Original Article

Evaluating Automation Using Supply Chain Cloud Solutions

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Abstract - The supply chain landscape is transforming significantly due to the increasing adoption of cloud-based solutions and advancements in automation. This paper evaluates the impact of these solutions on automating various supply chain processes. Literature review shows that cloud computing enhances supply chain integration, enabling better visibility, collaboration, and real-time decision-making. Cloud-based solutions offer access to the latest technologies and functionalities while being cost-effective and scalable. Organizations prioritize creating "smarter" supply chains by leveraging digital technologies to optimize operations, enhance responsiveness, and improve customer service. This paper systematically reviews cloud-based supply chain solutions from Google, Microsoft, AWS, and SAP, evaluating their impact on automation initiatives based on key features, popularity, and integration capabilities. SAP S/4HANA is the most widely adopted ERP system, especially among large enterprises with complex needs. It offers deep integration within the SAP ecosystem, comprehensive APIs, and strong support for non-SAP systems. Google Supply Chain and Logistics Cloud are ideal for organizations using Google services. It leverages seamless integration with Google Cloud and a growing partner ecosystem. Dynamics 365 Supply Chain Management excels in integrating with Microsoft products, making it attractive for companies heavily reliant on Microsoft technologies. AWS Supply Chain Management is compelling for enterprises using AWS infrastructure, offering tight integration with AWS services and robust data integration capabilities. Each solution shows robust integration capabilities tailored to its ecosystem. The choice depends on an organization's existing technology landscape, required integration level, and specific needs. While SAP S/4HANA is popular among large enterprises, Google, Microsoft, and AWS are gaining traction, offering viable alternatives for diverse technology preferences and integration requirements.

Keywords - Microsoft Dynamic 365 Supply Chain Management, Google Supply Chain and Logistics Cloud, AWS Supply Chain Management, SAP S/4 Hana, Supply Chain Logistics.

1. Introduction

Supply chain management encompasses the intricate network of processes, individuals, organizations, technologies, and resources involved in transforming raw materials into finished products and delivering them to end consumers. It is a strategic function that orchestrates the flow of goods, services, and information from origin to consumption. In today's interconnected and fast-paced business environment, effective supply chain management is paramount for several reasons Enhanced Customer Satisfaction that includes meeting customer demands for product availability, timely delivery, and competitive pricing hinges on a well-managed supply chain, Cost Optimization: Streamlining processes, reducing waste, and optimizing inventory levels through efficient SCM directly impact a company's bottom line, Competitive Advantage: Agile and responsive supply chains enable businesses to adapt to market

fluctuations, introduce new products swiftly, and gain an edge over rivals, Risk Mitigation: SCM helps identify and manage potential disruptions, such as natural disasters, supplier issues, or geopolitical instability, ensuring business continuity, Global Reach and Scalability: Effective SCM is essential for businesses operating in globalized markets, enabling them to source materials, manufacture, and distribute products efficiently across borders. In essence, supply chain management is no longer a behind-the-scenes operational necessity but a strategic driver of business success in the 21st century. The growing trend of automation in SCM and the role of cloud computing in facilitating this transformation. With the increasing adoption of technologies like the Internet of Things (IoT), machine learning, and predictive analytics, automation is becoming more prevalent in supply chain operations, from inventory tracking and demand forecasting to innovative warehousing and autonomous transportation

[1].[2] Cloud computing enables these advancements, providing the scalable, secure, and flexible infrastructure needed to harness the power of data and emerging technologies [3][2].

The paper aims to assess and contrast different cloud-based solutions for supply chain management. Recent disruptions in global supply chains have revealed the necessity for more resilient and flexible systems, leading to a growing demand for cloud-based SCM solutions. These solutions provide various benefits compared to traditional on-premises systems, such as scalability, real-time visibility, and enhanced collaboration throughout the supply chain network. Cloud computing has emerged as a crucial facilitator for automating supply chain processes, enabling organizations to utilize advanced technologies like the Internet of Things, machine learning, and predictive analytics. This paper will evaluate Google Supply Chain and Logistics Cloud, Microsoft Dynamic 365 Supply Chain Management, AWS Supply Chain Management, and SAP S/4 HANA. Compare these cloud solutions in terms of their features, capabilities, and impact on supply chain automation and performance. Automation is a crucial trend in transforming supply chain management, as it helps organizations streamline operations, reduce errors, and enhance responsiveness. Cloud-based SCM solutions are pivotal in enabling this automation [4].

2. Literature Review

Define the fundamental concepts of cloud computing and supply chain automation. Cloud computing refers to the on-demand delivery of computing services over the Internet, including storage, processing power, and software. It enables organizations to access and utilize these resources without the need to manage the underlying infrastructure, thereby reducing costs and increasing Flexibility. On the other hand, supply chain automation involves using technology to streamline and optimize various aspects of the supply chain, such as inventory management, order processing, transportation, and logistics. By integrating cloud computing into supply chain management, organizations can harness the power of automation to enhance efficiency, visibility, and responsiveness across their supply networks. The literature review explores the benefits and challenges of incorporating cloud-based solutions into supply chain management. Highlights how implementing wireless communication systems and the Internet of Things (IoT) can enable smart supply chain management, allowing for real-time product monitoring, enhanced safety, and increased automation. The research also underscores the importance of digital technologies like machine learning, advanced analytics, and 5G for streamlining supply chain performance and transforming traditional business models. [5] Cloud computing plays a pivotal role in facilitating the automation of supply chain processes, providing the scalable, flexible, and secure infrastructure needed to capitalize on emerging technologies. Cloud-based solutions enable enhanced

visibility, collaboration, and responsiveness across the supply chain network, helping organizations adapt to market fluctuations and evolving customer demands. [6][7]

Supply Chain Management Concepts involve end-to-end transparency throughout all supply chain stages, allowing for real-time tracking of materials, inventory, and information. Automation is critical in improving visibility by providing real-time data capture and analysis. The goal is to continuously enhance supply chain processes to achieve greater efficiency, reduce costs, and improve customer satisfaction. Automation aids in this Optimization by streamlining tasks, reducing errors, and offering data-driven insights for decision-making. Agility refers to the ability to quickly and effectively respond to changes in demand, supply, or market conditions. Automation's enablement of faster processing times, flexible production methods, and real-time adjustments within supply chain operations can be adopted, helping boost agility among companies that fit these criteria.

Collaboration involves seamless information sharing and coordination among all stakeholders, including suppliers, manufacturers, distributors, and retailers, through the provision of a central platform for communication, data exchange, and joint planning, thus ensuring effective collaboration between the parties involved. Automation strategies include process automation, which focuses on automating repetitive, rule-based tasks, freeing up human resources; Data Analytics, leveraging machine-learning techniques that help predict patterns and optimize inventory levels, etc.; Robotics and warehouse Optimization – deploying robots and automated systems aimed at enhancing warehouse operational precision; integration linking devices throughout your organization gathering necessary time-critical parameters ultimately leading into proactive monitoring. Automated Systems are not merely technological add-ons but form an integral enabler essential for successful supply chain management, achieving enhanced insight-driven visibility, better optimized cost-efficient operationally efficient processes while most importantly reinforcing strategic collaborative result-oriented engagement across varied sectors, facilitating overall performance improvement while conserving both financial resources as well as registering higher consumer approval rates than before

2.1. Google Supply Chain and Logistics Cloud

Google Cloud assists businesses in accelerating their digital transformation by leveraging cutting-edge technologies to develop high-quality solutions for enterprises. Trusted by customers worldwide, Google Cloud offers the Supply Chain and Logistics Cloud with a wide range of applications, data, and infrastructure capabilities focused on optimizing supply chain operations. These services utilize Google's big data, artificial intelligence, and cloud computing expertise to deliver supply chain visibility, predictive analytics, and improved collaboration.

The key features of Google's Supply Chain and Logistics Cloud include end-to-end supply chain planning, network optimization, inventory management, transportation management, and demand forecasting. The increasing complexity of supply chains, rising customer expectations, and growing regulatory pressures have made supply chain optimization a critical focus for many organizations. Cloud-based solutions can facilitate greater agility, resilience, and efficiency throughout the supply chain environment. Today's ever-changing business landscape, shaped by technological advances and globalization, demands global structural changes in corporate environments. As a result of this rapid development scenario, embracing cloud computing has become an essential element across industries, including logistics and supply chains, benefiting from integrating technologies like machine learning, the Internet of Things, etc., which is propelled by factors such as resource constraints and heightened client demand.

2.2. Dynamic 365 Supply Chain Management

Supply chain management in Dynamics 365 for Supply Chain Management gives manufacturers, distributors, and retailers all the necessary tools. A wide variety of features are available, from product information management, planning, and inventory management to sales and procurement. Dynamics 365 Supply Chain Management leverages the power of the Microsoft Cloud to deliver a unified, end-to-end solution for managing the entire supply chain lifecycle. Unlike traditional on-premises software, the cloud-based nature of Dynamics 365 enables real-time data synchronization, improved visibility, and seamless integration across departments and business functions.[6] The capabilities of Dynamics 365 Supply Chain Management include demand forecasting, inventory optimization, warehouse and transportation management, advanced analytics, and artificial intelligence-powered insights.[8] With this update, Dynamics 365 Supply Chain Management gets the following new inventory and logistics features to Allow you to do inventory accounting utilizing several costing ledgers to meet numerous accounting standards and internal management accounting simultaneously. In particular, this is beneficial to multinational organizations. External systems may query Supply Chain Management for the inventory location of requested products using the Inventory Visibility Add-in. The system provides an accurate inventory count and places the requested item on hold for a short period. The new rebate workbench streamlines rebate processing in the rebate management module. The Landed Cost Module additions provide warehouse managers additional control over the putaway process for goods-in-transit orders. An improvement in tracking the arrival dates of imported products in the Landed Cost module. Customizable cause codes to post on-site adjustments: Warehouse and retail shop personnel can pick the cause for each on-hand inventory modification while working. The system may then be configured to post each adjustment to its designated offset account immediately.

Flexible price characteristics specify prices and discounts in the pricing service. It offers an Omni channel pricing engine that can discover the proper price for the goods based on the relevant price, discounts and promotions, and a trade agreement, among other factors. This gives organizations a centralized pricing engine that can provide consistent and accurate pricing across all sales channels. App updates for the Warehouse Management mobile app: Instructions and prompts for employees that may be customized by the user and are localized. In order to speed up warehouse operations, the system may now scan GS1 standard barcodes. Supply chain management and standard production execution systems can be integrated. The solution's no-code onboarding procedure makes it easier to get started and saves time and money in the long run. This software offers an end-to-end view of the manufacturing process and a command of the factory floor.

For the first time, warehouse workers may record raw material consumption data using a smartphone app connected to a scale unit. Manufacturers may take advantage of a distributed hybrid architecture's enhanced robustness and performance while ensuring material traceability, precise inventory records, and shop-floor efficiency. Using finite scheduling techniques, determine whether future resource capacity constraints will result in unexpected delays. This method makes automated notification of material shortages and affected consumers possible. During scheduling, allocate resources according to their capabilities. A route operation's requisite capabilities might be specified rather than delegated to a particular collection of resources. Using this setup, the resource allocation for a specific production task will be determined by scheduling, which will match up the necessary capabilities with the capabilities of available resources. Incorporate planning optimization into process manufacturing scenarios. The system now supports batch orders and commodities with a limited shelf life for process manufacturers.

2.3. AWS Supply Chain Management

Amazon Web Services offers a wide array of tools and services to enhance supply chain management for businesses of all sizes. These solutions enable companies to streamline operations, improve visibility, and increase efficiency throughout their supply chains. Key AWS offerings tailored for supply chain management include Supply Chain Visibility, which provides real-time insights into operations, allowing businesses to monitor inventory levels, track shipments, and identify potential disruptions; Data Integration, which consolidates data from various sources like IoT devices, ERP systems, and third-party logistics providers to provide a unified view of the entire supply chain; Predictive Analytics that utilizes machine learning and artificial intelligence to predict demand trends, optimize inventory processes, and anticipate potential challenges ahead; Scalable Infrastructure with features like Elastic Scalability through services such as

Amazon Redshift and Amazon Kinesis that automatically adjust capacity based on varying data loads ensuring optimal performance during peak times as well as Serverless Computing offering cost-efficient code execution in response to supply chain events without the need for server management. [9][10][11] AWS provides robust security features, including data encryption at rest and in transit, identity and access management, and continuous monitoring. It also adheres to various industry standards and regulations to ensure secure and compliant handling of supply chain data. [12]Additionally, Amazon SageMaker offers advanced machine-learning algorithms for optimizing supply chain processes such as routing, inventory management, and logistics. AWS services contribute to operational efficiency by streamlining operations, reducing waste, improving resource utilization, and offering flexible API integration for third-party applications tailored to specific business needs using modular services.[13]

AWS's pay-as-you-go pricing model allows businesses to only pay for the resources they use, leading to significant reductions in operational costs. AWS provides cost management tools like AWS Cost Explorer and AWS Budgets to aid in managing and optimizing spending on supply chain operations. On the collaboration side, AWS enables secure data sharing across departments and external partners while offering real-time collaboration and communication tools for supply chain stakeholders[14]. Furthermore, with continuous updates featuring new features and improvements, businesses can always access the latest technologies through AWS services. Additionally, AWS's investments in AI and machine learning provide advanced automation capabilities and intelligent decision-making within supply chain management processes.[15] AWS's broad portfolio of services and tools equips organizations with a comprehensive platform to enhance their supply chain operations, reduce costs, and achieve greater visibility and control across their entire value chain.[16][17][12][18] By leveraging the AWS Cloud's scalability, reliability, and global reach, businesses can adapt their supply chain infrastructure to changing market demands and scale operations up or down as needed, avoiding the upfront capital expenditure and ongoing maintenance associated with on-premises IT infrastructure. Customers can also take advantage of the AWS Partner Network, which offers a wide range of third-party applications and solutions tailored for supply chain optimization, further enhancing the capabilities of the AWS platform.

2.4. SAP S/4 Hana
SAP S/4HANA is an integrated enterprise resource planning (ERP) suite designed to run on the SAP HANA in-memory database. It offers a modern, simplified, efficient approach to managing business operations. Below are the key features of SAP S/4HANA that make it a powerful tool for enterprises to streamline their supply chain management. Real-time analytics and reporting: SAP S/4HANA provides

real-time access to critical supply chain data, enabling businesses to make informed decisions based on up-to-date information. The platform's advanced analytics capabilities allow companies to gain deeper insights into their supply chain performance, identify bottlenecks, and optimize processes. [19][20] Intelligent automation: SAP S/4HANA incorporates intelligent automation features, such as machine learning and robotic process automation, to streamline repetitive tasks, improve forecasting, and automate decision-making. In-Memory Computing High Performance the SAP HANA in-memory database allows for real-time data processing and analytics, drastically reducing the time needed for data retrieval and analysis; simplified Data Model The in-memory architecture simplifies the data model by removing redundancies, allowing for faster transactions and analytics. Real-Time Analytics Embedded Analytics Provides real-time insights directly within the business processes, enabling data-driven decision-making without needing separate analytics tools. Predictive Analytics Utilizes advanced analytics and machine learning capabilities to predict future trends and outcomes, helping businesses to be proactive. Enhanced User Experience SAP Fiori UX A modern, role-based user interface that enhances user productivity and satisfaction with an intuitive design and seamless experience across devices; personalization: Users can personalize their interface to meet their specific needs, making accessing frequently used features and reports easier.

SAP S/4HANA integrates critical business functions like finance, sales, supply chain, manufacturing, and human resources into one platform. It facilitates smooth integration with other SAP solutions and third-party applications to ensure seamless end-to-end process integration across the organization. The Universal Journal combines financial and managerial accounting data into a unified source to comprehensively assess financial performance while reducing reconciliation efforts. Real-time data and automation features also enhance the speed and accuracy of financial closing processes. Additionally, it offers real-time supply chain visibility and advanced planning capabilities to optimize inventory levels and improve efficiency in supply chain operations. For manufacturing processes, it integrates with IoT technologies and Industry 4.0 to facilitate innovative manufacturing operations, including predictive maintenance and efficient production planning. Simplified Management of IT Complexity: SAP S/4HANA simplifies the IT landscape by consolidating data and processes into a single platform, making managing it more accessible. Deployment Flexibility: It offers various deployment options (cloud, on-premises, hybrid) for businesses to choose based on their needs. Enhanced Data Governance Centralized Data Hub ensures data consistency and accuracy across the enterprise. Improved compliance features help meet regulatory requirements while Robotic Process Automation automates repetitive tasks, leading to increased efficiency and reduced errors. Intelligent Insights Embedded AI and machine learning capabilities

optimize business processes, provide intelligent insights, and automate decision-making. Scalability & Flexibility The scalable architecture supports business growth while allowing modular design, which enables businesses to implement only the required functionalities. Compliance & Risk Mitigation SAP S/4HANA reduces non-compliance risk through support for global regulations and tools for identifying, assessing, and mitigating risks across the enterprise. Customer Interactions Enhancement Customer Experience is enhanced with personalized interactions facilitated by improved customer management capabilities. Vendor Collaboration Streamlines vendor management, enabling efficient procurement processes.

3. Methodology and Comparison
3.1. Features

Comparison of Key Features of Google Supply Chain and Logistics Cloud, Dynamics 365 Supply Chain Management, AWS Supply Chain Management, and SAP S/4HANA. When evaluating automation using supply chain cloud solutions, it is essential to compare the key features and capabilities of leading platforms in the market, as shown in Table 1.

Table 1. Key Feature Comparison

Feature	Google Supply Chain and Logistics Cloud	Dynamics 365 Supply Chain Management	AWS Supply Chain Management	SAP S/4HANA
Real-Time Analytics	Yes	Yes	Yes	Yes
AI and Machine Learning	Strong	Strong	Strong	Advanced
ERP Functionality	Limited	Comprehensive	Limited	Comprehensive
Data Integration	Strong	Strong	Strong	Strong
Scalability	High	High	High	High
Deployment Options	Cloud	Cloud, On-Premise, Hybrid	Cloud	Cloud, On-Premise, Hybrid
User Interface	Modern, Google Workspace Integration	Modern Microsoft Ecosystem Integration	Functional, AWS Management Console	Modern, SAP Fiori
Industry-Specific Solutions	General	Some industry solutions	General	Extensive
Security and Compliance	Robust	Robust	Robust	Robust
Predictive Analytics	Yes	Yes	Yes	Yes
IoT Integration	Yes	Yes	Yes	Yes
Vendor Management	Limited	Strong	Limited	Strong
Implementation Complexity	Moderate	Moderate	Moderate to High	High
Cost Efficiency	Pay-as-you-go	Variable licensing can be complex	Pay-as-you-go	High, depending on the customization

3.1.1. Google Supply Chain and Logistics Cloud

Google Supply Chain and Logistics Cloud offers a comprehensive suite of tools for optimizing supply chain operations, including demand forecasting, inventory management, transportation planning, and supplier collaboration [19]. It leverages Google's advanced analytics and machine learning capabilities to provide real-time visibility, intelligent automation, and predictive insights to enhance supply chain efficiency.

Key Features

Data integration involves combining information from diverse sources such as ERP systems, IoT devices, and third-party logistics providers to present a unified supply chain perspective. It utilizes Google's AI and machine learning expertise to forecast demand, optimize inventory, and recognize potential disruptions in the supply chain. Additionally, it delivers real-time analytics and insights to enhance decision-making processes and operational effectiveness. The system is designed with scalability in mind using Google Cloud's adaptable infrastructure, which can manage substantial volumes of data and transactions.

Collaboration is improved through tools like Google Workspace for seamless communication and data sharing. Moreover, it provides strong security features aligned with global standards while ensuring compliance. Its key strengths reside in its powerful AI capabilities, robust real-time analytics functionalities, and seamless integration across other Google Cloud services.

Limitations

While Google Supply Chain and Logistics Cloud offer a robust set of supply chain management capabilities, some businesses may require more specialized features or industry-specific solutions that other cloud platforms may better provide. Limited ERP functionality compared to dedicated ERP systems. Requires integration with existing ERP systems for comprehensive SCM.

3.1.2. Dynamics 365 Supply Chain Management

Dynamics 365 Supply Chain Management offers a comprehensive ERP solution that integrates supply chain management with other critical business functions such as finance, manufacturing, and sales. It provides advanced supply chain planning, warehouse, transportation, and asset management capabilities.[6]

Key Features

Comprehensive Visibility of the Supply Chain: Provides complete transparency across the supply chain, from procurement to production to distribution. Advanced Analytical Techniques: Leverages artificial intelligence and predictive analysis for optimizing operations and forecasting demand. Smooth Incorporation with Microsoft Software Suite: Seamlessly integrates with various Microsoft tools, including Azure, Power BI, and Office 365. Implementation of IoT and Use of Mixed Reality: Integrates IoT data for real-time monitoring and employs mixed reality for improved asset management and training. Diverse Deployment Alternatives: Available on cloud-based platforms, on-premise setups, or hybrid environments. Enhanced Management of Suppliers: Simplifies vendor relationships and streamlines procurement procedures. One of the notable strengths of this solution is its robust integration with the Microsoft ecosystem.

Limitations

Flexible deployment options may necessitate considerable tailoring for intricate supply chains. Advanced features in IoT technology and mixed reality applications can be a cutting-edge addition. Licensing for extensive deployments might involve intricacies and high costs.

3.1.3. AWS Supply Chain Management

AWS Supply Chain Management offers integrated services that enable businesses to optimize their supply chain operations.[7]It provides tools for demand forecasting, inventory management, transportation planning, and supplier collaboration, all powered by AWS's robust cloud infrastructure and advanced analytics capabilities.

Key Features

Real-Time Monitoring: Enables real-time monitoring and tracking of inventory, shipments, and supply chain operations. Predictive Analysis: Employs artificial intelligence and machine learning to predict demand and optimize inventory levels. Data Connectivity: Facilitates integration with diverse data sources and systems to establish a unified supply chain perspective. Expandable Framework: Leverages AWS's expandable cloud infrastructure to efficiently manage fluctuating data loads. Safety Measures & Adherence: Offers robust security features and adherence to industry standards for compliance. Event-Responsive Structure: Utilizes AWS Lambda to automate supply chain processes based on specific events. Its strengths lie in its highly scalable and adaptable infrastructure, strong predictive analytics capabilities, comprehensive data integration, and real-time monitoring benefits from AWS's resilient security measures ensuring compliance.[9]

Limitations

Implementation and integration with existing systems necessitate significant technical expertise. Full ERP functionality requires seamless integration with other systems, making the setup and management potentially complex without sufficient expertise.

3.1.3. SAP S/4HANA

SAP S/4HANA offers a comprehensive, cloud-based enterprise resource planning (ERP) solution that integrates supply chain management with other critical business functions [3].[19]It provides advanced supply chain planning, logistics, and procurement capabilities, with embedded analytics and machine learning for enhanced decision-making.

Key Features

In-Memory Computing: Delivers top performance and immediate data processing through the in-memory database of SAP HANA. Real-Time Analytics: Integrates analytics directly into business operations for instant insights. Extensive ERP Functionality: Merges all key business processes, such as finance, sales, supply chain, manufacturing, and HR. SAP Fiori UX: Presents a modern and user-friendly interface with SAP Fiori. Advanced Financial Management: Unites financial and managerial accounting within a single source. Supply Chain Optimization: Offers real-time visibility into supply chains and advanced planning capabilities. Industry-Specific Solutions: Tailors solutions to meet the needs of different industries, including comprehensive ERP functionality integrated SCM in strengths alongside real-time data processing and analytics strengths.

Limitations

Implementing and maintaining can be intricate and costly. It demands extensive customization to meet specific business requirements. While offering a robust and holistic solution, the complexity involved in implementing and managing SAP S/4HANA may pose challenges for some organizations, particularly SMEs, that require more agile and cost-effective supply chain management capabilities. Each solution offers unique strengths, with Google excelling in AI and real-time analytics, Dynamics 365 offering seamless integration with Microsoft products and robust ERP functionality, AWS

providing scalable infrastructure and predictive analytics, and SAP S/4HANA delivering comprehensive ERP capabilities with industry-specific solutions. The choice of solution depends on the business's specific needs, existing infrastructure, and strategic goals.

3.2. Popularity

When comparing the popularity of Google Supply Chain and Logistics Cloud, Dynamics 365 Supply Chain Management, AWS Supply Chain Management, and SAP S/4HANA, several factors need to be considered, including market penetration, adoption by major companies, industry recognition, and user community engagement as described in Table 2.

3.2.1. Google Supply Chain and Logistics Cloud

Google Supply Chain and Logistics Cloud is a relatively new entrant compared to other platforms, indicating its gradual market acceptance. Robust AI Capabilities: By utilizing Google's proficiency in AI and machine learning, it has the potential for rapid expansion, given the increasing adoption of these technologies in managing supply chains. Embraced by Technologically Proficient Companies: It is favored by firms already using Google Cloud Platform for other services due to smooth integration and familiar infrastructure—growing Market Presence: Gaining acknowledgment, particularly within industries making substantial investments in AI and analytics. Expanding User Community: Forming a community focused on Google Cloud

services with growing support and dedicated forums for supply chain solutions. The factors that contribute to the popularity of Dynamics 365's supply chain management include its strong integration with Microsoft's widely used ecosystem (such as Office 365 and Azure), making it a favored option for companies that have already committed to Microsoft technologies. Additionally, the software provides comprehensive ERP and SCM capabilities, appealing to mid-to-large enterprises due to its wide range of features that meet various business requirements.

Furthermore, it has achieved high market penetration across multiple industries, especially in areas where Microsoft products are widely utilized. Moreover, there is an established and active user community with extensive resources, forums, and support from Microsoft and third-party partners.

3.2.2. AWS Supply Chain Management

AWS Supply Chain Management is the leading force in cloud computing, with its supply chain management solutions gaining popularity due to its dominance in the market. It appeals to businesses seeking scalable, flexible infrastructure for their supply chain requirements. AWS has a high market penetration and is widely adopted across different industries, especially among companies that value cloud solutions and scalability. Additionally, it boasts a strong user community with ample support through forums and resources specific to AWS users engaging in supply chain management discussions.

Table 2. Popularity comparison

Feature	Google Supply Chain and Logistics Cloud	Dynamics 365 Supply Chain Management	AWS Supply Chain Management	SAP S/4HANA
Market Penetration	Emerging	High	High	Very High
Adoption by Major Companies	Growing, especially tech-savvy firms	Widely adopted across various industries	Broad adoption across industries	Extensive adoption, huge enterprises
Industry Recognition	Increasing	Well-recognized	Highly recognized	Long-standing and highly recognized
User Community	Growing	Established	Robust	Extensive
Integration with Existing Systems	Vital for Google Cloud users	Seamless with Microsoft products	Strong for AWS services	Comprehensive integration across systems

3.2.3. SAP S/4HANA

SAP S/4HANA Legacy and Trust in Popularity: SAP's established standing in the ERP market is continued through S/4HANA, which offers modern capabilities. Extensive ERP Functionality: Renowned for its thorough and strong ERP features, it is favored among large enterprises with intricate supply chain requirements. Wide Market Adoption: It holds one of the highest adoption rates globally, particularly within large corporations and industry-specific uses. Broad User Community: An expansive and well-developed user community with substantial resources such as forums, user groups, extensive documentation, and support from SAP exists. SAP S/4HANA is the most widely adopted by large enterprises, followed by Dynamics 365 and AWS, which have

strong user communities. Although Google is proliferating, it still needs to catch up in overall popularity but has significant potential due to its AI capabilities and integration with Google Cloud.

3.3. Integration Capability

The integration capabilities of these cloud-based supply chain solutions are essential for enterprises aiming to achieve smooth data exchange and process automation across their operations. This article thoroughly compares the integration features of Google Supply Chain and Logistics Cloud, Dynamics 365 Supply Chain Management, AWS Supply Chain Management, and SAP S/4HANA, as described in Table 3.

3.3.1. Google Supply Chain and Logistics Cloud

Google Supply Chain and Logistics Cloud is seamless integration with other Google Cloud services, such as BigQuery, Cloud AI, and Google Workspace. APIs and Data Connectors: It offers robust APIs and data connectors that facilitate integration with various third-party applications and existing ERP systems. Big Data Integration: The strong capability to integrate with big data tools and platforms enhances data analytics and insights.

Partner Ecosystem: A growing ecosystem of partners providing integration services and pre-built connectors. Strengths include excellent integration with Google's suite of tools and services, strong APIs for custom integrations, and effective for companies already using Google Cloud services. Limitations still need to be improved in building a broader ecosystem of third-party integrations compared to more established solutions.

3.3.2. Dynamics 365 Supply Chain Management

Integration Capabilities within the Microsoft Ecosystem seamlessly connect with other Microsoft products such as Azure, Office 365, Power BI, and Power Automate. Using Dataverse for data integration across Microsoft applications facilitates a unified data model. It offers an extensive collection of APIs and pre-built connectors to integrate with third-party applications and services.

Additionally, it provides strong integration capabilities with Azure IoT, Azure Machine Learning, and other Azure services. Its strengths include seamless integration within the Microsoft ecosystem, robust APIs and pre-built connectors, and effective data integration through Dataverse. However, challenges may arise in integrating non-Microsoft systems due to increased complexity.

3.3.3. AWS Supply Chain Management

Google Supply Chain and Logistics Cloud integrates seamlessly with AWS services like Amazon S3, Amazon Redshift, AWS IoT, and Amazon SageMaker. It offers extensive APIs and SDKs for integrating third-party applications and custom solutions. Moreover, it provides solid capabilities for creating data lakes and executing ETL operations using AWS Glue and Amazon Athena[16][12]. The large AWS Partner Network offers numerous integration solutions and services. Its strengths include excellent integration with the cloud services provided by AWS, extensive APIs and SDKs for customized integrations, and robust support for data lakes and ETL processes. However, effective integration requires expertise in working with AWS services.

3.3.4. SAP S/4HANA

Ecosystem Integrates seamless integration with various other SAP products such as SAP Ariba, SAP SuccessFactors, SAP Concur, and SAP Analytics Cloud is emphasized. Utilization of the SAP Business Technology Platform for integrating and extending applications is highlighted. Additionally, a wide array of APIs and integration services are available, including the use of SAP Cloud Platform Integration. Strong support for connecting with non-SAP systems through pre-built connectors and third-party tools is also mentioned as one of its strengths. It offers deep integration within the entire ecosystem, a comprehensive set of APIs, and strong support for complex enterprise-wide integrations. However, it may pose challenges in terms of complexity and may require extensive customization and expertise. Each solution offers robust integration capabilities customized to its environment, leading the decision-making process to rely heavily on the company's current technology stack and unique integration needs.

Table 3. Integration comparison

Feature	Google Supply Chain and Logistics Cloud	Dynamics 365 Supply Chain Management	AWS Supply Chain Management	SAP S/4HANA
Native Ecosystem Integration	Strong with GCP	Seamless within the Microsoft ecosystem	Strong with AWS services	Deep integration within the SAP ecosystem
APIs and SDKs	Robust APIs	Extensive APIs and pre-built connectors	Extensive APIs and SDKs	Comprehensive APIs and integration services
Third-Party Integration	Growing ecosystem	Robust with many pre-built connectors	Large partner network	Strong support for third-party systems
Data Integration	Strong big data integration	Unified data model with Dataverse	Robust data lake and ETL capabilities	Comprehensive data integration capabilities
Custom Integration	Flexible with APIs and connectors	Flexible with APIs and Power Automate	Flexible with APIs and SDKs	Flexible with APIs and SAP Cloud Platform
Partner Ecosystem	Growing	Established	Extensive	Extensive

4. Conclusion

The assessment of the automation and supply chain cloud solutions from Google, Microsoft, AWS, and SAP highlights each platform's strengths and limitations. While SAP S/4HANA remains the most widely adopted ERP system, particularly among large enterprises with complex supply chain requirements, the other solutions are gaining traction

and offering viable alternatives. Target Audience: Google Supply Chain and Logistics Cloud are well-suited for organizations already invested in the Google ecosystem, leveraging the seamless integration with other Google Cloud services and the growing partner ecosystem. Dynamics 365 Supply Chain Management excels at integrating with the broader Microsoft product suite, making it an attractive option for companies heavily reliant on Microsoft technologies. AWS Supply Chain Management is a compelling choice for enterprises that have already embraced the AWS cloud infrastructure, benefiting from the tight integration with a wide range of AWS services and robust data integration capabilities. On the other hand, SAP S/4HANA remains the preferred solution for large enterprises with complex supply chain requirements, as it offers deep integration within the entire SAP ecosystem, a comprehensive set of APIs, and strong support for integrating with non-SAP systems. The choice of automation and supply chain cloud solutions ultimately depends on the organization's existing technology landscape, the level of integration required, and the specific needs of the supply chain operations.Popularity Insights analysis, SAP S/4HANA maintains its position as the most widely adopted ERP system, particularly among large enterprises with intricate supply chain requirements. Nevertheless, the other solutions, such as Google Supply Chain and Logistics Cloud, Dynamics 365 Supply Chain Management, and AWS Supply Chain Management, are gaining traction and emerging as viable alternatives, catering to organizations with diverse technology preferences and integration needs. Integration Capability Insights various cloud-based supply chain solutions demonstrate robust integration capabilities tailored to their respective ecosystems. Google Supply Chain and Logistics Cloud seamlessly integrate with other Google Cloud services, exhibiting strengths in the Google-centric environment.

Dynamics 365 Supply Chain Management excels at integrating with the broader Microsoft product suite, making it a compelling choice for companies heavily invested in Microsoft technologies. AWS Supply Chain Management, on the other hand, offers tight integration with a wide range of AWS services, providing enterprises already embracing AWS cloud infrastructure with robust data integration capabilities.

Acknowledgements

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