



Using smart glasses and augmented reality head-mounted displays to drive supply chain innovation

A series exploring Industry 4.0 technologies and their potential impact for enabling digital supply networks in manufacturing

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Do you need smart glasses in your supply chain?

Smart glasses are already being used to improve quality, standardize workflows, accelerate decision making, and enhance communication in logistics, manufacturing, and maintenance operations throughout the supply chain.

Of interest because: A trend in more universal, data-driven decision making is evolving just as leaps in hardware and software capability have led to smaller, more ergonomic devices.

Could improve your supply chain by: Boosting labor effectiveness and productivity; reducing quality defects and rework; improving workflow standardization; enhancing workforce collaboration; improving safety.

Why not? The technology is still rapidly evolving and has not yet reached operational maturity. Companies will have to understand how they will leverage data for critical use cases and should expect difficult integration challenges.

Deloitte recommends: Evaluate the business case for smart glasses and augmented reality in your supply chain and pilot on a small number of critical use cases.

What are smart glasses and augmented reality HMDs?

Overview

Smart glasses and augmented or mixed reality head-mounted displays (HMDs) are wearable electronic devices that interface between humans and computing through various forms of a heads-up display. Smart glasses typically have multiple features to allow users to both display and analyze information relevant to their surroundings. With augmented or mixed reality, digital projections are overlaid onto real life objects, providing contextual information and allowing users to visually manipulate their surroundings. Today, augmented reality is possible through smartphones, tablets, and a host of other mediums; this paper will focus specifically on head-mounted displays and their impact on supply chains.

Recent developments and outlook

Smart glass technology has evolved significantly over the last five years. Today's devices are less intrusive, more ergonomic, and faster than their predecessors. Emerging from the initial lackluster reception these devices faced in the consumer setting, the capabilities enabled by smart glass solutions are poised to drive real value in enterprise environments. This enterprise movement will likely unfold over the next decade as smart glasses and augmented reality HMDs continue to improve on their ability to address important commercial use cases.

Smart glass technology is already advancing in hands-on industries such

as manufacturing, logistics, field services, inspection, and operations. A recent study showed that 93% of large industrial companies are either using or evaluating smart glasses in their enterprises today, indicating that decision-makers foresee wearables as a major enterprise platform.¹

Product-specific attributes such as an easy-to-use design, improved ergonomics, and portability have improved the general usability of the devices and decreased environmental safety risks. These changes are playing out in the market today: Alphabet recently relaunched Google Glass, eschewing the consumer market for serious enterprise customers. And many hardware manufacturers are incorporating



augmented reality into safety glasses or existing industrial equipment. The technology is improving at a rapid pace—battery life has been extended, visual latency continues to drop, and many devices can now even accommodate prescription lenses—and the technology hype is starting to turn into reality. Companies are starting to pilot the technology, selecting smart glasses that have high-performing hardware, a simple and intuitive interface, easy integration, and an ecosystem of services and accessories.

Forrester predicts over 14 million workers will use smart glasses by 2025. Enterprise spending on smart glasses, \$6 million in 2016, is expected to reach as high as \$4.3 billion in 2022.² Technology cost and barriers to adoption will continue to decrease as this market continues to grow, and it will likely be driven by increased

enterprise use in the supply chain and operations functions.

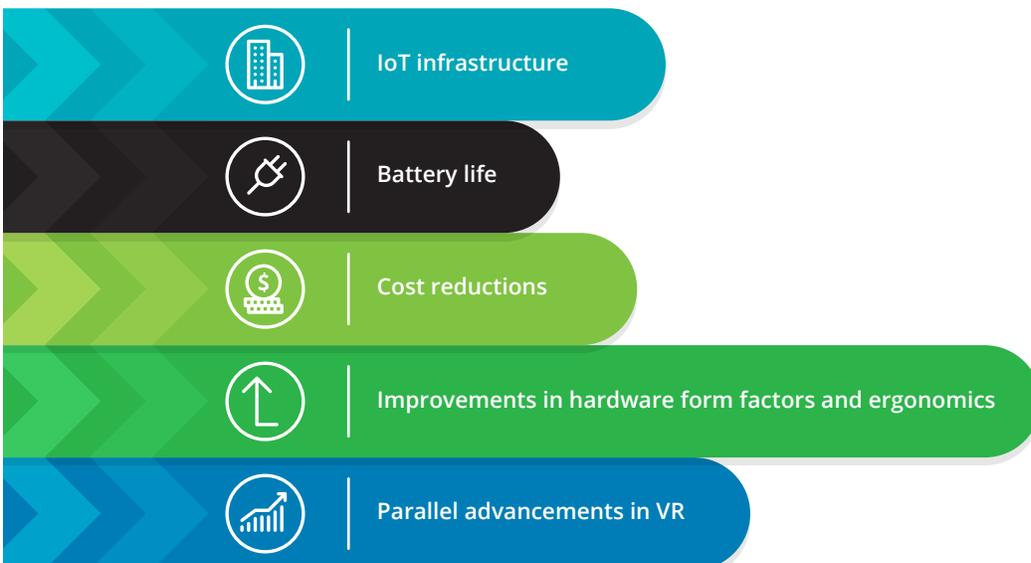
Smart glasses in the supply chain

Smart glasses and augmented reality devices have the potential to enhance and even replace existing technology solutions within enterprise supply chains, and in some cases even change the very structure of the work environment. Companies implementing augmented reality HMD pilots are already demonstrating use cases that lead to increases in workplace efficiency, productivity, and compliance, and this will only grow as the technology matures. Initial implementation will be driven through the logistics, maintenance, and assembly functions, but as the devices gain more mainstream adoption, companies will be more comfortable experimenting with the technology in different environments.

Overview

Value drivers	<ul style="list-style-type: none"> • Contextualized information • Increased workflow standardization • Enhanced training and communication • Hands-free assistance • Visual documentation and enhanced process tracking • Greater employee engagement
Scope	Enhanced capabilities within all segments of the supply chain
Technology substitutes	Smartphones, tablets, PCs, handheld scanners, manuals, VR devices

Five key developments in smart glasses and augmented reality



Benefits of smart glasses and AR in the supply chain

Primary potential benefits



Value drivers for smart glasses

When used effectively in the right setting, smart glasses and AR displays have a number of important advantages over computers, tablets, and other existing technology: contextualized information, increased workflow standardization, hands-free assistance, and documentation.

Smart glasses provide a hands-free approach to performing work by providing data and virtual instructions to workers as they complete activities. Virtual instructions are being used to standardize workflows in industries with seasonal labor changes, such as ecommerce logistics, and for complex, rapidly changing tasks, such as maintenance and repair.

Through audio and video capabilities, workers can interact with other colleagues and seek assistance on complex issues from experts within their organization anywhere on the globe. Such productivity gains improve the cost-effectiveness of supply chain operations, expedite issue troubleshooting, and reduce the number of quality errors. While performing complex tasks, workers can summon interactive on-demand training videos, which overlay augmented reality on their environment. This is especially critical in industries that face an aging workforce where significant institutional knowledge is disappearing rapidly. Companies are starting to mitigate the risks of industry transition and

Secondary potential benefits (intangibles) of smart glasses

- Simplify routine workflow items such as picklists and checklists
- Decrease risk in industrial operations
- Enhance effectiveness of training programs with the use of interactive and virtual sessions
- Capture workflow analytics to identify process improvement opportunities
- Increase accountability through inspection workflow recording



institutionalize knowledge by facilitating standardization and learning through the devices to increase speed to proficiency.

Furthermore, archived videos captured while performing job duties can be used as evidence during inspections to improve standardization and prove regulated steps were followed. Companies are starting to use these capabilities for end-of-line quality examinations where detailed checklists and documentation must be completed quickly.

Used as a tool to standardize quality and safety workflows—and provide this information hands-free—smart glasses offer additional intangible benefits to companies that operate in dangerous industrial environments. Leaders in energy, transportation, utilities, and industrial manufacturing workplaces will find the devices' ability to standardize and document safety measures attractive tools for improving workplace safety.

In the short term, cheaper devices such as laptops, smartphones, and tablets will compete with smart glasses. Organizations in the hands-on services space still use paper manuals and handheld electronic devices to provide workers with the information they need, deeming them “good enough” solutions. However, in the long-term, improved device design, capabilities, and cost will tip the scale for smart glass devices beyond existing technologies.

Case study: Semiconductor Manufacturing Co.³

A semiconductor manufacturer faced various issues with its incident resolution processes, resulting in severe delays during critical component assembly. An inability to visually communicate issues with remote experts and cumbersome process manuals were the key contributors of the issue.

The company decided to invest in a smart glass wearables solution to allow supplier technicians in an Asia-Pacific facility to communicate real-time with Manufacturing & Quality Experts in the US and EMEA. This implementation resulted in “see what I see” measures that significantly altered how the company executed troubleshooting on complex problems.

Observed benefits in the supply chain:

- Enabled high-quality and reliable off-shore manufacturing and assembly by providing the capability to bring real-time distributed expertise spread over three continents in a matter of seconds
- Fifty percent reduction in repair time for defects and assembly failures
- Reduced travel costs (~\$5,000 / engineer/trip) by more than \$500,000
- Increased productivity of remote experts
- Improved operational efficiency of component assembly when technicians received targeted procedures in field of view



Criteria for evaluation and adoption

Operational considerations

To adopt smart glasses and augmented reality HMDs in your supply chain, start by understanding where you will use the technology and how it will be adopted by your employees. The following five attributes can help shape your decisions and determine the potential overall return on your company's smart glasses investments.

Functional deployment

Complex, repeated tasks that benefit from improvement in standardization may offer the best initial deployment of smart glass devices. Understanding which functions, facilities, and individuals start with the technology will be critical to a successful rollout.

Key considerations in this category:

- Which functions offer the most opportunity for standardized workflows and improved decision making?
- Where will there be minimal change to existing workflows and work environments?
- How many devices do you need to achieve expected benefits?
- Do you have the right champions in your target functional area to drive adoption?

Technology infrastructure

Smart glass and augmented reality device success depends on facilitating interaction with the right data through integration with components of a company's IT ecosystem. In doing so, smart glasses can become a part of the workflow rather than a separate technology, seamlessly receiving and transferring data with enterprise systems, software, applications, and external devices.

Key questions to consider:

- What is the interaction layer for data (what data, synthesized in what way) that best supports users?
- What systems are required in the technology stack?
- What connectivity is needed and do you have it in the desired facilities?
- What parallel investments do you want to make (sensors, RFID, network, etc.) to enhance the value of the technology?

Security

Security is another major concern and potential barrier to the adoption of smart

glasses. Given the capabilities of smart glasses to record and transmit data easily, companies will need to set restrictions on certain smart glass capabilities to protect their employees and customers.

Key considerations in this category:

- Given increased device-enabled workflows, what are your mitigation strategies for a network disruption?
- Do you want to restrict data capture in certain GPS locations?
- How strong is your security network to contain information flow through the devices?



- Is your mobile device manager software equipped for these devices?
- Will implementation be delayed due to firewalls, port openings, approvals, and device testing?

Regulations

Industry regulation is an existing area of uncertainty for smart glasses. In many industries, devices must comply with OSHA, FCC, UL, ANSI, and other industry-specific requirements. According to the American National Standards Institute, both the physical smart glass frame and the computing equipment must pass performance standards for equipment worn in the workplace.⁵

Additional considerations in this category:

- Which countries do you operate in and how do regulations differ across each?
- What are the industry requirements for wearable devices in your workplace?
- What is your plan to handle intellectual property flowing globally through the devices?

Operating environments and perception

Companies looking to adopt augmented reality technology need to understand their employees' experience level with mobile devices and comfort with technological change. Appropriate trainings and change management processes can be implemented to help ease this transition and drive adoption.

Basic considerations in this category:

- How do you expect the current workforce to respond to working with smart glasses and augmented reality?
- Are you expecting employees to share the wearable devices with others?
- How much training is required to familiarize employees with the new technology?

Smart glasses procurement options

The technology stack

Smart glasses and AR device hardware form just one aspect of the overall technology stack. As companies look to invest in the technology, they must consider the other elements required to implement devices in their operations and what configuration must be done to their existing IT. Understanding the impact of these

elements on overall functionality and cost is important to any pilot. Companies must consider the cost of things like infrastructure improvements, additional software and operating systems, and device replacement rates that may all factor into overall budget.

Pricing factors

Prices for augmented reality devices vary from the low hundreds to \$5,000 or more per user setup, depending on the technology and functional capabilities.^{5,6}

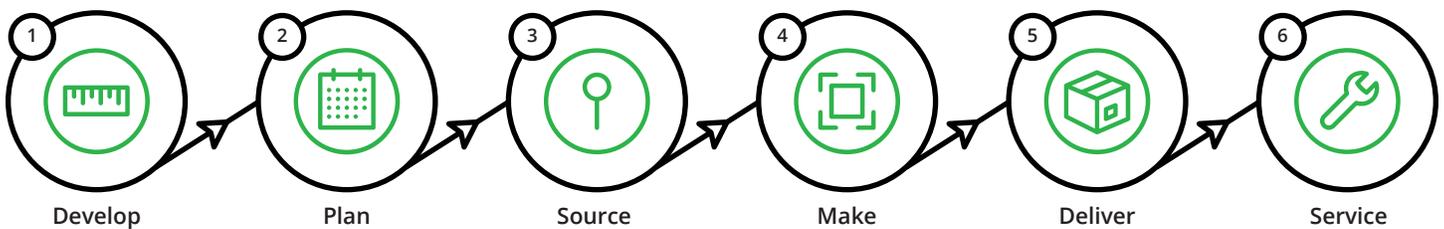
The lower end of the spectrum consists of many simple, eyeglass-like models. Prices increase with improved computing technology, better augmented reality interfaces, and additional features such as integrated safety equipment, fire-retardant properties, and bundled handheld scanning devices.

When evaluating devices, understand that hardware manufacturers offer different setup packages. Some packages will include only hardware, while most enterprise solutions sell the technology as a service, offering an integrated solution that can be tailored to a company's needs. Executives looking to implement the technology should consider the implications the purchasing model has on capital expenditure budgets and the technology time horizon.

Key applications for smart glasses in your supply chain

Supply chain applications

Significant opportunities for smart glasses exist at each stage of the supply chain.



Examples

1. Develop: Augmented reality visualization will benefit both the quality and speed of new product introduction. The ability to view a new product design in the context of its designated environment will lead to better designs. And the shift from physical to digital will save R&D organizations time and money.
2. Plan: Active augmented reality trainings allow companies to scale the workforce more rapidly than before in response to shifting or cyclical demand. This is especially relevant for seasonal peaks in logistics and manufacturing.
3. Source: Connected glasses with built-in sensors will easily scan incoming supplies during inspection and relay that data to suppliers. Hands-free inspection reports and related images can be submitted and attached to associated packages.
4. Make: Smart glasses can display complex work instructions that are updated as tasks are completed to provide real-time workflow sign-off. In addition, contextual heads-up checklists that adapt as users shift locations will increase productivity.

5. Deliver: Warehouse “vision picking” systems use smart glasses to guide order picking, increasing efficiency in distribution operations. Heads-up information displaying package weight, fragility, and associated information will also improve worker safety.
6. Service: See-what-I-see capabilities enabled by smart glasses allows service technicians in remote locations to collaborate with centralized maintenance experts and to receive real-time data and instructions in return.

These examples are just a few of the many opportunities to advance the supply chain with smart glasses. Opportunities exist in the end-to-end supply chain for cost reduction and value creation.

Motivation for action

The time for companies to assess their supply chains for smart glasses and augmented reality adoption is now. Leading companies across a host of industries are piloting and implementing smart glass technology within their organizations; they see the value of this technology within the supply chain and want to keep pace with the wave of innovation.

Enterprises with critical use cases for smart glasses and augmented reality that are not currently exploring this technology will soon find themselves playing catch-up to their peers. As the technology continues to mature at a rapid pace, driving down costs and improving technical capabilities, the business case for piloting smart glasses becomes ever clearer. But, as is the case with other technological shifts in the supply chain, simply placing it in the organization is not transformative; the real value comes from the process to select, design, apply, and integrate the technology. The approach to deploying smart glasses will be discussed in the final section.

Smart glasses add value throughout the supply chain:

- Increased productivity and efficiency
- Improved quality and accountability
- Reduced error rates
- Improved safety
- Greater employee engagement
- Enhanced training and communication

Getting started with smart glasses and augmented reality devices

Smart glasses can drive major changes to elements of the supply chain. But, like every major change, this technology advancement requires a strategic approach to begin deploying within a company. Leaders need to understand that piloting this technology mandates a shift in culture toward innovation, openness, and collaboration. A successful adoption strategy should include four major points.

Follow the business case. First, leaders must have a clear view of where smart glasses and augmented reality HMDs will drive the most value in the supply chain—in other words, identify the optimal use case or possible use cases. This will help make the business case and allow the technology to pay for itself in successive implementations as it is increasingly deployed across the company.

Clearly communicate the strategic goals. Second, supply chain leaders should make sure that the strategy for smart glasses is communicated clearly. Augmented reality can radically shift employee workflows and processes; these shifts may face difficult adoption in some areas of the workforce. Clear communication from leaders of the benefits and vision for the supply chain are critical, and will ensure confidence as implementation and other operational risks arise. This will help early adopters apply bold ideas and view each failure as a learning opportunity toward future success.

Target and pilot. Third, companies should pilot the technology in an area of the organization where the risk of process change due to smart glasses is low. Often, this may be the R&D organization, but for other use cases, it may simply be a small experimental team in the field. Piloting the technology may also mean choices about outsourcing aspects of the technology rather than developing it in-house. Careful design and execution on a pilot scale will help prove the technology for greater investment and adoption later.

Pick the “champions.” Finally, companies must find a small group of employee super-users who can help tailor smart glasses and augmented reality HMDs to the company’s needs and will ultimately champion its future rollout. Identify employees who can influence the rest of the workforce and help them serve as smart glasses and AR “champions.” These people will be eager to find out about the technology and, in this way, be in a position to advocate about the benefits and urge their coworkers to participate in training seminars and implement the technology in their work.



Key Deloitte contacts in smart glasses and augmented reality



Joseph Fitzgerald
Principal, Supply Chain &
Manufacturing Operations
Supply Chain Innovation
Deloitte Consulting LLP
+1.415.519.2115
josfitzgerald@deloitte.com



Tony DeMarinis
Managing Director, Deloitte Digital
Deloitte Consulting LLP
+1.571.814.6703
tdemarinis@deloitte.com



Allan Cook
Managing Director,
Digital Reality Lead
Deloitte Consulting LLP
+1.310.400.2060
allcook@deloitte.com



Kellen Smetana
Manager, Supply Chain &
Manufacturing Operations
Deloitte Consulting LLP
+1.248.231.6543
ksmetana@deloitte.com

The authors of this paper would like to thank the following contributors:

George Pilitsis, Deloitte Risk and Financial Advisory Services LLP; Lynne Calligaro, Deloitte Digital Studios;
Brenna Sniderman, Deloitte Insights; Mubeen Khumawala, Deloitte Consulting LLP.

Endnotes

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