

Transforming warehousing with AI



Message from FICCI

I am pleased to present the FICCI-PwC report, '**Transforming warehousing with AI**' which provides an important perspective on the rapid evolution of India's warehousing sector and its role in shaping the country's logistics and supply chain ecosystem.

Over the past decade, India's warehousing industry has undergone a significant transformation. The growth of manufacturing, e-commerce, organised retail, and domestic consumption, together with the increasing integration of India into global value chains, has accelerated the demand for modern, efficient, and scalable warehousing infrastructure. What was once viewed primarily as a storage function has now evolved into a strategic component of the supply chain, connecting production centres, consumption markets, ports, and other logistics infrastructure.

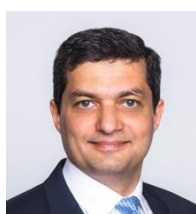
This transformation is however far from complete. As supply chains become more complex and customer expectations continue to rise, warehousing will need to become more agile, connected, productive, and responsive. The next phase of this evolution will not simply be about adding more automation; it will be about making operations more intelligent.

Artificial intelligence is emerging as an important enabler of this shift. By moving beyond rule-based automation towards predictive and data-driven decision-making, AI can support a wide range of warehouse functions, including demand forecasting, inventory optimisation, warehouse design and layout, workforce planning, predictive maintenance, and real-time operational management. When effectively integrated with the right processes, people, infrastructure, and data, these capabilities can help warehouses improve productivity, optimise costs, and build greater resilience across supply chains.

India's policy and infrastructure landscape is also evolving to support this transformation. Initiatives such as PM GatiShakti and the National Logistics Policy are helping create an enabling environment for improved connectivity, integrated infrastructure planning, and greater efficiency across logistics networks. As technology and operating models continue to evolve, sustained collaboration between government and industry will be essential to ensure that India's logistics ecosystem remains responsive to the needs of a rapidly changing economy.

This report examines the transformation of India's warehousing sector over the past decade, the evolution from automation to intelligence and the emerging role of AI in shaping the warehouse of the future. It also introduces the **intelligent warehouse framework**, bringing together technology, people, processes, infrastructure, and data, while outlining a roadmap towards 2047 focused on building smarter, more connected, resilient, and future-ready warehousing infrastructure in line with the aspirations of Viksit Bharat. As India strengthens its position in global value chains and works towards its 2047 development ambitions, efficient and intelligent warehousing will be an increasingly important enabler of competitiveness and sustainable growth.

I commend FICCI and PwC for developing a report that brings together relevant insights, industry perspectives, and a clear focus on the way forward. I hope you find this report useful and look forward to your feedback and continued engagement.



Rizwan Soomar

Chair, FICCI Committee on Logistics

CEO and Managing Director – Subcontinent, Central Asia, Levant, and Egypt, DP World

Message from PwC

Over the past decade, India's logistics and warehousing sector has evolved considerably, supported by the PM GatiShakti National Master Plan and the National Logistics Policy. These measures have given a push to multimodal connectivity and digital integration and lowered logistics costs. India's rise to the 38th rank among 139 countries in the World Bank's 2023 Logistics Performance Index reflects this progress. Achieving the National Logistics Policy's goal of reaching the top 25 by 2030¹ would require more efficient and connected warehouses.

Warehouses no longer are simply storage points; they are critical to supply-chain cost, service, and responsiveness.² Faster turnaround, accuracy, flexibility, traceability, and better utilisation of space and manpower are now fundamental. Digital systems and automation have improved visibility and execution, in line with the National Logistics Policy's emphasis on integration and standardisation. The next opportunity can be using this information for anticipating future demand and enabling better utilisation of inventory, workforce, equipment, and warehouse capacity while managing bottlenecks. AI has the potential to take warehouses from improved execution to faster, better decision-making, particularly where decisions are frequent, uncertainty is high, and errors are costly. Unlocking its value, however, depends on reliable data, integrated systems, appropriate governance, and an oversight by human.

The transition is therefore not just the adoption of technology, but to enable warehouses to sense change, interpret its operational impact, and respond with speed and precision by linking infrastructure, digital systems, data, and human judgement.

This paper examines how India's warehouses can become more adaptable with AI. It presents a practical framework to identify where AI may create value, integrate it with existing systems and processes, and deliver measurable improvements in cost, service, resilience, and sustainability. As the sector enters its next phase, the focus must move beyond adopting technology for its own sake to applying intelligence where it can improve operations and decisions. This paper aims to inform and stimulate discussions among industry and policy experts working towards an efficient, flexible, and globally competitive logistics ecosystem.



Manish R Sharma

Partner and Leader, Infrastructure, Transport, Logistics, and Real Estate
PwC India

1. PIB, India Marks Three Years of National Logistics Policy (accessed as on 22 September 2026)

2. NITI Aayog, Goods on the move (accessed as on 22 September 2026)

Table of contents

01 A decade of transformation in India's warehousing sector

02 From warehouse automation to intelligence

03 Role of intelligence in a warehouse

04 The intelligent warehouse framework

01

A decade of transformation in India's warehousing sector

India's warehousing sector has undergone a structural transformation over the past decade. The sector has moved from fragmented, tax-driven storage networks, and basic godown-style facilities towards larger, higher specification, and increasingly institutional-grade logistics assets. This shift has been driven by GST-enabled network consolidation, expansion of e-commerce, organised retail, manufacturing growth, increasing third-party logistics (3PL) participation, and private investments, which have collectively reshaped warehouse networks, the infrastructure, and the operating model in India.

As a result, the modern warehouse has evolved from a passive storage buffer to an enhanced operational facility that combines higher specification infrastructure with attributes such as higher clear heights, stronger flooring, better designed docks, improved inventory control, operational resilience, and end-to-end visibility. With the increasing need for these capabilities, there is stronger demand for Grade A facilities with improved infrastructure, mechanisation, and wider use of technology.

Regulation is also supporting the shift towards standardised warehousing. The Warehousing Development and Regulatory Authority (WDRA) is establishing the minimum quality standard for infrastructure, insurance, inspection, and shelf-life norms, while electronic negotiable warehouse receipts (e-NWRs) provide verifiable records of ownerships of the goods that enable banks to lend against stored goods, supported by the Credit Guarantee Scheme for e-NWR based Pledge Financing (CGS-NPF) guarantee. The shift is already visible: There are 7,512 WDRA-accredited warehouses as on 31 March 2026 and INR5,696.56³ crore has been pledged against e-NWRs in FY26. In short, the Government of India is making warehousing more bankable.



3. WDRA, Bhandaran Darpan - A Quarterly News Bulletin (accessed as on 25 September 2026)

Together, such developments are strengthening the sector’s capacity to support more demanding service requirements.

Increasing service complexity

India's warehousing sector has been reshaped over the past decade in terms of how networks are designed and what operators now demand from them. The figure below traces each lens from its earlier model to what changed and what it means strategically.

Figure 1. Network design and new demand patterns reshaped warehouse network design⁴

	Earlier model	What changed	Strategic implication
Network design 	Multiple state-level depots; fragmented footprint	GST supported consolidation into larger regional facilities, with hub-and-spoke networks developed around them	Scale economics and hub-and-spoke network optimisation became more important
Demand profile 	Storage-led requirement: few docks, limited SKUs, slow monthly replenishment cycles	E-commerce, 3PL, manufacturing, retail and quick commerce multiplied dock counts, SKU proliferation, and daily replenishment cycles	Speed, flexibility, and location became central to facility design

Warehouses are increasingly expected to handle larger order volumes and more complex fulfilment requirements, rather than provide basic storage. This shift is being driven particularly by the growth of e-commerce, 3PL, manufacturing, retail, and quick-commerce companies, each of which places distinct demands on warehouse operations.

- 01

E-commerce and quick-commerce companies require rapid order processing, dense urban fulfilment networks, and quick delivery requirements. These requirements have also led to the expansion of dark stores, where limited space, high-order frequency, and sub-hour delivery commitments require accurate inventory visibility, efficient product placement, frequent replenishment as well as rapid picking.
- 02

Organised retailers and FMCG companies need high-throughput, multi-channel distribution, and frequent replenishment.
- 03

Manufacturing sectors such as automotive, electronics, and pharmaceuticals require reliable inbound supply, specialised handling, traceability, and compliance.
- 04

3PL providers in turn need scalable, technology-enabled facilities that can serve multiple customers with different inventory profiles and service requirements.

Collectively, these sector-specific demands are increasing the need for larger, specialised, and higher-specification facilities.

4. India Transport & Logistics News, India’s logistics cities: Powering the next wave of trade and growth (accessed as on 22 September 2026)

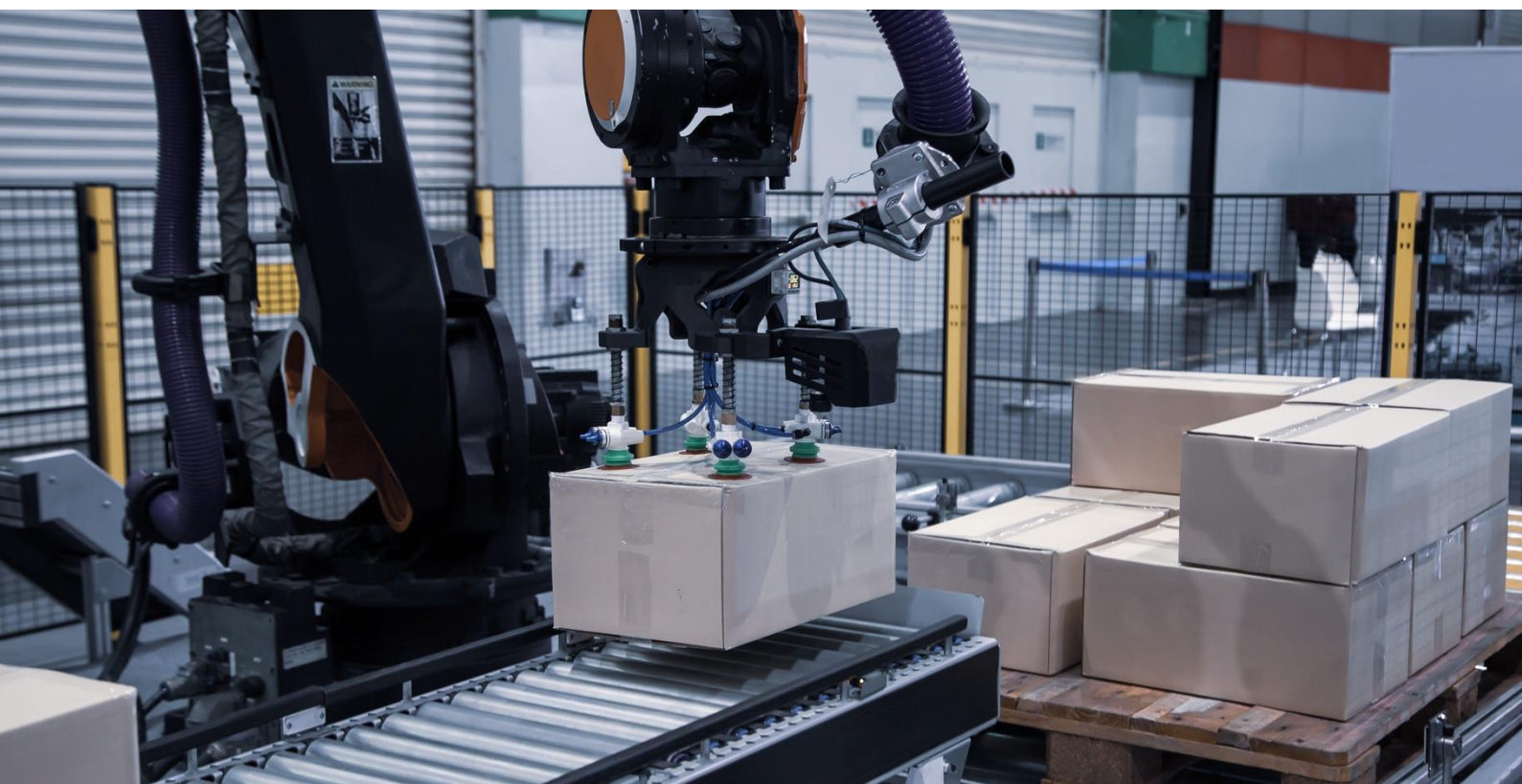
Quick deliveries and fluctuating order profiles have made speed, flexibility, and proximity to demand centres more important, while rising order volumes have increased the need for efficient layouts, docking capacity, material-handling infrastructure, and scalable operations. This need for greater proximity is also broadening the geographic footprint of modern warehousing. Emerging Tier-II and smaller markets accounted for 18% of warehousing stock and recorded 12 million sq. ft. of space take-up in 2025.⁵

With total warehousing stock projected to increase from ~610 million sq. ft. in 2025 to 850 million sq. ft. by 2030, continued investment would be needed to address both capacity expansion and asset quality.⁵

Multimodal logistics parks (MMLPs) take this a step further by fixing how warehouses connect to the rest of the freight system. Instead of a shipment being trucked to a goods yard, transferred, stored elsewhere, and cleared at a fourth place, an MMLP puts the rail siding, highway access, mechanised warehouses, container terminals, and customs clearance on one campus. That changes what a warehouse can do. Inside such a park, it can receive a full rake and not just dozens of trucks serve a manufacturing cluster, handle export and import containers, and still supply a nearby city.

Over the last 5–10 years, India's warehousing sector has moved beyond being primarily a storage function to becoming an important part of integrated supply chain operations. Businesses are increasingly looking at warehouses as strategic assets that can improve speed, flexibility, and customer service. The next phase will require greater technology adoption, efficient space utilisation, workforce capability, and seamless integration across the supply chain. AI presents significant potential to enhance warehouse operations through better forecasting, inventory visibility, route and slot optimisation, predictive maintenance, and intelligent automation. By 2047, India can build a highly connected and data-driven warehousing ecosystem, supported by modern infrastructure, multimodal networks, innovation, and continued collaboration between industry and government.

Ketan Kulkarni, Member - FICCI Committee on Logistics, and Managing Director and CEO, Allcargo Logistics Limited



5. Hindustan Times, Warehousing stock crosses 610 mn sq ft in 2025, Tier I cities account for 82% share (accessed as on 22 September 2026)

02

From warehouse automation to intelligence

Technology has transformed warehouses from manual, paper-based operations into connected and automated environments. Warehouse management systems provide real-time visibility into inventory and orders, while barcode scanning, radio-frequency identification (RFID), and IoT improve tracking and process control.

Conveyors, automated storage and retrieval systems, and robotics have accelerated material movement, picking and sorting, improving throughput, accuracy, and consistency. Together, these technologies have created the digital and operational foundation for the next phase of intelligent, AI-enabled warehousing. The focus must shift from visibility to decision intelligence. As warehouse networks become larger and more interconnected, the principal constraint is shifting from data availability to quality and timeliness of decisions. A warehouse management system (WMS) can show operators what has happened and where capacity or inventory is constrained. The next phase is to integrate these signals to anticipate bottlenecks, predict demand and labour requirements, flag inventory or product-condition risks, and recommend appropriate intervention.⁶ Warehousing transformation now should therefore be defined not just by the amount of data captured, but by how effectively technology-generated data is converted into predictive intelligence and faster, better-informed decisions.

Matching technology intensity to velocity, volume, and value at risk

Not every warehouse process requires advanced technology. Suitability depends on the velocity at which goods move, the volume handled, and the value at risk from error, delay, damage, or non-compliance.

Automation is most justified in high-volume, high-velocity environments where repetitive processes justify automation as benefits can be realised at scale.

Automation may also be warranted in lower-volume processes where the value at risk is high, such as those involving costly, fragile, temperature-sensitive, or regulated goods. However, lower-volume or variable activities with limited operational or financial risk may be better served through WMS, scanning, mechanised handling, and human judgement.

E-commerce, quick commerce, and organised retail typically operate at high velocity and volume, with broad stock-keeping unit (SKU) assortments, quick delivery, and frequent replenishment cycles. Manufacturing creates a different form of complexity: Warehouses increasingly support production and distribution through activities such as labelling, packaging, kitting, sequencing, and light sub-assembly, where traceability, accuracy, and the value of avoiding disruption are important.

Why adoption remains uneven across Indian warehouses

Moreover, adoption remains uneven. The warehouse automation market accounts for a small proportion of the overall warehousing market, indicating that many facilities continue to rely on manual processes and basic mechanisation. This gap contributes to inventory inaccuracies, labour and skill shortages, receiving and dispatch congestion, service-level pressures, spoilage, and compliance risks. This is particularly evident in temperature-sensitive supply chains, where cold-chain infrastructure has historically constrained the movement of fresh fruits and vegetables, leading to higher spoilage and quality risks.

6. Economic Times, The role of AI and predictive analytics in Indian warehousing (accessed as of 22 September 2026)

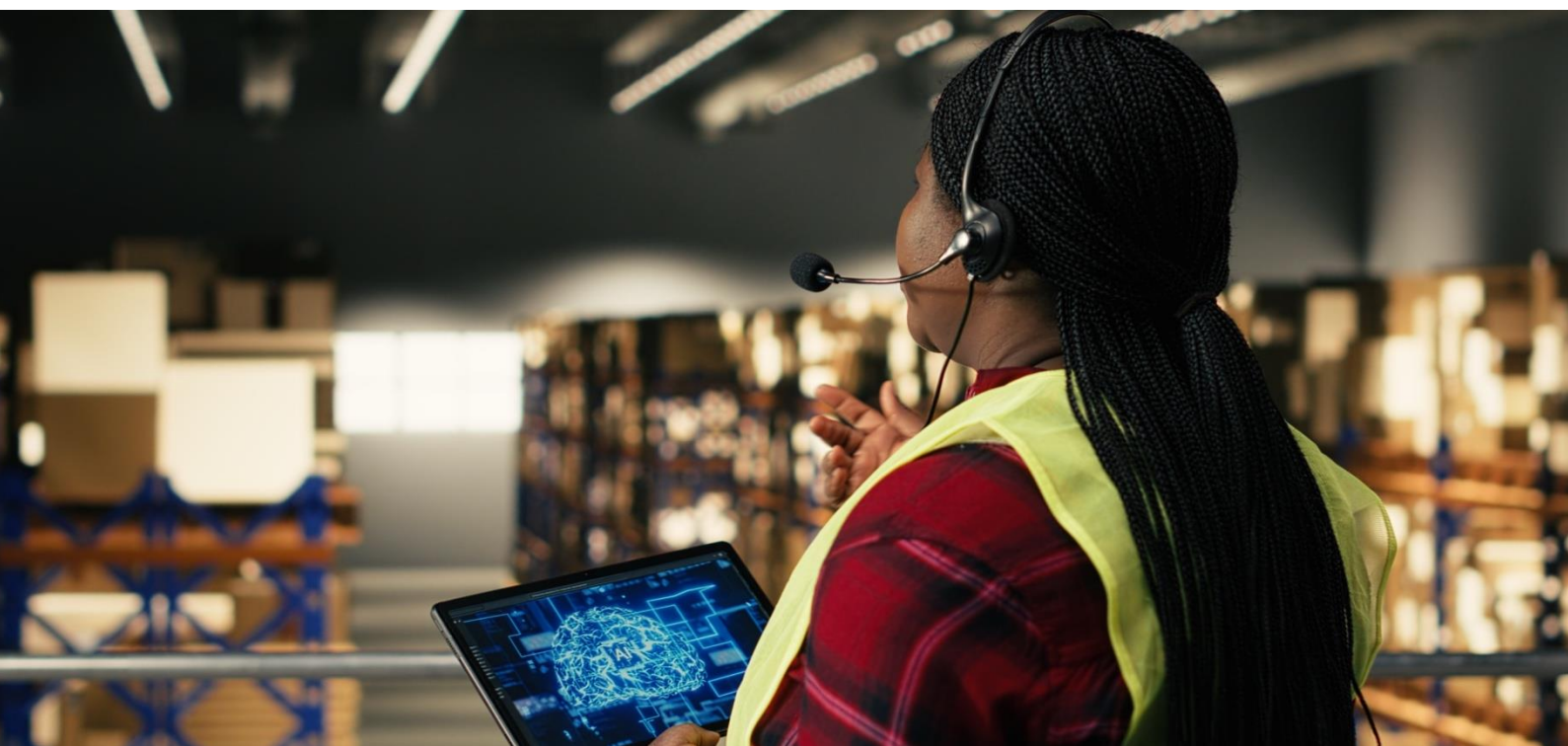
Structural pressures shifting the performance constraint to decisions

The need for this shift is being driven by pressures that are structural rather than cyclical. Warehousing land near consumption centres is increasingly scarce and expensive, limiting the ability to absorb growth by adding space. Labour availability is also tightening, while attrition and seasonal peaks make staffing less predictable. At the same time, broader SKU assortments, shorter service windows, and more frequent supply-chain disruptions are increasing operational complexity. Consequently, performance is increasingly judged by throughput per square foot and output per worker-hour rather than by absolute capacity. When space and headcount cannot be expanded freely, the principal performance lever becomes the quality and timeliness of decisions about how existing space, inventory, labour, and equipment are deployed.

From machine control to predictive warehouse orchestration

WCS and WES represent important stages in this progression. A WCS operates close to the physical automation layer, directing conveyors, sorters, automated storage, and retrieval systems and robots, while synchronising equipment movements. A WES sits above this control layer and connects warehouse plans with real-time operating conditions. It prioritises and releases work, balances load across labour and automated assets, and adjusts task sequencing when order priorities, queues, equipment availability, or bottlenecks change. WCS therefore coordinates machine execution, whereas WES provides rules-based, real-time orchestration across people, processes, and automation. AI may enhance this orchestration by predicting changing conditions and suggesting adaptive responses.

Artificial intelligence (AI) extends this operating model from responsive orchestration to predictive and adaptive decision making. By analysing historical and real-time data across orders, inventory, labour, equipment, and facility conditions, AI can anticipate demand and congestion, forecast labour and replenishment requirements, identify inventory, quality, or maintenance risks, evaluate operational trade-offs, and recommend or initiate corrective action. The progression is therefore cumulative: Automation executes predefined tasks; WCS coordinates equipment; WES dynamically orchestrates work within defined rules; and AI enables the operating logic to learn from patterns, anticipate outcomes, and improve decisions as conditions change. An intelligent warehouse does not replace WCS or WES; it builds on these execution layers by converting connected operational data into forward-looking choices.⁷



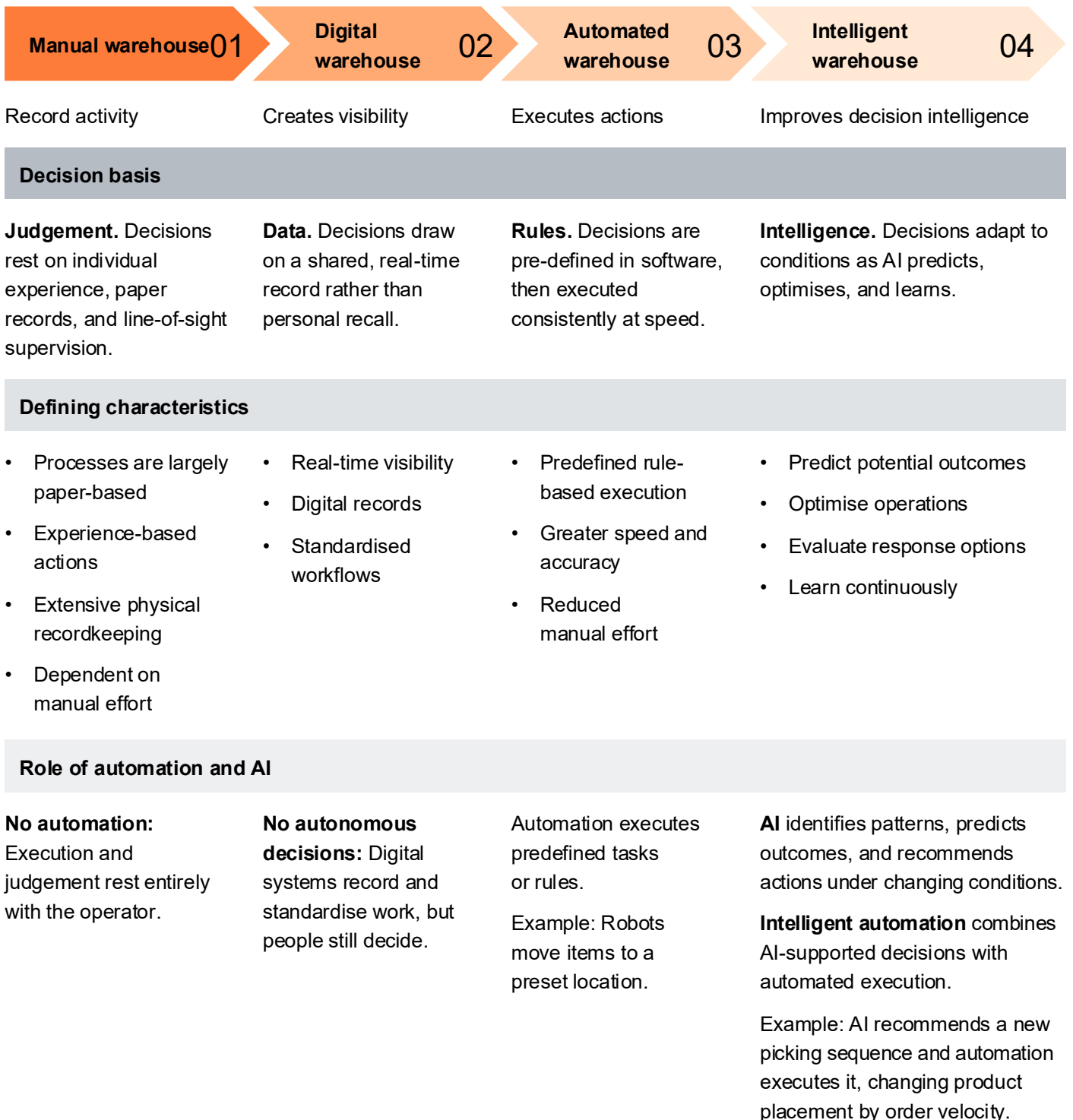
7. ET Infra, Role of AI and predictive analytics in Indian warehousing (accessed as on 22 September 2026)

The next stage of warehouse evolution therefore lies not only in executing efficiently and reliably, but also in decision intelligence. This is a shift from automation to intelligence in which systems interpret changing conditions, anticipate outcomes, and continuously optimise the response.

The warehouse maturity curve

Warehouses have evolved through four broad stages of maturity in their ability to respond to changing operating conditions. Each stage builds on the capabilities of the previous one, and most advanced warehouses operations today sit somewhere between the second and third stages.

Figure 2. Evolution of warehouse operations: From manual execution to intelligent decision making⁸

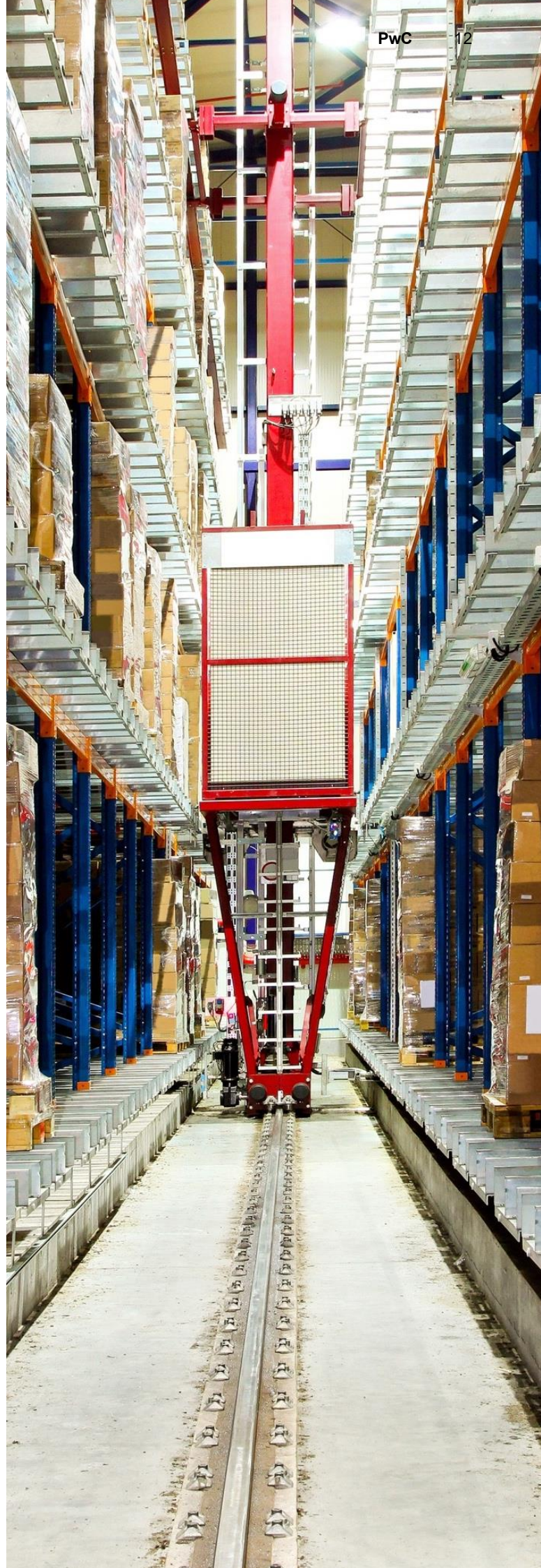


8. ET Enterprise AI.com, The role of AI and predictive analytics in Indian warehousing (accessed as on 22 September 2026)

Critical distinction lies between the third and fourth stages. At present, **digitalisation creates visibility and automation executes predefined workflows and tasks**. However, determining the best course of action in response to changing conditions remains largely dependent on human judgement which can be subject to bias, inconsistency, and slower response times. Warehouse managers, planners, and supervisors continue to interpret operational signals, evaluate trade-offs, and decide how inventory, labour, capacity, and exceptions should be managed.

The key capability missing from digitalised and automated warehouses is the ability to continuously interpret operational conditions and determine the most effective course of action in real time. This capability is increasingly important as warehouse operations become more complex, dynamic, and time sensitive. While digital systems can provide information and automated systems can execute predefined actions, neither can independently assess evolving conditions, predict potential outcomes, and identify the optimal response.

Intelligence can add this missing capability: It can connect operational signals, interpret changing conditions, anticipate likely outcomes, and recommend and/or, if applicable, initiate the most suitable response. This marks a shift from an execution-focused warehouse, which does what it is told, to an adaptive one, in which data continuously informs better decisions. In doing so, the role of operational data changes from producing reports that describe the past to enabling decisions that shape the future.

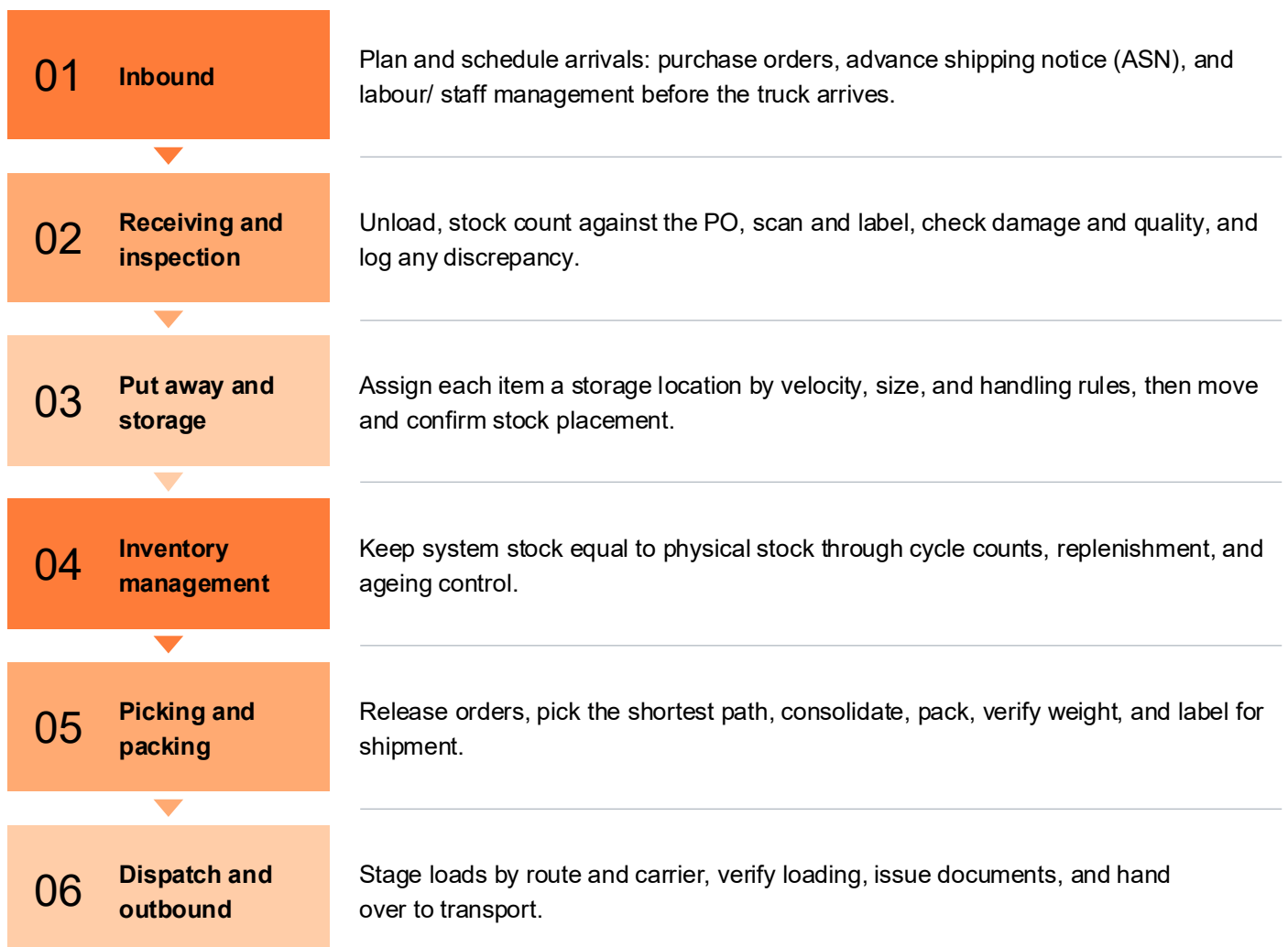


03

Role of intelligence in a warehouse

Warehouse performance depends on how efficiently tasks are executed, and equally on the quality of the decisions that direct them. Across receiving, put-away storage, replenishment, fulfilment, and dispatch, operators must continually judge how conditions shall evolve, how resources should be deployed in response, and how consistently those judgements can be applied across a high-volume operating environment. As Figure 3 illustrates, these activities form an interconnected flow: a delay, error, or capacity constraint at one stage can affect every subsequent stage. As distribution networks grow more interconnected and service commitments tighten, the volume, frequency, and interdependence of these decisions have increased materially.

Figure 3. Warehouse operations process flow



Notwithstanding the diversity of warehouse activities, many operational decisions can be framed around three fundamental questions. While the relevance of each question varies by process and industry together, they provide a useful framework for understanding how organisations move from foresight to action.

Table 1. Key decision question addressed by intelligent warehouses

Decision question	Decision category	Nature of the problem
What is likely to happen?	Prediction	Demand variability, supply disruptions, equipment degradation, and environmental fluctuations create ongoing operational uncertainty.
What should be done?	Optimisation	Determining the most effective response while balancing cost, service, throughput, and resource constraints.
Can the decision be executed automatically?	Decision automation	Inconsistent execution across shifts, zones, and volumes preventing operations from realising the full value.

Mapping use cases for AI in warehousing

Examined against this structure, warehouse AI applications can be mapped to the primary decision category below, although many span more than one stage of the decision cycle.

Table 2. Illustrative AI use cases across prediction, optimisation, and decision automation in warehousing⁹

Primary decision category	AI use case	Decision improved
Prediction	Demand forecasting	How much stock will be required by SKU during each period
	Supplier and inbound risk prediction	Whether inbound consignments will arrive on time and in full
	Equipment failure prediction	When an asset requires intervention before it fails
	Temperature-drift prediction	Whether a controlled environment will breach tolerance
Optimisation	Intelligent replenishment	What to reorder, in what quantity, and at what point
	Slotting design	Where inventory should be positioned within the facility
	Dynamic workforce planning	How labour should be allocated across zones and shifts
	Pick-path and order-batching optimisation	In what sequence work should be released and executed

9. ET Infra, The role of AI and predictive analytics in Indian warehousing (accessed as on 22 September 2026)

Primary decision category	AI use case	Decision improved
Decision automation	Automated replenishment triggering	Whether the replenishment decision executes without manual sign-off
	Real-time task orchestration	Which resource performs which task, as conditions change
	Automated exception management	How an at-risk order is re-prioritised or re-routed

AI applications in warehouses can be best understood through the decisions they improve rather than by the individual technologies they introduce. Forecasting engines anticipate future conditions, optimisation solvers determine the most appropriate response, and an orchestration layer coordinates the resulting decisions across warehouse systems, people, and automation assets. Viewed separately, these may appear discrete technology investments. Viewed together, they form a decision engine that addresses a single question: Does the warehouse anticipate, respond, and execute better than it did before? This framing determines whether the investment is defensible since it connects the technology directly to the operational outcomes against which warehouse is measured.

Where AI adds the most value

AI's value varies across warehouse processes. Rule-based software remains beneficial for stable, repetitive decisions where conditions are predictable and the governing logic can be clearly defined. AI adds the most value when decisions are **dynamic, uncertain, and highly interdependent**, where results depend on many variables changing at once, and where set rules or manual judgement may not be able to keep pace. In these situations, AI enables operations to anticipate events, optimise responses, and execute decisions that traditional methods cannot readily achieve. Key areas where AI can be useful are:

Demand forecasting:

AI analyses historical sales, demand pattern, and outside signals to assess future demand far more accurately than static models, reducing both situation of inventory shortages and excess inventory.



Inventory management:

Building on that forecast, AI optimises stock levels and placement and can trigger replenishment beforehand rather than at the time of inventory shortages.



Order fulfilment:

AI optimises how orders are picked, packed, and dispatched as well as a customer's ordering patterns to suggest, for example, that frequently co-picked items be slotted close together to cut travel time and enhance order processing speed.



From prediction to operational action

Forecasting future conditions is only the first half of the value. The harder part is to convert a prediction into the right operational action in real time. When sequencing and allocating work, AI weighs a range of factors, though which factors matter depends on the decision being made.

Table 3. Illustrative variables taken into account by AI in generating recommendations or decisions¹⁰

Decision area	Illustrative variables the AI weighs	Outcome
Order prioritisation and scheduling	Order priority levels, customer service agreements, faster delivery, and carrier cut-off schedules	Dispatch reliability, fewer missed cut-offs
Task allocation	Picker skill levels, current workload distribution, zone congestion, and equipment availability	Balanced labour use, reduced unproductive time
Pick-up and handling optimisation	Product characteristics such as item's size, weight, and handling requirements	Higher pick rate, lower damage

Balancing these factors simultaneously is a multi-dimensional optimisation problem. The aim is to find the combination that best satisfies various goals such as increasing speed, reducing cost, and service quality all at once. These factors typically exceed the capacity of manual planning. AI, by contrast, can resolve them in milliseconds and continuously re-optimize as new orders arrive or conditions change.

The same learning loop operates at the point of execution. Voice-directed picking systems, supported by natural language processing, interpret operator actions against the defined one and refine them progressively. Where pickers repeatedly request clarification at a given location, the system treats this as an indicator of a potential issue (e.g. inadequate signage, an unclear bin layout, or misplaced inventory) and escalates it for corrective action. Instructions consequently become clearer and error rates decline over time.

How AI differs from rules-based systems

Table 4. Rules-based systems and predictive AI in warehouse decision-making¹¹

Dimension	Rules-based systems	Predictive decisions	Warehouse decision example
Decision logic	Predefined and static	Derived from data and constantly refined	Reorder inventory when inventory levels fall below a defined threshold vs dynamically adjusting reorder levels based on changes in demand, performance of suppliers, and lead-time variability.
Timing of response	Subsequent to the event	In advance of the event	Expedite a shipment after an inventory unavailability occurs vs predicting inventory unavailability and replenishing inventory before service is impacted.
Treatment of complexity	Degrades as interacting variables increase	Evaluates interdependent variables concurrently	The planner manually balances labour, inventory, dock capacity, and order priorities vs AI evaluating all possible factors simultaneously to recommend the optimal action.

10. ET Infra, The role of AI and predictive analytics in Indian warehousing (accessed as on 22 September 2026)

11. PwC analysis based on NITI Aayog, Competition Commission of India

Dimension	Rules-based systems	Predictive decisions	Warehouse decision example
Adaptation to change	Requires manual reconfiguration	Re-optimises as conditions evolve	Slotting rules are updated periodically by warehouse teams vs AI continuously adjusting slotting recommendations based on demand and inventory movement patterns.
Output	Describes what has occurred	Recommends and, where appropriate, initiates the response	The dashboard reports inventory variance vs AI identifies the possible cause and recommends corrective actions.

The comparison above shows use of AI is crucial when warehouse decisions must adapt continuously rather than follow fixed instructions. Beyond predicting demand and managing inventory and order fulfilment, AI can create additional value in the following areas:

Supplier risk prediction. Risks may be identified early enough to enable alternative sourcing, revised inbound schedules, or buffer adjustments, helping prevent supply chain risk rather than merely absorb their impact.

Inventory variance root-cause identification. Variance may be attributed to its originating process defect rather than recorded only as an adjustment, allowing the cause to be corrected and recurrence prevented.

Temperature-drift prediction. Intervention may occur before tolerance is breached, preserving product quality, and value, and preventing compliance exposure associated with a confirmed excursion.

Across these applications the common characteristic test is whether a decision is dynamic, uncertain, and shaped by interacting variables. Where such conditions exist, AI can analyse and continuously refine a better operational response. Where the governing logic can be clearly written down, existing rules-based systems remain the more rational choice.

Where AI stands today

The use of AI in warehousing is progressing from isolated automation initiatives towards interconnected systems that connect data, machine learning, and robotics. Leading organisations are using these capabilities to strengthen demand forecasts, inventory placement, material movement, and fulfilment decisions. The following case studies show how this transition can progress from a targeted robotics pilot to enterprise-scale intelligent operations.

Table 5. How leading logistics players are deploying AI in warehouses

Case study 1 AI-enabled deployment of robotics at scale	Case study 2 AI-led operational orchestration
A leading global e-commerce player has progressively integrated goods-to-person robots, autonomous mobile robots, robotic arms, computer vision, and AI-based planning across fulfilment operations. AI analyses order, inventory, workflow, and equipment data to decide where inventory should be stored, how work should be prioritised, and which robot or resource should perform each task. Computer vision helps identify and track items, while robots execute the resulting movements, picking, sorting, and handling activities.	A global contract logistics provider has developed an AI-enabled operating platform that combines warehouse data and forecasting tools. The platform constantly analyses demand, inventory, labour, and workflow signals to identify potential issues and recommend or initiate actions across replenishment, picking, packing, shipping, and staffing.

Case study 1	Case study 2
AI-enabled deployment of robotics at scale	AI-led operational orchestration
The case illustrates a phased approach: Establish a proven automation foundation, add specialised technologies for individual workflows, and then link them through AI-enabled decision layer that allows the for improvement of fulfilment speed, utilisation of storage, and safety, and support further expansion.	This process moves warehouse management beyond retrospective reporting towards real-time decision support, enabling better resource allocation, stronger inventory visibility, and more effective response during changes in demand.

While intelligent warehousing has primarily led by leading private sector organisations, recent government initiatives indicate growing adoption within public-sector logistics infrastructure. In 2026, the Department of Food and Public Distribution launched an AI-powered smart warehousing system across Food Corporation of India (FCI) and Central Warehousing Corporation (CWC) facilities, incorporating AI-based monitoring, IoT-enabled environmental sensing, automated gate management, and forecasting of safety controls. The initiative shows how intelligent warehouse concepts are being applied at national scale to improve food security, inventory quality, and warehouse operational efficiency, emphasising the enhanced institutional support for digital warehouse transformation.¹²

This transformation is further supported by a broader policy ecosystem aimed at modernising India’s logistics and warehousing sector. Initiatives such as PM GatiShakti and the Unified Logistics Interface Platform (ULIP) are improving data sharing, network visibility, inter-operability, and multimodal coordination across supply chains. As of August 2025, ULIP facilitated secure API-based integration across more than 30 digital systems, enabling over 160 crore digital transactions.¹³ The National Logistics Policy promotes digital integration, process standardisation, reduced logistics cost, and greater logistics efficiency, while the development of MMLPs is creating integrated infrastructure that can support advanced warehousing operations. At the same time, the WDRA is expanding the adoption of e-NWRs, enhancing transparency and traceability in warehouse transactions. Emerging smart warehousing initiatives, including the deployment of AI and IoT-based technologies in public-sector foodgrain warehouses, further demonstrate the government’s commitment to modernising warehouse operations. Together, these initiatives provide a strong policy foundation for the adoption of intelligent warehousing technologies and position warehouse transformation as an important component of India’s broader logistics transformation agenda.¹⁴

Together, these examples demonstrate that intelligent warehousing is no longer a theoretical concept. Leading private-sector organisations have proven its operational value, while public-sector initiatives are creating the policy and infrastructure foundations needed to accelerate broader adoption. Although the intelligent warehouse is now technically achievable, adoption remains at an early stage. Most Grade A and Grade B facilities continue to operate at the digital or automated level, while AI-enabled decision-making remains at an early stage of adoption. As the foundations of accurate and consistent data, integrated systems, and connected automation mature, AI is likely to be the natural next stage of warehouse transformation. It will not replace existing systems but serve as the capability that turns their data into decisions.

12. PIB, Union Minister Shri Pralhad Joshi Launches Smart Warehousing System for Foodgrain Storage (accessed as on 22 September 2026)

13. PIB, India marks three years of National Logistics Policy: transforming India’s supply chain ecosystem (accessed as on 22 September 2026)

14. PIB, Gati Shakti Multi-Modal Cargo Terminals (GCTs): Driving India’s logistics transformation (accessed as on 22 September 2026)

From an industry perspective, the transformation of India's warehousing sector is increasingly shaped by the shift towards Grade A infrastructure, automation, and data-driven operations. Businesses today place greater emphasis on visibility, faster fulfilment, flexibility, and efficient asset utilisation. The key opportunity is to further integrate physical infrastructure with digital capabilities, enabling warehouses to respond more dynamically to changing demand. AI can support this transition through demand forecasting, inventory optimisation, intelligent slotting, workforce planning, and predictive maintenance. By 2047, India should aspire to build a connected, sustainable, and intelligent warehousing network where infrastructure can be planned, procured, operated, and maintained through integrated digital platforms. Achieving this will require standardised data, interoperable systems, skilled manpower, wider technology adoption, and close collaboration between industry and government.

Alok Bansal, Founder and CEO, 13SQFT, and Director, Buildmyinfra

AI is a strategic capability, to be applied selectively

Crucially, AI should be positioned as a **strategic business capability, not a default technology layer to be applied everywhere**. Not every warehouse challenge warrants it, and not every operation needs the same degree of autonomy. Its suitability should be assessed case by case, weighing value against effort. Intelligence tends to be most relevant where:

				
Operating conditions are changing	Decisions involve complex trade-offs	Decisions are repeated or time-sensitive	Business impact is material	Foundational readiness exists
Demand, inventory, labour, or equipment availability change frequently.	Multiple, competing constraints cannot be reconciled reliably through static rules.	Choices must be refreshed repeatedly, often in near real time.	Lack of timeliness and accuracy carry serious consequences related to cost, service, compliance, safety, and sustainability.	Data quality, system integration, and supervision by experts are sufficient to deploy and scale responsibly.

Applied with this discipline, AI ceases to be a bolt-on tool and becomes what its promise suggests: the intelligence layer that elevates the warehouse from executing decisions to also making them.

04

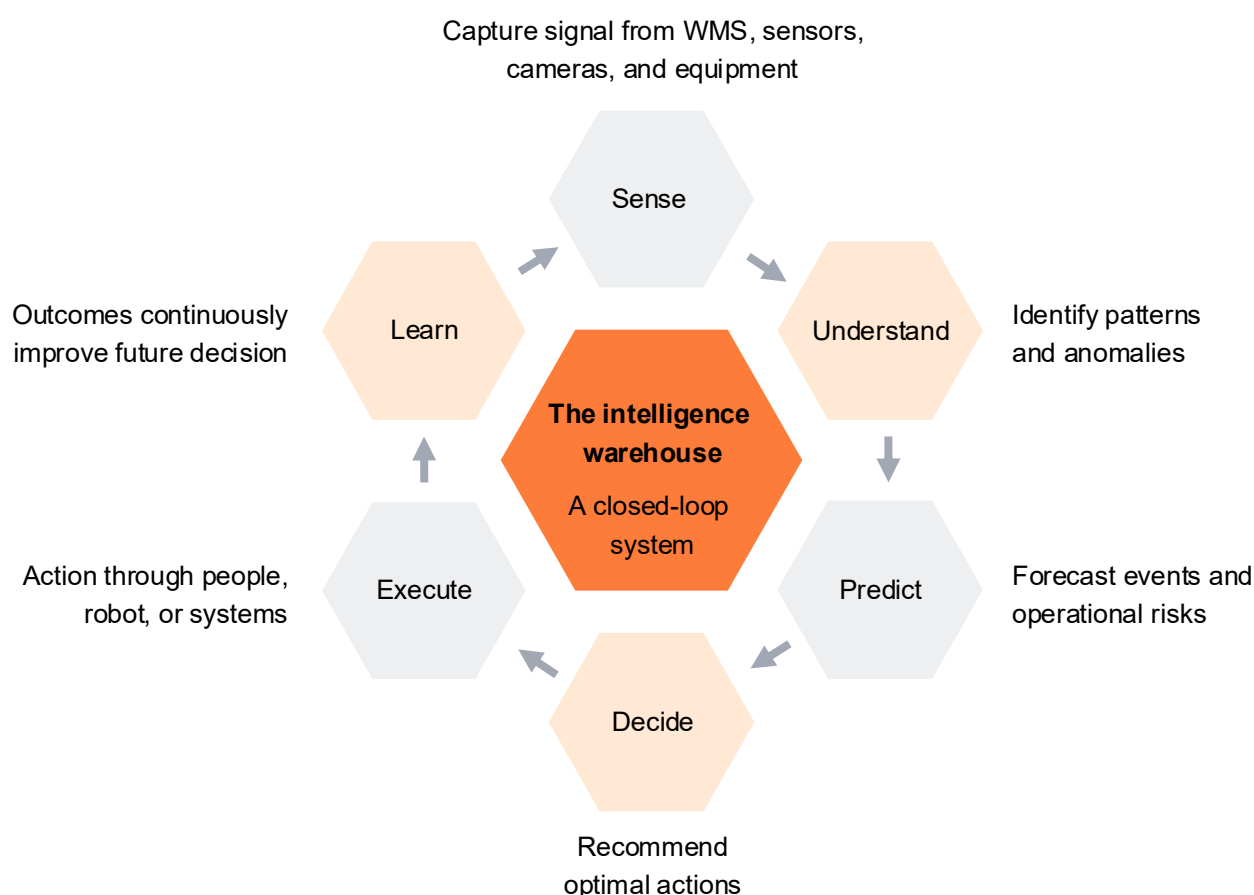
The intelligent warehouse framework

The preceding sections established that AI enables warehouses to move beyond automating systems for visibility and activity towards enabling intelligent decision-making. It can help forecast demand and operational risks, optimise inventory, labour, and order fulfilment, and automate time-sensitive decisions. Its greatest value lies in complex and fast changing operations where predefined rules and manual judgement cannot respond fast enough.

The question now is about how these functions would operate in coordination. Considered individually, a forecasting model, an optimisation engine or an automated trigger improves a single decision. However, collectively, they constitute an operating architecture in which each stage is dependent upon the stage preceding it and informs the stage that follows.

Figure 4. Intelligent warehousing: A continuous learning and decision cycle¹⁵

A closed-loop system where data, decision, execution, and learning continuously reinforce each other



15. Warehouse and logistics News, Intelligence throughout supply chain execution: How AI is Transforming the Modern Warehouse (accessed as on 22 September 2026)

The framework comprises six stages, applied across warehouse processes including receiving, put-away, storage, replenishment, picking, packing and dispatch, as well as planning and coordination activities that support them:

Sense (what is being observed): The first step is capturing operational signals across the warehouse. Warehouse management systems record transactional and inventory movement, barcode and RFID scans track goods by item and location, sensors report environmental and equipment conditions, cameras record physical state and activity, and automation assets report their utilisation and status. The output of this stage is raw, uninterpreted, and voluminous. The completeness and reliability of this layer concerns all subsequent stages as none can compensate for warehouse signals that are absent, delayed, inconsistent, or faulty.

Understand (what is happening and why): This stage is diagnostic step. Individual signals are correlated across sources to establish the current warehouse operating state: which receiving docks or picking zones are congested, which orders are behind schedule, where replenishment is delayed, or where physical stock has diverged from the system record. Where conditions depart from the established norm, the departure is isolated and attributed to a probable cause. This stage explains conditions that already exist, rather than projecting the future.

Predict (what is likely to occur): In this stage, demand is forecasted across stock-keeping units and periods, inbound reliability is assessed against supplier performance, inventory replenishment and labour need are anticipated, equipment degradation is anticipated towards probable failure, and conditions are projected against tolerance limits. The result is not an exact prediction but a quantified view of probable future warehouse conditions so that the organisation can plan remedial actions for such incidents.

Decide (which action is suitable): Predictions are converted into a recommended course of action, such as reprioritising an at-risk order, triggering replenishment, reallocating labour between warehouse zones, revising a picking wave or rescheduling a dock appointment. Competing constraints, service commitments, cost, available storage and handling capacity, labour availability and carrier schedules, are reconciled to determine the actions that are most likely to fulfil the warehouse operation's objectives. At this stage the framework progresses from characterising conditions to determining a response to them.

Execute (how the decision is actioned):

Recommendations are actioned through an orchestration layer that coordinates the resources available to the warehouse: personnel are directed through picking, put away or replenishment task instruction, automation assets such as conveyors, sorters or mobile robots are issued with commands, and WMS and dock plans are updated to reflect the revised course of action. Execution may be advisory, subject to confirmation by a warehouse operator, or autonomous, with the system acting directly. The appropriate mode is determined by the materiality of the decision and the adequacy of established oversight.

Learn (was the decision correct): Every decision the system makes, carries an expected warehouse outcome, such as a reduction in pick time, congestion, inventory unavailability or late dispatches. This stage compares that expectation against what actually happened and uses the difference to improve the models that produced it. Where a demand forecast has consistently run high for a particular SKU category, a replenishment rule has created avoidable shortages, or an allocation rule has performed poorly under certain operating conditions—the model is adjusted accordingly for each of these scenarios. The earlier stages assesses the state of the warehouse operation, while this stage assesses the quality of the system's own judgement. This capacity for self-correction is what separates an intelligent warehouse operation from an automated one, as performance improves through experience rather than through periodic manual reconfiguration.

The six stages constitute a closed loop rather than a linear sequence, and the distinction carries material consequence for warehouse operations. A sequence terminates at execution, which is the point at which conventional automation concludes (e.g. once a picking task is completed or a carton is sorted). The loop returns execution outcomes including pick times, inventory exceptions, equipment performance, and dispatch results to the sensing and prediction layers, such that each decision taken improves the quality of the next. The intelligence cycle is effective only when all stages operate together. If any stage is missing, the cycle breaks down. For example, sensing without learning enables continuous monitoring but does not improve future decisions, while deciding without execution results in recommendations that cannot be translated into operational outcomes. As a result, the warehouse cannot continuously adapt and optimise its performance. Therefore, the successful implementation of intelligent warehouse systems depends on the continuity of these stages.

As the use of AI in warehousing scales, its effectiveness will depend not only on warehouse operation effectiveness but also on the safeguards surrounding its use. Reliable decision-making requires complete, accurate, timely, and consistently governed data across warehouse systems, sensors, and automation assets. Cybersecurity must be embedded across connected equipment, interfaces, and data flows to protect operational continuity and prevent unauthorised access or manipulation. Human oversight should be proportionate to the materiality of the decision, with clear accountability, escalation mechanisms, and the ability to review or override automated actions. Therefore, responsible AI practices should be adopted to support transparency, fairness, and regular monitoring of model performance, particularly where decisions affect worker allocation, safety, compliance, or service outcomes.¹⁶

Business value realisation

It is important to measure the output of the framework based on the measurable business outcomes it delivers based on five parameters, as shown in Table 6.

Table 6. Business value dimensions and representative measures for intelligent warehousing¹⁷

Parameter	Impact	Representative measures
Operational efficiency	Allocation of labour, space, and equipment against actual rather than assumed conditions	Labour productivity, throughput per shift, storage density, and space utilisation, equipment availability
Service excellence	Earlier identification of at-risk orders and improved sequencing of work against delivery commitments	Order accuracy, fulfilment cycle time, on-time dispatch, perfect order rate
Risk reduction	Anticipation of compliance, safety, and supply exposures prior to materialisation	Compliance breaches, safety incidents, inventory variance, supplier failure rate
Sustainability	Consumption and loss reduced through continuous optimisation rather than fixed operating parameters	Energy consumption per unit handled, spoilage and write-off, packaging, waste volumes
Responsible adoption	Secure, reliable, and accountable use of data and AI-enabled decisions with integrity	Cybersecurity incidents, percentage of material decisions subject to human review, override frequency, incident frequency

These dimensions are interdependent rather than discrete. When applied to inventory policy, improved predictive accuracy can reduce buffer inventory, freeing up storage capacity, and lowering holding costs. It could also reduce the need for expedited replenishment, thereby enhancing service levels while decreasing transport-related emissions. A business case focused on a single dimension may therefore underestimate the true return potential. However, claims of benefits across multiple dimensions must be supported by evidence of the operational changes driving these outcomes.

16. NITI Aayog, Responsible AI (accessed as on 22 September 2026)

17. DPIIT, e -handbook on warehousing standards (accessed as on 22 September 2026)

Over the last decade, India's warehousing sector has evolved from fragmented, storage-led infrastructure into an increasingly organised, technology-enabled, and strategically important part of the supply chain. GST, e-commerce, rising customer expectations, and the growth of Grade A warehousing have accelerated this shift. The most significant change has been the transition of the warehouse from a cost centre to a critical enabler of speed, reliability, inventory optimisation, and customer experience. The next phase will be driven by intelligence. Key challenges remain around workforce productivity, inventory accuracy, space utilisation, and integration across complex supply chains. AI can be a powerful force multiplier—improving forecasting, inventory positioning, slotting, labour planning, predictive maintenance, safety, and real-time operational decision-making. The real opportunity lies in moving from reactive operations to predictive and increasingly autonomous warehouses, while augmenting human capability. By 2047, India has the potential to build one of the world's most advanced warehousing ecosystems—automated, digitally connected, sustainable, and multimodal. Achieving this will require interoperable technology platforms, stronger data standards and governance, greater adoption of automation and AI, workforce upskilling, and closer collaboration between government, industry, and technology providers. The ambition should not simply be to build more warehouses, but to create intelligent, resilient, and globally competitive supply chain infrastructure that becomes a strategic enabler of India's economic growth.

Anshuman Singh, Co-Chair, FICCI Committee on Logistics, and Managing Director and Chief Executive Officer, Indospace

Warehousing 2047: A future outlook

As India advances towards its long-term development ambitions, the warehousing sector is likely to undergo a significant transformation. Warehouses are expected to evolve from their traditional role as storage facilities and become integrated nodes within a broader logistics network. Supported by advances in technologies such as AI, IoT, robotics, and automated material-handling systems, they could become more connected, responsive, and capable of supporting real-time operational decision-making.

Policy initiatives such as PM GatiShakti, ULIP, and MMLPs are laying the groundwork for greater integration across transport modes and supply chain stakeholders. As digital connectivity across the logistics ecosystem increases, warehouses are likely to play a more active role in coordinating inventory flows, improving visibility across operations, and supporting faster and more efficient movement of goods.

Sustainability will be another important characteristic of the sector's future development. Growing adoption of renewable energy, energy-efficient equipment, green building standards, and smart resource management practices can help reduce the environmental impact of warehousing while also improving operational efficiency. As sustainability expectations continue to rise, environmental performance may become as important as traditional measures such as cost, speed, and service levels.

Realising this vision will require more than technology adoption. Progress will depend on continued investment in digital infrastructure, interoperable systems, cybersecurity, high-quality data, and workforce capabilities. Effective governance frameworks and collaboration among government agencies, warehouse operators, logistics providers, technology firms, and industry bodies will be equally important. Together, these efforts can help create a warehousing ecosystem that is more intelligent, connected, and sustainable.¹⁸

Conclusion

For decades the primary limitation in warehouse operation was execution capability—the capacity to move, store, and record goods accurately at speed. Successive developments in warehouse capabilities, such as WMS, have progressively addressed previous limitations by increasing visibility and process control, while mechanisation and automation have improved speed, accuracy, and consistency. Although challenges remain in execution, particularly in less mature warehouse operations, in more advanced facilities, the primary concern is no longer whether tasks can be completed efficiently, but whether the right decisions are made about what should be done, when, and how.

18. NITI Aayog, DPI@2047 for Viksit Bharat (accessed as on 22 September 2026)

The distinction between efficient execution and better decision-making is important. A system may execute an inefficient labour plan, inaccurate forecast, or poor replenishment decision quickly and accurately, but it cannot determine whether a better option was available.

Three conclusions emerge for organisations considering their next steps towards intelligent warehousing.

Intelligence should be applied selectively rather than across all warehouse processes. The value of AI depends on how volatile, uncertain, and interconnected the decision in question is and not on how sophisticated the technology is. In predictable conditions, where decision rules can be defined in advance, existing rules-based systems remain the more rational and economical choice. Therefore, organisations should identify the specific decisions where current rules do not work well and concentrate AI investment in areas where AI can deliver a clear operational outcome.

The loop must be closed to realise the return. Predictions that don't inform optimisation often lead to insights that remain unused. Similarly, optimisation plans that cannot be effectively executed quickly become outdated. Without evaluation, execution risks repeating the same mistakes. Therefore, investing in any single stage alone is likely to result in underperformance.

Foundational readiness determines feasibility. Data quality, system integration, and clear human oversight are the prerequisites for the framework and organisations that proceed without them will be limited not by the capability of the model but by the quality and reliability of the data it receives.

For the Indian market, the sequencing of these considerations carries additional weight. The sector's transition towards organised Grade A facilities has established the physical and systems foundation upon which intelligence can be built. This intelligence is already being used selectively in areas such as demand forecasting, inventory placement, replenishment, order prioritisation, and predictive maintenance, though adoption remains concentrated among more advanced operations.

The physical and digital capabilities represent a material advantage: Recently developed warehouses face fewer legacy-system integration challenges than facilities in more established markets. Therefore, the opportunity does not lie merely in adopting these capabilities but in implementing them alongside the existing setups.

The intelligent warehouse should ultimately be understood not as a technology programme but as an operating philosophy, one in which the organisation's accumulated operational experience is systematically converted into improved decisions. Warehouses have historically been designed to execute decisions made elsewhere. However, by implementing intelligent WMS, warehouses can enable the system to support decisions across every stage of operations along with required human oversight.



About FICCI

Established in 1927, FICCI is the largest and the oldest apex business organisation in India. Its history is closely interwoven with India's struggle for independence, its industrialization, and its emergence as one of the most rapidly growing global economies.

A non-government, not-for-profit organisation, FICCI is the voice of India's business and industry. From influencing policy to encouraging debate, engaging with policymakers and civil society, FICCI articulates the views and concerns of industry. The organisation serves its members from the Indian private and public corporate sectors and multinational companies, drawing its strength from diverse regional chambers of commerce and industry across states, reaching out to more than 2,50,000 companies. FICCI provides a platform for networking and consensus building within and across sectors and is the first port of call for Indian industry, policymakers, and the international business community.

Contact us

Neerja Singh

Assistant Secretary General
neerja.singh@ficci.com

Komal Sharma

Additional Director & Head – Transport
Infrastructure & Logistics
komal.sharma@ficci.com

Varun Gogia

Deputy Director – Logistics
varun.gogia@ficci.com

Anshuman Chaudhary

Assistant Director - Infrastructure, Logistics &
Road Safety
anshuman.chaudhary@ficci.com

Rishita Barman

Assistant Director – Logistics
rishita.barmen@ficci.com

About PwC

We help you build trust so you can boldly reinvent

At PwC, we help clients build trust and reinvent so they can turn complexity into competitive advantage. We're a tech-forward, people-empowered network with more than 364,000 people in 136 countries and 137 territories. Across audit and assurance, tax and legal, deals and consulting, we help clients build, accelerate, and sustain momentum. Find out more at www.pwc.com.

PwC refers to the PwC network and/or one or more of its member firms, each of which is a separate legal entity. Please see www.pwc.com/structure for further details.

© 2026 PwC. All rights reserved.

Contact us

Manish R Sharma

Partner and Leader, Infrastructure, Transport,
Logistics, and Real Estate
manish.r.sharma@pwc.com

Jaffrey Thomas

Partner, Transport and Logistics
jaffrey.thomas@pwc.com

Contributors

Nimisha Agarwal

Kirti Manjusha

Yukti Jain

Varun Deo Khare

Srijana Adhikari

Debarati Adhikari



Data Classification: DC0 (Public)

In this document, PwC refers to PricewaterhouseCoopers Private Limited (a limited liability company in India having Corporate Identity Number or CIN: U74140WB1983PTC036093), which is a member firm of PricewaterhouseCoopers International Limited (PwCIL), each member firm of which is a separate legal entity.

This document does not constitute professional advice. The information in this document has been obtained or derived from sources believed by PricewaterhouseCoopers Private Limited (PwCPL) to be reliable but PwCPL does not represent that this information is accurate or complete. Any opinions or estimates contained in this document represent the judgment of PwCPL at this time and are subject to change without notice. Readers of this publication are advised to seek their own professional advice before taking any course of action or decision, for which they are entirely responsible, based on the contents of this publication. PwCPL neither accepts or assumes any responsibility or liability to any reader of this publication in respect of the information contained within it or for any decisions readers may take or decide not to or fail to take.

© 2026 PricewaterhouseCoopers Private Limited. All rights reserved.

AP/September2026 - M&C 55189