VUZIX®

WHITE PAPER

AR Wearables in Logistics and Warehousing:
Using AR to Scale and Deliver Cost Savings

Today's customer experience demands connectivity among all aspects of a business—its people, processes, and products. Logistics and warehousing providers are increasingly leveraging technology, like augmented reality (AR) wearables, to strengthen those connections, maximize efficiencies throughout the organization, and boost profitability. Efficiency gains from the hands-free access to needed information and remote experts provided by AR wearables result in:

- **42% improvement in voluntary turnover** to help overcome a shortage of 5.5 million supply chain workers[1].
- **20% decrease in time-to-decision** to respond rapidly to changing market demands[1].
- **42% higher increase in YoY profitability[1].**

This white paper examines the potential and results of AR deployment within logistics and warehousing for:

- Warehouse Operations
- Transportation Optimization
- Value-Added Services

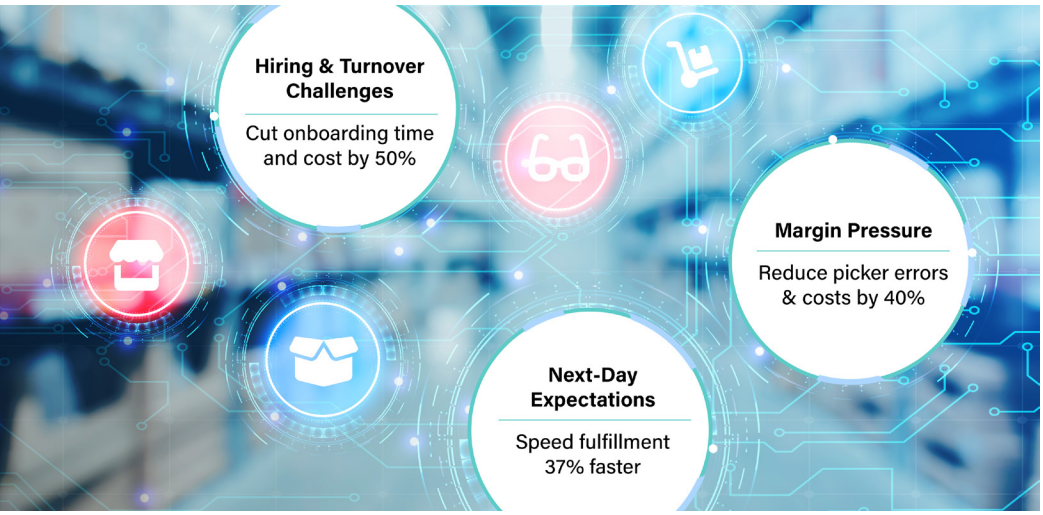
Omnichannel Expectations: The Current State of Logistics

The COVID-19 pandemic upended many industries, and those in warehousing and logistics experienced supply chain disruptions that have continued for the last three years. The rapid but lasting shift in customer behavior and demand, coupled with today's labor market, leaves the industry with challenges of scale and profitability:

- Warehouse capacity
- Industry consolidation
- Labor shortages and skill gaps
- Economic uncertainty and seasonal swings

Many warehouses are operating at 80% capacity or above[2], limiting their ability to scale and adapt to fluctuations in demand. With new space in short supply and real estate costs climbing, leading companies need new ways to expand and maximize existing space. As a result, industry consolidation is occurring, requiring new value-added services to retain and grow their customer base.

Organizations in logistics and warehousing are also facing a labor shortage and are struggling to find and retain workers. In 2022, **56% of third-party logistics providers (3PLs) and 79% of shippers indicated that labor shortages were impacting their operations.** The supply of both warehouse workers and truck drivers is insufficient to meet demand[2]. Finally, economic uncertainty continues with inflationary pressures and looming concerns about economic stagnation. While delivering goods to customers is less complicated now than it was during the height of the pandemic, rising energy and labor costs, weather events, and geopolitical volatility continue to impact operations.

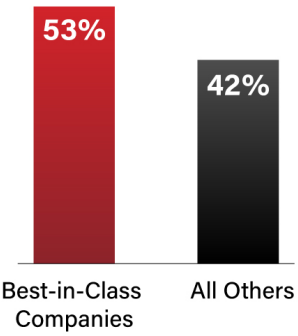


Vuzix M400™ smart glasses

- Expansive full-color OLED display with built-in barcode scanner
- Software integration with inventory systems
- Voice control in multiple languages
- Left or right eye use with all-day comfort mounting

Rising Customer Expectations and Demand

Figure 1: Adoption of Augmented Reality



Percent of respondents, n=262
Source: Aberdeen Strategy & Research, June 2022

Omnichannel is here to stay, and customers demand ever-faster, ever-broadening pickup or delivery options, with a low tolerance for errors or delays. To succeed in omnichannel logistics, companies need visibility into and seamless communication across all logistics operations.

Digital transformation allows these companies to leverage their sizable data troves to improve current business processes and create new ones, boost efficiencies, and deliver additional value to customers. With e-commerce and fulfillment volumes rising, operations leaders need increased innovation and automation to meet spikes with fewer workers.

Augmented reality deployment in logistics and warehousing can help meet these challenges and optimize operations. As companies increasingly deploy AR in their operations, **the total AR market is expected to increase from $14.7 billion in 2020 to $88.4 billion by 2026—a CAGR of 31.5%.** Global spending on **AR deployment within logistics and warehousing specifically is expected to total over US $23 billion** by 2025.

Understanding Augmented Reality

With augmented reality (AR), the physical world is enhanced with digital information, including text, graphics, video, sound, GPS data, and tactile feedback. AR systems work with the Internet of Things (IoT)-connected devices to enhance understanding and decision-making. IoT devices obtain real-time data from the physical world so it can be digitally analyzed, and AR systems render that digital data back into the physical world in an interactive, visual format providing users with real-time, situation-specific information.

Virtual reality (VR) immerses users in a completely virtual environment, while with AR, users remain connected to their physical environment, and digital information is overlaid for more intuitive interactions with available information. AR wearables allow users safe, productive access to the information they need in a hands-free format.

Warehouse Operations

In logistics, AR's greatest impact can be seen in warehouse operations, including **order picking, warehouse staff training, and warehouse planning.**

Order Picking

Within warehouse operations, efficiency in order picking is a top priority. The order picking process includes locating an ordered item in storage, loading the item on a vehicle or cart for transport, and delivering the item. Order picking is a costly and labor-intensive process and comprises **55-65% of the cost of warehouse operations**, and approximately **20% of logistics costs can be attributed to warehouse processes[3]**. Additionally, **60-70% of warehouse labor costs stem from the order fulfillment process[4].**

Picking errors, or mis-picks, can cost as much as $300 each to correct. **With picking error rates averaging between 1-3%, companies lose about 11-13% of their annual profits to mis-picks[5].** Picking errors result in additional shipping and processing expenses and can also have a significant negative impact on customer satisfaction.

Vuzix in Action

One global ground transportation company partnered with Vuzix to improve productivity. Their results to date:

- 20% increase in picking speed.
- 25% picking error reduction

Current picking methods, RF scanning, voice picking, and paper picking, get bogged down by operational inefficiencies, aisle congestion, and gaps in communicating needed information.

Most large enterprise companies have moved from pick-by-paper to RF picking, but most scanning devices present ergonomic strain and safety risks. **Warehousing and transportation companies lost $1.79 billion in 2022 due to workplace injuries associated with improper ergonomics and another $2.88 billion in injuries.6** Most voice picking systems are more ergonomically friendly but cannot provide real-time picking accuracy validation and increase cognitive load leading to mis-picks.

AR wearables can:

- Decrease picking errors
- Reduce item search and picking travel time—10.3 minutes with AR, vs. 16.5 minutes with traditional methods[7]
- Reduce labor costs
- Increase productivity

AR-based pick-by-vision systems employ head-mounted displays (HMDs) or smart glasses to provide visual and audio support and guidance throughout the order fulfillment process. An operator can communicate with the AR system using voice, gesture, or gaze and immediately view details including item name, location, quantity available, and quantity needed. The wearable AR system then directs the operator to an item's pickup location using the best route, confirms item accuracy, and, through integration with the Warehouse Management System, updates stock counts in real time once an item is picked. The automated features available with AR-based picking systems also enable operators to work on multiple orders simultaneously.

Pick-by-vision systems yield several efficiencies including:

- Improved productivity with heads-up, hands-free access to needed information.
- Decreased product search time and time spent traveling to picking locations.
- Reduced error rates and rework requirements with automatic picking verification.
- Increased visibility and improved quality with real-time inventory updates.

Compared with paper-based picking systems, field tests have demonstrated that **wearable AR systems enable warehouse pickers to:**

- **Fulfill orders 37% faster on average.[7]**
- **Reduce picking errors by up to 40%[7]—** although picking error rates today are very low, estimated at around 0.35%, they are costly to correct and can lead to lost customers, so error reduction remains vital[3].

Did you know?

Travel time accounts for 50% of total picking time[8]. AR pick-by-vision systems help reduce travel time by providing warehouse pickers with optimized route guidance.

Warehouse Staff Training

With record levels of turnover, and increasing hiring, training, and onboarding costs, faster time to proficiency is critical. Traditional training methods cannot keep pace. **80% of workers who are dissatisfied with the onboarding training received plan to quit[9].**

With AR wearables, the onboarding process is accelerated with:

- Interactive training materials that make it easier to visualize and contextualize information.
- "See-what-I-see" real-time capabilities enable on-the-job training.
- Remote oversight to spot picking errors and process inefficiencies.
- Access to knowledge bank, facilitating business continuity throughout workforce changes.

With faster, more effective training and oversight, organizations using AR can hire employees with less extensive skill sets. This hiring flexibility is critical at a time when finding and retaining workers is a significant challenge and results in a **27% greater decrease in cost-to-hire and 23% larger decrease in time-to-hire for companies using AR** compared to companies that have not implemented AR-based training (Fig 2)[10]. Companies leveraging AR smart glasses and other devices for training also see improvements in workplace safety—**the incidence rate for companies using AR is 10% lower than the average[1].**

Best Practice

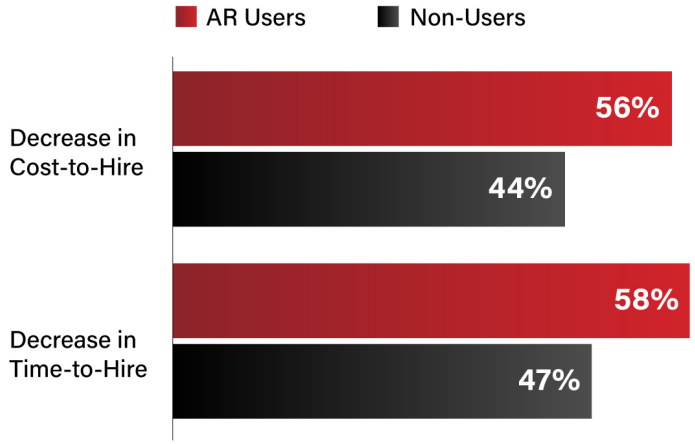
Companies using AR-based "pick-by-vision" systems train new employees up to 60% faster than organizations using traditional training methods[11].

AR-based employee training is faster, more thorough, and saves companies more money than traditional training methods, enabling organizations to keep pace with rapid change. **Companies utilizing AR have a 27% higher chance of experiencing a yearly reduction in employee time-to-proficiency** compared with companies that have not implemented AR[10], an important gain, especially in a temporary, seasonal workforce. Well-trained employees are often the most engaged employees, and **companies that use AR in training also experience an increase in employee engagement that is 42% higher than businesses that do not utilize AR.**

"[Vuzix smart glasses] give us extra speed to serve more customers without compromising on quality or accuracy."

— Gurumurthi Shankar, Chief Commercial Officer, Global Shipping & Logistics, LLC.

Figure 2: Business Results of AR-Based Employee Training



Percent of respondents that saw an improvement over the past year, n = 501
Source: Aberdeen Strategy & Research, June 2022

Warehouse Footprint Optimization

A 2022 survey of over 200 logistics professionals employed at third-party logistics (3PL) warehouses indicates that warehouse space is a significant challenge—**59% of 3PL warehouses are using over 90% of their available space and an additional 28% are at 80-89% capacity[12].**

Standalone distribution centers (DCs) and warehouses are also feeling the space crunch, with **31% of standalone DCs operating at a capacity level of over 80% and among those operating at over 50% capacity, the average capacity is 78%[13]. Among standalone warehouses, 23% use 80% of capacity or more and for those operating beyond 50% capacity, the average capacity is 80%[13].**

These capacity figures are significant—**at 80-85% capacity, efficiencies start declining,** and it can be difficult to continue growing the customer base and manage demand spikes. Additionally, the role of warehouses is expanding to include value-added services like product assembly, labeling, and repair, requiring more activity within an ever-shrinking amount of available space. Low vacancy rates and climbing real estate costs make acquiring a larger footprint difficult and cost prohibitive.

AR makes it possible for companies to find ways to:

- Optimize utilization of the space they have.
- Minimize facility redesign costs.
- Avoid throughput interruptions during the redesign planning process.

With AR, different layout and workflow configurations can be tested in the actual facility. Layout changes can be visualized in full scale with overlaid interactive digital simulations to determine the most efficient configuration.

Value-Added Services

To drive growth and remain competitive, many logistics providers are offering additional value-added services to their customers, including assembly and repair. In a recent survey, **over 80% of 3PLs indicated that value-added services are "very important" or "important" to their overall growth strategy[13].** With AR wearable deployment in assembly and repair operations, workers have heads-up, hands-free access to work instructions and can connect to remote experts who can view what the worker is doing and guide them through the steps needed for assembly or repair. This "see-what-I-see" capability of AR smart glasses combined with having both hands available for work results in multiple efficiencies, including increased **hands-on-tool time, less production downtime, faster manufacturing cycle time, and increased profitability (Table 1).**

Table 1: Efficiencies Gained with AR Smart Glasses[1]
(AR users vs. non-users)

34% greater decrease
in YoY **production downtime.**

36% greater decrease
in YoY **manufacturing cycle time.**

42% greater increase
YoY in **profitability.**

17% greater increase
in Hands-on-Tool time.

Key Takeaways

Logistics and warehousing providers are leveraging technology like AR wearables to navigate an industry that is changing quickly and becoming increasingly complex. The warehouse capacity crunch, industry consolidation, and labor shortages present significant challenges but also provide opportunities for companies to find innovative ways to remain competitive. With AR wearables, companies are gaining greater visibility throughout their processes, enabling them to move faster, reduce errors, scale the capabilities of their workforce, and add additional value. AR-enhanced logistics and warehousing services produce more satisfied employees and customers, decrease costs, and boost profitability.

Vuzix offers a comprehensive line of smart glasses and software solutions to meet your needs.

VUZIX BLADE 2™

VUZIX M400™

References

[1]Gaffney, Sarah. (Dec. 2021). *Close the Skills Gap and Usher-In Industry 4.0 With Augmented Reality and Real-Time Data.* https://www.ptc.com/en/resources/augmented-reality/report/close-skills-gap-with-real-time-data

[2]*2023 State of the Third-Party Logistics Industry Report.* 2023. https://www.extensiv.com/hubfs/2023%203PL%20SOI%20Report.pdf

[3]*Augmented Reality in Logistics.* DHL. https://dfreight.org/wp-content/uploads/2023/05/augmented-reality-in-logistics.pdf

[4]*The Hidden Costs of Paper Picking: A Deeper Look into the Paper Picking Process.* NextGen DC Systems. https://www.mhi.org/media/members/29725/131124552953638943.pdf

[5]Dudek, B. Mar. 31, 2021. *Order Picking Accuracy: Why the 3PL You Partner with Should Prioritize Optimization.* https://www.jaygroup.com/order-picking-accuracy/

[6]*Improper Ergonomics When Handling Objects and Awkward Postures Cost Employers Billions Annually in Workplace Injuries.* (Sept. 15, 2022). MHI Ergonomics & Safety. http://materialhandlingsafety.org/improper-ergonomics-when-handling-objects-and-awkward-postures-cost-employers-billions-annually-in-workplace-injuries/

[7]Leonard, Matt. Jan 26, 2021. *Pick Speed Improves when Augmented Reality Replaces Paper: Study.* Supply Chain Dive. https://www.supplychaindive.com/news/picker-augmented-reality-speed-warehouse-ar-china/593989/

[8]Botanni, E., Volpi, A., & Montanari, R. (Nov. 2019). *Design and Optimization of Order Picking Systems: An Integrated Procedure and Two Case Studies.* Computers & Industrial Engineering, 137. https://www.sciencedirect.com/science/article/abs/pii/S0360835219304942

[9]*The Effect of Poor Onboarding on New Hires.* (Jan. 16, 2023). Paychex. https://www.paychex.com/articles/human-resources/the-onboarding-crisis

[10]Gaffney, Sarah. (June 2022). *Connected Products, People, & Processes: The Business Value of Industrial AR & IoT. Aberdeen Strategy & Research.* https://www.ptc.com/en/resources/iiot/manufacturing/report/aberdeen-business-value-iot-ar

[11]*Revenues From Robotics Deployed in Warehouses to Cross US$51 Billion by 2030.* (Aug. 18, 2021). ABI Research. https://www.abiresearch.com/press/revenues-robotics-deployed-warehouses-cross-us51-billion-2030/

[12]*2022 Third-Party Logistics Warehouse Benchmark Report.* https://www.extensiv.com/resource-library/report/2022-third-party-logistics-warehouse-benchmark-report

[13]Michel, Roberto. Mar. 2, 2022. *2022 Warehouse/Distribution Center Equipment Survey: It's "Go Time" for Investment.* Logistics Management. https://www.logisticsmgmt.com/article/2022_warehouse_distribution_center_equipment_survey_its_go_time_for_investm

[14]*Gaining a Competitive Edge Through VAS.* https://see.nulogy.com/3pl-competitive-edge/

VUZIX® NASDAQ: VUZI