

# Enhancing Supply Chain Efficiency to Build Next-Gen Artificial Intelligence (AI)/Machine Learning Network Through AI-Driven Forecasting

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**Abstract**— The networking hardware industry is characterized by unique challenges when it comes to supply chain management. These include unpredictable demand patterns, complex logistics, besides disruptions caused by rapid technological advancements. This paper explores the integration of artificial intelligence (AI) into forecasting methodologies to enhance supply chain efficiency within the sector. Application of AI-driven forecasting models can help organizations improve demand predictions, refine inventory management, and streamline logistical operations. Drawing on recent research and industry practices, this article highlights the transformative impact of AI on supply chain efficiency and offers insights into best implementation practices. Furthermore, the research investigates the intersection of AI and networking hardware supply chain management, focusing on leveraging AI to analyze hardware failure patterns and interpret hardware-generated alarms and interrupts. By harnessing analytical capabilities of AI, modern organizations can extract actionable insights to reduce failure rates and enhance supply chain forecasting accuracy. The paper demonstrates the benefits of integrating AI models into networking equipment like routers, switches, and servers to predict failures and forecast spare parts needs, reducing network downtime. This innovative approach improves anticipation and preparation for hardware failures, optimizing spare part inventory and minimizing costly return merchandise authorizations (RMAs).

**Keywords**— Supply Chain, Supply Chain Management, SCM, IT, Networking, Hardware, IT Networking, data, communication, Artificial Intelligence, AI.

## 1. Introduction

Networking hardware, also known as network equipment or computer networking devices, refers to electronic devices which are needed for communicating and interacting between devices on a computer network. To be precise, these devices act as mediators in the transmission of data within a computer network. The progression of the Information and Communication Technologies (ICT) industry has resulted in growing demand for networking hardware as the constituent devices facilitate communication and data exchange between devices connected to the internet.

The Networking Hardware Market size is estimated to be worth \$110.8 bn in 2023 and is anticipated to grow at a compounded annual growth rate (CAGR) of 4.3% during 2024-2030, reaching \$148.77 bn by 2030 (Figure 1), driven by such factors as Digital Transformation initiatives, growing need for High-Speed and Reliable connections due to increase in hybrid and remote work mode, greater adoption of cloud computing, proliferation of Internet of Things (IoT), and adoption of 5G technology [1].

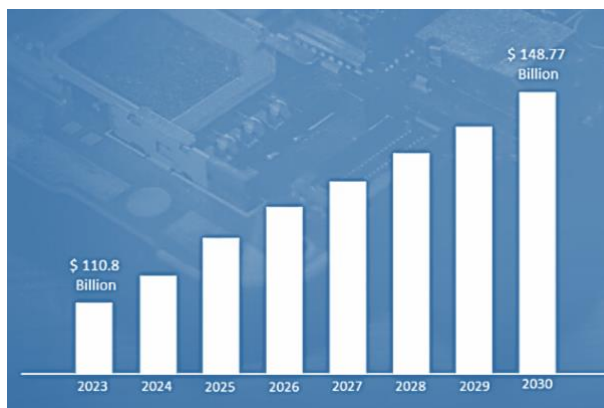


Figure 1: Worldwide Market for Networking Hardware

The modern era is seeing rapid expansion of digital technology throughout the world. This coupled with increased globalization has resulted in the introduction and diffusion of innovative network and information technologies. An obvious outcome of this development is the proliferation of various risks and threats to people and societies, both in terms of quality and quantity which in turn would demonstrably bring about the growth and development of a range of threats pertaining to information integrity. There is a high degree of possibility that the creation of different kinds of risks and the growth in the number of threats pertaining to information security would continue to result in larger and many more challenges due to factors such as the development and expansion of telecommunications network across the globe, the embracing and implementation of various novel network technologies, and the growth and expansion of semantic Internet and popular media [2].

The networking hardware industry faces distinctive challenges in managing its supply chain, marked by fluctuating demand patterns, intricate logistics, and constant technological evolution. This paper explores the transformative potential of integrating artificial intelligence (AI) into forecasting methodologies to enhance supply chain efficiency within the sector. By harnessing AI-driven forecasting models, organizations can achieve greater precision in demand predictions, refine inventory management practices, and streamline logistical operations. Moreover, the complexity of forecast and spare planning in this industry can lead to significant financial repercussions. Delays in supplying hardware for critical network expansions can result in revenue loss, while overstocking of

excess inventory can lead to wastage of resources. These challenges underscore the urgent need for innovative solutions, such as AI-driven forecasting, to mitigate risks and optimize supply chain performance.

## 2. Literature Review

The modern era is an era of globalization and digitalization. Communication and data are of utmost importance. Growth in ICT leading to proliferation of online businesses and an explosion of online consumerism has made it imperative for contemporary businesses to build resilience and agility into their systems to be able to cater to the fast-changing consumer demand. Coupled with these geopolitical instabilities have made it necessary that these organizations are able to alter their operations and brace for any kind of disruptions that may be caused. Technological disruptions altogether present a different set of challenges. All these factors make it necessary that the demand be forecasted with as much accuracy as is possible and carry out supply chain management using the next-generation networks. Enterprises are likely to create next-generation networks at the time they implement new technologies and strategies [3]. Flexibility, agility along with easy-to-manage architecture of next-generation networks make it possible for modern businesses to meet contemporary business demand. To build the next-generation network, it's essential to understand the intricate components involved in the supply chain (SC) process.

### 2.1 Supply Chain Process

Supply chain (SC) refers to the whole gamut of activities that is instrumental in the conversion of raw materials and various components into a device or product that is ready to use which is then dispatched for shipping to the final customer [4]. A supply chain involves the passage and storage of raw materials, work-in-process inventory, and the movement of goods from the point of its origin to point of its consumption [5]. Such a network comprises of a large number of activities and businesses, intertwined in an extremely complex manner, that operate in collaboration by drawing synergy from the series of activities involved such as the extraction and supply of raw materials, production of the commodity, integration of working sections using the assembly line, followed by packaging, transfer of the produced article to the distributors and retailers, and finally delivery of the finished product to the final consumers [6].

Management of supply chain, therefore, involves a difficult and challenging administrative process of managing the logistics system that is responsible for conversion of raw materials into final products ready for consumption and their delivery to the doorstep of the final consumers [7]. The supply chain process in the networking hardware industry encompasses various stages and components, each playing a crucial role in ensuring the seamless flow of products from procurement of inputs to delivery of outputs to the end-users.

#### *2.1.1. Procurement*

This involves sourcing raw materials and components required for manufacturing networking hardware [8]. It requires careful supplier selection, negotiation, and contract management to ensure timely availability of materials while maintaining cost-effectiveness. Irrespective of the level of experience of the purchasers, collection of data, transparency, and identification of better alternatives pose significant challenges. The restriction of malpractices is not enough to ensure cost efficiency and a structural transformation that accommodates continuous improvement is crucial [9].

#### *2.1.2. Manufacturing:*

Networking hardware manufacturing plays the pivotal role in the provision of the vital tools that are necessary for facilitating smooth functioning of different industries. Once the components are procured, they undergo the manufacturing process, where they are assembled into networking hardware products. The process of manufacturing comprises numerous critical components, that include product design, prototyping, testing, and production [10]. The key activities involved in this stage are efficient production planning, quality control measures, and adherence to industry standards to produce reliable and high-quality products.

#### *2.1.3. Inventory Management:*

Critical to balancing supply and demand, inventory management involves tracking and managing inventory levels of raw materials, work-in-progress, and finished goods to prevent stockouts or overstocking. Inventory visibility, knowing the precise time for ordering, the volume in which to order and the place in which to store the stock, are the crucial aspects of inventory management. Effective inventory management relies on accurate demand forecasting and optimization techniques. Inventory management is a critical aspect of the supply chain and involves keeping a track of the

inventory from manufacturers to warehouses and from the warehousing facilities to the point of sale (PoS). The key objective of efficient Inventory management is having the right products in the correct place and at the correct time [11].

#### *2.1.4. Logistics and Distribution:*

Distribution channels have a crucial role to play in the supply chain as they are the pathways through which products and services travel from the manufacturer to the end consumer. The efficiency and effectiveness of these channels depends heavily on the seamless integration of logistics processes. This entails the transportation of networking hardware products from manufacturing facilities to distribution centers and ultimately to end-users. It involves optimizing transportation routes, selecting reliable carriers, and ensuring timely delivery to meet customer demand. logistics costs are the sum of inventory, transportation, and facility costs for a supply chain network [12].

#### *2.1.5. Demand Forecasting:*

A pivotal component of supply chain planning is demand forecasting which helps in decision making and involves predicting future demand for networking hardware products based on historical sales data, present market trends, anticipated market developments and several other factors. It also creates the base for planning activities in response to consumer demand. Recent developments in statistical studies make it possible to forecast demand using novel, robust and easy approaches [13]. Accurate demand forecasting enables organizations to optimize production schedules, manage inventory levels, and allocate resources effectively.

#### *2.1.6. Spare Parts Management:*

Spare parts are crucial for supporting ongoing maintenance and repair activities, management involves maintaining an inventory of critical spare parts, optimizing stocking levels, and ensuring rapid availability to minimize downtime and service disruptions [14]. There are several sectors, such as automotive, Information & Communication Technology, medical and industrial equipment, in which the business of spare parts forms an important source of revenue. Nevertheless, this activity is generally difficult to handle since there is intensifying competition fueled by such developments as globalization, technological evolution and stronger emergence of spare parts markets [15].

### 2.1.7. Reverse Logistics:

Managing product returns, repairs, and recycling at the end of the product life cycle requires efficient processes for handling returns, refurbishing or repairing defective products, and responsibly disposing of end-of-life hardware to minimize environmental impact. Reverse Logistics (RL) has become increasingly important as a business strategy that is profitable and sustainable. It is defined to be a process that involves acceptance of used products from consumers by the manufacturer for recycling or remanufacturing those products. Both the finished products as well as their component parts can act as inputs for RL. Other items that can be used as inputs are the non-used products that have any defect, products that have remained unused past their expired date or information. In essence it is a reverse flow that begins with the end-product. In general, the RL processes operate from the consumers to the manufacturer and sometimes from the last user but not the final one. For instances where the purpose behind the recovery is that the product has gone past its expiry date. In these cases, the said product will be retired from the vendor and not from the final consumer [16].

## 2.2 Importance of Forecasting in Supply Chain Management (SCM)

Supply chains can run effectively when powered by accurate forecasting. In SCM within an industry, forecasting would mean the act of predicting supply, demand, and pricing [17]. Demand forecasting, considered to be extremely helpful in the determination of the necessary production capacity, scheduling of production orders, and allocation of resources in an efficient manner. From the perspective of inventory management, demand forecasting helps in maintaining optimal levels of inventory, bringing down the risk of stockouts or accumulation of excess inventory, and improving general inventory turnover [18]. The capacity to observe, examine and forecast demand, to optimize levels of inventory, and to better logistics planning has significant bearing on the creation and maintenance of a company's competitive edge and has hence become increasingly crucial in the contemporary fast-paced and highly dynamic global market [19]. Production volume that approximates consumer demand would be an ideal situation for every manufacturer as it reduces wastage and cuts down costs [13].

### 2.2.1. AI-Driven Forecasting Models:

This technology brought about a paradigm shift in supply chain management. AI-driven forecasting models offer advanced analytical capabilities and predictive insights that surpass traditional statistical methods [19]. By harnessing machine learning algorithms, neural networks, and predictive analytics, these models can analyze vast amounts of data, identify patterns, and generate accurate demand forecasts with unprecedented precision. Today's dynamic world demands reliable forecasting for companies to make informed decisions, handle prevalent and emerging risks, and achieve long-term success and AI has emerged as the transformative force that is likely to make all this possible [20].

### 2.2.2. Benefits of AI-Driven Forecasting:

Supply chain management has become more challenging than ever before, but help is just round the corner. AI provides one of the best solutions to these challenges. Artificial intelligence, or AI as it is popularly known, is a discipline that imparts human-like intelligence to computers which they apply while performing a task [21]. The adoption of AI-driven forecasting yields numerous benefits that translate into enhancement of supply chain efficiency and performance. These models offer higher accuracy in demand forecasting, proactive risk management, and real-time decision-making, thereby increasing agility and boosting competitiveness.

It is possible for AI to offer deeper insights to the teams. The relevant information and insights come at much higher frequency and with higher granularity compared to the past. Often forecasting turns out to be a challenging job in a business environment because of consequences of errors which are generally costly [22]. Nevertheless, this higher visibility alone will not suffice for capturing better value from supply-chain solutions that are based on AI. Just like in case of any other transformation, in case of AI as well the technology investment is significantly large and needs to be matched by alterations at the organizational levels, up-to-date business process, and efforts at large-scale upskilling of the workforce. All these are preconditions for the companies to capture the expected return on investments made in AI-driven demand forecasting solutions [23].

### 2.3 Supply Chain Day-to-Day Tasks While Building the Next Generation Network

In the dynamic realm of the networking industry, the supply chain orchestrates a myriad of day-to-day tasks essential for constructing the next-generation network infrastructure. At its core, the supply chain shoulders the responsibility of procuring an extensive array of materials and components vital for manufacturing networking hardware, ensuring seamless connectivity and robust performance across digital landscapes [24].

IT hardware networking endeavor begins with procurement, it involves the acquisition of electronic components, ranging from semiconductors and integrated circuits to resistors, capacitors, transistors, and diodes [25]. These components serve as the building blocks of networking devices, powering the intricate circuits that drive data transmission and processing.

Connectors and cables emerge as the essential conduits that facilitate physical connections within networking infrastructure. They are absolutely essential for connectivity and data transfer. Ethernet cables, fiber optic cables, connectors, adapters, and patch panels play a pivotal role in establishing reliable communication pathways, enabling the seamless flow of information across networks [26]. Deployment of ethernet cabling is a core component of any network and serves as the backbone that ensures reliable and high-speed data transfer and communication [27].

Printed circuit boards (PCBs) form the foundational framework upon which electronic circuits are constructed within networking hardware. Customized to meet specific device requirements in terms of size, shape, and layout, PCBs serve as the backbone of networking devices, enabling the integration of complex functionalities and features. PCB manufacturing lines have the capacity to significantly scale up the production yield and throughput and at the same time dramatically reduce the manufacturing costs [28].

Enclosures and casings provide vital protection for networking hardware, shielding delicate components from environmental hazards such as dust, moisture, and electromagnetic interference (EMI) [29]. Crafted from durable materials such as metals, plastics, or composites, enclosures ensure the longevity and reliability of networking equipment in diverse operating environments.

The efficient heat dissipation of electronic equipment is very important. Heat dissipation materials, including heat sinks, thermal pads, thermal paste, fans, and ventilation systems, play a crucial role in managing thermal energy generated

during operation. By dissipating excess heat, these components prevent overheating and ensure optimal performance and reliability of networking hardware [30].

Power supplies and batteries furnish the electrical energy required to power networking devices, comprising AC/DC power adapters, power cables, uninterruptible power supplies (UPS), batteries, and backup power systems. These components ensure continuous operation and data integrity, even in the face of power fluctuations or outages. Battery-based power is a third type of power supply which is essentially a mobile energy storage unit allowing easy portability [31].

Packaging materials safeguard networking hardware products during transit and storage, protecting them from damage and preserving product integrity [32]. Boxes, crates, padding, foam inserts, anti-static packaging, and protective films ensure that networking equipment arrives at its destination in pristine condition, ready for deployment [33].

Labels and documentation provide essential information for product identification, regulatory compliance, and user guidance. Serial number labels, product labels, barcodes, user manuals, safety data sheets (SDS), and regulatory certifications ensure adherence to industry standards and facilitate seamless integration into operational environments [34].

Furthermore, the supply chain is tasked with procuring routers, switches, line cards, power supply units, optics, fibers, and cables, as well as software licenses and country-specific certifications necessary for hardware deployment. Additionally, it oversees the shipping of products to all Points of Presence (POPs) and data center locations, and manages sparing and Return Merchandise Authorization (RMA) processes in case of failures, ensuring uninterrupted network operations and optimal performance [35].

### 2.4 How supply chain receives Forecast, RMA and Spare planning signals

A well-functioning supply chain is basic to the successful running of a business entity [36]. A robust supply chain will be able to simulate and handle different scenarios relating to lead time, transit time, service level, and forecast levels. Enterprises will be able to build next-generation networks successfully when they are able to implement novel technologies and strategies. This is again made possible through harnessing of data and analysis of relevant data captured in operation. They reveal valuable insights and are also helpful in early detection of changes, emerging needs and hence in forecasting.

The following diagram shows how signals are generated for calculating the optimal level of

inventory necessary for supporting the sparing needs

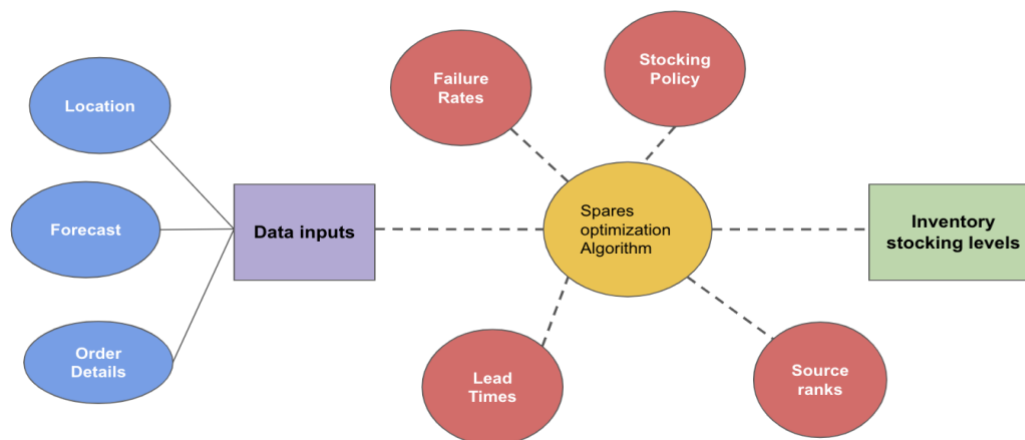


Figure 2: RMA Process

#### 2.4.1. Return Merchandize Authorization (RMA) Minimization

RMA is an important aspect of supply chain management. It is a process that is designed to facilitate return of products by customers and resolution of customer issues as also to ensure and maintain high degree of customer satisfaction. At the heart of it, RMA makes businesses resilient enough to handle returns in a structured way, to ensure that the suitable actions are taken at the time of considering optimization of inventory management, logistics management and planning of the supply chain [35]. An organized framework goes a long way to enhance transparency, reduce processing time, and minimize errors pertaining to return handling. It also plays an important part in improving Inventory Management. At the core of all these is the availability of relevant and authentic data. A key role is played by RMA in the networking hardware industry, in the management of product returns which is necessary for ensuring customer satisfaction and optimization of inventory as also efficient logistics management. A proper RMA system gives the consumer confidence in the company as they are assured that any faulty part can be returned by the buyer to the seller and the seller can also be requested to replace the same. An RMA number is assigned by the customer service department during the processing of the return [37]. It is essential to mention unambiguous, judicious, and timely communication throughout the entire process of RMA. Businesses need to keep the customers informed at every stage, and need to be updated on the advancement of their return and resolution of their issue. Effective communication

has significant customer satisfaction and makes important contributions towards optimization of logistics management and supply chain networks [35]. Telemetry services can be of immense help when it comes to data gathering in this respect.

#### 2.4.2. Data Collection Through Telemetry

The modern world is driven by data, which makes organizations continuously look for ways to collect actionable insights that can help in the improvement of performance, optimization of resource allocation, operational excellence, and the enhancement of security measures. The rapidly evolving Telemetry technology has emerged as a critical tool that can help to achieve these objectives. Telemetry services help to collect real time information from network hardware. It is the system or the process which allows IT teams to gather, document, and transmit facts and figures automatically from remote and other sources for scrutinizing and faster analysis [38].

Telemetry works through a subscription model where the client subscribes to the data, relevant to their line of business and operation, in the form of sensor paths. These sensor paths define such data models as OpenConfig or native Cisco data models. The client is able to access the OpenConfig and Native data models for telemetry from Github, a platform for software development which offers hosting services for version control. The client has the option to choose who initiates the subscription through the creation of a telemetry session between the receiver and the router. Such a session is launched using either a dial-in mode or a dial-out mode [39].

2.4.3. Utility of Data Collected Through Telemetry

Telemetry involves the assemblage and communication of data from distant and even inaccessible sources to a central location for supervision, examination, and decision-making. AI models can use these data gathered through Telemetry to predict failure which can be used by

Supply chain for forecast. With the advancement in technology, telemetry has undergone evolution to incorporate complex concepts and techniques. Artificial Intelligence (AI) and Machine Learning (ML) play a critical role in processing enormous volumes of telemetry data, pulling out meaningful patterns, detecting emerging trends early and offering actionable insights [38].

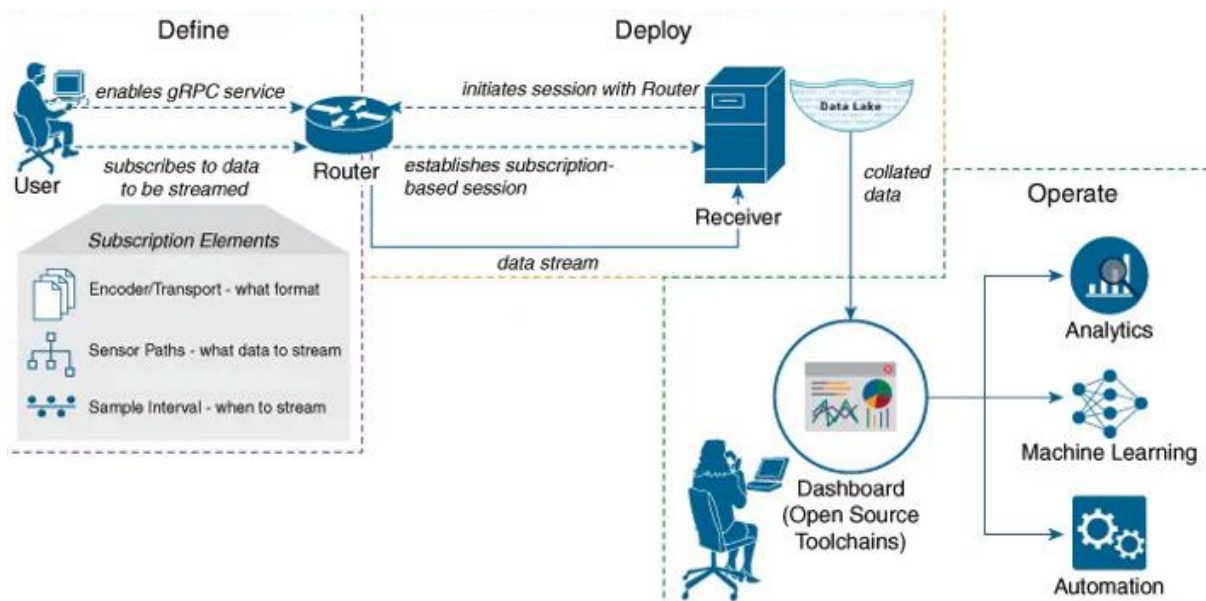


Figure 3: Data Processing Using Telemetry

Telemetry data is priceless for those business organizations who seek to improve their operations and augment their performances. Besides providing real-time visibility into processes, analysis of data gathered through Telemetry enables proactive decision-making and allows quick response to evolving issues. The benefits of this data include higher operational efficiency, better data security through early detection of risks, improvement and

optimization of resource allocation, and enhancement of overall system performance. Since Telemetry offers early detection of threat it also enables swift resolution of issues, minimization of downtime, and prevention of potential failures. Telemetry data brings valuable insights into user patterns, system behavior, and environmental conditions, that leads to informed strategic decision-making and enables innovation.

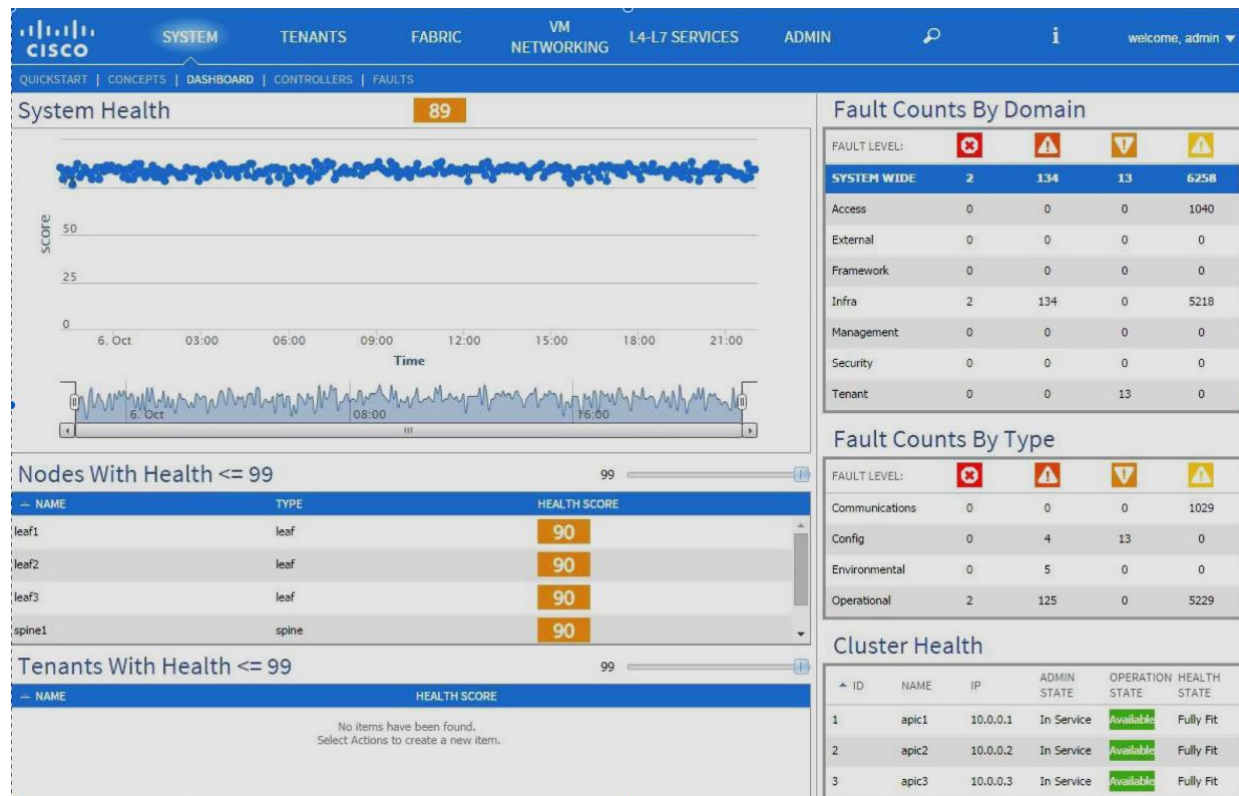


Figure 4: Sample visual analysis of system monitoring using the data collected from Cisco routers

### 3 Expectations from OEMs for Building the Next-Generation Network in the AI Era

In the rapidly evolving landscape of networking technology, Original Equipment Manufacturers (OEMs) face increasing pressure to innovate and adapt to the demands of the AI era. Artificial intelligence (AI) holds immense potential to revolutionize networking infrastructure, offering opportunities for enhanced performance, reliability, and efficiency. Artificial Intelligence is fast turning into an integral part of a large number of digital technologies that include software and many several aspects of ICT infrastructure [40]. As OEMs strive to build the next-generation network capable of harnessing the power of AI, several key expectations emerge:

#### 3.1 Leveraging AI on Networking Gears

OEMs are expected to make substantial investments and integrate AI models into networking gears such as routers, switches, bare-metal servers, optics, and other components [41]. These AI models can play a pivotal role in predicting failures and forecasting spare planning with greater accuracy, thereby

minimizing downtime and optimizing resource allocation. Future equipment failures can be anticipated using AI's predictive analysis tools that examine historical data and present conditions [42]. OEMs need to begin the integration process without much delay as the business environment keeps changing at a rapid pace. The integration will help in revolutionizing predictive maintenance of IT hardware networks and also facilitate asset optimization.

#### 3.2 Enhanced Data Logging Systems

IT hardware OEMs need to develop networking gears equipped with advanced data logging capabilities that makes the networking system better functional and more cost-effective. These systems need to be capable of capturing a comprehensive range of operational metrics and performance indicators, including network traffic patterns, device temperatures, CPU and memory utilization, error rates, packet drops, and other critical parameters. By collecting and analyzing this data in real-time, AI models can identify trends and patterns indicative of potential hardware failures or performance degradation. The successful and effective implementation of an AI-based requires an incessant supply of high-quality relevant data. [44]. The OEM



should concentrate on maintaining data quality along with ensuring data security.

### 3.3 Telemetry and Sensor Integration

Networking hardware should be designed with integrated telemetry sensors to continuously monitor key physical and environmental conditions. Temperature sensors, vibration sensors, humidity sensors, and other monitoring devices can detect anomalies that may precede hardware failures, providing early warning signs to AI models. By leveraging telemetry data, routers, switches, and other networking components can proactively identify and mitigate potential issues before they escalate into costly failures. It is expected to facilitate the examination of the physical or environmental conditions recorded by wireless sensors [45] which will help in better decision-making. Network Telemetry has a crucial role to play in data measurement and reporting from remote locations, improvement of network security and creating the capacity to make efficient decisions in a variety of industries [46].

### 3.4 Predictive Analytics Algorithms:

Predictive analytics algorithms find application in a wide range of industries, from healthcare and entertainment to weather and cybersecurity. Leveraging the collective power of machine learning, algorithms, and, statistical data, predictive analytics is able to access future requirements and consequences with the help of optimized analytics models, allowing companies to make better use resources and insights [47]. OEMs are expected to develop advanced predictive analytics algorithms tailored for networking hardware. Machine learning algorithms such as decision trees, neural networks, and random forests can be trained on historical failure data to recognize subtle indicators of hardware degradation or malfunction. By continuously learning from new data, these AI models can refine their predictions over time and adapt to evolving network conditions.

### 3.5 Anomaly Detection and Root Cause Analysis

Network security is one of the key focus areas for businesses all over the world. With the growing sophistication and complexity of the cyber threats, traditional security systems are facing a lot of challenges and are struggling to keep abreast and to sustain. One of the crucial components in the security infrastructure that have appeared lately is anomaly detection which is serving as an early

warning system that can identify unusual patterns that would hint at a security breach. The integration of artificial intelligence (AI) into anomaly detection has significantly enhanced the capability of these systems to identify and respond to threats [48]. Networking gears should be equipped with AI-driven anomaly detection techniques to identify deviations from normal operating behavior. By comparing current performance metrics against historical baselines, AI models can flag abnormalities and trigger proactive troubleshooting or remediation efforts. Additionally, AI-powered root cause analysis capabilities help pinpoint the underlying factors contributing to network failures, enabling more effective problem resolution and prevention strategies.

### 3.6 Integration with Supply Chain Systems:

The supply chain is a complex web that links together several diverse functions, which include procurement, production, logistics, marketing, and sales. It is possible for companies, using integrated planning, to balance trade-offs across functions which in turn helps to optimize earnings before interest, taxes, depreciation, and amortization (EBITDA) for the organization as a whole [23]. Networking hardware equipped with AI-driven predictive maintenance capabilities should seamlessly integrate with supply chain management systems. It is possible to achieve the integration of Artificial Intelligence or Machine Learning for the achievement of such autonomic and self-management of systems at various different levels of granularity, that spans across complete automation to human-in-the-loop automation [49]. By providing accurate forecasts of component failures and replacement timelines, routers, switches, and other networking components enable supply chain managers to maintain optimal stock levels of spare parts and replacement units. This proactive approach minimizes downtime, reduces inventory carrying costs, and ensures uninterrupted network operations. In summary, OEMs play a crucial role in shaping the next-generation network infrastructure for the AI era. One of the most significant contributions of AI in supply chain and logistics management lies in its ability to revolutionize demand fulfillment processes [50]. By leveraging AI-driven technologies and incorporating advanced features such as enhanced data logging, telemetry integration, predictive analytics, anomaly detection, root cause analysis, and integration with supply chain systems, OEMs can deliver networking solutions that are more resilient, efficient, and adaptable to the evolving demands of the digital

landscape.

#### 4 Implementation of Best Practices

Best practices are a set of standards or a compilation of guidelines that, if followed by people or organizations, would be able to turn out good results or make the endeavor successful. Experts from a large number of fields including medicine, healthcare, law and management, and ICT (information and communication technology), generally put a lot of emphasis on adopting the ways in which performance can be enhanced by way of identifying and then compiling and following those best practices [51]. The companies also favor adoption and implementation of best practices because of the obvious benefits. The key objective of the best practices is to make the work or the implementation of any technology, easy for the practitioners while maintaining the quality of the output. Hence, the best practices are so designed as to help the practitioners bring down the complexity, to stay involved in the task, to reduce the downtime to a minimum and to provide best possible connectivity throughout the entire process of transition [52].

Within the supply chain industry, artificial intelligence or AI technology has emerged as a groundbreaking force that empowers the business organizations to undertake precise capacity planning, enhance their productivity, have better and more accurate demand forecasting, and streamline their inventory management. With artificial intelligence, the capabilities are boundless. AI is endlessly transforming outdated and conventional approaches for making supply chains better sustainable, more efficiently managed, and future-ready [53]. Successful implementation of AI-driven forecasting requires a strategic approach along with the commitment to transform the process of making a decision to becoming largely reliant on data thereby reducing personal biases to the minimum [43].

Day in day out a supply chain manager is faced with handling a large number of situations that throw up multiple challenges and has to meet such expectations as minimization of costs, avoidance of disruptions, maintenance of high levels of customer satisfaction and most importantly preservation of the company's profitability and eventually its improvement over the time [54]. Global supply chains continue to become more complex. Along with that the factors that affect the costs associated with the supply chain are also becoming complex. With the rise in demand from consumers to deliver products to their doorsteps ASAP, companies have increasingly turned to technology to provide

customer services that could not otherwise be provided using conventional methods. Technology is now the differentiating factor. The success of any company now has significant contribution from its technological upgradation. The application of AI in building next-generation supply chains through sophisticated networking, deployment of automated trucks, application of AI in warehouse management, etc. would soon be the factors determining the survival of a company in a fast changing business world.

Systems powered by artificial intelligence bring levels of meticulousness to inventory management that have hitherto remained unseen. Intelligent algorithms analyze historical data, predict demand patterns, and optimize logistic operations [55]. All these demand a huge volume of data that is untampered. AI can function best when the data is clean. Hence it is essential for companies to ensure that the feed data is accurate and free of personal biases. The IT hardware networking industry thrives on the efficacy of the components and the speed and accuracy with which the network services are provided. This requires collaboration amongst cross-functional teams, including supply chain, IT, and data analytics, is essential for successful deployment. Ongoing monitoring and evaluation of forecasting performance are crucial for iterative refinement.

#### 5 Conclusion

"Next-generation networking" is a term that is being used to refer to the process of designing and fabricating IT network infrastructure through the application of novel and more sophisticated technologies. It is a dynamic realm powered with high levels for innovation that goes on relentlessly and affects the relevance of the prevailing technology. Technologies hence get fast outmoded. Flexibility is the key to sustenance. Next-generation networks are, therefore, adaptable, agile and acquire architectures that can be managed with ease and assist companies to achieve the capacity to meet the needs of modern customers and fulfill modern business demands simultaneously. The newest and most modern networking technologies have seen rapid progression over the last few decades. Such developments have simultaneously altered the concept of next-generation networking and its associated initiatives significantly. Modern business operations thrive in a rapidly changing and dynamic landscape in which technology plays a key role. The integration of Artificial Intelligence (AI) has apparently become a game-changer specifically in the realm of supply chain management systems. Thanks to globalization a supply chain for a firm

would now spread over multiple geographies which demand remote management of activities. Time and other constraints have expanded the demand for automation which also works towards lesser errors of omission and commission. The associated technological evolution is redesigning the conventional standards, optimizing competence and productivity, and in the process enhancing overall operational efficiency. AI makes it possible for the IT systems to self-correct, thus allowing for maximum uptime and offering prescriptive actions on the ways to resolve the problems that occur from time to time.

AI-based supply chain management solutions are likely to be powerful tools that can help organizations handle these challenges. An integrated end-to-end approach is likely to address not only the emerging opportunities but also help to tackle the constraints associated with all the business functions, beginning with procurement and ending with sales. The ability of AI to scrutinize huge volumes of data, comprehend relationships between various components, offer visibility into day-to-day operations, and reinforce superior decision making are some of the factors that explain why AI could be a potential game changer. AI driven networks should be considered as the linchpin that empowers networks, making them think, become smarter, forecast and foresee, nip issues in the bud and adapt to developing needs. The presence of AI makes sure that the evolution of systems, their self-learning, and continuous improvement in their functionality.

Getting the most out of AI-driven IT networking solutions is not just a simple straightforward matter of technology. However, the companies need to take deliberate measures and steps at the organizational level to ensure that the full value from AI is captured appropriately. The integration of AI-driven forecasting stands for the transformative opportunity that is available to businesses for the enhancement and improvement of their supply chain efficiency in the networking hardware industry. It is by way of leveraging advanced analytics and predictive insights that modern business organizations will be able to achieve higher accuracy in their demand forecasting, optimization of their inventory management practices, and improvement of their overall supply chain performance. The concepts and technologies are still in their early stages of development though substantial progress is happening. This leaves significant room for further research into integration of Artificial Intelligence (AI) and Machine Learning (ML) for the improvement of resource autonomy and large-scale operations. Achieving performance excellence continues to remain a fundamental challenge for many organizations due to funding constraints as all

these processes that are aimed at reducing human intervention to the minimum, are capital intensive.

## References

- [1] Verified Market Research, "Networking Hardware Market Size And Forecast," Feb 2024. [Online]. Available: <https://www.verifiedmarketresearch.com/product/networking-hardware-market/#:~:text=Networking%20Hardware%20Market%20Size%20And,the%20forecast%20period%202024%2D2030..> [Accessed 15 Apr 2024].
- [2] O. V. Syuntyurenko and R. S. Gilyarevskii, "Trends and Risks of Network Technologies," *Sci Tech Inf Proc.*, vol. 48, no. 2, pp. 97-106, 2021.
- [3] D. Darah, "7 characteristics of next-generation networking | TechTarget," 02 May 2023. [Online]. Available: <https://www.techtarget.com/searchnetworking/feature/Characteristics-of-next-generation-networking#:~:text=Enterprises%20can%20build%20next%2Dgeneration,%2D%2D%20help%20modernize%20network%20infrastructures..> [Accessed 18 Apr 2024].
- [4] P. Prakash, "V2G from Electric School Buses: The Impact on Children, Communities and Supply Chain Management," *Int. J Sup. Chain. Mgt*, vol. 12, no. 6, pp. 1-14, 2023.
- [5] Z. Zhang and J. Li, "Big-data-driven low-carbon management," in *Big Data Mining for Climate Change*, Elsevier Inc., 2020, pp. 287-299.
- [6] Datascope, "What is the Role of Transport Within the Supply Chain?," 28 Feb 2022. [Online]. Available: <https://datascopewms.com/blog/what-is-the-role-of-transport-within-the-supply-chain/#:~:text=TRANSPORTATION%20IS%20USED%20TO%20BYPASS,role%20in%20keeping%20customers%20happy...> [Accessed 18 Apr 2024].
- [7] NC State University, "What is Supply Chain Management (SCM)?," 09 Aug 2021. [Online]. Available: <https://scm.ncsu.edu/scm-articles/article/what-is-supply-chain-management-scm..> [Accessed 18 Apr 2024].

- [8] Pradeep h, "Procurement of raw materials: Process, strategies & factors: Tata nexarc Blog," 13 Feb 2023. [Online]. Available: <https://blog.tatanexarc.com/da/procurement-of-raw-materials/>. [Accessed 18 Apr 2024].
- [9] TCO Certified, "The IT supply chain – a risky business from raw materials to end user," 13 Sep 2021. [Online]. Available: <https://tcocertified.com/news/the-it-supply-chain-a-risky-business-from-raw-materials-to-end-user/>. [Accessed 15 Apr 2024].
- [10] J. Prakash, "A Comprehensive Guide to IT Hardware Manufacturing: The CEO Magazine India," 18 Apr 2024. [Online]. Available: <https://www.theceo.in/blogs/a-comprehensive-guide-to-it-hardware-manufacturing#:~:text=The%20IT%20hardwa re%20manufacturing%20process%20involves%20several%20critical%20components%2C%20including,at%20each%20of%20these%20 components..> [Accessed 20 Apr 2024].
- [11] IBM, "What is inventory management?," 2024. [Online]. Available: <https://www.ibm.com/topics/inventory-management#:~:text=Inventory%20managem ent%2C%20a%20 critical%20element,place%20at%20the%20ri ght%20time..> [Accessed 20 Apr 2024].
- [12] S. Banerjee, "Logistics Cost Analysis – Cost per unit, formula & how to calculate: Tata Nexarc Blog," 2023. [Online]. Available: <https://blog.tatanexarc.com/logistics/logistics-cost-analytics-formula/>. [Accessed 18 Apr 2024].
- [13] K. Hamiche, H. Abouaïssa, G. Goncalves and T. Hsu, "A Robust and Easy Approach for Demand Forecasting in Supply Chains," IFAC-PapersOnLine, vol. 51, no. 11, pp. 1732-1737, 2018.
- [14] J. Chan, "The Benefits of Spare Parts Management: Limble CMMS," 16 Apr 2024. [Online]. Available: <https://limblecmms.com/blog/the-benefits-of-spare-parts-management/>. [Accessed 20 Apr 2024].
- [15] Z. Achetoui, C. Mabrouki and M. Ahmed, "A review of spare parts supply chain management," Jurnal Sistem dan Manajemen Industri, vol. 3, no. 2, pp. 67-75, 2019.
- [16] J. A. Plaza-Úbeda, E. Abad-Segura, J. de Burgos-Jiménez, A. Boteva-Asenova and L. J. Belmonte-Ureña, "Trends and New Challenges in the Green Supply Chain," MDPI Sustainability, vol. 13, no. 1-18, 2021.
- [17] ASCM Houston, "8 Reasons Why Forecasting is Important in Supply Chain Management," 20 Jun 2019. [Online]. Available: <https://houston.ascm.org/blog/id/3>. [Accessed 20 Apr 2024].
- [18] Nalini, "Why Demand Forecasting is Critical for Effective Supply Chain Management in Manufacturing," 2024. [Online]. Available: <https://www.deskera.com/blog/demand-forecasting-supply-chain/#:~:text=It%20helps%20determine%20 the%20required,and%20 improving%20 overall%20 inventory%20 turnover..> [Accessed 20 Apr 2024].
- [19] Inferenz, "AI and Predictive Analytics in Supply Chain Management: Revolutionizing Efficiency and Optimization: LinkedIn," 07 Jun 2023. [Online]. Available: <https://www.linkedin.com/pulse/ai-predictive-analytics-supply-chain-management-revolutionizing/>. [Accessed 24 Apr 2024].
- [20] N. Kumar, P. Agarwal, G. Gupta, S. Tiwari and P. Tripathi, "AI-Driven Financial Forecasting: The Power of Soft Computing," in Intelligent Optimization Techniques for Business Analytics, IGI Global, 2024, p. 25.
- [21] Cisco, "What Is Artificial Intelligence (AI) in Networking?," 2024. [Online]. Available: <https://www.cisco.com/c/en/us/solutions/artificial-intelligence/artificial-intelligence-machine-learning-in-networking.html>. [Accessed 20 Apr 2024].
- [22] D. Johansson, "Exploring feasibility of AI-driven insights for decision making in an e-commerce environment: Msc. Complex Adaptive Systems - Master's Thesis," 2024. [Online]. Available: <https://odr.chalmers.se/server/api/core/bitstreams/9b24aed2-d782-4ad5-b4b9-d3fb862bea22/content>. [Accessed 20 Apr 2024].
- [23] McKinsey & Company, "Succeeding in the AI supply-chain revolution," 30 Apr 2021. [Online]. Available: <https://www.mckinsey.com/industries/metals-and-mining/our-insights/succeeding-in-the-ai-supply-chain-revolution>. [Accessed 20 Apr 2024].
- [24] GEP, "SUPPLY CHAIN NETWORK DESIGN : IMPORTANCE, BENEFITS,

- TYPES & CONTRIBUTING FACTORS," 14 Jun 2022. [Online]. Available: <https://www.gep.com/blog/strategy/supply-chain-network-design-explained>. [Accessed 25 Apr 2024].
- [25] P. Duplissey, "Procurement — The Start of the Supply Chain," 13 Mar 2023. [Online]. Available: <https://www.linkedin.com/pulse/procurement-start-supply-chain-philip-duplisey/>. [Accessed 27 Apr 2024].
- [26] The Home Depot, "Types of Cables and Connectors in Networking," 2024. [Online]. Available: <https://www.homedepot.com/c/ab/types-of-cables-and-connectors-in-networking/9ba683603be9fa5395fab90e9250f90>. [Accessed 19 Apr 2024].
- [27] E. Mikac, "Ethernet Cabling Essentials: Connectors and Cable Management: CBT Nuggets," 09 Sep 2023. [Online]. Available: <https://www.cbtnuggets.com/blog/technology/networking/ethernet-cabling-essentials-connectors-and-cable-management>. [Accessed 19 Apr 2024].
- [28] A. Bhattacharya and S. G. Cloutier, "End-to-end deep learning framework for printed circuit board manufacturing defect classification," *Scientific Reports*, Vols. 12, 12559, 2022.
- [29] DOHO Electric, "What is Electrical Enclosure? Benefits, Types and Applications," 01 Aug 2022. [Online]. Available: <https://dohoelectric.com/what-is-electrical-enclosure/>. [Accessed 19 Apr 2024].
- [30] D. Yang, Q. Yao, M. Jia, J. Wang, L. Zhang, Y. Xu and X. Qu, "Application analysis of efficient heat dissipation of electronic equipment based on flexible nanocomposites," *Energy and Built Environment*, vol. 2, no. 2, pp. 157-166, 2021.
- [31] Wavelength Electronics, "Battery-based power is a third type of power supply and is essentially a mobile energy storage unit," Application Note AN-LDTC03 Rev. B, 2021.
- [32] A. Jain, "Protective Packaging Is Done To Protect Several Products That Are Delicate, Luxurious, or Harmful and Can Damage Easily Causing Several Other Damages," 08 Jul 2021. [Online]. Available: <https://www.linkedin.com/pulse/protective-packaging-done-protect-several-products-delicate-jain/>. [Accessed 19 Apr 2024].
- [33] Network Packaging, "Packaging to keep electronics safe in transit," 24 Aug 2017. [Online]. Available: <https://networkpack.co.uk/electronics-packaging-transit-blog/>. [Accessed 19 Apr 2024].
- [34] K. Labels, "The Role of Labels in Compliance and Regulatory Requirements: LinkedIn," 20 Jun 2023. [Online]. Available: <https://www.linkedin.com/pulse/role-labels-compliance-regulatory-requirements/>. [Accessed 19 Apr 2024].
- [35] ServiceCentral, "Return Merchandise Authorization – Everything You Need to Know," 20 Jun 2023. [Online]. Available: <https://www.servicecentral.com/news/return-merchandise-authorization-everything-you-need-to-know/>. [Accessed 25 Apr 2024].
- [36] U. K. Kar, R. Dash, M. McMurtrey and C. Rebman, "Application of Artificial Intelligence in Automation of Supply Chain Management," *Journal of Strategic Innovation and Sustainability*, vol. 14, no. 3, 2019.
- [37] K. T. Hanna, "Return Merchandise Authorization (RMA): TechTarget," Jul 2022. [Online]. Available: <https://www.techtarget.com/whatis/definition/return-merchandise-authorization-RMA>. [Accessed 30 Apr 2024].
- [38] Motadata, "What is Telemetry: 5 Benefits, Use Cases and Best Practices," 21 Mar 2024. [Online]. Available: <https://www.motadata.com/blog/telemetry/#:~:text=Telemetry%20is%20a%20system%20or%2C%20based%20on%20the%20application..> [Accessed 20 Apr 2024].
- [39] Cisco, "Chapter: Establish a Model-Driven Telemetry Session from a Collector to a Router," in *Telemetry Configuration Guide for Cisco 8000 Series Routers, IOS XR Release 7.3.x*, Cisco Systems Inc., 2022.
- [40] Mind Commerce, "Artificial Intelligence in Next Generation Networking: LinkedIn," 16 Jan 2022. [Online]. Available: <https://www.linkedin.com/pulse/artificial-intelligence-next-generation-networking/>. [Accessed 25 Apr 2024].
- [41] M. Kässer, A. Padhi, A. Tschiesner and D. Wee, "What opportunities does AI open up for mobility, and how can OEMs capture them in

- the short and long run?," McKinsey & Company, 2018.
- [42] Rapidops, Inc., "13 Roles of AI in Predictive Maintenance and Asset Optimization," 23 Aug 2023. [Online]. Available: <https://rapidops.medium.com/13-roles-of-ai-in-predictive-maintenance-and-asset-optimization-eb07c9f9dbd4#:~:text=Predictive%20analysis%20for%20fault%20prediction,schedule%20maintenance%20just%20in%20time..> [Accessed 25 Apr 2024].
- [43] Khastgir, A. & Kumar, A. (2024). Demand Planning: Riding Disruptive Wave of AI and Accelerated Computing. *International Journal of Supply Chain Management*, 13(2), 19-28.
- [44] A. Aldoseri, K. N. Al-Khalifa and A. M. Hamouda, "Re-Thinking Data Strategy and Integration for Artificial Intelligence: Concepts, Opportunities, and Challenges," *MDPI Applied Sciences*, vol. 13, no. 12, 2023.
- [45] G. Suci, V. Suci, V. C. A. Focsa, S. Halunga, O. A. Mohamad, S. C. Arseni and C. Butca, "Integrating telemetry sensors with cloud computing," in 2015 14th RoEduNet International Conference - Networking in Education and Research (RoEduNet NER), Craiova, Romania, 2015.
- [46] Pro-Tech Systems Group, "What is Network Telemetry: Improving Network Security And Performance," 2024. [Online]. Available: <https://www.ptecinc.com/network-telemetry/>. [Accessed 25 Apr 2024].
- [47] Hewlett Packard Enterprise, "What is Predictive Analytics?," 2024. [Online]. Available: <https://www.hpe.com/in/en/what-is/predictive-analytics.html>. [Accessed 25 Apr 2024].
- [48] A. V. P. Ram, "A Closer Look into AI-Driven Anomaly Detection for Networks: Infraon," 29 Nov 2023. [Online]. Available: <https://infraon.io/blog/a-guide-on-ai-driven-networks-anomaly-detection/>. [Accessed 28 Apr 2024].
- [49] S. S. Gill, M. Xu, C. Ottaviani and P. Patros, "AI for next generation computing: Emerging trends and future directions," *Internet of Things*, pp. 1-43, 2022.
- [50] OmneelabWMS, "How AI is Revolutionizing Warehouse Management," 08 Dec 2023. [Online]. Available: <https://medium.com/@omneelabWMS/how-ai-is-revolutionizing-warehouse-management-5178fe3b23a7#:~:text=One%20of%20the%20most%20significant,patterns%2C%20and%20optimize%20picking%20routes..> [Accessed 29 Apr 2023].
- [51] J. Wu, Y. Liu and S. Bretschneider, "Best practice is not just "best": An empirical study based on judges' perceptions," *Urban Governance*, vol. 3, no. 2, pp. 130-137, 2023.
- [52] J. Roundy, "6 data center migration best practices: TechTarget," 24 May 2023. [Online]. Available: <https://www.techtarget.com/searchdatacenter/tip/Data-center-migration-best-practices>. [Accessed 01 Mar 2024].
- [53] Sphinx Solutions Pvt. Ltd., "Why are Enterprises Using AI in Supply Chain Management?: LinkedIn," 06 Mar 2024. [Online]. Available: <https://www.linkedin.com/pulse/why-enterprises-using-ai-supply-chain-management-cqdbc/>. [Accessed 26 Apr 2024].
- [54] D. Blanchard, *Supply chain management best practices*, John Wiley & Sons, 2021.
- [55] Singh, P. K., 2023. Digital Transformation in Supply Chain Management: Artificial Intelligence (AI) and Machine Learning (ML) as Catalysts for Value Creation. *International Journal of Supply Chain Management*, 12(6)