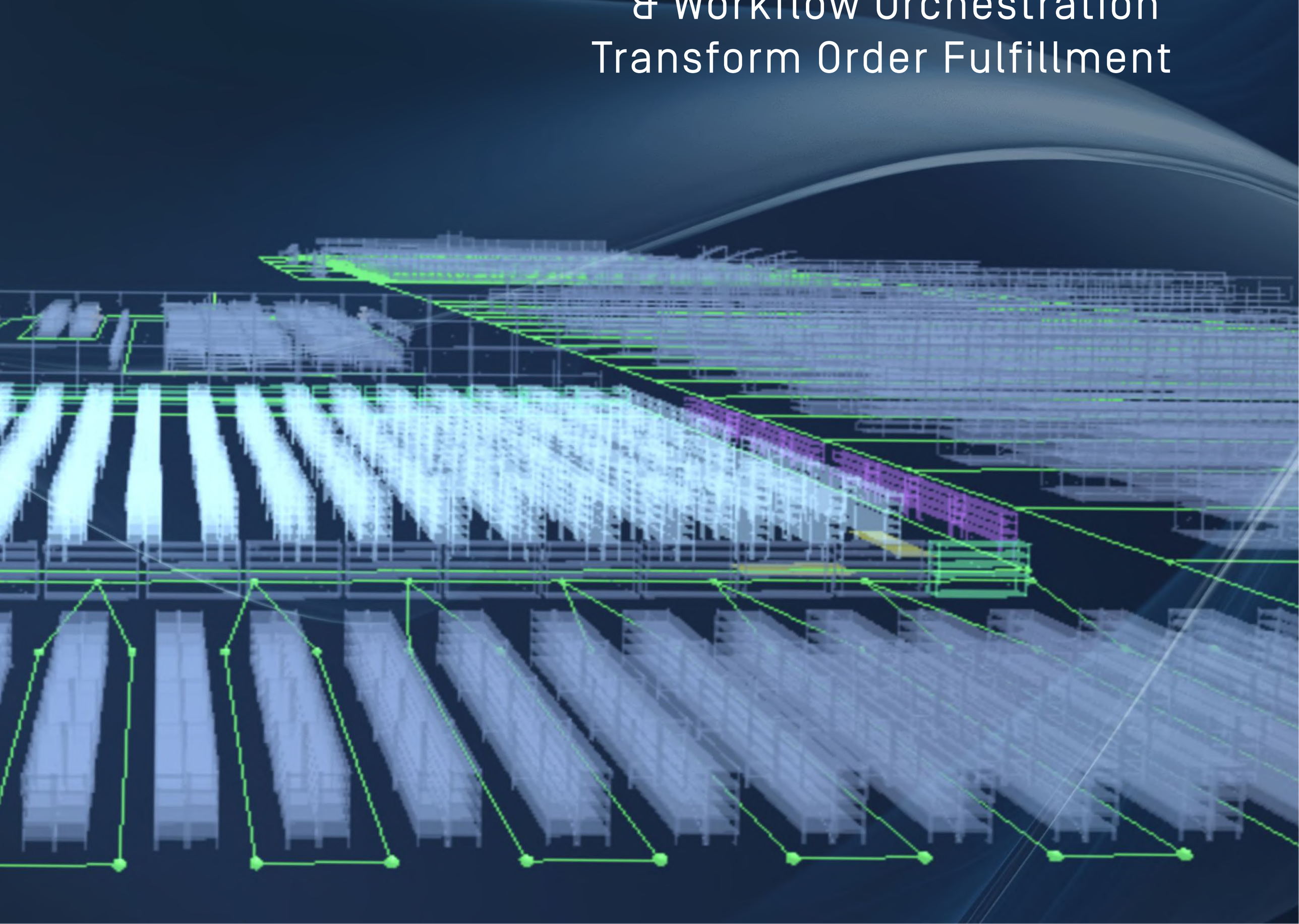
INVIA ROBOTICS

BUILDING **HYPER-EFFICIENT** WAREHOUSES

How AI Decision Intelligence
& Workflow Orchestration
Transform Order Fulfillment



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INTRODUCTION

Welcome to the world of modern order fulfillment, where warehouses are grappling with a host of new challenges: thousands of products requiring random access, faster delivery expectations, high return rates, and the need to maintain excellent service standards.

To meet these challenges and thrive in the competitive eCommerce landscape, businesses need to become hyper-efficient, leveraging advanced strategies and intelligent technologies.

WAREHOUSES UNDER PRESSURE

With online shopping continuing to rise, businesses are under growing pressure to meet eCommerce fulfillment demands efficiently. It’s becoming increasingly difficult to do so.

The complexity of inventory management has surged with the increasing variety of SKUs. Consumer expectations are also evolving. Beyond speed and low-cost delivery, consumers now demand real-time tracking, personalized services, and hassle-free returns, adding to the operational burden. Despite some improvements, the warehouse labor market is still facing significant challenges, including staffing shortages and rising wages needed to retain workers.

Home Delivery Consumer Sentiment Study

- **67%** experienced a delivery problem
- **44%** preferred lower-cost deliveries
- **28%** preferred faster deliveries
- **13%** preferred fast & precise, with cost being less important

Source : Descartes Insights Ecommerce Sentiment Study

Historically, warehouses delivered bulk quantities of a single product to stores, where consumers would “pick” and purchase the items on their own. The modern model requires warehouses to handle a large number of individual orders, delivering directly to customers' doorsteps, meeting tight deadlines, and navigating labor market challenges, all while maintaining low costs.

To tackle escalating pressures, warehouses are increasingly turning to advanced technologies like AI, robotics, and IoT to enhance efficiency and remain competitive.

THE COMPLEXITY OF ORDER FULFILLMENT

Managing a dynamic and demanding warehouse environment means finding ways to optimize every step of the fulfillment process. The goal is to consistently meet SLAs in the most efficient and cost-effective way.

That’s not an easy thing to do. Warehouses struggle to move products through the warehouse. In distribution centers, it's common to see items piling up in different locations. This could be because items were picked quickly but not packed fast enough, causing orders to build up at pack-out.

Or perhaps there are not enough resources to put away new products to storage from the receiving area. These bottlenecks create a ripple effect across the entire fulfillment process, causing inefficiencies and missed deadlines.

The problem is that the warehouse workflows are interconnected.

There are many automation solutions that optimize specific tasks, like picking, but the fulfillment process is not optimized holistically. As a result, a delay in one area can cascade through the system, escalating order cycle time.

FULFILLMENT ORCHESTRATION

To streamline the fulfillment process, companies must look at the big picture. Optimizing one area is not enough to eliminate bottlenecks. Every task and every workflow must be meticulously prioritized and coordinated. This includes inventory management, replenishment, order picking, and packing. Each phase is crucial to ensure timely delivery.

Leveraging advanced AI can transform these complex operations into smooth, efficient workflows, creating hyper-efficient warehouses that adapt to varying demands and conditions.

THINK OF A WAREHOUSE AS A CITY DURING RUSH HOUR TRAFFIC.

What if a traffic light fails and no alternative routes are available?

What if all the traffic from a four-lane road needs to pass through a one-lane bridge?

THE POWER OF DECISIONS IN A WAREHOUSE

Orchestrating workflows to create a hyper-efficient fulfillment process requires making informed decisions —a continuous flow of them.

Decisions on task prioritization, resource allocation (determining which agent should do what and when), and workflow coordination are crucial for driving warehouse productivity and ensuring seamless operations.

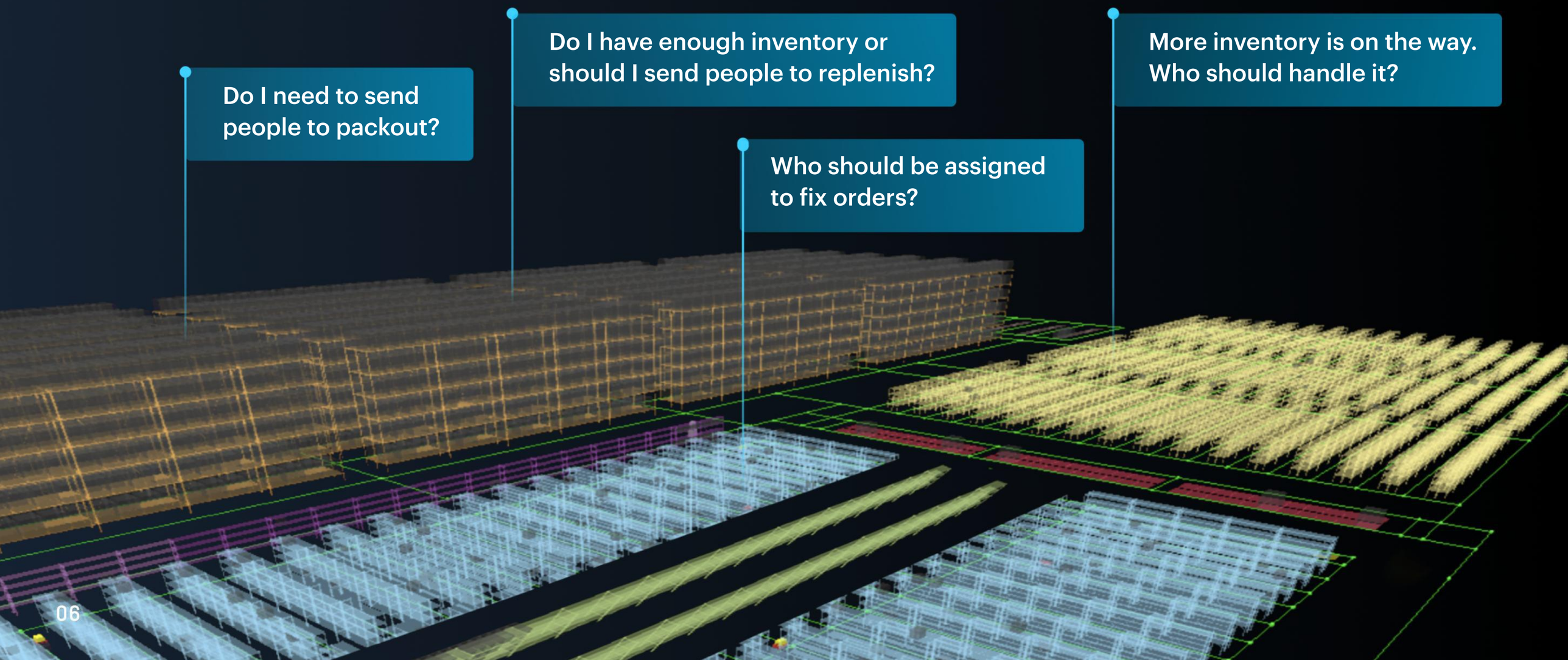
Making these decisions efficiently requires an in-depth understanding of all moving parts within the warehouse and how they are interconnected.

More importantly, it's about anticipating needs before they become urgent and allocating resources where they will be most effective.

THE SCIENCE OF DECISION-MAKING

Research shows that people can make fewer than **200 informed decisions daily**, and decision fatigue causes their judgment to decline without proper breaks and rest.

WHO SHOULD DO WHAT TASK, HOW AND WHEN?



HUMAN DECISION-MAKING CAPACITY AND AI

At the core of warehouse operations are managers and workers, who make countless decisions to keep things running. Warehouse managers face a daily multitude of orders, inventories, and problems, all requiring immediate attention and prioritization.

First, they must decide WHO SHOULD DO WHAT TASK, HOW AND WHEN while also navigating the complexities of service level agreements (SLAs).

Every order comes with a ticking clock, and meeting the deadline is critical for maintaining customer satisfaction.

Orders with issues such as short picks often don't receive the attention they need because they are more challenging to resolve. The problematic order is set aside to deal with it later, but the clock keeps ticking.

Next, managers must decide WHERE THE INVENTORY SHOULD GO.

Often, managers don't have time for proper organization, leading to outdated products, like Christmas items in January, occupying valuable space meant for the fastest-moving items. Without proper re-slotting, inefficiencies arise.

Finally, there is the question of the **OPTIMAL WAREHOUSE CONFIGURATION**.

Should they maintain a large forward pick location? Is it better to have smaller pick zones? Should they install an AS/RS system or rely on forklift drivers for cherry-picking?

Imagine relying on one person to manage all city traffic flow.

In a distribution center, warehouse managers face constant decision-making demands. Yet, the complexity of modern warehousing often surpasses human cognitive capacity.

That’s why traditional decision-making methods are now being complemented by AI that can sift through vast amounts of data, identify trends, and manage work quickly and accurately far exceeding human capability.

TRANSFORMING WAREHOUSES WITH AI TECHNOLOGY

Unlike people, AI systems don't get tired. They can process thousands of data points simultaneously and continuously. They make informed decisions at a speed and volume that is simply unattainable for any single person, bubbling up the issues so people can make high-level decisions.

Plus, the more AI is used, the smarter it gets. AI learns and adapts through algorithms that analyze patterns within data. Over time, it becomes even more efficient, learning from past decisions to make predictive judgments that solve problems before they arise.

At inVia Robotics, we've leveraged this capability within inVia Logic Warehouse Execution System (WES) software.

Powered by **inVia IQ AI engine**, it’s capable of making over 1 million decisions per day to fulfill orders, scaling decision-making far beyond what a warehouse manager could achieve.

For warehouses and distribution centers, AI acts as an omnipresent traffic controller, keeping tasks flowing smoothly and instantly redirecting them if a bottleneck is detected.

WMS & WES: INTEGRATING AI FOR OPTIMAL EFFICIENCY

To fully leverage AI in warehouse management, it's crucial to understand how it integrates with the foundational systems that drive operations—namely, the Warehouse Management System (WMS) and Warehouse Execution System (WES).

These two systems work in tandem to ensure smooth operations. While they are often mentioned together, they serve distinct yet complementary roles.

WMS: Defining the "What"

The WMS is responsible for handling the "what" of warehouse operations. It answers key questions such as what orders need to go out, what SLA rules govern them, what inventory is on hand, and which workers are available to execute tasks.

WES: Optimizing the "How"

The WES takes the “what” from the WMS and focuses on “how” they should be handled in the most efficient way. It processes the order and worker profiles, SLA rules and inventory data, then plans, prioritizes, assigns and manages work autonomously. It continually monitors and adjusts workflows in real time, ensuring tasks are executed as efficiently as possible.

AI enhances the WES by making it smarter and more responsive. It sifts through data from the WMS to make informed, real-time decisions about task assignments and workflow optimization.

inVia Logic WES software is powered by inVia IQ AI engine that collects WMS data and uses machine learning to optimize workflows and build effective decision plans.

inVia IQ AI engine, makes **more than 1 million decisions a day** required to fulfill daily orders.

AI PLANS AND MAKES DECISIONS LEAVING NOTHING TO CHANCE

Traditionally, managers have relied on "wave" systems to coordinate tasks, but these methods often come with limitations that lead to decreased productivity and unplanned downtime.

For instance, if sorters process items but packers aren't ready, bottlenecks occur. Similarly, if replenishment isn't done on time, pickers have to wait. Proper task distribution is crucial—without it, one worker can become overwhelmed while others are underutilized.

AI offers a dynamic alternative.

inVia Logic WES software transforms operational data into a living, breathing order fulfillment plan that continuously recalculates and adapts to changing conditions.

First, inVia Logic gathers extensive data from WMS systems, including order details, SLAs, inventory levels, and user profiles.

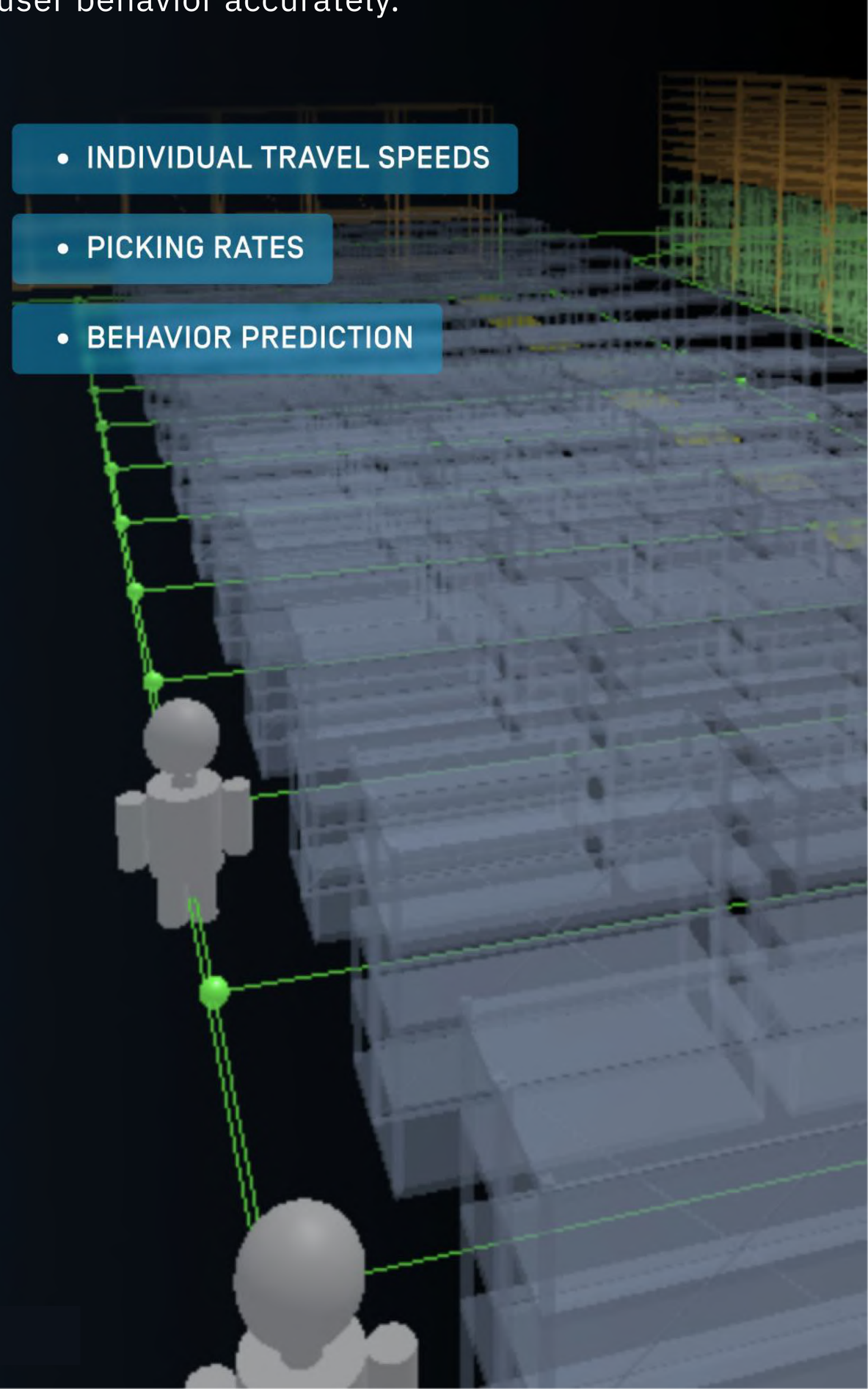
Each service level agreement (SLA) can have numerous constraints:

- WHAT IS THE DELIVERY DEADLINE?
- WHAT SHOULD BE DONE IF THE ORDER IS INCOMPLETE?
- DOES THE CUSTOMER NEED TO APPROVE A PRODUCT REPLACEMENT IF THE ITEM THEY ORDERED IS NOT IN STOCK?

Understanding the business rules that govern them is crucial.

Next, inVia Logic learns what resources are available in the warehouse in general and on any given day, as well as daily patterns and user behaviors, such as individual travel speeds and picking rates.

Instead of relying solely on UPH as the productivity metric, it digs deeper. Handling large items takes longer than smaller ones, picking across different zones adds complexity—the system considers these variables and predicts user behavior accurately.



DYNAMIC TASK SCHEDULING

Finally, the system merges these two steps and seamlessly matches SLA demands with real-time resource availability.

It orchestrates order fulfillment with great precision and can do that instantly on a massive scale. It perpetually:

- **PLANS**
- **PRIORITIZES**
- **SCHEDULES TASKS**
- **ASSIGNS THE RIGHT PERSON TO THE RIGHT TASK**

For example, if one worker picks items quickly but walks slowly, and another picks slowly but walks quickly, the system assigns more walking tasks to the faster walker. Additionally, if a worker is already picking items in one location, the system assigns more tasks there to boost efficiency.

Warehouse conditions are anything but static; they change from minute to minute. Whether it’s an unanticipated delay, equipment failure, or a sudden change in order priorities, these unexpected events are part of daily warehouse operations.

The revolutionary aspect of AI in decision-making is its ability to continuously monitor and fine-tune task assignments. It's a perpetual cycle of monitoring, analyzing, and adjusting to maintain peak efficiency.

By interleaving tasks and guiding all resources effectively, inVia's AI system enhances warehouse operations, ensuring smooth and efficient fulfillment processes.

Traditional task scheduling

inVia Logic Dynamic task scheduling

INTELLIGENT PATH PLANNING

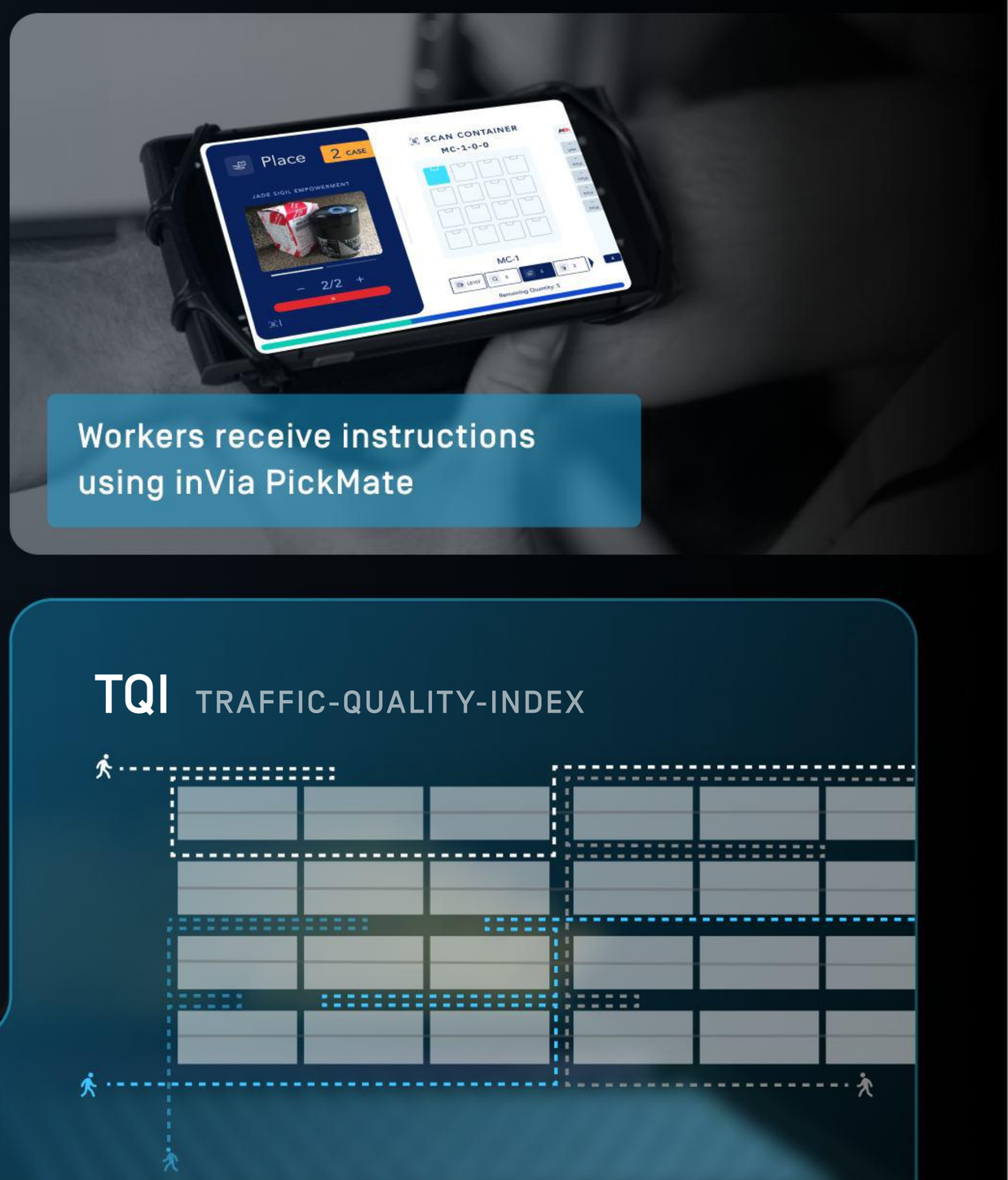
With AI-driven planning and dynamic task scheduling in place, effective employee guidance becomes the next priority. Knowing what to do is one thing, but knowing how to do it quickly and efficiently is another.

One of the key elements of AI decision intelligence is optimizing path planning. The system must decide which route each worker should take to most efficiently complete a task. The fastest path isn't always the shortest; the system considers all variables to determine the optimal route.

It scrutinizes SKU velocities and employs intelligent batching and spatial planning to avoid multiple trips to the same aisle. It goes even further to maximize efficiency: for instance, if an item is on the bottom shelf and another is on the top, picking the top item first can block access to the bottom item. The system optimizes the picking sequence, directing workers to pick items from bottom to top to avoid such conflicts and maintain a smooth flow.

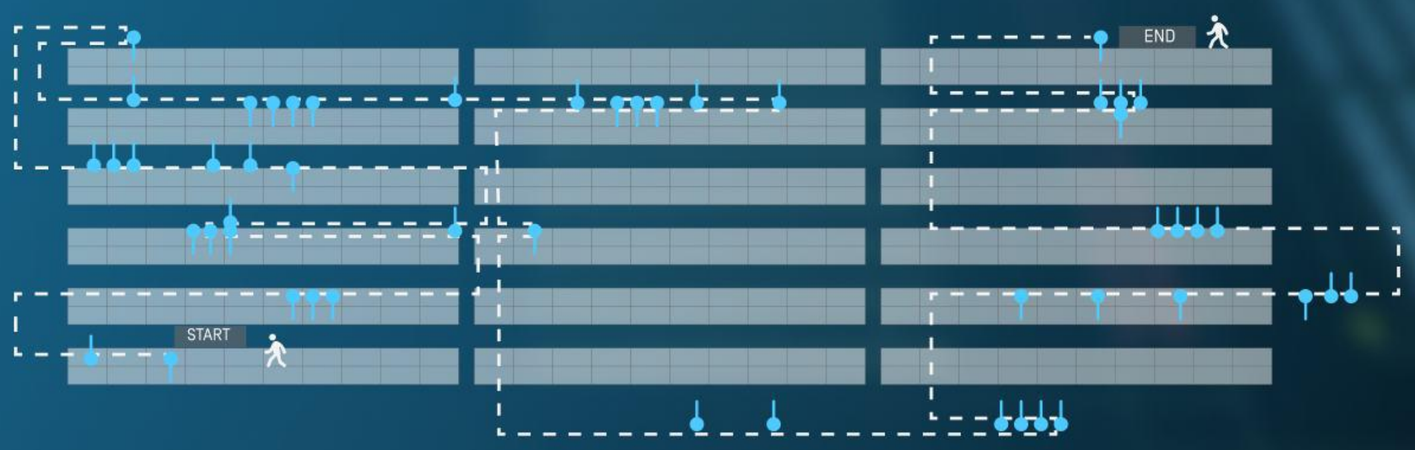
Traffic density is also a crucial factor. Imagine two forklift drivers heading into the same aisle. The system intelligently tracks and adjusts paths of people, robots and machines to minimize congestion.

AI perpetually sifts through vast amounts of data, optimizing tasks, paths, and orders individually while considering all ongoing processes in the warehouse.



inVia SmarthPath

Optimized path planning



TQI TRAFFIC-QUALITY-INDEX

OPTIMAL INVENTORY PLACEMENT

One critical aspect of AI decision intelligence is determining the optimal placement of inventory, which can fluctuate due to seasonality and product popularity. When new inventory arrives, warehouse managers face the challenge of deciding where each item should go. Should they re-slot inventory to make picking more efficient or move existing items to make space?

Advanced AI systems, such as inVia Logic, can analyze many variables to ensure optimal inventory placement.

INTELLIGENT RE-SLOTTING

The system dynamically re-slots SKUs to their optimal locations. It can predict the ideal location on the XYZ axis—identifying not just where in the warehouse but also the best height on the shelves.

CHOOSING STORAGE TYPE

AI identifies the most optimal material handling storage type, such as pallet or carton flow systems to optimize space and handling efficiency.

ROBOTIC INVENTORY CONSOLIDATION

Slow-moving items are grouped together to free up prime locations for faster-moving products.

JUST-IN-TIME FULFILLMENT

The system intelligently aligns putaway, replenishment and picking tasks ensuring smooth and efficient order fulfillment.

Optimal inventory placement, guided by AI decision intelligence, transforms warehouse efficiency. By continuously fine-tuning the organization of inventory, the system ensures that every inch of space is utilized effectively.

This comprehensive approach not only maximizes density but also streamlines the picking process, leading to faster order fulfillment and improved operational efficiency.

DISCOVERING THE BEST OPERATIONS DESIGN FOR THE WAREHOUSE

In the modern warehouse, operations design is everything. Decisions on layout, workflow design, and placement of inventory can significantly impact efficiency, order accuracy, and overall operational costs.

Ideally, the warehouse manager would continually iterate and adapt the warehouse layout to match the evolving business needs. However, the complexity and additional workload often mean these critical adjustments are overlooked.

This is where decision intelligence makes a big impact. Advanced AI allows businesses to easily create a digital twin of their real-world warehouse and then simulate different scenarios to find the best layouts, workflows, and automation solutions in minutes.

InVia's Twin IQ Intelligent Simulation enables businesses to run various scenarios and predict outcomes without disrupting the actual warehouse environment. It accurately replicates real-life fulfillment scenarios, including mistakes typically overlooked by traditional simulations. This process facilitates continuous improvement and efficient decision-making.

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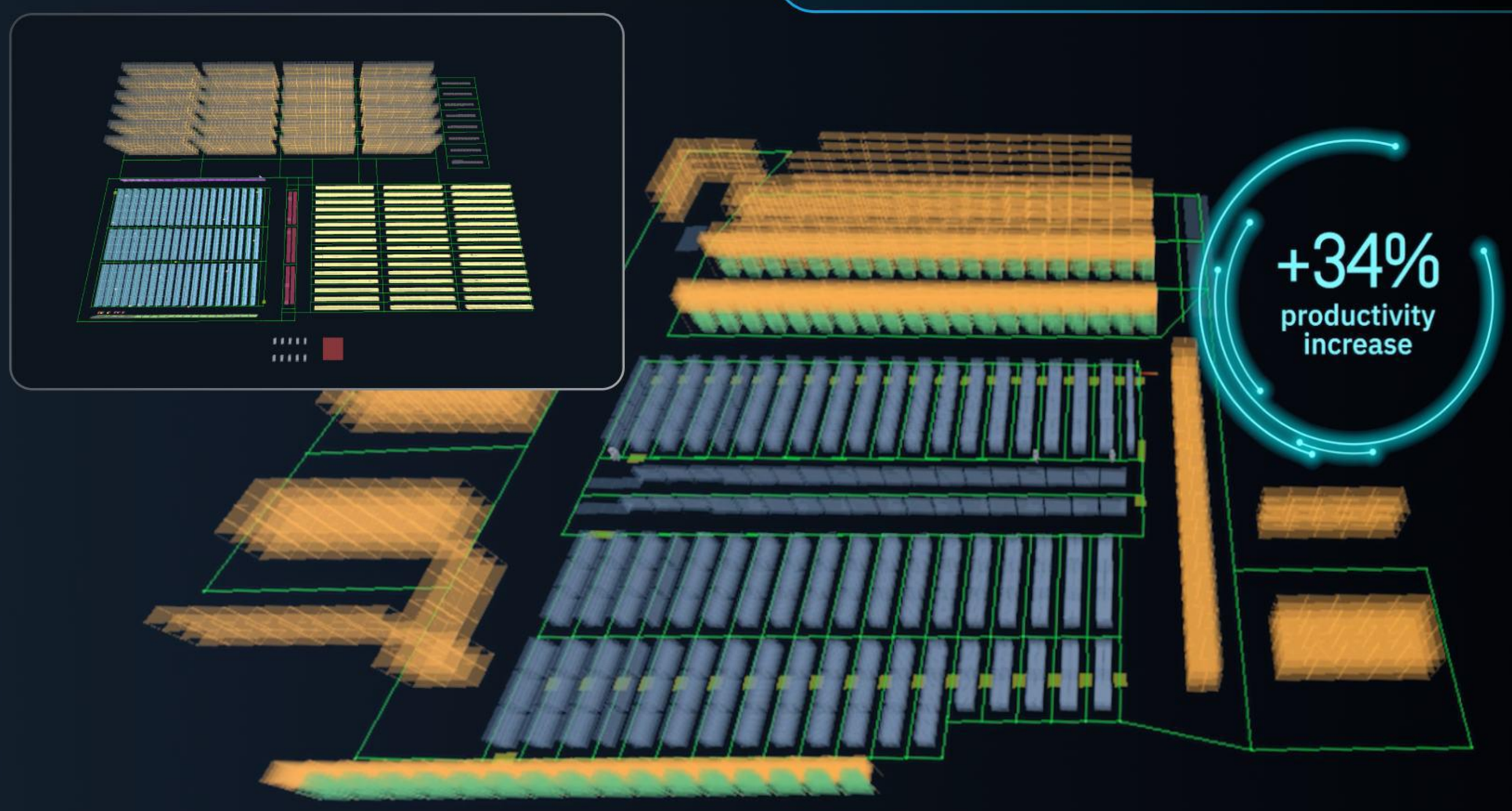
Assessing warehouse efficiency used to consume weeks, even months, of our time and resources. We'd deploy teams of engineers, gather data, and analyze operations extensively to identify areas for improvement. **Now, with a few clicks, we can simulate scenarios, conduct thorough analyses, and pinpoint optimization opportunities in just minutes.**

Michael Huffaker COO, CarParts.com



TAKING EFFICIENCY FURTHER WITH ROBOTICS

After leveraging AI-driven decision intelligence to automate task scheduling, path planning, inventory placement, and warehouse design, the next step in building hyper-efficient warehouses is to integrate robotics. While AI sets the stage for operational efficiency, robotics can significantly enhance this efficiency by automating and streamlining physical tasks.

A prime example of how integrated robotics can elevate warehouse efficiency is the inVia PickerWall. This innovative Goods-to-Person (G2P) automation **eliminates the main cause of bottlenecks in robotic solutions: the people-robot dependency.**

inVia Picker robots deliver totes to inVia PickerWall, building a dynamic pick/put wall with each day's orders. People work on the other side of the wall pulling products and sorting them into order bins. They are able to work in bursts, while robots do their non-stop work.

NO PEOPLE-ROBOT DEPENDENCY

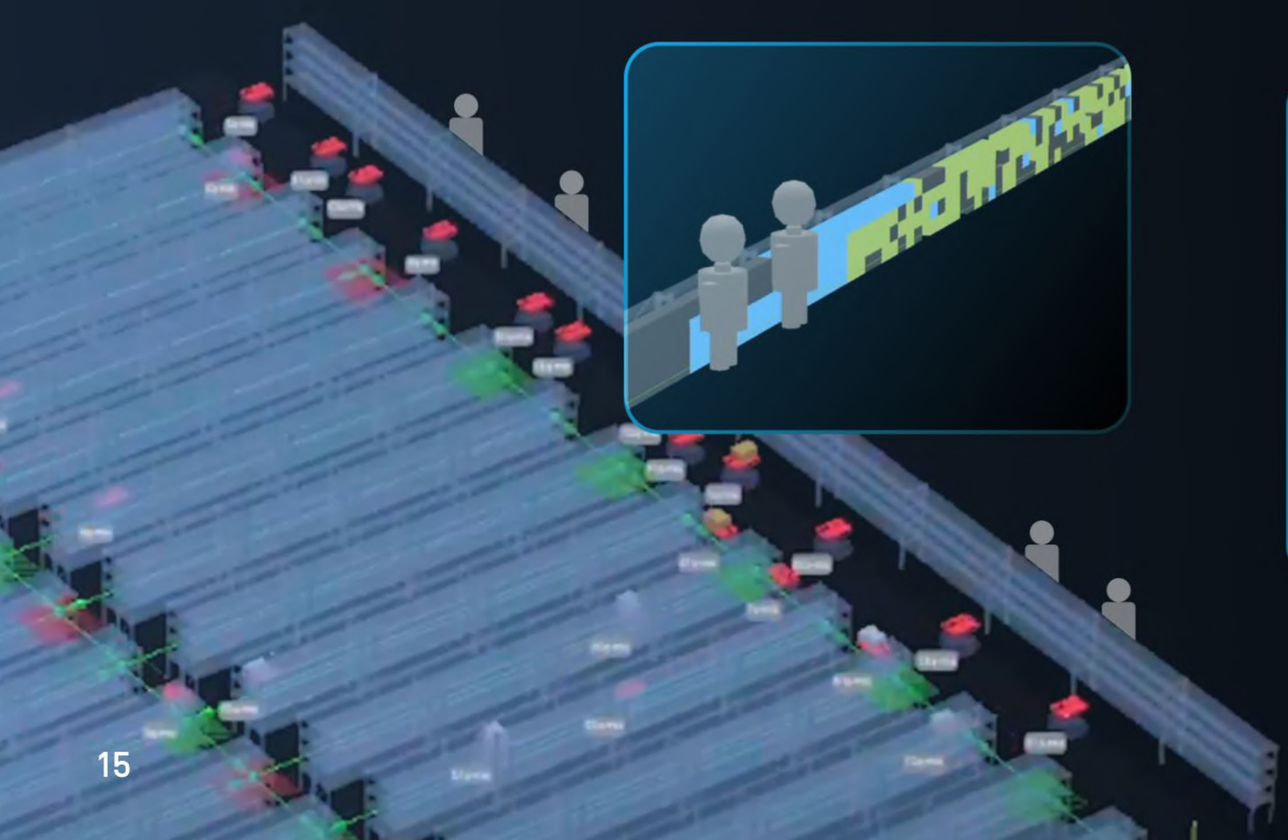
Robots do not wait on people, and people do not wait on robots. This leads to increased productivity rates.

90% LESS WAREHOUSE WALKING

The PickerWall condenses picking area down 75% or more. This reduces walking through the warehouse by as much as 90%.

5X+ INCREASE IN PRODUCTIVITY

inVia PickerWall system results in an average 350-450 UPH pick rate and can help realize bursts up to 1,000 UPH.



The inVia PickerWall revolutionizes the picking process by directly delivering items to workers, drastically reducing the time and effort required for manual picking.

THE NEXT CHAPTER FOR WAREHOUSES

Building hyper-efficient warehouses requires strategic management and the integration of advanced technologies. AI decision intelligence plays a pivotal role in that transformation.

inVia Logic, AI-powered software, can sift through vast amounts of data, continuously recalculating and adapting to changing conditions. It makes **over one million decisions a day** to accurately manage the entire flow of operations. It addresses key challenges such as task prioritization, resource allocation, and inventory management, ensuring that every aspect of the operation is finely tuned.

Combining advanced AI with robotics, like the inVia PickerWall, warehouses can achieve unprecedented levels of efficiency.

THE EVOLVING ROLE OF WAREHOUSE MANAGERS

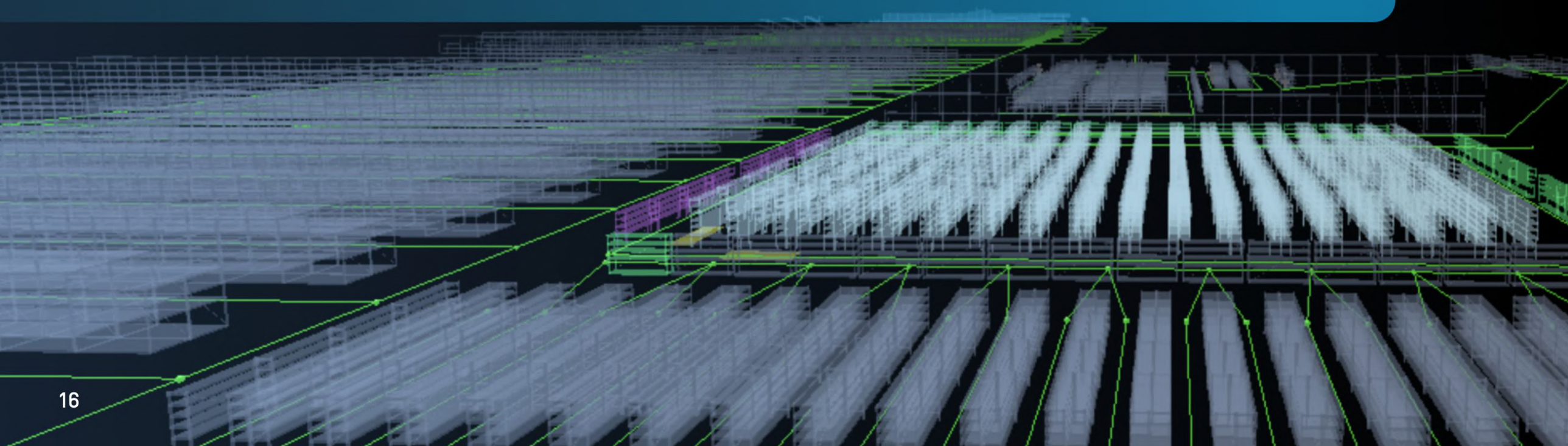
Implementing AI decision intelligence marks a paradigm shift in the role of warehouse managers.

With the system taking over routine tasks, such as job assignment, path planning, and inventory management, managers can move beyond the day-to-day responsibilities that once consumed their time.

This transformation allows modern warehouse managers to evolve from task coordinators to strategic thinkers.

Warehouse managers can now leverage data to make informed decisions, focusing on long-term strategies. They can focus on optimizing workflows, identifying areas for improvement, and reducing costs through data-driven insights.

With AI as the omnipresent traffic controller handling day-to-day tasks, the warehouse manager is taking over the role of a strategic leader driving long-term growth and innovation.



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inVia Robotics is an award-winning automation company that provides the next generation of warehouse optimization solutions. Our system leverages AI-driven software and autonomous mobile robots to help e-commerce businesses and 3PLs optimize and automate material flow across fulfillment centers.

We deliver our comprehensive automation services as a subscription and with options to use the software to optimize existing labor or to add robots to augment workforces. Our systems are built to deploy quickly and without disruption to existing operations. The results are up to 4-5X increases in productivity and accuracy rates of 99.9% - all at a fraction of the cost of traditional automation. Learn more about how we can optimize your operations at www.inviarobotics.com.

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