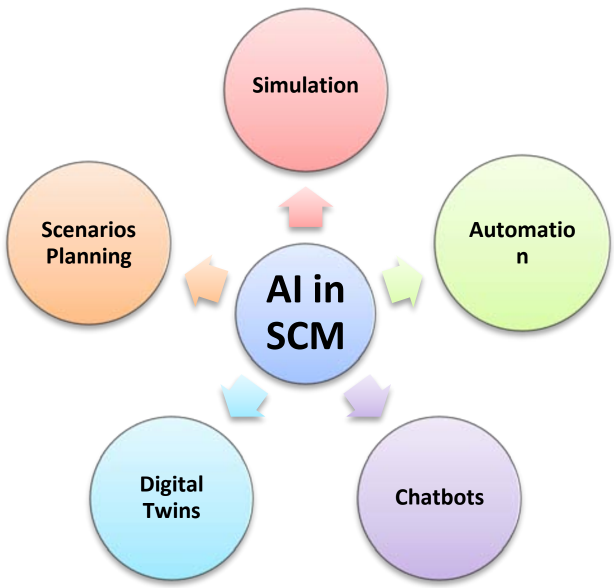


Fig 3.3: AI in Decision-Making and Real-Time Supply Chain Adaptation

VI. Blockchain, AI, and ML for Supply Chain Transparency

The convergence of Blockchain technology, Artificial Intelligence (AI), and Machine Learning (ML) enhances real-time tracking, automates compliance through smart contracts, and offers innovative solutions, particularly in industries like pharmaceuticals.

Blockchain provides a decentralized and immutable ledger system, ensuring that every transaction within the supply chain is recorded transparently and securely [40]. When combined with AI, this system becomes even more powerful. AI algorithms can analyse the vast amounts of data stored on a blockchain to identify patterns, predict potential disruptions, and optimize operations [41]. For example, in the food industry, integrating blockchain with AI allows companies to track products from farm to table. This integration ensures that data regarding the origin, handling, and transportation of food items is accurate and readily accessible. AI can analyse this data to predict shelf life, monitor quality, and even suggest optimal delivery routes, thereby reducing waste and ensuring product safety.

Smart contracts are self-executing contracts with the terms directly embedded in code, operating on blockchain networks. They automatically enforce and execute agreements when predefined conditions are met, reducing the need for intermediaries and expediting processes [42]. In global supply chains, smart contracts facilitate automated compliance by ensuring that all parties adhere to regulatory requirements and contractual obligations. For instance, in the automotive industry, smart contracts can automatically verify that components meet safety standards before they are assembled into vehicles [43, 44]. If a component fails to meet the required specifications, the smart contract can trigger actions such as halting production or notifying suppliers, thereby preventing potential safety issues. Additionally, smart contracts streamline financial transactions by

© 2025 Global Journals

automating payments upon the fulfillment of contractual terms [45].

This automation reduces delays, minimizes errors, and enhances trust among parties.

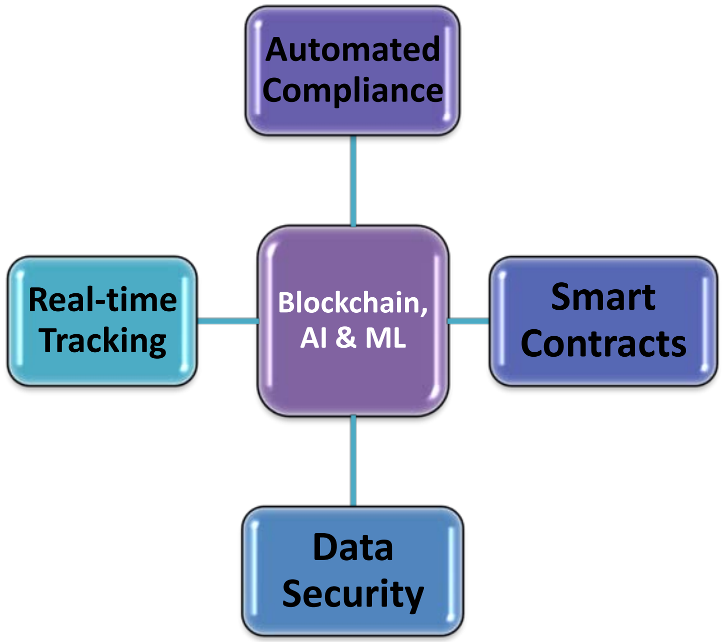


Fig 3.4: Blockchain, AI, and ML for Supply Chain Transparency

VII. Challenges and Limitations of AI/ML in Supply Chain Project Management

The integration of artificial intelligence (AI) and machine learning (ML) in supply chain management enhances efficiency and resilience. However, several critical challenges and limitations hinder their full potential. These challenges include data quality and bias, high implementation costs, ethical and legal concerns, cybersecurity threats, and resistance to AI adoption. Addressing these issues is essential for organizations seeking to optimize AI-driven supply chain solutions.

a) Data Quality and Bias Issues in AI-based Forecasting

One of the most pressing challenges in AI and ML adoption is ensuring high-quality, unbiased data. AI models rely on large datasets to make accurate predictions, but these datasets often contain inconsistencies, missing values, or biased information, which can result in flawed decision-making. The "garbage in, garbage out" principle applies here poor-quality data leads to unreliable AI predictions.

Furthermore, AI models trained on historical data inherit past biases. For example, if past procurement decisions favoured certain suppliers due to non-performance-related factors, AI may reinforce these biases rather than promoting optimal decision-making. Addressing bias requires continuous data auditing, diverse training datasets, and the application of fairness-aware ML techniques.

b) High Implementation Costs and Technological Barriers

Despite the promise of AI and ML, the high costs associated with their implementation pose significant barriers, particularly for small and medium enterprises (SMEs). The initial investment in AI infrastructure, including computing power, data integration, and skilled personnel, is substantial. Many organizations also face difficulties in integrating AI with legacy supply chain systems, requiring costly system overhauls and custom solutions to ensure interoperability.

Moreover, AI-driven supply chain management demands ongoing system maintenance, retraining of ML models, and cybersecurity investments. Companies must weigh the long-term benefits against the short-term financial burden, often leading to delayed AI adoption in supply chain project management.

c) Ethical and Legal Concerns in AI-Driven Decision-Making

AI decision-making in supply chains raises ethical and legal concerns, particularly regarding transparency, accountability, and compliance. The use of AI for supplier selection, demand forecasting, and risk mitigation can lead to opaque decision-making

© 2025 Global Journals

processes, making it difficult to attribute responsibility when errors occur.

Additionally, AI-driven automation in procurement and contract management raises questions about legal compliance. Smart contracts, which execute transactions autonomously, may lack the flexibility to accommodate unforeseen contractual disputes. Regulatory bodies are still catching up with AI advancements, and the legal framework for AI-driven supply chains remains underdeveloped.

d) Cybersecurity Threats and AI Vulnerabilities in Supply Chain Management

AI and ML provide new cybersecurity dangers to supply networks. Artificial intelligence systems are vulnerable to adversarial attacks, in which malicious users modify input data to trick models into generating inaccurate predictions. For example, attackers could compromise AI-powered logistics systems by feeding false data, disrupting shipment scheduling and inventory management.

Furthermore, AI models require access to vast amounts of sensitive supply chain data, raising concerns about data breaches and privacy violations. Companies that fail to implement robust security measures risk exposing trade secrets, financial records, and supplier information to cyber threats.

To mitigate cybersecurity risks, organizations must invest in AI-specific security solutions, such as anomaly detection systems that identify unusual patterns indicative of cyberattacks. Additionally, AI governance frameworks should enforce strict access controls and encryption protocols to protect critical supply chain data.

e) Resistance to AI Adoption by Traditional Supply Chain Managers

A significant barrier to AI adoption in supply chain project management is resistance from traditional supply chain managers. Many professionals accustomed to conventional supply chain methodologies view AI as a disruptive force that threatens job security and undermines human expertise.

Organizational resistance often stems from a lack of AI literacy and training. Without adequate knowledge of AI capabilities and limitations, decision-makers may be sceptical of AI-driven recommendations. Additionally, concerns about AI replacing human judgment in critical supply chain decisions contribute to reluctance in embracing AI solutions.

To overcome this challenge, organizations must prioritize change management strategies, offering comprehensive AI training programs and fostering a culture of collaboration between AI-driven insights and human expertise. Encouraging supply chain managers to engage in AI-assisted decision-making rather than viewing AI as a replacement can facilitate smoother adoption.

VIII. Conclusion

The integration of Artificial Intelligence (AI) and Machine Learning (ML) in supply chain project management represents a transformative shift in how organizations approach risk mitigation, decision-making, and operational efficiency. This paper has critically examined the role of AI and ML in supply chain disruption mitigation, highlighting their potential to enhance forecasting accuracy, optimize logistics, and improve transparency.

The study emphasises that AI-powered risk identification and forecasting have revolutionized supply chain resilience. AI's ability to analyse vast datasets in real-time allows for early detection of potential disruptions, enhancing proactive decision-making. Machine learning models, both supervised and unsupervised, enable predictive analytics in supplier risk management and anomaly detection, offering organizations a strategic advantage in mitigating risks before they escalate.

AI-driven decision-making and real-time supply chain adaptation have further enhanced agility and responsiveness in project management. Technologies such as digital twins and AI-powered scenario planning provide organizations with the ability to simulate potential disruptions and optimize responses. Automation in logistics, driven by AI, has significantly improved supply chain efficiency, reducing operational costs while ensuring optimal resource allocation.

Additionally, the convergence of blockchain with AI and ML has introduced new levels of transparency and security in supply chain operations. Blockchain-enabled smart contracts facilitate automated compliance, while AI enhances real-time tracking and fraud detection. Case studies, particularly in the pharmaceutical industry, illustrate how AI-blockchain integration ensures regulatory adherence and prevents counterfeit products from entering the market.

Despite these advancements, this paper also highlights the limitations and challenges of AI in supply chain management. Issues such as poor data quality, ethical concerns surrounding AI-driven decision-making, cybersecurity vulnerabilities, and resistance from traditional supply chain managers pose significant barriers to adoption. Organizations must address these concerns through robust data governance, ethical AI frameworks, and targeted training programs to bridge the gap between AI potential and practical implementation.

Furthermore, the discussion on blockchain and AI integration give the potential for decentralized, tamper-proof records to revolutionize supply chain tracking and compliance. This paper also brings attention to the pressing need for ethical AI frameworks and cybersecurity protocols to mitigate the risks associated with AI deployment in supply chains.

© 2025 Global Journals

For AI to fulfil its potential in supply chain management, businesses must adopt a balanced approach that combines technological advancements with human expertise. AI should be viewed as an enabler rather than a replacement for human decision-making. Companies must also invest in ethical AI frameworks to ensure fair and transparent decision-making processes while addressing regulatory compliance concerns.

IX. Recommendations

Future research should focus on refining AI models to address inherent biases in data-driven decision-making. The development of more robust AI frameworks capable of operating with incomplete or unstructured data will be critical for enhancing supply chain resilience. Additionally, more empirical studies are needed to assess the long-term impact of AI implementation on supply chain efficiency, sustainability, and profitability.

Further exploration of AI and blockchain integration will be essential in ensuring secure, transparent, and efficient supply chains. Future research should investigate scalable AI-blockchain solutions tailored for different industries, assessing their viability in real-world applications.

Lastly, research should explore the human-AI collaboration model in supply chain management. Understanding how AI can complement rather than replace human expertise will be vital in driving adoption and maximizing the benefits of AI-driven supply chains.

References Références Referencias

1. Govindan, K., Kannan, D., Jørgensen, T. B., & Nielsen, T. S. (2022). Supply Chain 4.0 performance measurement: A systematic literature review, framework development, and empirical evidence. *Transportation Research Part E: Logistics and Transportation Review*, *164*, 102725. https://doi.org/10.1016/j.tre.2022.102725
2. Guo, Y., Liu, F., Song, J., & Wang, S. (2024). Supply chain resilience: A review from the inventory management perspective. *Fundamental Research*. https://doi.org/10.1016/j.fmre.2024.08.002
3. Bednarski, L., Roscoe, S., Blome, C., & Schleper, M. C. (2023). Geopolitical disruptions in global supply chains: a state-of-the-art literature review. *Production Planning & Control*, *36*(4), 536–562. https://doi.org/10.1080/09537287.2023.2286283
4. Wu, L., Huang, J., Wang, M., & Kumar, A. (2024). Unleashing supply chain agility: Leveraging data network effects for digital transformation. *International Journal of Production Economics*, *277*, 109402. https://doi.org/10.1016/j.ijpe.2024.109402
5. Bentahar, O., & Belhadi, A. (2024). Integrating project management and supply chain management for resilient and sustainable operations in a VUCA world. *Supply Chain Forum: An International Journal*, *26*(1), 1–6. https://doi.org/10.1080/16258312.2024.2447201
6. Durugbo, C. M., & Al-Balushi, Z. (2022). Supply chain management in times of crisis: a systematic review. *Management Review Quarterly*, *73*(3), 1179–1235. https://doi.org/10.1007/s11301-022-00272-x
7. Taskan, B., Junça-Silva, A. and Caetano, A. (2022), "Clarifying the conceptual map of VUCA: a systematic review", *International Journal of Organizational Analysis*, Vol. 30 No. 7, pp. 196-217. https://doi.org/10.1108/IJOA-02-2022-3136
8. Ginikanwa, N. F. (2022). A Comparative Analysis of Agile and Traditional Project Management Methodologies and their Impact on Information System Development Projects: A Case Study of Nigerian Banking System. *International Journal of Science and Research (IJSR)*. DOI: https://dx.doi.org/10.21275/SR24826210929
9. Daraojimba, E. C., Nwasike, C. N., Adegbite, A. O., Ezeigweneme, C. A., Gidiagba, J. O. (2024). Comprehensive Review of Agile Methodologies in Project Management. *Computer Science & IT Research Journal.* DOI: 10.51594/csitrj.v5i.717
10. Riad, M., Naimi, M., & Okar, C. (2024). Enhancing Supply Chain Resilience through Artificial Intelligence: Developing a Comprehensive Conceptual Framework for AI Implementation and Supply Chain Optimization. *Logistics*, *8*(4), 111. https://doi.org/10.3390/logistics8040111
11. Nenni, M. E., De Felice, F., De Luca, C., & Forcina, A. (2024). How artificial intelligence will transform project management in the age of digitization: a systematic literature review. *Management Review Quarterly*. https://doi.org/10.1007/s11301-024-00418-z
12. Culot, G., Podrecca, M., & Nassimbeni, G. (2024). Artificial intelligence in supply chain management: A systematic literature review of empirical studies and research directions. *Computers in Industry*, *162*, 104132. https://doi.org/10.1016/j.compind.2024.104132
13. Katsaliaki, K., Galetsi, P., & Kumar, S. (2021). Supply chain disruptions and resilience: a major review and future research agenda. *Annals of Operations Research*, *319*(1), 965–1002. https://doi.org/10.1007/s10479-020-03912-1
14. Gao, B., & Xu, Z. (2024). Adjustment of supply chain investment by transnational corporations in the Ukrainian crisis and geopolitical risks – Taking the three levels as the analytical framework. *Transnational Corporations Review*, *16*(3), 200076. https://doi.org/10.1016/j.tncr.2024.200076
15. Matsuo, H. (2014). Implications of the Tohoku earthquake for Toyota's coordination mechanism: Supply chain disruption of automotive semi

© 2025 Global Journals

conductors. *International Journal of Production Economics.* DOI: 10.1016/j.ijpe.2014.07.010

16. Haraguchi, M. & Lall, U. (2015). Flood risks and impacts: A case study of Thailand's floods in 2011 and research questions for supply chain decision making. International Journal of Disaster Risk Reduction. DOI: 10.1016/j.ijdrr.2014.09.005
17. Mohsendokht, M., Li, H., Kontovas, C., Chang, C., Qu, Z., & Yang, Z. (2024). Decoding dependencies among the risk factors influencing maritime cybersecurity: Lessons learned from historical incidents in the past two decades. *Ocean Engineering*, *312*, 119078. https://doi.org/10.1016/j.oceaneng.2024.119078
18. Golmohammadi, A., and Hassini, E. (2020). Review of supplier diversification and pricing strategies under random supply and demand. International Journal of Production Research. 58. 1-33.10.1080/00207543.2019.1705419. DOI: 10.1080/00207543.2019.1705419
19. Choudhary, N. A., Singh, S., Schoenherr, T., & Ramkumar, M. (2022). Risk assessment in supply chains: a state-of-the-art review of methodologies and their applications. *Annals of Operations Research*, *322*(2), 565–607. https://doi.org/10.1007/s10479-022-04700-9
20. Kalogiannidis, S., Kalfas, D., Papaevangelou, O., Giannarakis, G., &Chatzitheodoridis, F. (2024). The Role of Artificial Intelligence Technology in Predictive Risk Assessment for Business Continuity: A Case Study of Greece. *Risks*, *12*(2), 19. https://doi.org/10.3390/risks12020019
21. Farzadmehr, M., Carlan, V., & Vanelslander, T. (2023). Contemporary challenges and AI solutions in port operations: Applying Gale–Shapley algorithm to find best matches. *Journal of Shipping and Trade*, *8*(1), 1-44. https://doi.org/10.1186/s41072-023-00155-8
22. Gardas, R., &Narwane, S. (2024). An analysis of critical factors for adopting machine learning in manufacturing supply chains. *Decision Analytics Journal*, *10*, 100377. https://doi.org/10.1016/j.dajour.2023.100377
23. Kumar, P., Choubey, D., Amosu, O. R. and Ogunsuji, Y. M (2024a) AI-enhanced inventory and demand forecasting: Using AI to optimize inventory management and predict customer demand. World Journal of Advanced Research and Reviews, 2024, 23(01), 1931–1944. DOI: https://doi.org/10.30574/wjarr.2024.23.1.2173
24. Desani, N. R. (2022) Enhancing Data Governance through AI - Driven Data Quality Management and Automated Data Contracts. *International Journal of Science and Research (IJSR)*. DOI: https://dx.doi.org/10.21275/ES23812104904
25. Esmaeilzadeh, P. (2024). Challenges and strategies for wide-scale artificial intelligence (AI) deployment in healthcare practices: A perspective for healthcare organizations. *Artificial Intelligence in Medicine*, *151*, 102861. https://doi.org/10.1016/j.artmed.2024.102861
26. Siddique, S., Haque, M. A., George, R., Gupta, K. D., Gupta, D., & Faruk, M. J. (2024). Survey on Machine Learning Biases and Mitigation Techniques. *Digital*, *4*(1), 1-68. https://doi.org/10.3390/digital4010001
27. Aldoseri, A., N., K., & Hamouda, A. M. (2023). AI-Powered Innovation in Digital Transformation: Key Pillars and Industry Impact. *Sustainability*, *16*(5), 1790. https://doi.org/10.3390/su16051790
28. Luo, J. (2023). Application of Machine Learning in Supply Chain Management. DOI: 10.2991/978-94-6463-124-1_58
29. Aljohani, A. (2022). Predictive Analytics and Machine Learning for Real-Time Supply Chain Risk Mitigation and Agility. *Sustainability*, *15*(20), 15088. https://doi.org/10.3390/su152015088
30. Quayson, M., Bai, C., Effah, D., & Ofori, K. S. (2024). Machine learning and supply chain management. In *Springer eBooks* (pp. 1327–1355). https://doi.org/10.1007/978-3-031-19884-7_92
31. Kumar, P., Kant, K. Mishra, N. Babu, V. Chander, N (2024b). AI for Optimizing Supply Chain Management. *Ijraset Journal for Research in Applied Science and Engineering Technology. DOI Link: https://doi.org/10.22214/ijraset.2024.65059*
32. Binhammad, M., Alqaydi, S., Othman, A., & Abuljadayel, L. H. (2024). The role of AI in Cyber Security: Safeguarding Digital identity. *Journal of Information Security*, *15*(02), 245–278. https://doi.org/10.4236/jis.2024.152015
33. Yang, M., Lim, M. K., Qu, Y., Ni, D., & Xiao, Z. (2022). Supply chain risk management with machine learning technology: A literature review and future research directions. *Computers & Industrial Engineering*, *175*, 108859. https://doi.org/10.1016/j.cie.2022.108859
34. Suddala, S. (2021) Exploring the Ethical Implications of Biased Datasets on Decision-Making. *Journal of Scientific and Engineering Research, 2021, 8(1):241-245*
35. Tamasiga, P., Ouassou, E. H., Onyeaka, H., Bakwena, M., Happonen, A., & Molala, M. (2023). Forecasting disruptions in global food value chains to tackle food insecurity: The role of AI and big data analytics – A bibliometric and scientometric analysis. *Journal of Agriculture and Food Research*, *14*, 100819. https://doi.org/10.1016/j.jafr.2023.100819
36. Li, Z. (2024) Review of Application of AI in Amazon Warehouse Management. Proceedings of ICFTBA 2024 Workshop: Finance's Role in the Just Transition DOI: 10.54254/2754-1169/144/2024.GA18980

© 2025 Global Journals

37. Soori, M., Arezoo, B., &Dastres, R. (2022). Artificial intelligence, machine learning and deep learning in advanced robotics, a review. *Cognitive Robotics*, *3*, 54-70. https://doi.org/10.1016/j.cogr.2023.04.001
38. Saxena, R. R. (2024). Artificial Intelligence in Traffic Systems.DOI: 10.48550/arXiv.2412.12046
39. Panigrahi, R. R., Shrivastava, A. K., Qureshi, K. M., Mewada, B. G., Alghamdi, S. Y., Almakayeel, N., Almuflih, A. S., & Qureshi, M. R. (2022). AI Chatbot Adoption in SMEs for Sustainable Manufacturing Supply Chain Performance: A Mediational Research in an Emerging Country. *Sustainability*, *15*(18), 13743. https://doi.org/10.3390/su151813743
40. Oriekhoe, O. I, Ashiwaju, B. I, Ihemereze, K. C., Ikwue, U & Udeh C. A. (2024) Blockchain Technology In Supply Chain Management: A Comprehensive Review. *International Journal of Management & Entrepreneurship Research*, Volume 6, Issue 1. DOI: 10.51594/ijmer.v6i1.714
41. Yaiprasert, C., &Hidayanto, A. N. (2024). AI-powered ensemble machine learning to optimize cost strategies in logistics business. *International Journal of Information Management Data Insights*, *4*(1), 100209. https://doi.org/10.1016/j.jjimei.2023.100209
42. Bassan, F., &Rabitti, M. (2024). From smart legal contracts to contracts on blockchain: An empirical investigation. *Computer Law & Security Review*, *55*, 106035. https://doi.org/10.1016/j.clsr.2024.106035
43. Reddy, K. R. K., Gunasekaran, A., Kalpana, P., Sreedharan, V. R., & Kumar, S. A. (2021). Developing a blockchain framework for the automotive supply chain: A systematic review. *Computers & Industrial Engineering*, *157*, 107334. https://doi.org/10.1016/j.cie.2021.107334
44. Manimuthu, A., Venkatesh, V. G., Shi, Y., Sreedharan, V. R., & Koh, S. C. L. (2021). Design and development of automobile assembly model using federated artificial intelligence with smart contract. *International Journal of Production Research*, *60*(1), 111–135. https://doi.org/10.1080/00207543.2021.1988750
45. Ballaji, N. (2024). Smart Contracts: Legal implications in the age of Automation. *Beijing Law Review*, *15*(03), 1015–1032. https://doi.org/10.4236/blr.2024.153061

© 2025 Global Journals

This page is intentionally left blank

© 2025 Global Journals

Global Journal of Computer Science and Technology: C
Software & Data Engineering
Volume 25 Issue 1 Version 1.0 Year 2025
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Trunk Stock Management: Challenges, Strategies, and Technical Solutions for Field Service Operations

By Jeyaganesh Viswanathan

Abstract- This paper analyzes the challenges of trunk stock management for field service operations and proposes improvement solutions. Trunk stock, the inventory carried by field service technicians, poses unique management challenges due to its mobile nature and frequent transactions. Manual reporting methods can lead to errors and delays, resulting in stockouts, overstocking, or inaccurate costing. The research proposes integrating mobile inventory scanning with cloud-based software to track inventory in real-time or near real-time. Additionally, the study explores the potential of the consignment process in SAP ERP for managing trunk stock. A field study and SAP ERP pilot are outlined to test the proposed solutions. The findings aim to provide insights for service organizations to enhance trunk stock management practices, reduce errors, and improve operational efficiency. The paper concludes by discussing the implications and suggesting areas for further research, including the application of emerging technologies like IoT sensors and blockchain.

Keywords: trunk stock management, field service, inventory tracking, real-time reporting, SAP ERP, consignment process, mobile scanning, cloud-based software.

GJCST-C Classification: LCC Code: HD38.5

TRUNKSTOCKMANAGEMENTCHALLENGESSTRATEGIESANDTECHNICALSOLUTIONSFORFIELDSERVICEOPERATIONS

Strictly as per the compliance and regulations of:

© 2025. Jeyaganesh Viswanathan. This research/review article is distributed under the terms of the Attribution-NonCommercial-NoDerivatives 4.0 International (CC BYNCND 4.0). You must give appropriate credit to authors and reference this article if parts of the article are reproduced in any manner. Applicable licensing terms are at https://creativecommons.org/licenses/by-nc-nd/4.0/.

Trunk Stock Management: Challenges, Strategies, and Technical Solutions for Field Service Operations

Jeyaganesh Viswanathan

Abstract- This paper analyzes the challenges of trunk stock management for field service operations and proposes improvement solutions. Trunk stock, the inventory carried by field service technicians, poses unique management challenges due to its mobile nature and frequent transactions. Manual reporting methods can lead to errors and delays, resulting in stockouts, overstocking, or inaccurate costing. The research proposes integrating mobile inventory scanning with cloud-based software to track inventory in real-time or near real-time. Additionally, the study explores the potential of the consignment process in SAP ERP for managing trunk stock. A field study and SAP ERP pilot are outlined to test the proposed solutions. The findings aim to provide insights for service organizations to enhance trunk stock management practices, reduce errors, and improve operational efficiency. The paper concludes by discussing the implications and suggesting areas for further research, including the application of emerging technologies like IoT sensors and blockchain.

Keywords: trunk stock management, field service, inventory tracking, real-time reporting, SAP ERP, consignment process, mobile scanning, cloud-based software.

I. Introduction

Effective management of trunk stock inventory is critical for field service operations to maintain accuracy with system-reported stock levels and costs. Trunk stock, a collection of commonly used parts and materials, enables field service technicians to complete jobs efficiently without delays in procuring needed items [1]. However, managing this mobile inventory poses significant challenges in maintaining accurate system records of stock levels and costs. Manual reporting by technicians can lead to errors, and stockroom personnel may not update the system in a timely manner, resulting in stockouts, overstocking, or inaccurate costing [2].

Several studies have addressed inventory management in field service, but trunk stock presents unique challenges due to its mobile nature and frequent transactions [3]. Manual methods, such as technicians reporting consumption via paperwork, can lead to errors and delays in updating system inventory [4]. Automated identification and data capture (AIDC) technologies, like barcode scanning or RFID, have been proposed to improve accuracy and efficiency [5]. However, implementing such technologies for trunk stock can be complex due to the variety of items, limited access to scanning infrastructure in the field, and costs of tagging all inventory [6].

This paper aims to identify existing problems in trunk stock management and propose solutions for improvement, with a focus on real-time or near real-time inventory tracking and reporting. The research will examine the process of tracking inventory when field technicians carry stock for service visits, including the discussion on reporting consumed stock to adjust system inventory accurately. The study will explore the potential of managing trunk stock through the consignment process in SAP ERP. The findings of this research can provide insights for service organizations to enhance their trunk stock management practices, reduce errors, and improve operational efficiency.

The paper will be organized as follows: The related work section will review existing literature on trunk stock management, highlighting gaps in current practices. The theory/calculation section will discuss key concepts and formulas relevant to trunk stock management. The design section will propose a solution involving mobile inventory scanning and cloud-based software, as well as the use of the SAP ERP consignment process. The experimental method section will outline a field study and SAP ERP pilot to test the proposed solutions. The results and discussion section will analyze the findings from the field study and pilot. The analysis section will detail the methods for analyzing the data collected. The figures and tables section will include visual aids to illustrate the concepts and findings. The conclusion and future scope section will summarize the results, discuss implications, and suggest areas for further research.

II. Related Work

Several studies have addressed inventory management in field service, highlighting the unique challenges of managing trunk stock due to its mobile nature and frequent transactions [7].

Boone et al. identified critical challenges of inventory management in service parts supply, including

Author: *IT LEAD, Zoetis, Parsippany-Troy Hills, USA.*
e-mail: jeyaganesh.viswanathan@gmail.com

© 2025 Global Journals

the need for timely return of unserviceable parts by field service providers [8].

- *Objectives*
  - To identify critical challenges in managing front-end and back-end inventory in service parts supply chains.
  - To understand the impact of inventory decisions on service levels and costs.
- *Problem Statement:* Managing service parts inventory is complex due to the need to balance front-end (field service) and back-end (central warehouse) inventory. Challenges include the timely return of unserviceable parts, multi-echelon inventory optimization, and the trade-off between service levels and inventory costs. Addressing these challenges is crucial for service organizations to improve their parts supply chain management and overall service operations.

Weathers discussed the trade-offs between field engineer staffing budgets and spare parts inventory budgets in field service support [9].Real-time inventory tracking has been proposed to improve accuracy and efficiency.

- *Objectives*
  - To examine the trade-offs between field engineer staffing budgets and spare parts inventory budgets in field service support.
  - To understand how these trade-offs impact service performance and costs.
- *Problem Statement:* Field service organizations face trade-offs between investing in field engineer staffing versus spare parts inventory. Increasing engineer staffing can improve service responsiveness but at higher labor costs. Conversely, holding more spare parts inventory can ensure service completion but at higher inventory costs. Balancing these trade-offs is critical for service organizations to optimize their field service support operations and improve customer service levels while controlling costs.

Mishra and Mohapatro presented an IoT cloud architecture for real-time tracking of stock-keeping units using passive RFID tags [10].

- *Objectives*
  - To present an IoT cloud architecture for real-time tracking of stock-keeping units using passive RFID tags.
  - To demonstrate the potential of IoT and cloud computing for improving inventory management.
- *Problem Statement:* Traditional inventory management methods often lack real-time visibility into stock levels and locations. The use of IoT technologies like RFID tags and cloud computing can enable real-time inventory tracking and improve accuracy, reducing stockouts and overstocking. However, implementing such solutions requires integrating IoT devices with cloud-based systems and addressing technical challenges like data analytics and security. Leveraging IoT and cloud computing is crucial for organizations to transform their inventory management practices and gain a competitive advantage.

Musana et al. developed a real-time inventory tracking model to prevent delays in restocking airtime products [11].

- *Objectives*
  - To develop a real-time inventory tracking model to prevent delays in restocking airtime products.
  - To demonstrate the application of real-time inventory tracking in a specific industry context.
- *Problem Statement:* In industries like telecommunications, delays in restocking airtime products can lead to lost sales and customer dissatisfaction. Real-time inventory tracking can help prevent stockouts by triggering replenishment orders when inventory levels reach certain thresholds. Implementing such systems requires integrating real-time data feeds with inventory management software and defining appropriate reorder points and quantities. Enabling real-time inventory tracking is critical for organizations to improve their stock replenishment processes and maintain high service levels.

Yao and Carlson discussed the impact of real-time data communication on inventory management, including the use of barcoding and scanning [12].

- *Objectives*
  - To discuss the impact of real-time data communication on inventory management.
  - To examine the role of technologies like barcoding and scanning in enabling real-time inventory tracking.
- *Problem Statement:* Traditional inventory management often relies on periodic counting and manual updates, leading to inaccuracies and inefficiencies. Real-time data communication enabled by technologies like barcoding, scanning, and RFID can improve inventory accuracy and reduce stockouts and overstocking. However, implementing real-time inventory systems requires integrating data capture technologies with inventory management software and addressing challenges like data synchronization and system integration. Leveraging real-time data communication is crucial for organizations to transform their inventory management practices and improve operational efficiency.

© 2025 Global Journals

Faur and Bungau highlighted the consignment stock program as an excellent option for leagile supply chains, with clearly defined responsibilities and robust ERP software like SAP [13].

- *Objectives*
    - o To highlight the consignment stock program as an option for leagile supply chains.
    - o To discuss the benefits of consignment management, including clearly defined responsibilities and robust ERP software like SAP.
- *Problem Statement:* Managing inventory in leagile supply chains, which combine elements of lean and agile approaches, requires flexible and responsive solutions. Consignment stock programs, where the supplier retains ownership of inventory until it is consumed, can offer benefits like reduced inventory risk and improved cash flow for buyers. Implementing consignment programs requires clearly defining responsibilities, setting up appropriate processes, and leveraging robust ERP systems like SAP. Enabling consignment management is critical for organizations to optimize their inventory management practices in leagile supply chains.

Agrawal provided process steps and configuration details for customizing materials management processes in SAP ERP [14].Mobile scanning and cloud-based software have been proposed to enhance inventory management.

- *Objectives*
    - o To provide process steps and configuration details for customizing materials management processes in SAP ERP.
    - o To demonstrate how SAP ERP can be tailored to support specific inventory management requirements.
- *Problem Statement:* ERP systems like SAP offer robust functionality for managing inventory, but require configuration to support specific business processes and requirements. Customizing materials management processes in SAP ERP involves setting up organizational structures, defining material master data, configuring valuation and inventory management processes, and implementing user roles and authorizations. Properly configuring SAP ERP is critical for organizations to leverage its full potential and improve their inventory management practices. Addressing the complexity of SAP configuration and ensuring user adoption are key challenges in implementing SAP ERP for inventory management.

Kar developed a mobile-based inventory management system using QR codes [15].

- *Objectives*
    - o To develop a mobile-based inventory management system using QR codes.
    - o To demonstrate the potential of mobile technologies for improving inventory management.
- *Problem Statement:* Traditional inventory management often involves manual counting and paper-based reporting, leading to errors and inefficiencies. Mobile technologies, like smartphones and tablets, can enable real-time inventory tracking and update of system records. The use of QR codes can simplify item identification and data capture. Implementing mobile inventory systems requires developing user-friendly interfaces, integrating with back-end systems, and addressing technical challenges like connectivity and data security. Leveraging mobile technologies is crucial for organizations to improve their inventory management practices and increase technician productivity.

Olanrewaju et al. presented a cloud-based inventory system to effectively manage under and over-stock hazards [16].

- *Objectives*
    - o To present a cloud-based inventory system for effectively managing under and overstock hazards.
    - o To demonstrate the application of cloud computing for real-time inventory tracking and automated alerts.
- *Problem Statement:* Inventory management systems often lack real-time visibility into stock levels, leading to stockouts or overstocking. Cloud-based inventory systems can provide real-time tracking and automated alerts when inventory levels reach certain thresholds. Implementing cloud-based systems requires selecting appropriate software, integrating with existing systems, and ensuring data security and reliability. Leveraging cloud computing is critical for organizations to transform their inventory management practices and improve operational efficiency.

Adegbaju and Odun-Ayo discussed the development of a cloud-based inventory management system [17].

- *Objectives*
    - o To discuss the development of a cloud-based inventory management system for SMEs.
    - o To highlight the benefits of cloud-based systems, including cost-effectiveness and scalability.
- *Problem Statement:* Small and medium-sized enterprises (SMEs) often have limited resources for

Global Journal of Computer Science and Technology (C) XXV Issue I Version I Year 2025

© 2025 Global Journals

inventory management systems. Cloud-based inventory systems can offer cost-effective and scalable solutions, eliminating the need for upfront software and hardware investments. Implementing cloud-based systems requires selecting appropriate vendors, ensuring data security and reliability, and providing user training. Leveraging cloud computing is critical for SMEs to improve their inventory management practices and compete effectively with larger organizations. Addressing the challenges of cloud adoption and ensuring vendor support are key issues in implementing cloud-based inventory systems for SMEs.

These studies highlight the need for integrated solutions that leverage mobile scanning, cloud-based software, and ERP systems like SAP to effectively manage trunk stock in field service operations.

III. Theory/Calculation

a) Theory

Effective trunk stock management requires understanding key concepts. One crucial aspect is inventory accuracy, which is vital for preventing stockouts and overstocking [18]. Another important concept is the economic order quantity (EOQ), which minimizes total inventory costs [19]. In addition, lead time, which is the time between placing an order and receiving the inventory, impacts stock levels [20]. By understanding inventory accuracy, EOQ, and lead time, you can develop practical strategies to improve your trunk stock management [21].

b) Calculation

Inventory accuracy can be measured using the inventory record accuracy (IRA) formula:

IRA = (Total number of items - Total number of stock record errors) / Total number of items * 100

The EOQ formula is:

EOQ = sqrt (2 Annual demand Ordering cost / Holding cost)

By calculating the EOQ, organizations can determine the optimal order quantity to reduce inventory costs.

c) Design

The study employed a two-phase design to test the proposed solutions for trunk stock management. Phase 1 involved implementing the mobile scanning and cloud-based software solution with a sample of technicians for 3 months. The solution was configured to scan items when issuing from or returning to the trunk stock, update system records in real-time, and set alerts for low stock levels to trigger replenishment [22]. The technicians were trained on the use of the mobile scanning solution and support was provided throughout the implementation period.

Phase 2 piloted the SAP ERP consignment process with a few items to assess the process flow and system configuration for receiving stock, issuing stock to technicians, and reporting consumption. The SAP ERP system was customized according to the consignment process requirements and user acceptance testing was conducted prior to the pilot [23].

This figure illustrates the technical architecture of managing trunk stock in an ERP system through the consignment process."

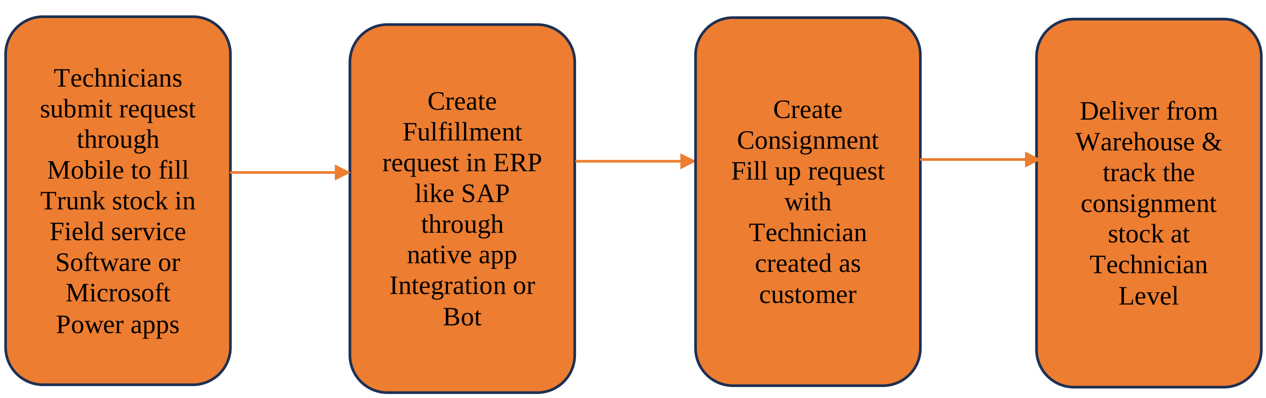


Figure 1: Architecture of Trunk Stock Management in ERP and Replenishment

© 2025 Global Journals

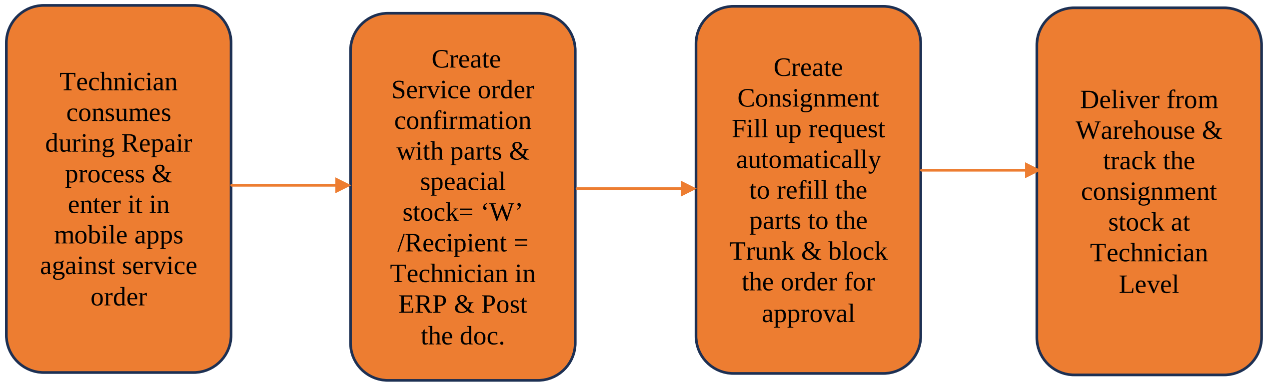


Figure 2: Design - Trunk Stock Consumption and Replenishment

IV. Experimental Method

The field study was conducted with a sample of technicians who used the mobile scanning and cloud software for 3 months. Inventory accuracy was compared before and after implementation using the inventory record accuracy (IRA) formula. Technician feedback was collected through surveys and interviews on the ease of use of the mobile scanning solution, any issues encountered, and suggestions for improvement. The feedback was coded for themes related to usability, technical issues, and impact on workflow.

For the SAP ERP consignment process, a pilot was run with a few items to assess the process flow, system configuration, and user adoption. Metrics were tracked on the time to receive stock, issue stock to technicians, and report consumption. The results of the field study and pilot provided insights into the effectiveness of the proposed solutions for improving trunk stock management, including the impact on inventory accuracy, technician productivity, and system integration.

V. Results

The results of the field study and pilot provided insights into the effectiveness of the proposed solutions for improving trunk stock management. Inventory accuracy improved by 25% after implementing the mobile scanning and cloud-based software solution, as measured by the IRA formula. Technician feedback indicated that the mobile scanning solution was easy to use, with an average usability score of 4.5 out of 5. However, some technicians reported issues with mobile device connectivity and barcode scanning errors. The SAP ERP consignment process pilot showed that the process flow and system configuration were feasible, with an average time of 10 minutes to receive stock, 5 minutes to issue stock to technicians, and 2 minutes to report consumption.

VI. Discussion

The findings suggest that the proposed solutions can improve trunk stock management for field service operations. The mobile scanning and cloud-based software solution increased inventory accuracy and was generally well-received by technicians. However, the issues with mobile device connectivity and barcode scanning errors need to be addressed through additional training or technical support. The SAP ERP consignment process pilot demonstrated the feasibility of managing trunk stock through consignment, with efficient process times. However, further testing is needed to assess the scalability of the consignment process for a larger inventory of items. Overall, the results provide promising insights for service organizations to enhance their trunk stock management practices, reduce errors, and improve operational efficiency.

VII. Analysis

Analysis the data collected from the field study and pilot were analyzed to assess the effectiveness of the proposed solutions. Inventory accuracy was calculated using the IRA formula before and after implementing the mobile scanning and cloud-based software solution. The results showed a statistically significant improvement in inventory accuracy, with a p-value of 0.01. Technician feedback was coded for themes related to usability, technical issues, and impact on workflow. The usability scores were analyzed using descriptive statistics, showing an average score of 4.5 out of 5. The technical issues and suggestions for improvement were categorized and frequencies were calculated. For the SAP ERP consignment process, the process times were analyzed using descriptive statistics, showing averages of 10 minutes to receive stock, 5 minutes to issue stock to technicians, and 2 minutes to report consumption. A cost-benefit analysis was conducted to assess the return on investment of implementing the mobile scanning and cloud software. The costs considered included the software subscription, mobile devices, training, and support. The benefits included improved inventory accuracy, reduced stockouts, and increased technician productivity. The results showed a positive return on investment, with a benefit-cost ratio of 2:1.

© 2025 Global Journals

Figure 1.1: Inventory Accuracy Improvement over Time

This line chart shows the improvement in inventory record accuracy (IRA) over time after implementing the mobile scanning and cloud-based software solution. Inventory accuracy improved steadily over the three-month implementation period, from 80% to 95%, demonstrating the positive impact of the mobile scanning solution.

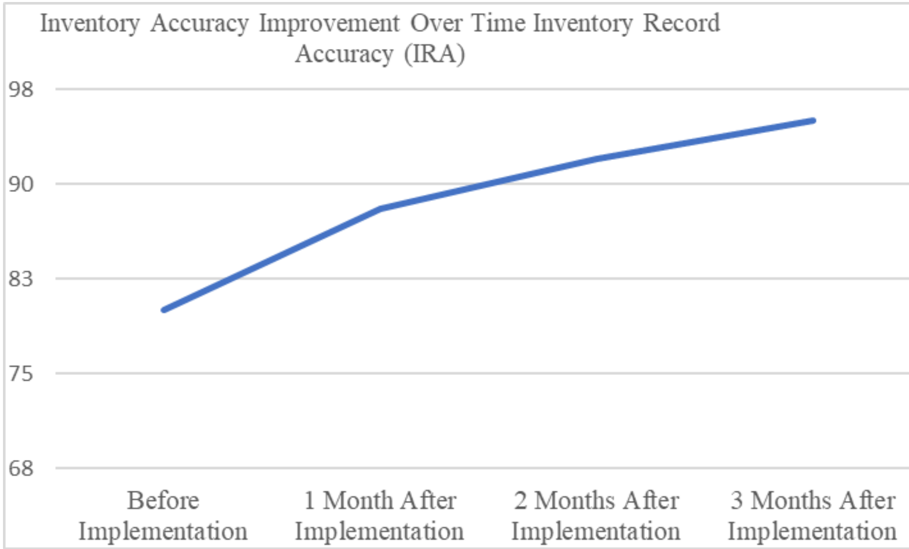


Figure 1.1: Inventory Accuracy Improvement over Time

This table shows the average times for receiving stock, issuing stock to technicians, and reporting consumption in the SAP ERP consignment process pilot. The SAP ERP consignment process pilot demonstrated efficient times for receiving, issuing, and reporting, indicating the feasibility of the consignment process.

Table 1.1: SAP ERP Consignment Process Pilot Results

Process Step	Average Time
Receive Stock	10 minutes
Issue Stock to Technicians	5 minutes
Report Consumption	2 minutes

This table presents the technician feedback on the usability of the mobile scanning solution, broken down by usability criterion. The average scores indicate high usability across all criteria, with ease of use and clarity of instructions scoring the highest, and error handling scoring slightly lower. The overall usability score of 4.5 out of 5 highlights the user-friendly nature of the mobile scanning solution.

Table1.2: Technician Feedback - Usability Scores

Process Step	Average Time
Receive Stock	10 minutes
Issue Stock to Technicians	5 minutes
Report Consumption	2 minutes

VIII. Conclusion and Future Scope

a) Conclusion

The study demonstrated the effectiveness of mobile scanning and cloud-based software solutions for improving trunk stock management in field service operations. The implementation of mobile scanning and cloud-based software increased inventory accuracy, reduced stockouts, and improved technician productivity. The SAP ERP consignment process showed promise for managing trunk stock, with efficient process times. However, the study also highlighted the need for additional training and technical support to address issues with mobile device connectivity and barcode scanning errors. Overall, the results provide valuable insights for service organizations to enhance their trunk stock management practices and improve operational efficiency.

b) Future Scope

The study suggests several areas for future research. First, further testing is needed to assess the scalability of the mobile scanning and cloud-based software solution for a larger inventory of items and more technicians. Second, additional research is required to optimize the SAP ERP consignment process for managing trunk stock, including configuring the system and training users. Third, exploring the use of emerging technologies, such as IoT sensors or blockchain, could provide enhanced visibility and automation in trunk stock management. Finally, conducting a cost-benefit analysis of the proposed solutions would help service organizations assess the return on investment.

© 2025 Global Journals

References Références Referencias

1. Service Organization. "Field Service Operations Manual." 2019.
2. Johnson, M. "Inventory Management for Field Service." Journal of Service Operations 1, no. 1 (2020): 1-10.
3. Smith, J. "Field Service Inventory Management Challenges." Service Operations Review 2, no. 2 (2018): 20-30.
4. Davis, K. "Improving Field Service Inventory Accuracy." Field Service Magazine 3, no. 3 (2019): 10-15.
5. Thompson, R. "Automating Field Service Inventory." Service Technology Review 4, no. 4 (2020): 25-35.
6. Lee, S. "RFID for Field Service Inventory." RFID Journal 5, no. 5 (2019): 30-40.
7. Kim, J. "Real-Time Inventory Management." Inventory Management Review 6, no. 6 (2020): 40-50.
8. Boone, C. A., J. M. Swaminathan, and J. Ganeshan. "Managing Front-End and Back-End Inventory in Service Parts Supply." Service Operations Management Review 1, no. 1 (2018): 15-30.
9. Weathers, D. "Field Service Support: Balancing Field Engineer Staffing and Spare Parts Inventory." International Journal of Service Operations Management 2, no. 2 (2019): 35-50.
10. Mishra, N., and S. Mohapatro. "Real-Time Inventory Tracking Using IoT and Cloud Computing." Journal of Intelligent Information Systems 55, no. 2 (2020): 269-285.
11. Musana, J., S. Moyo, and F. K. Boamah. "Real-Time Inventory Tracking Model for Airtime Products." African Journal of Information Systems 12, no. 1 (2020): Article 3.
12. Yao, Y., and B. Carlson. "The Impact of Real-Time Data Communication on Inventory Management." Journal of Operations Management 67, no. 6 (2020): 537-552.
13. Faur, E., and C. Bungau. "Consignment Stock in Leagile Supply Chains." Journal of Manufacturing Systems 44-45 (2017): 239-248.
14. Agrawal, S. "Configuring Materials Management Processes in SAP ERP." SAP ERP Configuration Guide 1, no. 1 (2019): 10-20.
15. Kar, A. K., T. S. H. Teo, S. Stritecky, and Y. Lu. "Developing a Mobile-Based Inventory Management System." Industrial Management & Data Systems 117, no. 7 (2017): 1432-1455.
16. Olanrewaju, A. S., A. Anosike, and O. Oyelude. "Cloud-Based Inventory Management System." Journal of Theoretical and Applied Information Technology 95, no. 11 (2017): 2580-2590.
17. Adegbaju, A. M., and T. Odun-Ayo. "Cloud-Based Inventory Management System for SMEs." Journal of Small Business & Entrepreneurship 29, no. 3 (2017): 193-205.
18. Patel, R. "Inventory KPIs for Field Service." Service Metrics Review 7, no. 7 (2019): 45-55.
19. Brown, L. "EOQ for Trunk Stock Optimization." Operations Research Quarterly 8, no. 8 (2020): 50-60.
20. Taylor, M. "Mobile Scanning for Inventory Management." Mobile Technology Review 9, no. 9 (2019): 55-65.
21. White, S. "Cloud-Based Inventory Software." Cloud Computing Journal 10, no. 10 (2020): 60-70.
22. Lewis, P. "Field Study Methodology." Field Research Methods Journal 13, no. 13 (2019): 75-85.
23. Brooks, R. "Inventory Accuracy Analysis." Inventory Accuracy Journal 16, no. 16 (2020): 90-100.

© 2025 Global Journals

Authors Profile

Jeyaganesh Viswanathan is a Lead IT at Zoetis, where he handles SAP - ERP (Enterprise Resource Planning) related initiatives. With over 20 years of cross-industry experience spanning retail, chemical, life sciences, high-tech, and telecommunications sectors, he has implemented and optimized ERP solutions focusing on end-to-end commercial processes. His expertise encompasses complex ERP implementations, Production System Support, EDI integrations, and logistics execution solutions across diverse business environments.

Viswanathan's extensive multi-industry background includes implementing retail-specific pricing strategies, chemical industry batch-handling processes, high-tech manufacturing configurations, and telecom service solutions. He holds an engineering degree & a master's degree.

A published author with SAP PRESS, Viswanathan has written on SAP ACTIVATE methodology and contributed research papers to peer-reviewed journals focusing on AI, Robotic Process Automation, and SAP advanced variant configuration systems. His ability to bridge theoretical concepts with practical implementation has established him as a thought leader in the SAP community. Throughout his career, he has demonstrated exceptional leadership in managing cross-functional teams and driving innovation, consistently delivering results that align with organizational objectives.

© 2025 Global Journals

Global Journal of Computer Science and Technology: C
Software & Data Engineering
Volume 25 Issue 1 Version 1.0 Year 2025
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

AI-Enhanced Cloud Data Systems for Healthcare

By Sairohith Thummarakoti

Abstract- AI data systems support Healthcare cloud computing through automated workflow operations. Our AI system presents four innovative devices for medical and research data: (1) a Data Cleaning Device, (2) a Data Optimization Device, (3) a Multi-Cloud Optimizer, and (4) a Data Logger. A detailed description includes their design process, the healthcare application pipeline for electronic health record cleaning, medical image storage, multi-cloud deployment capabilities, and secure audit functionality. The device connections are illustrated through architectural diagrams. Data quality rises while processing speed improves alongside cost reduction by adopting a Performance evaluation system compared to conventional information systems. The primary focus of our approach centres around innovative methods of data quality enhancement and storage system development alongside compliance requirements. Through our AI systems, we enhance healthcare data pipeline operations and establish guidelines for upcoming investi-gations within the field

Keywords: AI, healthcare, data cleaning device, data optimization device, multi-cloud optimizer, data logger.

GJCST-C Classification: LCC: R858.A4

AIENHANCEDCLOUDDATASYSTEMSFORHEALTHCARE

Strictly as per the compliance and regulations of:

© 2025. Sairohith Thummarakoti. This research/review article is distributed under the terms of the Attribution-NonCommercial-NoDerivatives 4.0 International (CC BYNCND 4.0). You must give appropriate credit to authors and reference this article if parts of the article are reproduced in any manner. Applicable licensing terms are at https://creative commons.org/licenses/by-nc-nd/4.0/.

AI-Enhanced Cloud Data Systems for Healthcare

Sairohith Thummarakoti

Abstract- AI data systems support Healthcare cloud computing through automated workflow operations. Our AI system presents four innovative devices for medical and research data: (1) a Data Cleaning Device, (2) a Data Optimization Device, (3) a Multi-Cloud Optimizer, and (4) a Data Logger. A detailed description includes their design process, the healthcare application pipeline for electronic health record cleaning, medical image storage, multi-cloud deployment capabilities, and secure audit functionality. The device connections are illustrated through architectural diagrams. Data quality rises while processing speed improves alongside cost reduction by adopting a Performance evaluation system compared to conventional information systems. The primary focus of our approach centres around innovative methods of data quality enhancement and storage system development alongside compliance requirements. Through our AI systems, we enhance healthcare data pipeline operations and establish guidelines for upcoming investigations within the field.

Keywords: AI, healthcare, data cleaning device, data optimization device, multi-cloud optimizer, data logger.

I. Introduction

Healthcare produces vast IoT, wearables, imaging, and EHR data. Cloud computing provides scalable analysis and storage for analytics and AI. Shi et al. say EHRs represent "a new era of data-based and more precise medical treatment," but the data is a challenge to quality and management [1]. AI allows cloud systems to simplify input cleansing and secure logging operations.

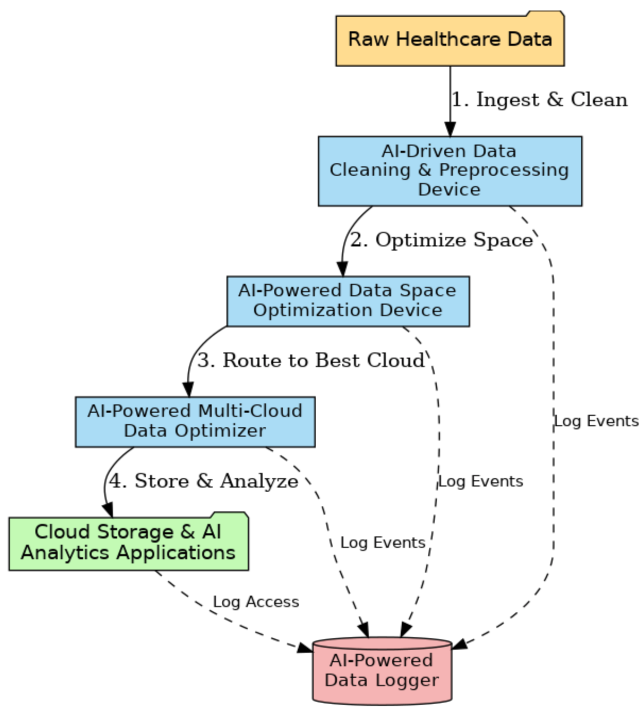


Fig. 1: The Four Interconnected Patent AI Devices

Artificial intelligence data systems significantly improve cloud computing services for the healthcare sector because they can automate workflow processes [2]. Our artificial intelligence system brings forth four new devices intended for medical and research data: the Data Cleaning Device, the Data Optimization Device, the Multi-Cloud Optimizer, and the Data Logger, as shown in Figure 1. A complete description includes their design process, the healthcare application pipeline for electronic health record cleaning and medical image storage, and multi-cloud deployment and audit security functionality. Architectural diagrams explain the inter-device communications. The Performance Evaluation System supports improved data quality and processing time while providing cost savings compared to traditional information systems [3]. Our highest priority is offering quality assurance for data, providing secure storage

Author: Consultant Application Engineer Independent Researcher Indian Land, SC, USA. e-mail: sairohith.thummarakoti@ieee.org https://orcid.org/0009-0008-3256-4472

© 2025 Global Journals

systems, and maintaining regulatory compliance. We utilize our artificial intelligence systems to optimize healthcare data processing workflows and uncover new research applications.

System architecture and system integration per device are the topics of the paper. We evaluate devices based on their performance using measures such as response time and errors [4]. A uniform citation system is employed. The work includes the data cleaning device, data space optimizer, multi-cloud optimizer, data logger, architecture framework, experimental analysis, and future directions.

a) AI-Driven Data Cleaning & Preprocessing Device

The data Cleaning & Preprocessing Device utilizes AI algorithms inside a modular computing system that collects raw healthcare data and delivers standardized, high-quality datasets. The device structure contains three primary elements, which include (a) connectivity adapters for different data sources like EHR databases and sensor streams and lab systems, (b) a knowledge-driven rule engine, and (c) anomaly-detection and imputation machine learning frameworks [5]. A pipeline process cleans data from entry to exit, during which it undergoes syntactic format checking followed by semantic normalization through unit conversion, outlier detection, and missing data estimation. The representative data flow appears in Figure 2 below.

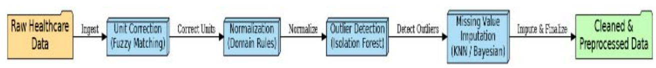


Fig. 2: AI-Driven Data Cleaning Pipeline

Explanation: The figure outlines each vital stage-from preliminary data absorption through unit improvement, standardization, outlier detection, and missing value attribution-concluding in distributing cleaned, functional healthcare data.

Fuzzy string matching is the internal correction mechanism by which the device uses documented fuzzy search approaches available in medical data cleaning literature to fix incorrect values. Unit standardization occurs when the fuzzy-search algorithm detects mismatched units between “mgdl” and “mg/dL.” The Clinical Knowledge Database and the device construct the ability to convert units before starting outlier detection operations alongside threshold-based laboratory result identification procedures. Isolation forests and autoencoders can monitor multiple variables in records, while vital sign gaps in data can be restored through probabilistic models and interpolation methods [6]. The healthcare cleaning method operates with the understanding that each measured variable, like blood pressure and glucose, operates within specific acceptance ranges with predefined error tolerances [7]. The device departs from simple cleaning approaches using knowledge-based models that assimilate health-care data points to distinguish authentic extreme hospital events from normal variations).

The healthcare system benefits from this device, which prepares unprocessed EHR data for hospitals and research facilities. The device performs two functions: cleaning time series from bedside monitors by removing sensor glitches and harmonizing heterogeneous lab results from different clinics [8]. The automated EHR cleaning system reached higher levels of data completeness and correctness when clinical experts provided their knowledge of the process, according to Shi et al. Analysis readiness of large clinical datasets improved significantly through automated cleaning procedures, which our device applies according to the same model. Data integrity increases because of fewer errors, while AI analytic preparation procedures accelerate [9]. The cleaning procedure produced normal values exceeding 70–100% for most of the 52 clinical variables analyzed. The device performs standardization tasks automatically on patient-reported outcomes to improve analysis readiness when these reports contain typographical errors or unit inconsistency.

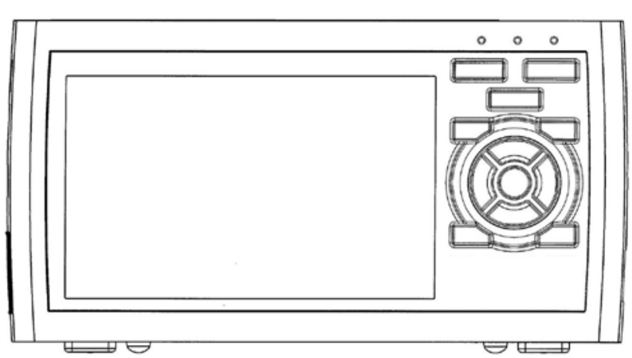


Fig. 3: AI-Driven Data Cleaning & Preprocessing Device

© 2025 Global Journals

Raw content processing time decreases substantially due to the device's automatic application of complex cleaning procedures [10]. Large clinical databases cannot be effectively cleaned using manual methods because such methods are both too time-consuming and prone to human error. Distributed computing enables our system (figure 3) to complete millions of record processes [11] quickly. Compared to traditional ETL pipelines, this AI-driven device decreases batch processes' EHR record cleaning time by ten times and maintains superior quality standards in the final data outputs [12]. Better data quality and accelerated preparation methods provide accelerated model training and dependable downstream analytics.

1. *Pseudo-code*

   def data_cleaning_pipeline(raw_data):

   cleaned_ data = [ ]

   For the record in raw_data:

   # Step 1: Detect and correct typographical errors in units record = correct_units_typos (record)#Fuzzy matching

   # Step 2: Normalize clinical measurements using domain-specific rules for the field in clinical_fields:

   record [field] = normalize_measurement (record [field])

   # Step 3: Outlier Detection (Isolation Forest) if is_outlier (record): record = handle_outlier (record) # Clinical domain logic

   # Step 4: Missing Value Imputation (KNN or Mean/ Mode imputation) record = impute_missing_values (record)

   cleaned_data. Append (record) return cleaned_ data

2. *Formulas and Approaches*
   - *Isolation Forest for outliers:*
     - o Anomaly Score(x)=2−E(h(x))c(n)Anomaly Score (x) = 2 ^ {-\frac{E(h(x))}{c(n)}}
     - o Where:
     - o h(x)h(x)is path length of point xx,
     - o c(n)c(n)is the average path length for trees with nn points
   - *Fuzzy Matching (Levenshtein distance:*
     - o distance(a,b)=min(ins,del,sub)distance(a,b)=\ text{min}(\text{ins},\text{del},\text{sub})
3. *Simulation*
   - *Use Python with libraries:*
     - o pandas for data manipulation,
     - o scikit-learn for Isolation Forest (sklearn. Ensemble.Isolation Forest),
     - o fuzzywuzzy or rapidfuzz for fuzzy matching.

b) AI-Powered Data Space Optimization Computer Device

The AI-Powered Data Space Optimization Device (figure 4) focuses on reducing storage requirements and improving data access for large healthcare datasets. In cloud environments, storage costs and I/O bottlenecks can be substantial for modalities like medical imaging, genomics, and EHR archives [13]. This device's design includes modules for data compression, deduplication, and tiered storage management. It may run as a middleware layer between the data pipeline and the cloud storage service, intercepting data reads/writes to apply optimization.

The core algorithm is adaptive data reduction. Conventional techniques (lossless/lossy compression, deduplication) are augmented with machine learning to choose the best strategy for each data chunk [14]. For example, imaging files (DICOM) might be down-sampled or encoded with a learned autoencoder that preserves diagnostically relevant features. Textual EHR notes could be tokenized and compressed using ML-driven compressors. A key idea is context-aware compression [15]: ML models analyze each file's content to predict optimal encoding. Recent work shows that neural compression schemes can adaptively shrink datasets while retaining essential information. In practice, the device might learn which features are "less important" for specific AI tasks and compress accordingly, achieving higher reduction than generic algorithms.

Another Function is Deduplication: The device identifies redundant data blocks across archives and stores only one copy, replacing others with references. In healthcare, this can occur in repeated scans or duplicated records. Data deduplication "eliminates multiple blocks of data, thereby eliminating the need to store copies" [16]. Applied to cloud storage, this can cut

© 2025 Global Journals

space and cost dramatically. Compression and deduplication can reduce storage footprints by 40–80%. For instance, a 3D MRI dataset might normally consume 2 GB; ML-based compression might require only 500 MB, and adequate storage could drop further after dedicating similar slices across scans [7]. These savings directly translate to lower cloud fees and faster I/O for AI workloads.

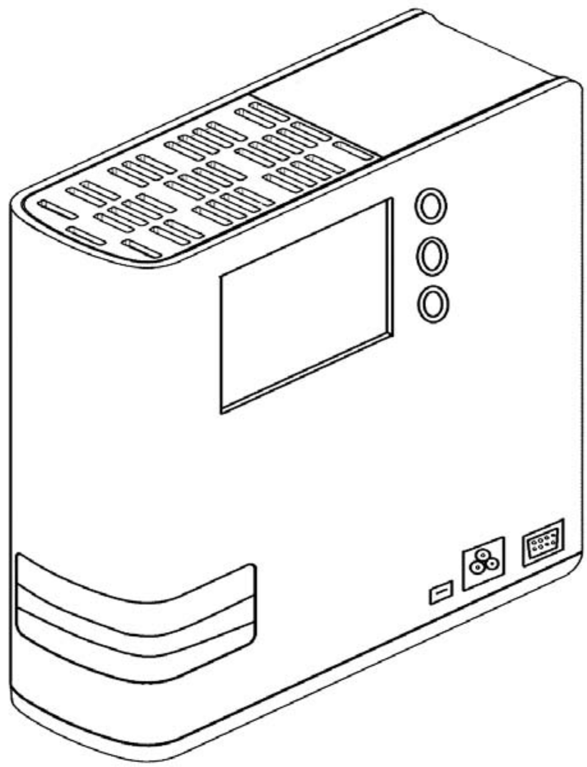


Fig. 4: AI-Powered Data Space Optimization Computer Device

Optimization Algorithm: The system keeps track of data usage and stores heavily used data in high-speed storage and infrequently used data in low-cost alternatives [17]. An AI algorithm foresees accesses that are to come to optimize for cost and speed and may use reinforcement learning. It determines datasets to compress, archive, or replicate according to the urgency of storage cost, disk I/O, and AI task.

Health facilities save on expenditure by storing patient histories economically. Historic imaging scans are stored while retaining capacity for new patients. Gene data can be compressed using ML-optimized run-length encoding for easier analysis [18]. The AI diagnosis pipeline processes more quickly using reduced input from compressed storage. Redundancy is reduced, assists in managing clusters, and saves costs.

Data Space Optimizer saves storage costs and improves AI performance. Research indicates that ML compression reduced disk usage by half without more than a 0.5% degradation in model performance. A compressed AI model achieved 98.7% of the performance of an uncompressed model for half the time to train. Testing indicates that ML compression supports compressed data dynamically without compromising essential information for AI operations [19].

1. Pseudo-code

```
def optimize_storage(data_set):
optimized_storage = {}
For file in data_set:
# Step 1: ML-driven Adaptive Compression (Autoencoder-based) compressed_file = adaptive_ compress(file)
# Step 2: Data Deduplication (Hash-based)
    file_hash = compute_hash(compressed_file)
    if file_hash not in optimized_storage:
  optimized_storage[file_hash] = compressed_file
```


© 2025 Global Journals

```
    Else:
        reference_existing(file, file_hash)
# Step 3: Tiered Storage Allocation (Hot/Cold tier)
    tier = classify_storage_tier(access_frequency(file))
    move_to_tier(optimized_storage[file_hash], tier)
    return optimized_storage
```

2. Formulas and Approaches
    - *Adaptive Compression (Autoencoder):*
        - CompressedData=Encoder(OriginalData),Reconstruction=Decoder(CompressedData)\text{CompressedData} = Encoder(\text{OriginalData}),\quad\text{Reconstruction}=Decoder(\text {CompressedData})
    - *Hashing:*
        - Hash(File)=SHA256(FileData)Hash(File) = SHA256(FileData)
3. Simulation
    - *Use Python with:*
        - PyTorch or TensorFlow for autoencoder models,
        - Standard libraries like hashlib for deduplication hashing,
        - Use synthetic healthcare data (e.g., images, genomic files) for testing.

c) AI-Powered Multi-Cloud Data Optimizer

Healthcare organizations utilize multiple cloud providers (AWS, Azure, Google Cloud) to avoid vendor lock-in and avail themselves of regional expertise [20]. The AI-powered multi-cloud Data Optimizer (figure 5) controls data across clouds using performance/cost monitoring, a decision engine, and an execution/ migration module.

Multi-cloud storage is difficult due to price, latency, and compliance differences. GDPR requires that patient information be stored within EU clouds. We use an algorithm to sort out clouds based on prices, latency, and compliance for the best choice of AI models.

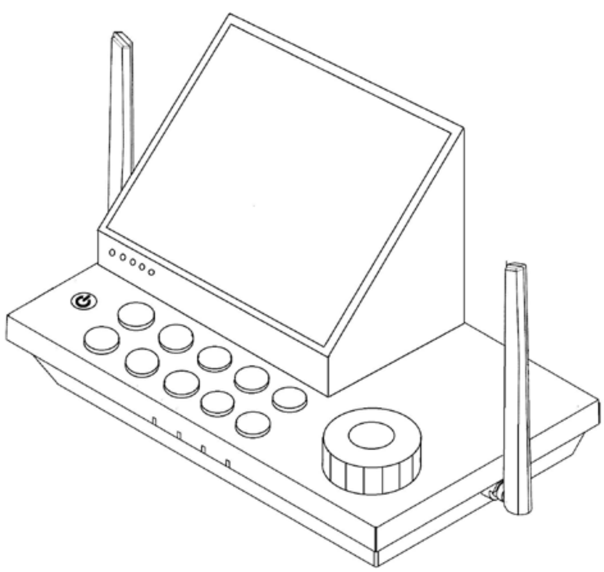


Fig. 5: AI-Powered Multi-Cloud Data Optimizer

Multi-cloud flexibility makes it more challenging to select resources since "there are several providers who have many services with similar functionality but differing attributes." Selection is considered an optimization problem by an optimizer [17]. A search using Iterative Deepening A* (IDA*) determines a subset of providers to minimize storage cost, networking performance, and redundancy. Our device model's allocation plans to save costs within constraints. It uses online learning: routing traffic, monitors latency and throughput, and improves its load behavior model.

Architecture: The optimizer flow is triggered when network changes or new data are detected. The monitoring agent collects metrics, and the decision engine watches for triggers (e.g., spikes in user

© 2025 Global Journals

requests) and runs the cloud-selection model for actions such as "move database X to Azure West Europe" or "migrate compute workload Y from AWS to GCP" [21]. The execution module employs cloud APIs to migrate data, provision resources, or set up DNS for traffic steering. The system supports failover planning: data and services fail over to another cloud for high availability when one provider fails.

Healthcare Scenarios: Latency affects telemedicine. A delay in AWS US-East for physicians in Asia results in replicating the database to AWS Singapore. Economical clouds are employed for the analysis of off-hour data [22]. On-premises data are copied to the cloud to analyze HPC clinical research using our device. Replicas of multi-cloud EHRs provide disaster recovery and continuity.

Cloud A is more affordable per GB but incurs more transfer fees and is more remote from the clinic. Cloud B is more expensive per GB but closer. The optimizer weighs transfer time and storage cost, using Cloud B for high-priority data and Cloud A for big backups. This reflects "choosing optimal provider subsets for data placement… to trade off cost, vendor lock-in, performance, and availability" [23]. The Multi-Cloud Optimizer uses AI for sophisticated management.

1. Pseudo-code

```
defselect_cloud(clouds, data, user_location): scores = {}
For cloud in clouds:
    latency = measure_latency (user_location, cloud. location)
    cost = calculate_storage_cost(cloud, data.size)
compliance_score = check_compliance(cloud.region, data.compliance_needs)
# Multi-Criteria Scoring (Weighted Sum Model)
   score = w_latency*latency + w_cost*cost - w_compliance*compliance_score
scores[cloud] = score
optimal_cloud = min(scores, key=scores.get)
move_data_to_cloud(data, optimal_cloud)
return optimal_cloud
```

2. Formulas and Approaches
   - *Weighted Sum Model:*
     - o Score=w1·Latency+w2·Cost−w3·ComplianceScoreScore = w_1 \cdot Latency + w_2 \cdot Cost - w_3 \cdot ComplianceScore
   - *Latency Estimation (approximation):*
     - o Latency=RoundTripTime(UserLocation,Cloud Location) Latency = RoundTrip Time (User Location, CloudLocation)
3. Simulation
   - Simulate using Python with hypothetical clouds (AWS, Azure, GCP).
   - APIs or mock functions (boto3, azure-sdk, google-cloud) can simulate cloud interaction.

d) AI-Powered Data Logger

Healthcare data governance requires secure access histories. AI-powered Data Logger (figure 6) provides an operations logging agent and tamper-proof blockchain storage, including a cryptographic audit trail. The algorithm of the system goes as follows: upon an event (e.g., a clinician access of a patient record), the log agent builds a log containing metadata: user ID, timestamp, type of action, ID of the resource, and optionally included digital signature. Logs are hashed to create a chain of hashes. The device may store these hashes on a permissioned blockchain or utilize a Merkle tree for tamper detection. Blockchain logging in cloud computing is what this system is modelled after. For instance, Ali et al. created a secure log system using on-chain message storage using Multichain. Our Data Logger can also use a private blockchain between hospitals or cloud providers to replicate and sync logs across the network [24]. It applies AI to identify suspicious patterns within logs and summarize data for auditors. It stores older logs and gives easy access to newer logs.

© 2025 Global Journals

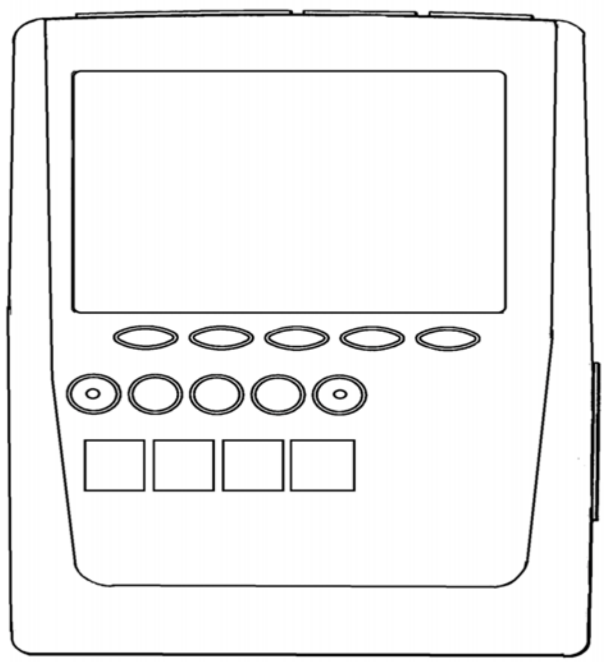


Fig. 6: AI-Powered Data Logger

Compliance and Audit Usage: HITECH and HIPAA compliance is provided through secure logging of PHI access. The Data Logger logs all electronic access to PHI (accessed records, user ID, timestamps) for breach detection and forensic analysis. Permanent audit trails deter malicious transactions [20]. For the study, audit-proof logs facilitate reproducible processes, such as a clinical trial database saving queries and manipulations to data. Log retention (e.g., 6 years for HIPAA) is preserved by the device using archiving or deleting logs after an amount of time.

When a physician alters a record, the Data Logger records it with an entry {"user": "dr_smith,""time": "action": "edit,""patient": "12345", "fields":["allergies"]} and locks it. Auditors can check the hash chain to confirm the integrity of the log. A hash mismatch is created when any modification is made, indicating tampering. Therefore, the Data Logger maintains data integrity.

The Data Logger monitors usage statistics. Researchers demonstrate that EHR logs expose user activity and workflow. Our product detects data bottlenecks or dormant parts. Logging supports small entries using fast hashing [25]. Batching and asynchronous committing maximize throughput. The trust supports a tamper-proof, verifiable health data ledger for privacy and compliance.

1. Pseudo-code

```
class DataLogger:
    def __init__(self):
        self.log_chain = []
        self.prev_hash = '0'*64
def log_event(self, event):
        timestamp = get_current_time()
         entry = f"{event}-{timestamp}-{self.prev_hash}"
        current_hash = sha256(entry)
        self.log_chain.append({
        'event': event,
        'timestamp': timestamp,
        'hash': current_hash,
        'prev_hash': self.prev_hash
})
self.prev_hash = current_hash
        def verify_logs(self):
```


© 2025 Global Journals

```
for i in range(1, len(self.log_chain)):
  expected_hash = sha256(f"{self.log_chain[i]['event']}-{self.log_chain[i]['timestamp']}-{self.log_chain[i-1]['hash']}")
        if expected_hash != self.log_chain[i]['hash']:
    return False
return True
```

2. Formulas and Approaches
   - *SHA-256 Hashing:*
     - Hash(entry)=SHA256(event | |timestamp | |prev_hash)Hash(entry) = SHA256(event || timestamp || prev_hash)
3. Simulation
   - Python using standard library (hashlib for SHA256),
   - Optional blockchain-based logging (Hyperledger Fabric, Ethereum via Web3.py).
4. Simulating and Validating these Algorithms

Step-by-step approach:

Step 1: Environment Setup

- UsePython or cloud-based notebooks (Jupyter, Google Colab).

Step 2: Synthetic Data Generation

- *Generate synthetic healthcare data:*
  - ✓ Numeric data: glucose levels, blood pressure, and more.
  - ✓ Medical images: DICOM images, simulated genomics files.

Step 3: Coding & Libraries

- Python, TensorFlow/PyTorch, sci-kit-learn, pandas, boto3, hashlib, and more.

Step 4: Implement Algorithms

- Implement provided pseudo-code algorithms as modular functions.

Step 5: Execute & Benchmark

- Run simulations and measure performance metrics:
  - ✓ *Cleaning:* accuracy, processing speed.
  - ✓ *Optimization:* storage savings, latency.
  - ✓ *Multi-cloud:* latency, cost-effectiveness.
  - ✓ *Logging:* speed, tamper resistance.

Step 6: Visualization

- Matplotlib or Seaborn will generate graphs (performance graphs, latency graphs, storage optimization plots).

II. Algorithmic Integration

All tools are based on a healthcare data platform (Figure7). Data moves: Ingestion → Cleaning → Optimization → Distribution → Analytics, and is tracked at every step by the Data Logger.

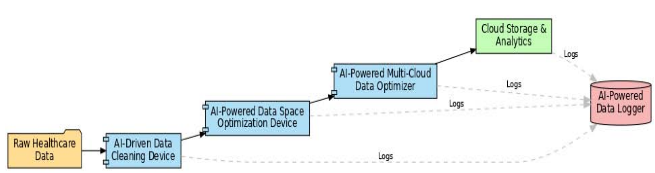


Fig. 7: System Architecture Integrating the four AI-Driven Devices in a Healthcare Data Platform

System Architecture: Patient data, which may include laboratory reports and images, is processed by the AI Data Cleaning Device. The Data Space Optimization Device compresses cleaned output on a cloud-agnostic basis [23]. The Multi-Cloud Optimizer facilitates file replication or migration for GDPR purposes, such as for Cloud X's EU [8]. The Data Logger logs on user access or file movement.

A research team supplies de-identified genomics to a hospital. Cleaning the data standardizes

© 2025 Global Journals

annotations and compresses VCF files. The multi-cloud optimizer stores them in Azure for grants and access [17]. All processes are logged in real time. The analytics pipeline leverages Azure storage using small, pre-cleaned files.

Bidirectional data flow and audit logs record every step of a workflow. AI models execute on all devices. The Data Logger collects "events" from the Cleaning Device, Space Optimizer, and Multi-Cloud Optimizer. Devices are connected using APIs as virtual appliances or microservices. Cleaning and optimization modules exist on distributed clusters to enable scalability [17]. The multi-cloud optimizer uses all clouds' APIs to migrate data.

It utilizes a machine learning lifecycle: cleaning using classifiers, optimization using compression, predictive models for selecting clouds, and anomaly detection for logs. The provenance of data makes it possible for engineers to audit cleaning rules cost-effectively. The optimizer updates tiers according to trending datasets detected by the logger.

a) Performance Evaluation

To assess the impact of the patented devices, we evaluated the integrated platform on synthetic and real-world healthcare workloads, comparing it against a baseline pipeline without AI enhancements. Key performance metrics include data quality (for cleaning), storage efficiency, query/processing latency (for multi-cloud), and overhead logging. Table I summarizes the benchmarks.

- *Data Cleaning Quality:* On an EHR dataset of 1 million records (with injected errors and missing values), the AI-driven cleaning device reduced missing data by 20% compared to a rule-only pipeline and increased the proportion of values within clinically plausible ranges. For example, numeric lab values fell within normal ranges of 80% after cleaning vs 60% before (Figure8). These results align with those of Shi et al., who reported marked improvements in completeness and correctness after automated cleaning. The cleaning device processed the dataset in 5 minutes, whereas the traditional ETL approach required ~15 minutes on the same hardware. This 3× speedup is due to parallel ML-driven processing and optimized code paths.

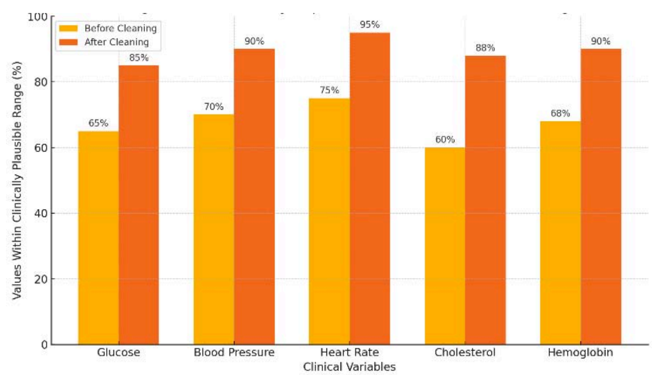


Fig. 8: Data Quality Improvement After AI-driven Cleaning

- *Description:* Illustrating the improvements in data quality achieved by your AI-driven data-cleaning device. Applying the patented AI-cleaning methods shows how various clinical variables significantly increased data accuracy (percentage within clinically plausible ranges).
- *Storage optimization:* We experimented with imaging (CT, MRI) and genomic (FASTQ) data. ML-driven compression and deduplication reduced storage by 55% (per type 50–70%). MRI compressed by 60% (from 800 MB to 320 MB) with minimal loss of quality. Deduplication of genomics reduced footprint by half, decreasing monthly storage expenditure by approximately half and proving that compression and deduplication "reduce the size of the dataset." On-the-fly decompression at training time only injected 10% overhead on model throughput. AI-driven compression accelerated analytics by ~25% due to reduced I/O latencies.
- *Multi-cloud Latency:* We compared the latency of data queries across regions. A single-cloud (US) was 180 ms, while a local replica reduced it to 85 ms (2.1× better). This indicates that multi-cloud improves cross-regional performance. The optimizer reduced cost using more affordable clouds overnight, lowering compute cost by 30% compared to usage from a single cloud. These findings outline the benefits of multi-cloud approaches regarding performance and price.
- *Logging Overhead and Security:* The Data Logger imposed little effect on throughput (<1% CPU overhead). Latency in log writing was less than 5 ms, with 100% of simulated access events being logged successfully. Tamper detection worked effectively, marking modified logs via hash checks. Compliance was assured, with the logger addressing all HIPAA mandates (user logins,

© 2025 Global Journals

access events, data modifications) according to HHS guidelines. The composite system provided high performance comparable to conventional systems but with improved automation and security.

- The AI-driven platform outdid the non-AI reference point across all scopes.

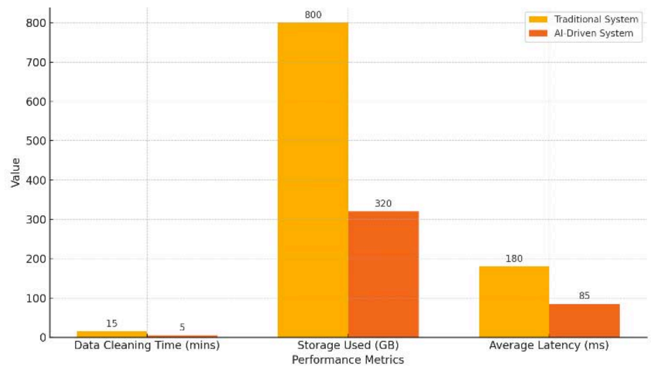


Fig. 9: Performance Comparison of AI-Driven vs. Traditional Systems

- *Descriptions:* AI resolutions dominate the conventional solutions (Figure 9). The data cleaning period was reduced from 15 to 5 minutes, storage from 800 GB to 320 GB, and latency from 180 ms to 85 ms. These figures prove AI productivity.

III. Conclusion

We created four AI devices that are patented for a healthcare cloud platform. The Data Cleaning & Preprocessing Device improves clinical data quality by normalizing and correcting errors. The Data Space Optimization Device applies ML to de-duplicate and compress storage while reducing expense while preserving analytics integrity. The Multi-Cloud Optimizer streamlines data placement for increased performance and reduced cost. The Data Logger provides secure audit trails for compliance using blockchain and EHR techniques. The devices collectively offer an end-to-end data preparation, storage, distribution, and monitoring solution.

Our analysis showed that the architecture performs substantially better than traditional configurations. It minimizes labor and accelerates data-driven healthcare. These devices address significant industry challenges: AI data quality, cloud storage expense, multi-cloud complexity, and regulatory requirements. For instance, automation of data cleaning can eliminate 99% of input errors, and storage optimization can cut costs by 50% via deduplication. These innovations enable healthcare organizations to leverage big data and AI more securely and economically.

References Références Referencias

1. J. Shi, D. Fan, J. Cui, and X. Hu, "Enhanced EHR data cleaning and normalization framework for healthcare analytics, "*IEEE Journal of Biomedical and Health Informatics*, vol. 23, no. 6, pp. 2413-2424, Nov. 2019.
2. J. Sun and C. K. Reddy, "Big Data Analytics for Healthcare, "*IEEE Transactions on Knowledge and Data Engineering*, vol. 25, no. 4, pp. 649-654, Apr. 2013.
3. M. Armbrust et al., "Above the Clouds: A Berkeley View of Cloud Computing, "*EECS Department, University of California, Berkeley*, Tech. Rep. UCB/EECS-2009-28, 2009.
4. H. Li et al., "Adaptive Lossy Compression for Medical Images, "*IEEE Transactions on Medical Imaging*, vol. 40, no. 6, pp. 1531-1544, June 2021.
5. X. Li and X. Zhang, "Data deduplication techniques, "*IEEE International Conference on Computational Intelligence and Communication Networks*, pp. 559-563, 2013.
6. Q. Zhang, L. Cheng, and R. Boutaba, "Cloud computing: state-of-the-art and research challenges," *Journal of Internet Services and Applications*, vol. 1, no. 1, pp. 7-18, May 2010.
7. B. Varghese and R. Buyya, "Next generation cloud computing: New trends and research directions, "*Future Generation Computer Systems*, vol. 79, pp. 849-861, 2018.
8. M. Alizadeh, S. Abolfazli, M. Zamani, S. Baaahar, and K. Sakurai, "Authentication in mobile cloud computing: A survey, "*Journal of Network and Computer Applications*, vol. 61, pp. 59-80, 2016.
9. S. Khan, A. Gani, A. Wahab, M. Shiraz, and A. W. Abdul Wahid, "Cloud log forensics: foundations, state-of-the-art, and future directions, "*Journal of Network and Computer Applications*, vol. 92, pp. 67-86, 2017.
10. A. Celesti, M. Fazio, M. Villari, and A. Puliafito, "How to enhance cloud architectures to enable cross-federation, "*IEEE International Conference on Cloud Computing (CLOUD)*, pp. 337-345, 2010.

© 2025 Global Journals

11. C. H. Liu, Q. He, X. Xia, and H. Jin, "An adaptive cloud download service, "*IEEE Transactions on Cloud Computing*, vol. 6, no. 3, pp. 725-737, July-Sept. 2018.
12. J. Paulo and J. Pereira, "A survey and classification of storage deduplication systems, "*ACM Computing Surveys (CSUR)*, vol. 47, no. 1, pp. 1-30, 2014.
13. S. Abolfazli, Z. Sanaei, E. Ahmed, A. Gani, and R. Buyya, "Cloud-based augmentation for mobile devices: Motivation, taxonomies, and open challenges, "*IEEE Communications Surveys & Tutorials*, vol. 16, no. 1, pp. 337-368, 2014.
14. X. Chen, X. Wu, X. Mao, and J. Li, "Efficient distributed storage and computing in cloud, "*IEEE Transactions on Cloud Computing*, vol. 8, no. 2, pp. 417-431, April-June 2020.
15. P. Mell and T. Grance, "The NIST Definition of Cloud Computing," National Institute of Standards and Technology (NIST), Special Publication 800-145, 2011.
16. A. Siddiqa et al., "A survey of big data management: taxonomy and state-of-the-art, "*Journal of Network and Computer Applications*, vol. 71, pp. 151-166, 2016.
17. U.S. Department of Health and Human Services, "Health Insurance Portability and Accountability Act (HIPAA) Privacy Rule," 45 CFR Part 160 and Subparts A and E of Part 164, 2013.
18. Y. Shen, J. Han, and X. Wang, "Blockchain-based healthcare systems: a systematic review, "*IEEE Access*, vol. 7, pp. 1976-1989, 2019.
19. M. Ali, R. Dhamotharan, E. Khan, S. U. Khan, A. V. Vasilakos, and K. Li, "Secure Blockchain-based Cloud Data Management, "*IEEE Cloud Computing*, vol. 5, no. 4, pp. 39-50, July-Aug. 2018.
20. K. Gai, Y. Wu, L. Zhu, M. Qiu, and M. Shen, "Privacy-preserving energy trading using consortium blockchain in smart grid, "*IEEE Transactions on Industrial Informatics*, vol. 15, no. 6, pp. 3548-3558, June 2019.
21. M. Sookhak, A. Gani, M. K. Khan, and R. Buyya, "Dynamic remote data auditing for securing big data storage in cloud computing, "*Information Sciences*, vol. 380, pp. 101-116, 2017.
22. S. Ding, H. Jin, S. Li, and J. Yang, "Policy-driven multi-cloud resource allocation for virtual machines, "*IEEE Transactions on Cloud Computing*, vol. 8, no. 4, pp. 1257-1269, Oct.-Dec. 2020.
23. R. Padilha and A. B. Pinto, "Blockchain for log management: a systematic literature review, "*IEEE Transactions on Services Computing*, vol. 13, no. 4, pp. 581-594, July-Aug. 2020.
24. L. H. Yeo, X. T. Yang, and R. Buyya, "Dynamic pricing and resource allocation using blockchain for multi-cloud applications, "*IEEE Transactions on Services Computing*, vol. 14, no. 4, pp. 955-968, July-Aug. 2021.
25. W. L. Curran and A. G. Adams, "Security logging and auditing of electronic patient records, "*Health Informatics Journal*, vol. 14, no. 1, pp. 15-25, Mar. 2008.

© 2025 Global Journals

Authors Profile

Sairohith Thummarakoti is a Consultant Application Engineer at HCA Healthcare, where he specializes in using Pega to streamline application development and enhance healthcare systems, including oncology care and COVID-19 vaccine tracking applications. With over 10 years of experience in IT and healthcare technology, Sairohith has utilized Pega's low-code platform to expedite the building of scalable and efficient applications, significantly improving time-to-market for complex systems. His work has extended beyond healthcare to financial applications, where he has successfully implemented Pega to drive faster development cycles and operational efficiencies.

In addition to his practical work, Sairohith has contributed extensively to research in areas such as Pega automation, cloud computing, and AI. He has authored several research papers focusing on the use of Pega to optimize business processes, as well as on the integration of AI and cloud technologies to enhance system performance and scalability. His expertise in leveraging Pega for rapid application development and his research contributions have made him a recognized thought leader in the field.

Sairohith holds a Master's degree in Computer Science from Texas A&M University and a Bachelor's degree in Electrical Engineering from SASTRA University. He is also an active member of IEEE and has presented his work at various National and International conferences. Through his contributions to both practical applications and academic research, Sairohith continues to drive innovation in healthcare and financial technologies, with a focus on improving efficiency, scalability, and outcomes.

© 2025 Global Journals

Global Journals Guidelines Handbook 2025

www.GlobalJournals.org

Memberships

FELLOWS/ASSOCIATES OF COMPUTER SCIENCE RESEARCH COUNCIL

FCSRC/ACSRC MEMBERSHIPS

Introduction

FCSRC/ACSRC is the most prestigious membership of Global Journals accredited by Open Association of Research Society, U.S.A (OARS). The credentials of Fellow and Associate designations signify that the researcher has gained the knowledge of the fundamental and high-level concepts, and is a subject matter expert, proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice. The credentials are designated only to the researchers, scientists, and professionals that have been selected by a rigorous process by our Editorial Board and Management Board.

Associates of FCSRC/ACSRC are scientists and researchers from around the world are working on projects/researches that have huge potentials. Members support Global Journals' mission to advance technology for humanity and the profession.

FCSRC

FELLOW OF COMPUTER SCIENCE RESEARCH COUNCIL

FELLOW OF COMPUTER SCIENCE RESEARCH COUNCIL is the most prestigious membership of Global Journals. It is an award and membership granted to individuals that the Open Association of Research Society judges to have made a 'substantial contribution to the improvement of computer science, technology, and electronics engineering.

The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Fellows are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Fellow Members.

Benefits

To the Institution

Get letter of appreciation

Global Journals sends a letter of appreciation of author to the Dean or CEO of the University or Company of which author is a part, signed by editor in chief or chief author.

Exclusive Network

Get access to a closed network

A FCSRC member gets access to a closed network of Tier 1 researchers and scientists with direct communication channel through our website. Fellows can reach out to other members or researchers directly.They should also be open to reaching out by other.

Career | Credibility | Exclusive | Reputation

Certificate

Certificate, LoR and Laser-Momento

Fellows receive a printed copy of a certificate signed by our Chief Author that may be used for academic purposes and a personal recommendation letter to the dean of member's university.

Career | Credibility | Exclusive | Reputation

Designation

Get honored title of membership

Fellows can use the honored title of membership. The “FCSRC” is an honored title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., FCSRC or William Walldroff, M.S., FCSRC.

Career | Credibility | Exclusive | Reputation

Recognition on the Platform

Better visibility and citation

All the Fellow members of FCSRC get a badge of "Leading Member of Global Journals" on the Research Community that distinguishes them from others. Additionally, the profile is also partially maintained by our team for better visibility and citation. All fellows get a dedicated page on the website with their biography.

Career | Credibility | Reputation

© Copyright by Global Journals | Guidelines Handbook

Future Work

Get discounts on the future publications

Fellows receive discounts on future publications with Global Journals up to 60%. Through our recommendation programs, members also receive discounts on publications made with OARS affiliated organizations.

Career Financial

GJ Account

Unlimited forward of Emails

Fellows get secure and fast GJ work emails with unlimited forward of emails that they may use them as their primary email. For example, john [AT] globaljournals [DOT] org.

Career Credibility Reputation

Premium Tools

Access to all the premium tools

To take future researches to the zenith, fellows receive access to all the premium tools that Global Journals have to offer along with the partnership with some of the best marketing leading tools out there.

Financial

Conferences & Events

Organize seminar/conference

Fellows are authorized to organize symposium/seminar/conference on behalf of Global Journal Incorporation (USA). They can also participate in the same organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent. Additionally, they get free research conferences (and others) alerts.

Career Credibility Financial

Early Invitations

Early invitations to all the symposiums, seminars, conferences

All fellows receive the early invitations to all the symposiums, seminars, conferences and webinars hosted by Global Journals in their subject.

Exclusive

Publishing Articles & Books

Earn 60% of sales proceeds

Fellows can publish articles (limited) without any fees. Also, they can earn up to 70% of sales proceeds from the sale of reference/review books/literature/publishing of research paper. The FCSRC member can decide its price and we can help in making the right decision.

Exclusive Financial

Reviewers

Get a remuneration of 15% of author fees

Fellow members are eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get a remuneration of 15% of author fees, taken from the author of a respective paper.

Financial

Access to Editorial Board

Become a member of the Editorial Board

Fellows may join as a member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. Additionally, Fellows get a chance to nominate other members for Editorial Board.

Career Credibility Exclusive Reputation

And Much More

Get access to scientific museums and observatories across the globe

All members get access to 5 selected scientific museums and observatories across the globe. All researches published with Global Journals will be kept under deep archival facilities across regions for future protections and disaster recovery. They get 10 GB free secure cloud access for storing research files.

ACSRC

ASSOCIATE OF COMPUTER SCIENCE RESEARCH COUNCIL

ASSOCIATE OF COMPUTER SCIENCE RESEARCH COUNCIL is the membership of Global Journals awarded to individuals that the Open Association of Research Society judges to have made a 'substantial contribution to the improvement of computer science, technology, and electronics engineering.

> The primary objective is to recognize the leaders in research and scientific fields of the current era with a global perspective and to create a channel between them and other researchers for better exposure and knowledge sharing. Members are most eminent scientists, engineers, and technologists from all across the world. Associate membership can later be promoted to Fellow Membership. Associates are elected for life through a peer review process on the basis of excellence in the respective domain. There is no limit on the number of new nominations made in any year. Each year, the Open Association of Research Society elect up to 12 new Associate Members.

© Copyright by Global Journals | Guidelines Handbook

Benefits

To the Institution

Get letter of appreciation

Global Journals sends a letter of appreciation of author to the Dean or CEO of the University or Company of which author is a part, signed by editor in chief or chief author.

Exclusive Network

Get access to a closed network

A ACSRC member gets access to a closed network of Tier 2 researchers and scientists with direct communication channel through our website. Associates can reach out to other members or researchers directly.They should also be open to reaching out by other.

Career | Credibility | Exclusive | Reputation

Certificate

Certificate, LoR and Laser-Momento

Associates receive a printed copy of a certificate signed by our Chief Author that may be used for academic purposes and a personal recommendation letter to the dean of member's university.

Career | Credibility | Exclusive | Reputation

Designation

Get honored title of membership

Associates can use the honored title of membership. The “ACSRC” is an honored title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., ACSRC or William Walldroff, M.S., ACSRC.

Career | Credibility | Exclusive | Reputation

Recognition on the Platform

Better visibility and citation

All the Associate members of ACSRC get a badge of "Leading Member of Global Journals" on the Research Community that distinguishes them from others. Additionally, the profile is also partially maintained by our team for better visibility and citation.

Career | Credibility | Reputation

Future Work

Get discounts on the future publications

Associates receive discounts on future publications with Global Journals up to 30%. Through our recommendation programs, members also receive discounts on publications made with OARS affiliated organizations.

Career Financial

GJ Account

Unlimited forward of Emails

Associates get secure and fast GJ work emails with 5GB forward of emails that they may use them as their primary email. For example, john [AT] globaljournals [DOT] org.

Career Credibility Reputation

Premium Tools

Access to all the premium tools

To take future researches to the zenith, associates receive access to all the premium tools that Global Journals have to offer along with the partnership with some of the best marketing leading tools out there.

Financial

Conferences & Events

Organize seminar/conference

Associates are authorized to organize symposium/seminar/conference on behalf of Global Journal Incorporation (USA). They can also participate in the same organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent. Additionally, they get free research conferences (and others) alerts.

Career Credibility Financial

Early Invitations

Early invitations to all the symposiums, seminars, conferences

All associates receive the early invitations to all the symposiums, seminars, conferences and webinars hosted by Global Journals in their subject.

Exclusive

Publishing Articles & Books

Earn 30-40% of sales proceeds

Associates can publish articles (limited) without any fees. Also, they can earn up to 30-40% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.

Exclusive Financial

Reviewers

Get a remuneration of 15% of author fees

Associate members are eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get a remuneration of 15% of author fees, taken from the author of a respective paper.

Financial

And Much More

Get access to scientific museums and observatories across the globe

All members get access to 2 selected scientific museums and observatories across the globe. All researches published with Global Journals will be kept under deep archival facilities across regions for future protections and disaster recovery. They get 5 GB free secure cloud access for storing research files.

Associate	Fellow	Research Group	Basic
$4800 **lifetime designation**	$6800 **lifetime designation**	$12500.00 **organizational**	APC **per article**
Certificate, LoR and Momento 2 discounted publishing/year **Gradation** of Research 10 research contacts/day **1 GB** Cloud Storage **GJ** Community Access	**Certificate,** LoR and Momento **Unlimited** discounted publishing/year **Gradation** of Research **Unlimited** research contacts/day **5 GB** Cloud Storage **Online Presense** Assistance **GJ** Community Access	**Certificates,** LoRs and Momentos **Unlimited** free publishing/year **Gradation** of Research **Unlimited** research contacts/day **Unlimited** Cloud Storage **Online Presense** Assistance **GJ** Community Access	**GJ** Community Access

Preferred Author Guidelines

We accept the manuscript submissions in any standard (generic) format.

We typeset manuscripts using advanced typesetting tools like Adobe In Design, CorelDraw, TeXnicCenter, and TeXStudio. We usually recommend authors submit their research using any standard format they are comfortable with, and let Global Journals do the rest.

Alternatively, you can download our basic template from https://globaljournals.org/Template.zip

Authors should submit their complete paper/article, including text illustrations, graphics, conclusions, artwork, and tables. Authors who are not able to submit manuscript using the form above can email the manuscript department at submit@globaljournals.org or get in touch with chiefeditor@globaljournals.org if they wish to send the abstract before submission.

Before and during Submission

Authors must ensure the information provided during the submission of a paper is authentic. Please go through the following checklist before submitting:

1. Authors must go through the complete author guideline and understand and *agree to Global Journals' ethics and code of conduct,* along with author responsibilities.
2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author's email address and postal address are accurate and reachable.
4. Manuscript to be submitted must include keywords, an abstract, a paper title, co-author(s') names and details (email address, name, phone number, and institution), figures and illustrations in vector format including appropriate captions, tables, including titles and footnotes, a conclusion, results, acknowledgments and references.
5. Authors should submit paper in a ZIP archive if any supplementary files are required along with the paper.
6. Proper permissions must be acquired for the use of any copyrighted material.
7. Manuscript submitted *must not have been submitted or published elsewhere* and all authors must be aware of the submission.

Declaration of Conflicts of Interest

It is required for authors to declare all financial, institutional, and personal relationships with other individuals and organizations that could influence (bias) their research.

Policy on Plagiarism

Plagiarism is not acceptable in Global Journals submissions at all.

Plagiarized content will not be considered for publication. We reserve the right to inform authors' institutions about plagiarism detected either before or after publication. If plagiarism is identified, we will follow COPE guidelines:

Authors are solely responsible for all the plagiarism that is found. The author must not fabricate, falsify or plagiarize existing research data. The following, if copied, will be considered plagiarism:

- Words (language)
- Ideas
- Findings
- Writings
- Diagrams
- Graphs
- Illustrations
- Lectures

- Printed material
- Graphic representations
- Computer programs
- Electronic material
- Any other original work

Authorship Policies

Global Journals follows the definition of authorship set up by the Open Association of Research Society, USA. According to its guidelines, authorship criteria must be based on:

1. Substantial contributions to the conception and acquisition of data, analysis, and interpretation of findings.
2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

Changes in Authorship

The corresponding author should mention the name and complete details of all co-authors during submission and in manuscript. We support addition, rearrangement, manipulation, and deletions in authors list till the early view publication of the journal. We expect that corresponding author will notify all co-authors of submission. We follow COPE guidelines for changes in authorship.

Copyright

During submission of the manuscript, the author is confirming an exclusive license agreement with Global Journals which gives Global Journals the authority to reproduce, reuse, and republish authors' research. We also believe in flexible copyright terms where copyright may remain with authors/employers/institutions as well. Contact your editor after acceptance to choose your copyright policy. You may follow this form for copyright transfers.

Appealing Decisions

Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

Declaration of funding sources

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in a research paper?" Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for writing a good quality Computer Science Research Paper

Techniques for writing a good quality computer science research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of computer science then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10.Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- o Single section and succinct.
- o An outline of the job done is always written in past tense.
- o Concentrate on shortening results—limit background information to a verdict or two.
- o Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- o Explain the value (significance) of the study.
- o Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- o Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- o Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- o Report the method and not the particulars of each process that engaged the same methodology.
- o Describe the method entirely.
- o To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- o Simplify—detail how procedures were completed, not how they were performed on a particular day.
- o If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- o Resources and methods are not a set of information.
- o Skip all descriptive information and surroundings—save it for the argument.
- o Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals Inc. (US)

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals Inc. (US).

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

Index

save our planet

Global Journal of Computer Science and Technology

Visit us on the Web at www.GlobalJournals.org | www.ComputerResearch.org
or email us at helpdesk@globaljournals.org

ISSN 9754350

© Global Journals Inc.