AUTOMOTIVE SECTOR COMPLEXITIES AND THE ROLE OF AUGMENTED REALITY

ABIresearch THE TECH INTELLIGENCE EXPERTS™ TeamViewer

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TABLE OF CONTENTS

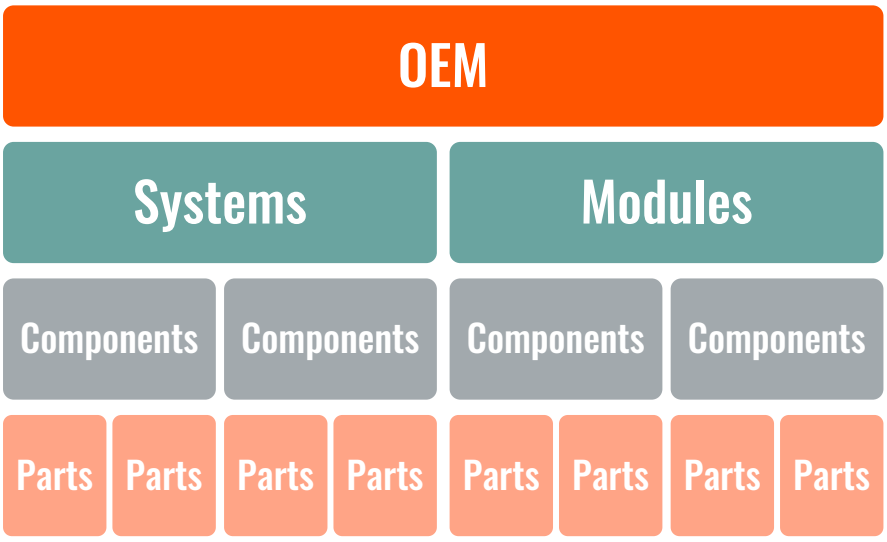
INTRODUCTION

The more complex the environment, the more can go wrong. This has been borne out for decades in enterprise sectors that run high cost, but high return operations. Automotive is a perfect example of this—end-to-end challenges raise the stakes for companies, and solutions that can minimize the impact from disruption are immensely valuable. Automotive players face extreme downtime costs, significant product development costs, and rapidly shifting consumer sentiment. The supply chain for automotive is equally complicated, with tiers of global suppliers each integral to an Original Equipment Manufacturer's (OEM) operation.

With complicated supply chains spanning the globe, automotive operators are beholden to every facet of their value chain to maintain production. If a parts supplier experiences unexpected downtime, the impact is felt through the rest of the value chain up to the OEM.

Many-Faceted Supply Chain in Automotive

(Source: ABI Research)



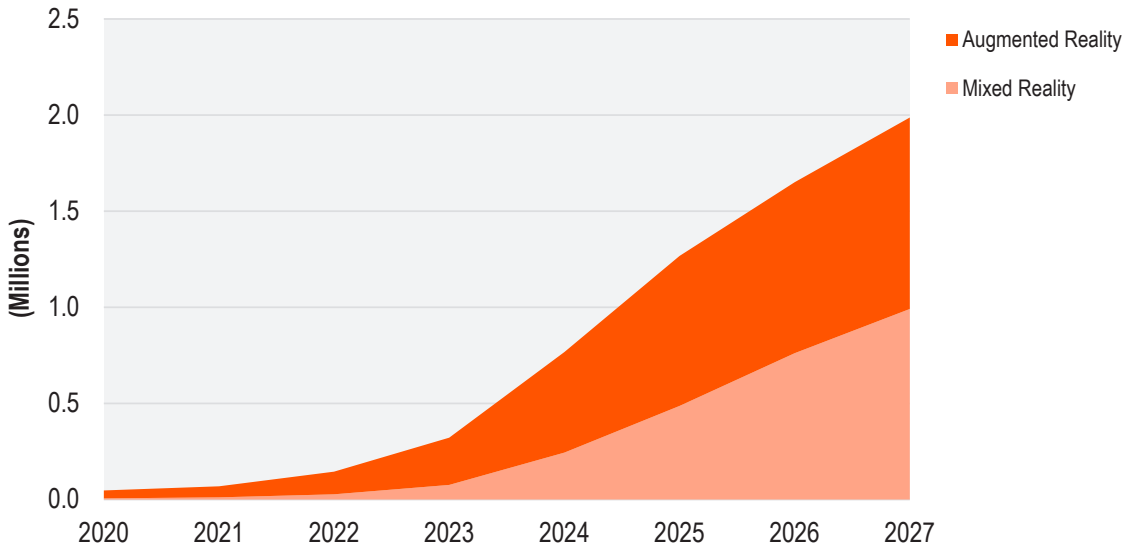
Enter Augmented Reality (AR). In the quest to keep downtime to a minimum and streamline operations through the entire value chain, AR can do both. Reduced error rates and increased safety for workers are matched with reduced operational downtime, reduced travel time and costs, and, ultimately, increased operational efficiency.

Companies have some choice on how to implement AR with variables like upfront cost, level of desired integration, target use cases, likely users and usage environments, and safety needs all dictating what approach is best. Device type is the most dynamic decision, with three main categories:

- **AR (or assisted reality) smart glasses are usually monocular (single display) Head-Mounted Displays (HMDs).** These devices aim to provide quick information access, while maintaining user vision. Most assisted reality solutions can supply connectivity and Two-Dimensional (2D) content display, but additional value can be created through elements like onboard cameras (for point-of-view content capture) and voice navigation and control. Prominent examples in the automotive space include RealWear Navigator 500 and Vuzix M400.
- **Mixed Reality (MR) devices are binocular (dual display) HMDs that can enable immersive, spatially tracked Three-Dimensional (3D) content.** MR devices are more expensive than assisted reality devices, on average, and can be more difficult to implement due to more complex content needs, but can easily prove worthwhile thanks to their application. MR is like a hybrid between AR and Virtual Reality (VR), taking the immersion and spatial tracking of VR, but adding greater environmental awareness and overlay capability thanks to see-through displays. With the higher price also comes higher resource costs to create content for MR, although many platform providers are offering low-code or no-code toolsets for MR content creation. Microsoft HoloLens 2 is the best-known MR smart glasses product today.
- **Mobile devices are an alternative to HMDs, although, of course, they are not hands free.** Thanks to onboard cameras and sensors, AR-enabled mobile devices sit in between assisted reality and MR, with devices capable of spatial tracking and content locking like MR HMDs, but, by nature, not an immersive 3D experience with a standard smartphone or tablet screen. Mobile devices are a mature and well-supported form factor, with existing installed bases presenting a low-cost entry point. Both Apple and Google support AR at the Operating System (OS) level with ARKit and ARCore, respectively, giving developers easy access to AR tracking features.

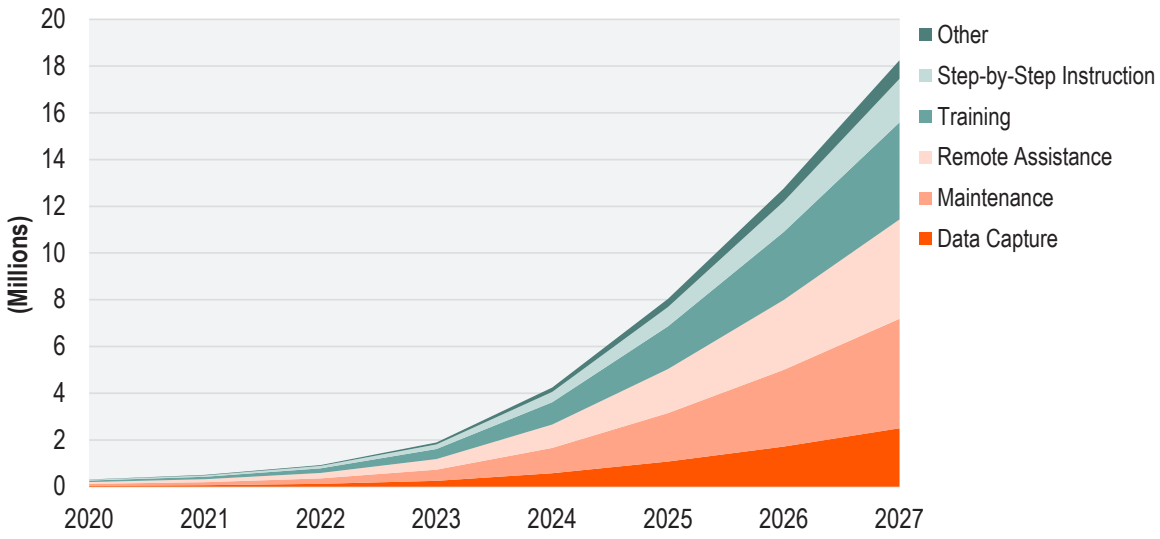
Automotive Smart Glasses Shipments by Device Type
World Markets: 2020 to 2027

(Source: ABI Research)



Automotive AR Active Users by Use Case
World Markets: 2020 to 2027

(Source: ABI Research)



Hands-free access to data, possible with AR and MR smart glasses, has innate benefits for worker safety and efficiency. 3D, spatially tracked content adds immersive content capabilities suited for complicated visualization needs—immersion also has benefits in retention and recall, with key performance indicators for training efforts.

The automotive sector can use all three of these device types to their full extent. High-value use cases like remote assistance, training, and visually guided step-by-step instruction for assembly and logistics operations are feasible across all three device types, but environment and user factors can dictate which is the best. Highly dynamic environments, such as a factory floor, may favor assisted reality devices to maximize user awareness, at the expense of losing spatial tracking and 3D content. Similarly, complex maintenance or training using MR can leverage the visualization and spatial capability to maintain clarity and ease of use for the user.

MARKET NEEDS: CAPABILITY AND FLEXIBILITY

While the value of an AR implementation can be immense, it is not without its challenges. As AR hardware has matured, customer needs have shifted from knowledge gathering (what can these devices do?), to research (how can these devices help?), and to action (how can these devices be implemented?). Throughout that progression, two core customer needs arose with consistency: capability and flexibility. Customers have recognized specific capability desired in AR, as well as the flexibility to implement and adjust that capability to best suit targeted operations.

AR implementations have grown from single use case to multi use case, and from small scale to large scale. As use case coverage expanded, so did interest in greater device capability. Cost-friendly mobile device AR has been the most popular entry point for most companies first pursuing AR, but as value was proven, AR and MR devices increasingly came into the fold.

It is one thing to deliver AR "over the top" of existing infrastructure and workflows, but another to fully integrate that AR solution. Companies almost always have platforms already in place that can benefit from AR being integrated into them. Especially as digitization continues to expand in all markets—automotive is no exception—the platforms in use are significant in both breadth and depth: Customer Relationship Management (CRM), Internet of Things (IoT), Product Lifecycle Management (PLM), Master Data Management (MDM), Artificial Intelligence (AI) and analytics, and more. This integration can create significant added value over a light integration or fully siloed AR platform, but requires greater effort up front to ensure compatibility.

In automotive, there are significant and ever-changing parts catalogs, component and module installations, and vehicle Stock Keeping Units (SKUs) that grow exponentially in complexity. Having an unbroken connection between all systems that touch the supply and value chain has far reaching value. Accurate tracking also ensures accurate data throughout systems, which follows through to after-sales support for a product.

For example, a remote assistance solution can be entirely standalone, with an application on smart glasses being the only required software. Users, content, login information, and more are unique to that remote assistance platform. This is very quick to implement and can be valuable for its simplicity and time to value. However, lacking compatibility with information that already exists—users and content, especially—is an unnecessary barrier to usage. At the most basic level, being able to use existing enterprise account and user information in the AR solution saves time and improves user experience.

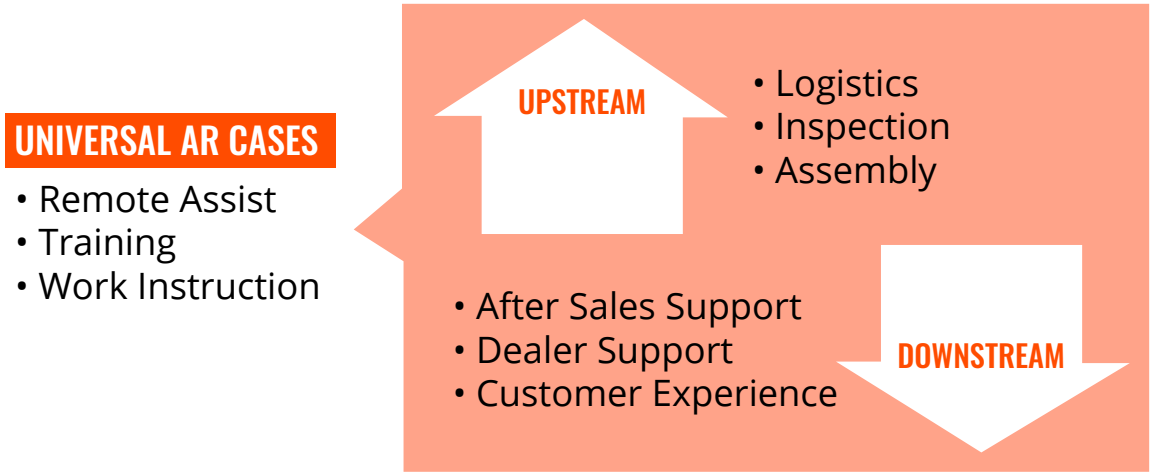
Going a step further, AR can tap into existing content stores, using data like instructions, Computer Aided Design (CAD) and 3D models, design guidelines, and more. Content is often the make-or-break for a user-facing technology like AR, so enabling existing content access by default can again quicken time to value, while improving AR capability: more content available to users means more possibilities.

Tying this integration story together is the relationship between direction of product for a system, upstream versus downstream. Upstream applications involve anything necessary for producing a product, while downstream involves processes and product post-production (sales and post-sales support).

Many AR platform providers and customers focus only on one or the other—assembly guidance is an upstream use case and dealer remote assistance is a downstream use case, as examples. A focus on only one side is simpler to implement, but lacking in capability. In a mature AR solution, both sides must be supported.

Upstream and Downstream Use Cases with AR Applicability

(Source: ABI Research)



There are no steadfast rules for what kind of AR solution maps to what segment of the market; MR has been favorable in downstream applications, while assisted reality has proven popular in upstream applications, but this is not universally true. For example, there are successful downstream applications using MR for Quality Assurance (QA) training—no-code MR content tools create inspection points for a user to follow that are spatially tracked and visualized against the actual vehicle.

Flexibility is key for a successful implementation; single use case and/or single segment AR implementations are proven valuable, while an all-in-one solution tackling upstream and downstream expands value further. A solution that can support any scale, from single user to organization-wide AR support, creates opportunity for a customer to enter the market and scale up exactly as best suits the company. This flexibility, without sacrificing the outright capability to achieve it, is a powerful opportunity for AR customers to bring to market.

TeamViewer, for instance, has experience and time in the market with both backend and frontend integration. The company's Frontline platform has built on that with AR capabilities spanning AR and MR devices, while supporting upstream and downstream use cases. AR-specific offerings include four main solutions within the Frontline platform:

- **xPick** for inventory and picking
- **xMake** for assembly instructions, QA, and training
- **xInspect** for guided maintenance, service, diagnosis, and troubleshooting
- **xAssist** for remote support, after-sales support, and live troubleshooting

On the back of core AR functionality, TeamViewer has built out Frontline into a full-featured AR and MR solution. Spatial is a part of the Frontline platform, offering immersive workflow and workspace content creation for MR. The company also recently launched AiStudio as part of Frontline, which enables no-code AI integration for applications like object and state detection—AI is a critical component of next-generation AR use cases that use automation and prediction.

TeamViewer has a deep partnership with SAP, with AR through Frontline an official SAP-endorsed app. AR-enabled asset management is a fitting example of the power of integration and end-to-end support. SAP Asset Manager (SAM), Field Service Manager (FSM), and Extended Warehouse Management (EWM), in combination with Frontline's xAssist, xInspect, and xPick products, support technicians in the field, while enabling knowledge transfer and training.

Upstream AR in Action: Schnellecke Logistics is a logistics service provider enabling production lines in the automotive sector with Just-in-Time (JIT) delivery. The company needed to increase both speed and quality of its Just-in-Sequence (JIS) processes to maintain the performance level of its service. To do this, the company needed to not only increase process speed, but also reduce the error rate simultaneously. Workers are required to handle large and heavy components, so they needed a hands-free solution. Schnellecke partnered with TeamViewer to integrate the company's Frontline AR solution into its existing infrastructure—errors were reduced to zero, alongisde an average time saving of 20% using AR. Improved training times and greater staffing flexibility were also seen thanks to Frontline.

Downstream AR in Action: BMW differentiates in the automotive market with strong after-sales support and positive dealer service experiences for customers. To continue that, BMW North America outfitted all of nearly 400 BMW and MINI dealers in the United States with TeamViewer Frontline, specifically xAssist, for remote expertise and collaboration during vehicle service. Two-way communication with annotations, pictures, and video with offsite experts had three main impact points: streamlined and quickened technician and expert collaboration,improved first-time fix rate, and, ultimately, improved both customer and technician satisfaction.

LOOKING FORWARD

Today's AR story is focused on capability and flexibility. Tomorrow's story will be understanding how to add more value to key AR use cases through enabling technologies. When looking solely at AR technology, MR solutions will become more commonplace and more affordable, with new devices on the horizon entering a maturing and content-rich ecosystem. Assisted reality devices will still play a valuable role in high-complexity environments, common in automotive manufacturing, for example.

Outside of pure AR technology, AI is one of the most prolific enabling technologies today, with usage in many digital platforms for analytics and big data processing. For AR, AI is also used for analytics, with unique data types adding value; spatial tracking and visual heatmaps are becoming more common.

Going forward, AI will go a step beyond user enablement and begin enabling automation and prediction. Rather than having a worker start a remote expertise session, an AI-enabled platform can leverage existing content and deliver JIT guidance, saving expert time and resources. Training is a similar story, with the ability to use appropriate existing content (often captured using an AR device) automatically.

Machine vision as a form of AI is also already in use today as well, with applications growing. MR devices often use Simultaneous Location and Mapping (SLAM), enabling user tracking in space and content georegistration (e.g., locking content to objects and/or the environment). Going a step further, semantic labeling enables object and process tagging with metadata for later use, which is excellent for training and workflow instruction. By training a machine vision model, companies can use machine vision to enable automated workflow verification. An AR device with a camera can run an AI model to detect the state of an object or environment and compare it to the ideal or correct state or give contextual information on a part when needed.

A NEW AND EXCITING CHALLENGE: ELECTRIC VEHICLES

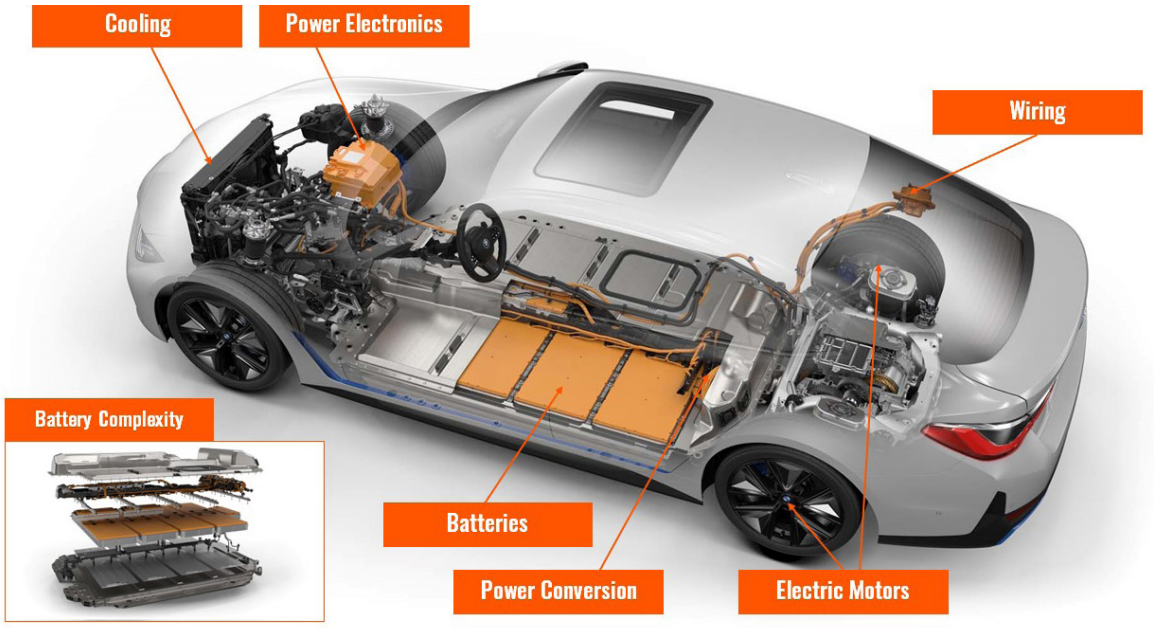
Matching these enabling technologies to new challenges in end markets will differentiate in an increasingly competitive space. In the automotive industry, the most prolific upcoming challenge is the novelty and complexity of Electric Vehicles (EVs). Every component of the supply and value chain for automotive OEMs is affected by EVs.

Although there are technically fewer parts overall compared to an Internal Combustion Engine (ICE) vehicle, complexity is higher overall. Vehicle models can now include both electric and ICE power trains, dramatically different from each other from design through to support. EVs present new module and component requirements with complicated wiring and programming, and they will, of course, require unique training content and support documentation. EV batteries are an entirely new product that has seen incredibly quick iteration and capability improvement, again compounding EV manufacture and support complexity.

Relatedly, charging technologies and needed infrastructure are also in flux—some automakers are working toward charging standards, while others are using proprietary solutions. This infrastructure needs planning, design, construction, and maintenance just as a vehicle does, and this can fall on the automotive OEM, creating yet another novel challenge. AR can be incredibly effective in all these areas used similarly to more common automotive use cases—remote expertise and training content can improve field service, reduce downtime, and improve both customer and worker sentiment.

Critically, this is all possible in an incredibly flexible and robust way. AR can adapt to changes more quickly than traditional training and instruction methods, meaning content is available quicker and staff are up-skilled faster. With low-code/no-code solutions, this adaptation can be done incredibly quickly, and when a more robust solution is needed, professional services from an end-to-end service provider can create, integrate, and provide support through the entire process.

New Components and Added Complexity for Electric Vehicles



AR can help address these new challenges and enable operators to keep up with pace of change for EVs more effectively.

EV Case Study: Plug Power is a hydrogen solutions provider. The company identified the difficulties in keeping training and onboarding procedures accurate and efficient, which required in-person sessions due to system and operation complexity. Travel restrictions forced the company to provide a suitable replacement for in-person sessions, which AR enabled. TeamViewer xInspect and Frontline Creator enabled streamlined training content creation capabilities, resulting in 100% remote AR-powered training with Return on Investment (ROI) seen after four sessions.

SUMMARY AND RECOMMENDATIONS

The automotive sector is a high-value, high-complexity market. This is true not only in areas where complexity is a given, such as in manufacturing, but also in design, assembly, sales, customer service, and more. AR is a unique tool that can lessen complexity and ensure effectiveness in all these areas. Each company is unique in its needs when it comes to AR, but the devices on offer and the maturity of platform partners brings a level of both capability and flexibility that can tailor and adapt to these needs. As automotive advancements continue at a rapid pace thanks to EVs, the need for a holistic digital platform, leveraging AR and other key enabling technologies, becomes a necessity for automakers to keep up and minimize inefficiencies.

RECOMMENDATIONS:

- **Understand how to initiate an implementation and what is needed to ensure success.** Identify what areas of operation would be best suited to AR, and the scale at which to start. Existing platforms and teams will likely need to be involved, such as Information Technology (IT). Estimate a budget and what is possible in-house versus through a partner and/or system integrator. As efforts scale, a combination of in-house and third-party will be common, so minimizing overlap in responsibility and resources (e.g., content creation, software development, and integration) is important.
- **Relatedly, integration remains a primary obstacle to realized/expected ROI with AR.** Take stock of existing platforms and sentiment toward them, and then identify potential integration synergies, as well as obstacles. For instance, having a device management platform that supports AR smart glasses will make content delivery and support easier. Even if smart glasses are not planned for the immediate future, scaling up AR efforts often will lead to introducing smart glasses and expanding into MR.
- **Identify the actual hardware needs for target use cases.** Hands-free will likely be the first critical facet to understand and will dictate much of the discussion afterward. If hands-free data access is needed, then smart glasses are the solution of choice. If hands-free is not a requirement, then mobile device AR may be acceptable. Many features of AR span both mobile and glasses today—value adds like correct scale visualization, spatial tracking, and virtual assistant usage are possible across both device types.
- **Invest in enabling technologies, especially AI.** AI touches several critical elements of an AR implementation and will be increasingly important to success (and differentiation for AR platform providers), as automation and prediction become more commonplace. Today, AI for spatial tracking, semantic labeling, automation, and advanced analytics is already proven. Frontline worker support using AI for varying levels of content prediction and task automation is also being proven.
- **Recognize both upstream and downstream opportunities, and what use cases best fit with those opportunities.** Logistics, inspection, and assembly are common upstream automotive segments, while downstream includes support across dealers and customers—both are served well by all AR device types, with individual customer needs and wants dictating the best solution. Many AR use cases apply to multiple sides, such as remote assistance, training, and work instruction.

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