TECHNOLOGY TRENDS **2025**

By Ken Lyon & Laura Serban, Ti

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INTRODUCTION

This is our annual paper outlining what we believe to be the leading technology trends for the coming year. Over recent years we have mentioned a range of technologies that have been significant enough to merit inclusion because of their impact on the logistics and supply chain management landscape and often beyond.

Artificial Intelligence (AI) is different, like the arrival of the Internet and the World Wide Web some 30 years ago, it will impact every aspect of society and commerce.

Last year we focused primarily on AI, and because we think that the impact this will have on the sector is only just beginning, we have decided to continue this focus and update last year's report, augmenting it with additional material where relevant.

Generative AI (GenAI) and Artificial General Intelligence (AGI) differ in scope and capabilities. GenAI is a specialised form of AI designed to generate content such as text, images, and code based on patterns in training data, excelling in specific, predefined tasks but lacking deep reasoning and adaptability. In contrast, AGI aims to achieve human-like cognitive abilities, enabling it to understand, learn, and apply knowledge across diverse tasks autonomously and flexibly.

While GenAI is actively used in industries today, AGI remains theoretical and under development, with the potential to revolutionise decision-making and problem-solving across all domains. The key distinction lies in GenAI's narrow focus and dependence on human guidance, whereas AGI aspires to generalise intelligence and operate independently across varied contexts.

In Dec 2023: The Wall Street Journal stated:

"Enterprises worldwide will have spent around $19.4bn on generative AI solutions by the end of 2023, according to an estimate from International Data Corp. That spending—which includes generative AI software and related hardware plus IT and business services—will reach $151.1bn by 2027, the research firm forecasts, translating into a compound annual growth rate of 86.1% over the four-year period."

These estimates turned out to be too conservative as according to Synergy Research, the actual spend in 2024 was closer to $282bn.

GenAI Spending by Industry in 2024

As of August 2024, the global Artificial Intelligence market stood at nearly $235bn. The three leading industries in terms of Artificial Intelligence spending are software and information services, banking, and retail. Combined, these sectors have allocated about $89.6bn towards AI in 2024, representing 38% of the global AI market.

However, the latest update from Synergy Research Group indicates that the global AI spending is about $282bn for the whole of 2024. This figure is based on actual data for the first three quarters of 2024, plus Synergy's forecast for the final quarter.

Worldwide spending on Artificial Intelligence (AI) will more than double by 2028 when it is expected to reach $632bn, according to a new forecast from the International Data Corporation (IDC). The rapid incorporation of AI, and generative AI (GenAI) in particular, into a wide range of products will result in a compound annual growth rate (CAGR) of 29.0% over the 2024-2028 forecast period.

According to the IDC spending guide, the largest categories of technology spending will be registered by software, such as AI-enabled Applications and AI Platforms, followed by AI hardware, including servers, storage, and Infrastructure as a Service (IaaS).

Going forward, the financial services industry is expected to spend the most on AI solutions over the 2024-2028 forecast period, followed by software and information services and retail.

The following is an updated and augmented look at the areas related to logistics and supply chain management where we think Generative AI is really making headway.

The areas we believe to be the most interesting and likely to see the most activity are:

AI Agents (CoPilots)

Predictive Analysis, Dynamic Routing and Optimisation

Process Automation

Automated Inventory Management

Remote Asset Monitoring - The Internet of Things (IoT)

Robots and Smart Robotics for Warehousing

Digital Twins and New Manufacturing Methods

These areas include existing technology and solutions, many of which have been deployed and are in use.

Other topics that play a critical role the technology driven landscape for 2025 include the following:

Cyber risk

As organisations transition into a ‘digital first’ operating model, the opportunities for cyber attacks increase. As AI systems begin to support decision making, this amplifies the potential for significant challenges.

Supply chains driven by AI will be able to absorb, process, and action, huge amounts of data and information in real-time. The supply chain operators and managers will be able to converse in natural language with the AI and discuss any suggestions or solutions presented. But if the data has been compromised and the AI subtly adjusted to provide incorrect responses, the damage could be enormous. We try to provide some context around these possibilities.

How much Data can you really Trust?

By definition the supply chains that support the manufacture, shipment and use of physical products across the globe, all rely on information technology. As the velocity of these operations increase, the requirement for better visibility at all levels is obvious. This means that decisions that are either augmented or actioned by AI have a fundamental need for verifiable and accurate data.

Throughout most supply chains this does not yet exist. But solutions to this problem are starting to emerge, leveraging global platforms and protocols that can scale.

People, People, People

As was mentioned above, every organisation needs to understand and have some form of strategy for exploiting AI. Most SME’s and, from observation, several very large ones lack the internal ability to address this challenge. Generative AI does require direction to provide the most effective results. How do organisations identify and then encourage the individuals with appropriate levels of knowledge to help them? We explain why this is important and outline the skillsets required.

To help appreciate the scale of the AI introduction into business operations, a survey for IBM’s’ Institute for Business Value’ claims that around 60% of senior executives are either considering, or implementing, some form of AI driven workflows and processes by 2026. Given the astonishing speed at which the large AI companies are developing their models, despite the constraints of computing capacity and training data, it is reasonable to assume this will happen.

Our ‘One to Watch’ company from last year is getting attention as it innovates.

AI AGENTS (COPILOTS)

AI Agents, also known as AI Copilots, companions or AI assistants, are intelligent systems designed to work alongside humans, providing constant guidance, personalised assistance, and context-aware support in various tasks and decision-making processes. Think of them as your helpful and proactive partners who can answer your questions, offer suggestions, and even automate certain tasks to make your life easier and more efficient, if that's appealing to you?

Here are some key characteristics of AI Agents/copilots:

- Context-aware: They can understand the context of your current situation and use that information to provide relevant and timely support.
- Adaptive: They learn from your behaviour and preferences, constantly fine-tuning their responses to better suit your needs.
- Proactive: They anticipate your needs and offer suggestions before you even ask, helping you stay ahead of the curve.
- Multi-talented: They can handle a wide range of tasks, from scheduling appointments and writing emails to analysing data and generating creative content.
- Personalised: They adapt to your unique way of working and thinking, creating a personalised experience that's just right for you.

There may be a variety of benefits of AI agents and multiagent AI systems:

- Capability. AI agents can automate interactions with multiple tools to perform tasks.
- Productivity. AI agents can plan and collaborate to execute complex workflows based on a single prompt.
- Self-learning. AI agents can rapidly improve their output quality over time.
- Adaptability. AI agents can reason and plan new approaches, rapidly reference new and real-time data, and engage with other agents to meet changing needs.
- Accuracy. "Validator" agents can interact with "creator" agents to test and improve quality and reliability.
- Intelligence. When agents specialising in specific tasks work together, new levels of machine-powered intelligence are made possible.
- Transparency. Multiagent AI systems enhance the ability to explain AI outputs by showcasing how agents communicate and reason together.

This is a step change from many of the characteristics exhibited by existing language models. The following table created by WSJ/Deloitte highlights this.

	Typical language models	AI agents
Use case scope	Automate tasks	Automate entire workflows/processes
Planning	Are not capable of planning or orchestrating workflows	Create and execute multistep plans to achieve a user's goal, adjusting actions based on real-time feedback
Memory & fine-tuning	Do not retain memory and have limited fine-tuning capabilities	Utilize short-term and long-term memory to learn from previous user interactions and provide personalized responses; Memory may be shared across multiple agents in a system
Tool integration	Are not inherently designed to integrate with external tools or systems	Augment inherent language model capabilities with APIs and tools (e.g., data extractors, image selectors, search APIs) to perform tasks
Data integration	Rely on static knowledge with fixed training cutoff dates	Adjust dynamically to new information and real-time knowledge sources
Accuracy	Typically lack self-assessment capabilities and are limited to probabilistic reasoning based on training data	Can leverage task-specific capabilities, knowledge and memory to validate and improve their own outputs and those of other agents in a system

Source: WSJ/Deloitte

Here are some key areas where they can be game-changers:

1. Optimising Routes and Transportation:

- AI copilots can analyse real-time traffic data, weather conditions, and vehicle performance to determine the most efficient routes for deliveries, reducing fuel consumption and transit times.
- They can also factor in driver availability, vehicle capacity, and delivery deadlines to create dynamic and optimised schedules.

2. Warehouse Management and Automation:

- AI copilots can assist with tasks like inventory management, order fulfilment, and picking and packing. They can use computer vision and sensor data to track inventory levels, optimise warehouse layouts, and automate mundane tasks, freeing up human workers for more complex jobs.
- This is a huge area of innovation with new kinds of robots and operating platforms emerging every month encompassing many of the solutions above.

3. Predictive Maintenance and Supply Chain Resilience:

- AI copilots can analyse data from sensors in vehicles, equipment, and infrastructure to predict maintenance needs and prevent costly breakdowns. This helps ensure smooth operations and avoids unexpected delays in the supply chain.
- They can also analyse market trends and weather patterns to anticipate disruptions and predict demand, allowing companies to proactively adjust their supply chains and minimise impacts.
- Any initiatives related to this topic will need to be coordinated with the principal operational control platforms.

4. Enhanced Customer Service and Visibility:

- AI copilots can provide real-time tracking information to customers, allowing them to see the status of their shipments and stay updated on any potential delays. They can also handle basic customer enquiries and offer automated solutions for common issues.
- These should help to improve customer satisfaction and create a more transparent and responsive logistics experience.

5. Improved Decision-making and Data Analysis:

- AI copilots can analyse vast amounts of data from various sources within the logistics network, identifying hidden patterns and providing insights to help managers make informed decisions. This last point is key.
- They can assess risks, optimise pricing strategies, and identify areas for cost reduction, leading to improved overall operational efficiency and profitability.
- Again, we stress the point that these technologies should be viewed in most cases as tools to 'support' decision making.

Overall, AI copilots have the potential to transform logistics operations by:

- Boosting efficiency and productivity: Automating tasks, optimising routes, and improving overall workflow.
- Enhancing accuracy and reducing errors: Real-time data analysis and error prevention systems minimise mistakes and miscalculations.
- Increasing transparency and visibility: Providing real-time information and improved communication throughout the supply chain.
- Improving decision-making: Data-driven insights and recommendations lead to better strategic planning and risk management.
- Reducing costs and optimising resource allocation: Streamlining operations and minimising waste to improve profitability.

As an example of this technology in use can be seen with the partnership between Maersk & Captain AI: This global shipping giant partnered with Captain AI to implement an AI copilot for route optimisation. Captain AI's technology analyses weather patterns, ocean currents, and fuel

consumption to suggest the most efficient shipping routes in real-time, saving Maersk significant fuel costs and reducing greenhouse gas emissions.

Other companies across various industry sectors have integrated AI Agents into their operations to enhance efficiency, decision-making, and customer service. Here are some notable examples:

1. Johnson & Johnson

- Application: Utilising AI agents to optimise chemical synthesis in drug discovery, accelerating processes with minimal manual intervention.
- Impact: Speeds up the drug development pipeline, allowing for faster time-to-market for new medications.

2. Moody's

- Application: Employing AI agents to conduct autonomous financial analyses, enabling diverse conclusions on complex financial matters.
- Impact: Enhances analytical capabilities and provides more comprehensive financial insights.

3. eBay

- Application: Leveraging AI agents for coding, creating marketing campaigns, and planning features to assist buyers and sellers on its platform.
- Impact: Improves platform functionality and user experience, leading to increased engagement.

4. Deutsche Telekom

- Application: Introducing an internal AI agent, askT, to assist employees with policy, benefits enquiries, and HR tasks.
- Impact: Significantly enhances internal efficiency and employee satisfaction.[1]

5. Walmart

- Application: Investing in AI and robotics through a partnership with Symbotic to automate pickup and delivery centers.
- Impact: Enhances shopping convenience and operational efficiency in fulfilling eCommerce orders.[2]

AI copilots have the potential to revolutionise logistics operations in several ways, bringing improvements in efficiency, accuracy, and decision-making. But it must be kept in mind that these technologies will only suggest options and it's the human controllers that will decide how to use them.

[1] WSJ
[2] The US Sun

PREDICTIVE ANALYSIS FOR DEMAND FORECASTING, DYNAMIC ROUTING AND OPTIMISATION AND AUTOMATED INVENTORY MANAGEMENT

Artificial intelligence (AI) is revolutionising the logistics and supply chain industry by enabling smarter, more efficient operations across various domains, including demand forecasting, dynamic routing, and inventory management. By leveraging the power of AI, companies can process vast amounts of data, predict and adapt to market changes, and streamline processes with unprecedented accuracy and speed.

PREDICTIVE ANALYSIS FOR DEMAND FORECASTING

AI is reshaping demand forecasting in logistics, offering capabilities far beyond traditional methods. Conventional forecasting often relied on limited historical data and simplistic models. In contrast, AI harnesses massive datasets from diverse sources such as sales records, social media trends, weather patterns, and even competitor strategies. This comprehensive analysis delivers deeper insights into demand drivers, producing more accurate and adaptive forecasts.

AI algorithms excel at identifying complex patterns within data that human analysts might overlook. By capturing subtle trends, seasonal variations, and the impact of unexpected events like promotional campaigns or product launches, AI-based forecasts reduce biases and adapt swiftly to dynamic market conditions. Leveraging advanced machine learning techniques, such as neural networks and deep learning, AI systems continuously improve over time, staying ahead of evolving trends.

Furthermore, AI provides granular predictions, enabling logistics companies to forecast demand at specific product, regional, or even outlet levels. This precision allows for more effective inventory management and resource allocation, minimising risks of overstocking or under-stocking. However, this potential can only be fully realised if adjacent systems and processes align with AI-driven recommendations.

Automation is another game-changing feature of AI-driven demand forecasting. Routine tasks such as data collection, cleaning, and model training can be automated, freeing human analysts to focus on strategic planning and insights. Yet, challenges remain—implementing AI models is resource-intensive, and data quality is critical. Moreover, human oversight is essential to interpret AI forecasts and make informed decisions. Companies like Amazon, JD Logistics, and the Dada Group exemplify successful integration of AI in demand forecasting, setting a benchmark for others in the industry.

DYNAMIC ROUTING AND OPTIMISATION

Dynamic routing and optimisation represent another domain where AI is driving transformative changes. By analysing real-time data, including traffic conditions, weather patterns, vehicle status, and delivery locations, AI algorithms can predict potential disruptions and dynamically reroute vehicles. This ensures timely deliveries even amidst unexpected challenges such as accidents or road closures.

AI's ability to personalise routing and scheduling enhances efficiency further. It accounts for factors like driver skills, vehicle capabilities, and customer preferences to create tailored delivery plans. This flexibility allows for last-minute adjustments and optimal resource utilisation. Additionally, AI systems can recommend the most efficient routes and delivery sequences, consolidating shipments, minimising empty miles, and reducing fuel consumption.

Beyond routing, AI optimises warehouse operations, predicting demand, automating inventory management, and expediting picking and packing processes. These improvements lead to faster loading times, streamlined dispatching, and maximised operational efficiency.

PROCESS AUTOMATION

AI (Artificial intelligence) will continue to play a transformative role in logistics. Its evolution will expedite the processing of vast amounts of freight information to streamline data and document processing.

AI-driven document process flow automation is transforming logistics by enhancing efficiency, accuracy, and speed in handling various documents.

AI can quickly extract data from raw documents, including those in non-standardised formats, and organise it for use in various logistics processes, such as customs compliance entries.

As an example, consider the ocean carrier contract, which is a long, multi-page document that outlines freight rates for container shipping transactions. Manually managing these contracts is a tedious and time-consuming job. AI is currently being used to process these contracts, reducing manual processing to enable a much faster, less cumbersome process. People continue to play a key role in validating categorised rate data, allowing them to correct any inaccurate information that AI got wrong, but the overall process is drastically accelerated. Plus, the AI learns from the corrections and applies them automatically to future contract processing. With AI for carrier contracts, the total handling time is reduced by 75%, and oftentimes even more.

In addition, AI will enhance predictive accuracy and adaptability in areas like route optimisation, vendor financial statements, invoice processing, entry summaries, packing lists, and demand forecasting, driving smarter decision-making and operational excellence.

AI-powered document automation will increasingly drive massive time savings by reducing time-consuming manual processing, preventing errors, and boosting efficiency.

As an example: C.H. Robinson, the global logistics firm implemented proprietary generative AI technology to automate various stages of the freight shipment lifecycle. This innovation enabled the company to process over 10,000 routine email transactions daily without manual intervention, significantly reducing processing times. For instance, the time to handle emailed load tenders was reduced from up to four hours to just 90 seconds. This automation encompassed tasks such as providing price quotes, accepting loads, scheduling pickup and delivery appointments, and monitoring in-transit shipments.

"With AI, the human component will NOT be eliminated. As we saw with carrier contracts, human verification is a key aspect of effective AI solutions as people serve to oversee, guide, and validate the outputs of AI systems. People work faster, better, and accomplish more when working with AI solutions.

By combining the power of human expertise with artificial intelligence, logistics service providers can enhance the accuracy, reliability, and relevance of AI-generated results, completely revolutionising their operations and unlocking new opportunities." GlobalTradeMag (India)

Here are some examples:

Bills of Lading (BoL)

AI-powered Intelligent Document Processing (IDP) systems can automatically extract and validate data from Bills of Lading, reducing manual entry errors and accelerating processing times.3

Invoices

Logistics companies handle numerous invoices daily. AI-driven automation can process these invoices swiftly, ensuring accurate data extraction and timely payments, thereby improving cash flow management.

Delivery Receipts

Automating the processing of delivery receipts with AI enables real-time updates to inventory and order management systems, enhancing supply chain visibility and customer satisfaction.

Customs Documentation

AI systems can streamline the handling of customs documents by accurately extracting necessary information and cross-referencing it with regulatory requirements, reducing clearance times and compliance risks.

Purchase Orders

[3] super.AI

By automating purchase order processing, AI helps in maintaining accurate records, monitoring order statuses, and managing supplier relationships more effectively.

Freight Bills

AI-driven automation can handle the complexities of freight bills, including various charges and tariffs, ensuring accurate billing and auditing.

Inventory Reports

Automating inventory reports with AI allows for real-time inventory tracking and management, leading to optimised stock levels and reduced holding costs.

Shipping Manifests

AI can process shipping manifests to ensure all shipment details are accurately recorded and communicated, facilitating smoother logistics operations.4

Compliance Certificates

Handling compliance certificates through AI automation ensures that all regulatory documents are up-to-date and easily accessible, reducing the risk of non-compliance.5

Implementing AI-driven document automation in these areas not only reduces manual workload but also enhances accuracy, compliance, and overall operational efficiency in logistics.

Consulting Firms

Major consulting firms such as Deloitte, KPMG, EY, and PwC have invested in AI technology, deploying custom-built virtual assistants similar to ChatGPT to enhance productivity and efficiency. These AI tools assist in automating tasks like email drafting, data formatting, and document summarisation, allowing employees to focus on higher-value activities and improving overall client service.

AUTOMATED INVENTORY MANAGEMENT

Automated inventory management is a system using software and technology to track, manage, and optimise stock levels without significant human intervention. It automates various tasks traditionally handled by manual processes, leading to increased efficiency,

AI-driven inventory management systems have revolutionised stock control by automating tasks traditionally handled manually. Real-time tracking through barcodes, scanners, or RFID tags ensures

[4] Amazon Web Services, Inc.
[5] WNS | Business Transformation Services

accurate and up-to-date information about stock levels. These systems automatically reorder inventory when thresholds are reached, preventing stockouts and ensuring seamless operations.

By analysing sales data, market trends, and other factors, AI enhances demand forecasting, allowing businesses to adjust inventory levels proactively. Automated warehouse management further optimises inventory location and movement, reducing errors and streamlining operations. Advanced reporting and analytics offer valuable insights into trends, supplier performance, and overall stock efficiency.

The benefits of automated inventory management are manifold. Businesses can achieve significant cost savings through enhanced efficiency and reduced error rates, leading to better customer satisfaction and loyalty. Data-driven insights facilitate informed decision-making, and the scalability of AI systems allows businesses to grow without logistical bottlenecks.

Benefits of Automated Inventory Management:

- Reduced Costs: Increased efficiency, lower error rates, and optimised operations lead to cost savings in purchasing, warehousing, and labour.
- Improved Customer Satisfaction: Avoiding stockouts and ensuring timely deliveries enhance customer satisfaction and loyalty.
- Better Decision-Making: Data-driven insights help businesses make informed decisions about inventory levels, pricing, and resource allocation.
- Increased Scalability: Automated systems can adapt to changes in demand and easily scale with business growth.

DHL & Redwood Logistics example: DHL Supply Chain, a major logistics provider, partnered with Redwood Logistics to utilise their AI-powered warehouse management system. This system leverages computer vision and machine learning to optimise warehouse layout, automate picking and packing processes, and predict inventory needs. This collaboration resulted in a 20% increase in picking efficiency and a 15% reduction in labour costs for DHL.Integrating barcode and RFID technologies within Internet of Things (IoT) frameworks has significantly enhanced operational efficiency across various industries. Notable examples include:

Integrating barcode and RFID technologies within Internet of Things (IoT) frameworks has significantly enhanced operational efficiency across various industries. Notable examples include:

- Retail and Supply Chain Management: Retailers utilise RFID tags to monitor inventory levels in real-time, reducing overstocking and stockouts. This integration with IoT devices enables automated data collection and analysis, streamlining supply chain operations.[6]
- Warehouse Management: Companies like Amazon have implemented RFID and IoT technologies to optimise warehouse processes. RFID tags track items throughout the

[6] Peak Technologies

warehouse, while IoT devices facilitate real-time data transmission, enhancing inventory accuracy and operational efficiency.

- Smart Shelves in Retail: Retailers are adopting IoT-enhanced barcode systems, such as smart shelves equipped with sensors that monitor product availability. These systems automatically detect low stock levels and trigger restocking processes, improving inventory management and customer satisfaction.[7]
- Asset Tracking in Logistics: Logistics companies employ RFID tags combined with IoT networks to track assets during transportation. This integration allows for real-time monitoring of asset location and condition, improving supply chain transparency and efficiency.[8]
- Industrial Automation: In manufacturing, RFID-based systems integrated with IoT networks detect materials, machines, and personnel. This setup creates advanced industrial networks that ensure high levels of efficiency, connectivity, and cost-effectiveness.[9]

These examples demonstrate the transformative impact of combining barcode and RFID technologies with IoT, leading to smarter, more efficient operations across various sectors.

Several companies are pioneering the integration of barcode and RFID technologies with IoT to transform their operations. Here are some notable examples:

- Amazon:
  Amazon uses RFID tags in its warehouses to track items in real-time. Combined with IoT-enabled robotics and sensors, these technologies streamline order picking and inventory management, reducing errors and delivery times.
- Walmart:
  Walmart integrates RFID with IoT to enhance supply chain transparency. Their system enables real-time inventory tracking across stores and distribution centers, ensuring better stock management and reduced shrinkage.
- Maersk:
  In the logistics and shipping sector, Maersk employs RFID and IoT for container tracking. This integration allows real-time monitoring of cargo location and environmental conditions, ensuring safer and more efficient deliveries.
- Decathlon:
  The sports retailer uses RFID technology for inventory management across its stores. Coupled with IoT-enabled analytics, the system improves shelf replenishment, minimises stockouts, and enhances customer experience.
- Boeing:
  Boeing employs RFID and IoT in its manufacturing processes to track parts and tools. This

[7] Free Barcode
[8] QodeNext
[9] RFID Card

combination improves production efficiency and reduces downtime by ensuring critical components are available when needed.

- Tesla:
  Tesla integrates RFID with IoT to manage parts and materials in its Gigafactories. This technology helps optimise the supply chain, ensuring seamless manufacturing of electric vehicles.

Automated inventory management is not a one-size-fits-all solution. Different businesses will have varying needs and require customised systems. However, the potential benefits it offers in terms of efficiency, accuracy, and cost reduction make it a valuable tool for businesses of all sizes in today's competitive landscape.

REMOTE ASSET MONITORING

AI revolutionises the way we monitor remote assets in several ways, bringing significant benefits in terms of efficiency, predictive maintenance, and overall asset health. Here are some key areas where AI shines:

Real-time data analysis and anomaly detection:

AI algorithms can analyse huge amounts of data from sensors, cameras, and other monitoring devices attached to your assets. This data includes vibration, temperature, pressure, sound, and even visual inspections.

Advanced algorithms can then identify subtle anomalies and deviations from normal operating patterns, indicating potential issues before they escalate into costly breakdowns.

Predictive maintenance:

By analysing historical data and current sensor readings, AI can predict when equipment is likely to fail and recommend proactive maintenance interventions. This prevents unplanned downtime, reduces repair costs, and extends asset lifespan.

This proactive approach minimises disruptions and ensures optimal asset performance.

Automated tasks and alerts:

AI can automate mundane tasks like data collection, anomaly detection, and initial alert generation. This frees up human technicians for more complex troubleshooting and repairs.

Automated alerts ensure timely information reaches the right people, allowing them to respond quickly and efficiently to potential issues.

Improved decision-making and insights:

AI provides valuable insights into asset health and performance trends. This data helps operators make informed decisions about maintenance schedules, resource allocation, and even future investments.

By understanding underlying patterns and correlations, businesses can optimise their asset management strategies and improve overall operational efficiency.

Enhanced safety and risk management:

AI can be used to monitor environmental conditions, track worker movements, and even detect safety hazards in real-time. This proactive approach helps prevent accidents and ensures a safer work environment.

Early detection of potential safety risks minimises potential damage and protects both personnel and assets.

Beyond these specific applications, AI can also:

Integrate with other technologies like drones and robots for autonomous inspections and data collection in remote or hazardous locations.

Continuously learn and adapt to changing conditions, improving the accuracy and effectiveness of monitoring over time.

Utilise advanced techniques like computer vision and image recognition to gain deeper insights from visual data captured by cameras and sensors.

Challenges to consider:

Implementing and maintaining AI systems can be complex and require expertise in data science and technology.

Data quality is crucial for accurate predictions, and ensuring a reliable data pipeline is essential.

Cybersecurity concerns need to be addressed to protect sensitive data and infrastructure from potential attacks.

Examples of companies using AI for this include Rolls Royce, GE Aviation (with GE Predix - to remotely monitor jet engines in operation), the Danish renewable energy company Orsted using AI powered vision systems for offshore turbine monitoring and Rio Tinto for mining equipment monitoring for predictive maintenance.

Overall, AI offers a powerful toolbox for remote asset monitoring, improving efficiency, safety, and predictive maintenance capabilities. By embracing AI technology and addressing the challenges, businesses can optimise asset management, reduce costs, and gain a competitive edge.

SMART ROBOTICS FOR WAREHOUSING

According to the Robot Report, almost $19 billion dollars has been invested in robotics companies in 2024. This is an increase of almost $10 billion dollars from 2023. This level of investment is building on years of work (and many failures), new technologies and reducing costs of critical systems, e.g. optical sensors and vast amounts of data.

Smart robotics is rapidly transforming the landscape of warehousing, injecting significant improvements in efficiency, accuracy, and safety. Here are some key ways smart robots are deployed in modern warehouses:

Automated Material Handling:

- Automated Guided Vehicles (AGVs): These driverless vehicles navigate pre-programmed routes to move pallets, containers, and materials around the warehouse, eliminating manual forklift operation and reducing labour costs.
- Autonomous Mobile Robots (AMRs): These highly flexible robots can navigate dynamic environments, adapting to changing layouts and picking up individual items or small batches for transport.
- Drone-based Transportation: In larger warehouses, drones can be used for rapid aerial transport of urgent items or inventory checks in high-reaching areas.

Automated Picking and Packing:

- Robotic Arms: Equipped with sophisticated vision systems and grippers, robots can automate picking tasks, selecting specific items from shelves or bins with high accuracy and speed.
- Goods-to-Person Systems: Robots deliver shelves or bins containing the required items directly to pickers, minimising walking and optimising the picking process.
- Automated Packing Systems: Robots can pack items into boxes or containers based on order specifications, ensuring consistency and reducing packing errors.

Inventory Management and Optimisation:

- Inventory Drones: Autonomous drones equipped with scanners can conduct automated inventory audits, ensuring accuracy and reducing manual counting time.
- Smart Shelving Systems: Shelves equipped with sensors and actuators can track and manage inventory levels, automatically reordering stock when needed.
- Warehouse Management Software (WMS) Integration: Robots seamlessly integrate with WMS systems, receiving commands, reporting actions, and providing real-time data for optimised inventory management.

Improved Safety and Security:

- Collision Avoidance Systems: Sensors and software enable robots to navigate safely around people and obstacles, preventing accidents and damage.
- Access Control and Surveillance: Robots can monitor restricted areas, detect unauthorised access, and enhance warehouse security.
- Ergonomic Improvements: By automating heavy lifting and repetitive tasks, robots reduce workplace injuries and improve worker well-being.

Benefits of Smart Robotics in Warehousing:

- Increased Efficiency and Productivity: Automation significantly speeds up processes, reduces labour costs, and improves overall warehouse throughput.
- Enhanced Accuracy and Reduced Errors: Robotic systems minimise human error in picking, packing, and inventory management.
- Improved Safety and Security: Collisions and injuries are reduced, while automated surveillance enhances security.
- Greater Scalability and Flexibility: Robots can adapt to changing demand and warehouse layouts, increasing operational flexibility.
- Data-Driven Optimisation: Real-time data from robots facilitates better decision-making for warehouse management and resource allocation.

Challenges to Consider:

- High Initial Investment: Implementing and maintaining robotic systems can be expensive, requiring upfront capital expenditure.
- Integration and Training: Integrating robots with existing systems and training personnel to operate and manage them can be complex.
- Job Displacement: Concerns regarding potential job losses due to automation need to be addressed through reskilling and training programmes.

Overall, smart robotics offers a powerful tool for revolutionising warehousing operations. By carefully considering the benefits and challenges, businesses can leverage this technology to achieve significant gains in efficiency, accuracy, and overall competitiveness.

Some of the companies who are developing and producing robots for warehousing operations include:

Dexterity

Dexterity have built a robot that can handle multiple jobs, including sorting packages, moving boxes on and off pallets, and loading and unloading trucks.

Mytra

Makes robotic platforms, flat metal squares that can move pallets and boxes through Mytra's storage structures. Its software allows customers to adjust settings, such as whether to store boxes more densely or move materials more quickly.

The companys robots work 24 hours per day at an Albertsons warehouse in Tracy, Calif., where one bot moves boxes through the storage structure while anothers battery recharges and two more wait on standby.

Pickle

Pickles robots roll into storage containers and set boxes on conveyor belts, which carry the boxes into the warehouses.

Collaborative Robotics

Their robot, Proxie, has been designed to assist humans in settings like warehouses and hospitals. Early customers include shipping giant Maersk, healthcare logistics company Owens & Minor, Mayo Clinic, Moderna and Tampa General Hospital.

Some companies are exploring ways to collaborate with each other, depending on the skills and capabilities of their technologies. The idea behind this is similar to the familiar role of systems integrators that link different applications together to create an end to end process flow. So in the context of various robotic systems, dexterous robots will perform stack, pick and pack tasks, handing off to other robots that move pallets around the facility.

We expect huge advances and a growing number of implementations within real operations over the next 12 months.

DIGITAL TWINS

We recently briefed about the robotics company Dexory that used a combination of innovative physical robots matched with a ‘digital twin’ platform (Dexory View) that is used to replicate actual facilities. The digital twin can then be used to proactively monitor operations and also simulate various situations.

Digital twin platforms can be highly useful for logistics and supply chain management, offering significant advantages across various aspects of the field. Here's how:

Improved Visibility and Transparency:

- Digital twins create virtual replicas of your physical supply chain, including assets, processes, and data flows. This provides real-time visibility into operations, allowing you to track shipments, monitor performance, and identify potential issues proactively.

Enhanced Optimisation and Decision-Making:

- By simulating different scenarios within the digital twin, you can test new strategies, optimise routes, and predict the impact of changes before implementing them in the real

world. This data-driven approach leads to more effective decision-making and improved operational efficiency.

Predictive Maintenance and Reduced Downtime:

- Sensor data from real-world equipment can be integrated into the digital twin, enabling AI-powered predictive maintenance. This allows you to anticipate equipment failures before they occur, preventing costly downtime and disruptions.

Improved Collaboration and Communication:

- Digital twins offer a shared platform for stakeholders across the supply chain to access data, visualise processes, and collaborate effectively. This transparency fosters better communication and reduces friction between partners.

Specific Applications in Logistics and Supply Chain Management:

- Route optimisation: Simulate different routes and traffic conditions to identify the most efficient delivery paths.
- Warehouse management: Optimise warehouse layout, inventory levels, and picking processes for improved efficiency and accuracy.
- Predictive logistics: Anticipate disruptions such as weather events or traffic congestion to adjust schedules and minimise delays.
- Demand forecasting: Use historical data and market trends to predict future demand and optimise production and inventory levels.
- Risk management: Identify and mitigate potential risks within the supply chain, such as supplier disruptions or quality issues.

We also think that companies will maintain libraries of different facilities that may be customer specific, to quickly model the operations in preparation for reconfiguration and handling of increased order flow, new product introductions or similar products from other suppliers.

Challenges and Considerations:

- Implementing and maintaining a digital twin platform can be costly and require expertise in data analytics and modelling.
- Data quality and integration are crucial for accurate simulations and insights.
- Security and privacy concerns need to be addressed to protect sensitive data within the digital twin.

Overall, while challenges exist, the potential benefits of digital twin platforms for logistics and supply chain management are significant. By carefully considering the needs and limitations, businesses can leverage this technology to gain a competitive edge and improve their overall operational efficiency and resilience.

SUMMARY:

We have attempted to highlight the areas where we believe technology will make significant progress in the coming year. We have also tried to provide relevance and examples for those areas. We have also suggested a few factors that organisations should consider examining to prepare themselves for AI driven logistics and supply chain management operations.

These are our views and we make no guarantees as to how they will manifest themselves over the next year. We are very confident that the areas we have highlighted will be 'interesting'.

For further analysis of real-world software implementation, cyber risk management, and data integrity assurance, please contact us.

ABOUT TI

Ti Insight is a leading logistics and supply chain market research and analysis company providing:

- Supply Chain and Logistics Market Research Reports
- Global Supply Chain Intelligence (GSCi) online knowledge platform
- Consulting and Market Research projects
- Training, Conferences, and Webinars.
- Ti has acted as advisors to the World Economic Forum, World Bank, UN and European Commission as well as providing expert analysis to the world's leading manufacturers, retailers, banks, consultancies, shipping lines and logistics providers.

Expertise includes:

- Analysis of corporate strategies of leading express, freight forwarding and logistics companies.
- Global usage and perception studies of shipper and logistics provider behaviour.
- Micro-economic analysis of key logistics segments: express, freight forwarding, road freight, contract logistics, warehousing, air cargo, shipping and e-commerce logistics.
- Analysis of supply chain strategies employed in industry vertical sectors: pharmaceutical, fashion, high tech, oil and gas, consumer, chemical, cold chain, automotive and retail.
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