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Smart Innovators: Augmented Reality Solutions For Remote Assistance

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BY HUGO FULLER
WITH MALAVIKA TOHANI

OPERATIONAL EXCELLENCE

Smart Innovators: Augmented Reality Solutions For Remote Assistance

This report provides buyers of augmented reality (AR) solutions for remote assistance with an overview of the current state of the market and an assessment of vendors with the most comprehensive offerings. The study also provides executives at vendors with an understanding of how their capabilities stack up relative to their competitors across eight assessment criteria. Features such as secure connectivity with remote expertise, device agnosticism and retention of call quality even in reduced bandwidth areas are key AR solution capabilities. The report finds that the maturing of AR hardware products has coincided with an increased demand for connected worker solutions owing to workplace restrictions enforced during the COVID-19 pandemic. Buyers must consider four main criteria before selecting an AR solution vendor: the scalability of the solution, the capabilities and use cases in which vendors specialize, the vendor innovation strategy, and integration and future tech developments afforded by the vendor's partner ecosystem.

TABLE OF CONTENTS

TABLE OF FIGURES

ORGANIZATIONS MENTIONED

Acty, Alstom, AMA, Apprentice, Atheer, Brochesia, CANCOM, Coca-Cola Hellenic, Daqri, Epson, Fieldbit, GE Aviation, Google, Industrial Augmented Reality (iAR), Iristick, JoinPad, Kognitiv Spark, Librestream, Linde, LLVision, Magic Leap, Microsoft, National Oilwell Varco, oculavis, Plutomen, PTC, QualComm, RealWear, RE'FLEKT, Remote

Eye, Rogers Electric & Machine, Scope AR, SGS, Sibur, SwipeGuide, TeamViewer, ThyssenKrupp Bilstein, Trimble, Ubimax, Unity, Upskill, UtilityAR, Vital Enterprises, Vuzix, WakingApp, Wikitude, XMReality, Zebra.

Smart Innovators: Augmented Reality Solutions For Remote Assistance

Since the Microsoft HoloLens was released in 2016, AR has moved from niche consumer product to viable industrial solution. Augmented reality solutions for remote assistance offer functionality with applications across a variety of industries and can be integrated with existing IT systems. To help customers interpret the functionality of AR solutions, Verdantix has evaluated the capabilities and use cases of 27 vendors. With many firms left exposed during the COVID-19 pandemic, chief information officers and operations managers should consider the vendors discussed in this report in implementation plans concerning AR for remote assistance.

A Multitude Of Factors Have Increased The Attractiveness Of Augmented Reality Wearables

Both environmental and technological factors have led to a significant increase in the viability of AR wearables in the last five years. Adoption of AR wearables has been driven by:

- **Technology pivoting from the consumer to the industrial market.**
  The unprecedented popularity of the AR smartphone game Pokémon Go in 2016 coincided with the release of Microsoft's HoloLens, while the Google Glass Enterprise Edition was released in July 2017. Pure industrial hardware offerings for AR gained traction shortly after. Daqri raised $260 million of investment in 2017, while RealWear's initial investment of $17 million rose to $118 million by 2019. AR software solutions also attracted investment as PTC acquired the Vuforia AR platform from Qualcomm in 2015 for $65 million.

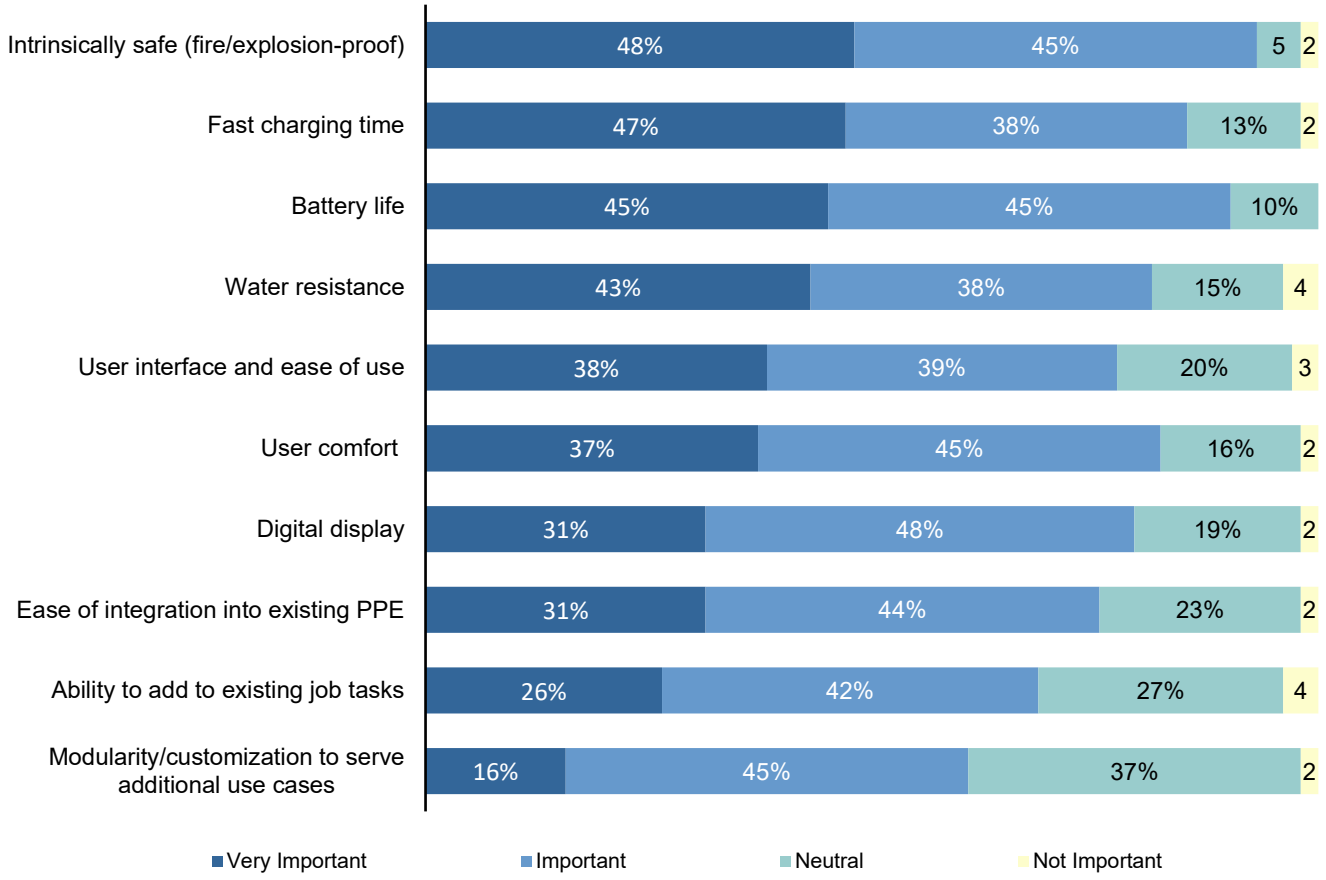
- **Maturing of hardware offerings, particularly head mounted displays (HMDs).**
  While technology for industrial wearables significantly improved in the last five years, concerns over charging speeds, battery life, comfort, ease-of-use, ruggedness and water resistance had to be addressed before AR wearables could provide utility in sites where chemicals, dust and fluctuating temperatures might affect operability (see Figure 1). Hardware producers for HMDs have made iterative improvements to their products to make them viable in industrial environments. Providers include Epson, Iristick, LLVision, Magic Leap, Microsoft, RealWear, Vuzix and Zebra. The form factor of the HMD has diversified: alongside binoculars such as Google Glass and the Microsoft HoloLens, Vuzix's M300 and RealWear's HMT line have opted for a monocular design which attaches to hardhats.

- **COVID-19 restrictions generating market urgency.**
  While the benefits and use cases for AR solutions for remote assistance are established, most firms did not consider the technology a must-have until COVID-19. Several vendors have experienced an uptick in interest, with multiple reporting user numbers rising considerably. All industrial firms have been affected by lockdown orders and higher rates of staff sick days, as well as government-mandated social distancing measures. As a result, there has been a sharp rise in the number of remote assistance use cases, such as remote inspections, as in-person inspections are prohibited in many regions. Issues with machinery which would usually require in-person attention from a specialist can now only be resolved through remote guidance of a reduced on-site workforce. Industrial firms left exposed by the COVID-19 pandemic have identified AR solutions for remote assistance as a method to maintain normal working processes.

FIGURE 1

Important Operational Criteria When Selecting Wearable Devices

"From an operational perspective, how important are each of the following criteria when selecting an industrial wearable device?"



Note: data labels are rounded to zero decimal places.
Note: percentages less than 5% have been written as numbers.
Source: Verdantix

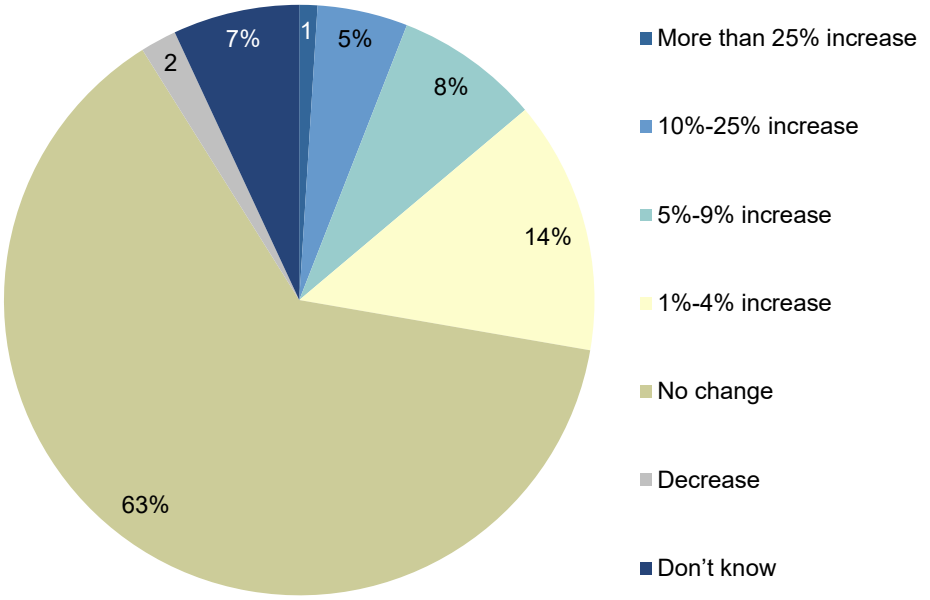
n=284

- **Increasing demand for wearables capable of remote content delivery.** Augmented reality wearables are a primary delivery method of remote content in industrial settings. According to the Verdantix Industrial Wearables Survey 2019 with 102 senior EHS decision-makers, 22% of firms planned to utilize wearables for remote content delivery or mentoring widely across all their operations over the next 12 months. A further 34% reported that industrial wearables would be used at multiple facilities while 18% of interviewees noted that they would undertake a pilot project at one facility (see Verdantix Industrial Wearables Survey 2019: Budgets, Priorities & Tech Preferences).

FIGURE 2

2020 Investment Plans For Wearable Device Use Cases

"How will your firm's spend change on industrial wearables for the following use cases during the next twelve months?"



n=102

Note: percentages less than 2% have been written as numbers.
Source: Verdantix

Partnerships And Acquisitions Define The Market For Augmented Reality Solutions

The market for AR solutions is growing, driven by a variety of factors such as maturing of the technology and increasing customer demand which has been amplified during the COVID-19 pandemic. According to the 2019 Verdantix Industrial Wearables Survey, 28% of the respondents interviewed plan to increase their investment in industrial wearables for remote content delivery or mentoring, with 6% expecting double digit growth and 22% expecting growth between 1% and 9% (see Figure 2). To take advantage of this positive momentum in the market, AR solution vendors are adding to their product capabilities as well as increasing market share via:

- **Partnerships with software firms.**
  AR software providers expand their capabilities through partnerships with software firms who fill the gap with specific capabilities (see Figure 3-1 and Figure 3-2). XMReality's Remote Guidance solution lacks a work instruction creator natively, but buyers have the option to purchase a combined solution owing to its partnership with SwipeGuide, the Amsterdam-headquartered digital work instruction vendor. Interconnectivity with existing IT systems is also expedited through partnerships. oculavis partners with CANCOM, a Munich-based IT service management firm, to expedite the integration of its AR solution SHARE with customer relationship management (CRM), enterprise resource planning (ERP) and product lifecycle management (PLM) systems.

FIGURE 3-1

Partnerships In The Augmented Reality Solutions For Remote Assistance Market

AR Solution Vendors	Hardware	Software
Acty	Epson, Iristick, RealWear, Vuzix	Deskoala, Microsoft (Dynamics), Salesforce, SAP, Zapier
AMA	Dust Mobile, Dino-Lite, Epson, FLIR, Google (Glass), Getac, Inmarsat, Iristick, i.safe Mobile, LLVISION, RealWear, Toshiba, Vuzix	Proceedix
Apprentice	Epson, Microsoft (HoloLens), RealWear, Vuzix	
Atheer	Epson, Microsoft (HoloLens), RealWear, Vuzix	Design Interactive, Wikitude
Brochesia	Epson, Open Fiber, Qualcomm, RealWear, Seek Thermal, Vuzix, WINDTRE, ZTE	
Epson		AMA XpertEye, Apprentice, Atheer, BrickSimple, Librestream, PORECT, OPTiM, Scope AR, SimInsights, Spinar, vStream, Ubimax, Upskill,UtilityAR, Vital Enterprises, Remote Eye
Fieldbit	Epson, RealWear, Vuzix	Amdocs
iAR		
JoinPad	Cisco, LLVISION, Samsung	Crunchfish
Kognitiv Spark	Microsoft (HoloLens)	GemDT
Librestream	Cisco, dynabook, ecom, Epson, FLIR, Microsoft (HoloLens), Olympus, Pepper+Fuchs, RealWear, Samsung, Verizon, Vuzix	Cisco, Honeywell, Microsoft, ServiceNow, ThingWorx
Microsoft		Acty, Apprentice, Atheer, Kognitiv Spark, Librestream, PTC, RE'FLEKT, Scope AR, Upskill
oculavis		IconPro

Source: Verdantix

FIGURE 3-2

Partnerships In The Augmented Reality Solutions For Remote Assistance Market

AR Solution Vendors	Hardware	Software
Plutomen		
PTC	Microsoft (HoloLens), RealWear	Unity
RealWear	Bullard, ESSERT, Kinemic	Adtance, augmentIT, Beeware, bitnamic, CIM, EVOCALL, GADV, Inosoft, Intoware, ioxp, jujotech, nxtBase, rise, SPRYFLASH, SupportSquare
RE'FLEKT	Microsoft (HoloLens), RealWear, Vuzix	CAD-IT, Cortona3D, Siemens, Unity, visionLib
Remote Eye	Epson, Iristick, MAD Gaze, Optinvent, RealWear, Vuzix	
Scope AR	Microsoft (HoloLens)	ServiceMax
Teamviewer		
Trimble		
Ubimax	dynabook, Epson, Google (Glass), KOAMTAC, Optinvent, ProGlove, RealWear, Samsung, Socket Mobile, Telepathy, Trivisio, Vuzix, West Unitis, Zebra	SAP, soft2tec
Upskill	Google (Glass), Microsoft (HoloLens), RealWear, Vuzix	AirWatch, Nuance, Salesforce, ServiceMax
UtilityAR	Epson, RealWear, Vuzix	Unity
Vital Enterprises	RealWear	
Vuzix		1Minuut Innovation, AccuWeather, Cisco, ProGlove, Qualcomm, SAP, Sensory, SightCall, TensorMark
XMReality	Iristick, RealWear, Vuzix, Zebra	Hexagon, Netcetera, Novacura, SwipeGuide

Source: Verdantix

- **Partnerships between hardware and software firms.**
  For hardware providers such as RealWear and Vuzix, the bulk of software available on their devices is provided through partnerships. RealWear users can create AR work instructions through PTC Vuforia Expert Capture and contact remote experts through Microsoft Teams or Acty. The Vuzix App Store allows users to download AR for remote assistance software solutions, including TeamViewer Pilot from the remote workforce software developer TeamViewer and Remote from German competitor RE'FLEKT. RE'FLEKT is also a reseller of various devices including the RealWear HMT-1 line and Vuzix smart glasses.

- **Acquisitions of software firms offering specific use case functionality.**
  To expand product capabilities, AR software providers are acquiring smaller firms with specific functionality. American AR software supplier Scope AR acquired WakingApp, an Israeli AR firm, in December 2019. The purchase enhanced the capabilities of Scope AR's WorkLink offering, an AR platform which combines remote assistance and AR work instruction authoring software. In July 2020, TeamViewer acquired Ubimax, a German AR software developer, to incorporate new functionality into the TeamViewer Pilot AR solution.

Introducing The Augmented Reality For Remote Assistance Market

The industrial AR market has expanded owing to the maturing of AR hardware, an increased appetite for industrial wearables capable of remote content delivery and through partnerships and acquisitions which extend product capabilities. The COVID-19 pandemic has provided the impetus for firms to invest in AR solutions, which will trigger a new phase of growth for the technology. Reflecting the wide variety of solutions in the market, Verdantix defines AR solutions for remote assistance as:

"A combination of augmented-reality-capable hardware – smartphones, tablets and head-mounted displays (HMDs) – and software which connects remote experts with on-site workers through voice and video calls incorporating live augmented reality annotations."

While AR for industrial application has numerous use cases and vendors may offer extensive AR capabilities, this report evaluates only those relevant to AR for remote assistance. To gain an in-depth understanding of the AR for remote assistance market, Verdantix surveyed 27 AR solution vendors. The following eleven vendors provided a briefing: Atheer, JoinPad, Kognitiv Spark, Librestream, oculavis, Plutomen, PTC, RealWear, RE'FLEKT, Scope AR and Trimble. Five vendors provided details of product offerings through email correspondence: Brochesia, Microsoft, Ubimax, UtilityAR and XMReality. Vendors who were contacted but did not respond or missed deadlines were: Acty, AMA, Apprentice, Epson, Fieldbit, Industrial Augmented Reality (iAR), Remote Eye, TeamViewer, Upskill, Vital Enterprises and Vuzix.

Augmented Reality Solutions For Remote Assistance Cover Five Main Use Cases

Augmented reality solutions for remote assistance can be utilized across various industries, ranging from aerospace to manufacturing. The use cases for these industries are relatively established but are evolving over time as new capabilities are incorporated into the software. The five main usage scenarios for remote assistance include (see Figure 4):

FIGURE 4

Augmented Reality For Remote Assistance Use Cases

	Commissioning and installation	Inspections and field surveying	Just in time learning/training	Maintenance and repair	Servicing and Troubleshooting
Acty		■	■	■	■
AMA		■	■	■	■
Apprentice		■	■	■	■
Atheer	■	■	■	■	■
Brochesia		■	■	■	■
Epson		■	■	■	■
Fieldbit		■	■	■	■
iAR		■	■	■	■
JoinPad		■	■	■	■
Kognitiv Spark		■	■	■	■
Librestream	■	■	■	■	■
Microsoft		■	■	■	■
oculavis	■	■	■	■	■
Plutomen		■	■	■	■
PTC		■	■	■	■
RE'FLEKT		■	■	■	■
RealWear	■	■	■	■	■
Remote Eye		■	■	■	■
Scope AR		■	■	■	■
TeamViewer		■	■	■	■
Trimble		■	■	■	■
Ubimax		■	■	■	■
Upskill		■	■	■	■
UtilityAR		■	■	■	■
Vital Enterprises		■	■	■	■
Vuzix		■	■	■	■
XMReality		■	■	■	■

Source: Verdantix

- **Plant commissioning and machine installation.**
  Utilizing AR solutions for remote assistance during plant commissioning ensures that equipment is properly verified and that finished machinery systems match intended designs. Through video-call recording, compliance teams have visual proof of each test being performed during the commissioning process and remote experts can double check each step in real-time. With HMDs, workers can perform handsfree machine fitting while the remote expert views documentation or blueprints to guarantee error-free installation. Automotive technology supplier ThyssenKrupp Bilstein has expanded its use of the oculavis SHARE AR solution from routine maintenance tasks to commissioning and equipment optimization owing to COVID-19 travel restrictions, using RealWear and Epson headsets alongside Android and iOS smartphones.

- **Inspections and field surveying.**
  Remote inspections at plants have been an increasingly popular use case since COVID-19 interrupted normal operations worldwide. With remote assistance, on-site workers can perform inspections of key equipment with the oversight of a remote expert. Field workers can survey an area with the guidance of a remote expert before scheduling in-person follow-ups with the relevant workers. Visual records of inspections and surveys can be revisited in future, including videos and images with annotations which were added during the original inspection. With conference calling, key personnel can view pertinent sections of inspections and surveys in real-time through the eyes of the on-sight worker, expediting communications between workers in interconnected roles. SGS, a Swiss inspection and verification firm, incorporated remote inspections to its services offering by white-labelling Librestream's Onsight Connect. SGS recorded productivity improvements alongside increased safety measures and reduced travel costs.

- **Just-in-time learning and training.**
  AR for remote assistance expedites the training of junior employees getting to grips with routine tasks. Knowledge sharing is more streamlined through "see-what-I-see" technology with visual annotations, and potentially costly mistakes are eliminated as the user can check each step in real-time with the remote expert. Using Ubimax's xAssist and xInspect offerings, Coca-Cola Hellenic achieved a 30% reduction in onboarding training time in their laboratories. Workers who must step-in at short notice can be trained on tasks they aren't familiar with, while experienced employees benefit from top-up training on tasks they complete infrequently. Senior employees can also record daily activities with commentary or annotations for training purposes.

- **Troubleshooting for maintenance, servicing and repair.**
  Integrating AR solutions in maintenance schedules yields improvements to operational efficiency. Connecting with existing asset management systems allows users to file reports and compare current maintenance data with historical maintenance data. Accessing records on which personnel have performed maintenance on the machine or component helps inform maintenance procedure in real-time. Remote experts clarify techniques to maintain, repair or service machines, which expedites planned maintenance. GE Aviation incorporated Upskill's Skylight platform into its preventative maintenance on B-nuts, a critical component in aircraft engines, achieving an average of 8 to 12% increase in mechanical efficiency.

Augmented Reality Solutions For Remote Assistance Have Eight Primary Capabilities

Each of the four key uses cases of AR solutions for remote assistance require specific product features to excel in industrial environments. Given the numerous AR for remote assistance solutions, Verdantix recommends that potential buyers assess vendors based on their ability to offer (see Figure 5-1 and Figure 5-2):

- **Low bandwidth functionality in areas with poor communications infrastructure.**
  Where an AR solution is deployed in locations without Wi-Fi or strong cellular network connectivity, it is imperative that voice and video are still available during calls. Several vendors, such as Upskill or Atheer, have auto-detect functionality which adjusts the video quality based on available bandwidth. In remote areas, internet speeds can dip below 56 kbp/s. For these scenarios, certain vendors have added a feature which allows the user to take high-quality photos and send them to the remote expert, who can annotate the image and send it back while retaining the voice call. Librestream Onsight Connect can maintain voice and video functionality as low as 30 kbp/s with the option of sending images with annotations when bandwidth is extremely limited.

- **Secure connection between user and remote expert.**
  Given that sensitive information can feature regularly on remote assistance calls, a guaranteed secure connection with each participant is a must. The best security includes end-to-end encryption and ISO27001 certification. Libresteam and Upskill undergo regular third-party audits of security standards to ensure integrity, while Kognitiv Spark is Cyber Essentials certified, a UK government backed scheme, which protects against a wide range of cyber-attacks.

- **Device agnostic software which offers a similar experience across all platforms.**
  One of the barriers to adoption of AR solutions is the cost of initial investment in AR-ready technology. Not every firm is able to invest in an HMD solution; in the Verdantix Industrial Wearables Survey, 28% of the 102 respondents indicated that wearables for remote content delivery or mentoring were too expensive. Considering that the vast majority of AR use is on smartphones, AR software should be accessible on Android, iOS or via desktop computers or laptops, for both the on-site user and the remote expert. AR software vendors such as Acty, AMA, Librestream and XMReality all offer support for various HMDs including those from Iristick, Microsoft, RealWear and Vuzix, alongside Android and iOS smartphones and tablets.

- **Conference calling with three or more participants.**
  Native support for calls with more than two personnel is increasingly standard for AR solutions for remote assistance use cases, especially with COVID-19 constraints on in-person meetings. With conference calls, field workers can receive advice from multiple experts simultaneously. Those unfamiliar with remote assistance software can observe calls to quickly understand the solution's processes. Junior employees can also join calls to gain insight into work tasks from a first-person point of view. Multi-personnel calling also allows for inter-departmental conferences, which improve operational efficiency as experts can relay specifics to both the field worker and those responsible for procuring replacement parts or machinery. RE'FLEKT and Librestream offer full functionality to conference call attendees including visual and text annotations for fifteen or more participants.

- **Integration with existing systems.**
  Interconnectivity with existing IT systems provides further functionality for remote assistance. Workflows can be enhanced with real time data from components or information on previous inspections of a machine. Vendors offer connectivity with ERP and CRM systems which allow for paperless records and deeper analytics. Vendors such as Acty and XMReality work with open APIs such that buyers can integrate existing systems themselves. Trimble PULSE Remote Expert, which is part of Trimble's Field Service Management offering, can be used in conjunction with construction management software Trimble WorksOS or alongside Trimble Connect, an AR construction tool for 3D visualizations.

- **Work instruction creator for step-by-step guidance.**
  Step-by-step instructions can be superimposed into the user's field of view using AR to provide constant guidance during work tasks. The Scope AR WorkLink platform allows users to incorporate text, images and videos into work instructions to ensure accuracy. PTC's Vuforia Expert Capture incorporates hazard warnings and relevant locations in work instructions which are optimized for Microsoft HoloLens and RealWear HMT-1 HMDs.

- **Offline features for areas with no internet connectivity.**
  Although the primary function of AR solutions for remote assistance necessitates an online connection, in areas with limited or no network bandwidth, offline functionality is valuable. Offline features include the ability to save voice and video calls with annotations, record offline processes, take screenshots with

FIGURE 5-1

Augmented Reality Solutions For Remote Assistance Vendor Capabilities

	Low bandwidth capabilities	Security	Device agnostic	Conference calling
Acty	2	3	4	3
AMA	2	4	4	2
Apprentice	1	3	3	2
Atheer	1	3	4	3
Brochesia	2	3	2	3
Epson	1	3	1	1
Fieldbit	2	3	4	1
iAR	1	1	2	1
JoinPad	2	2	3	1
Kognitiv Spark	3	4	1	1
Librestream	4	4	4	4
Microsoft	3	4	2	2
oculavis	3	3	4	3
Plutomen	1	2	4	3
PTC	1	3	3	1
RealWear	3	2	1	3
RE'FLEKT	3	3	4	4
Remote Eye	2	3	4	1
Scope AR	2	3	3	1
TeamViewer	3	3	4	3
Trimble	1	1	2	1
Ubimax	1	1	4	3
Upskill	3	4	3	1
UtilityAR	3	3	4	3
Vital Enterprises	1	3	4	1
Vuzix	2	2	1	1
XMReality	2	3	4	3

Source: Verdantix

FIGURE 5-2

Augmented Reality Solutions For Remote Assistance Vendor Capabilities

	System integration	Work instruction creator	Offline mode	Analytics
Acty	3	1	0	0
AMA	2	2	3	2
Apprentice	3	2	0	2
Atheer	3	4	4	4
Brochesia	2	3	4	2
Epson	1	0	0	0
Fieldbit	3	0	3	0
iAR	2	2	2	0
JoinPad	3	3	0	1
Kognitiv Spark	3	3	4	0
Librestream	4	3	3	3
Microsoft	3	3	4	2
oculavis	4	3	1	2
Plutomen	2	2	1	1
PTC	0	4	3	0
RealWear	2	1	1	2
RE'FLEKT	2	3	4	3
Remote Eye	3	0	0	0
Scope AR	1	4	3	2
TeamViewer	0	0	0	0
Trimble	4	2	3	1
Ubimax	3	4	3	2
Upskill	4	3	2	2
UtilityAR	2	2	3	1
Vital Enterprises	2	2	0	0
Vuzix	2	2	2	2
XMReality	2	3	4	2

Source: Verdantix

annotations and store information captured, which is automatically uploaded once internet connectivity is restored. These features reduce task duplication and ensure that data is captured in real-time. Vendors who incorporate the best offline functionality include AMA, Atheer, Kognitiv Spark and XMReality.

- **Analytics which incorporate usage statistics, AI, and machine learning algorithms.**
  Safety, workflow efficiency and performance can be improved by analysing data gathered. Granular usage statistics presented on dashboards can provide insight into how long certain tasks are taking or if workers more regularly request assistance at certain points in the task. AI, which incorporates machine learning algorithms, can cross-reference historical data and alert users to potential bottlenecks within workflows. Atheer's AR Front Line OS uses AI to improve job efficiency through analytics from previous instances of work tasks, suggesting calls with specific experts who have subject knowledge to expedite task completion.

Augmented Reality Solutions For Remote Assistance Deliver Multiple Benefits To Customers

The business case for AR solutions for remote assistance is emerging, as the benefits afforded by these solutions overtake the costs. These benefits include:

- **Cost savings through efficiency improvements and reduced travel.**
  Cost savings are seen through process efficiency improvements, as AR solutions for remote assistance allow workers to quickly consult an expert on tasks they are finding challenging, without having to relearn sequences through manuals. Accordingly, Alstom, a French rolling stock manufacturer, selected JoinPad's Smart Assistance software to improve communications between its on-field operators and remote experts. The firm recorded decreased downtime and costs as the number of errors during maintenance and repair operations were reduced using JoinPad's solution. Firms can also circumvent travel costs usually incurred when specialists must travel to repair or install equipment, as experts communicate with users on the ground to remediate issues at a fraction of the cost. Using Kognitiv Spark's RemoteSpark solution, Rogers Electric & Machine, a sales and service provider for electric motors and heavy machinery equipment, saved $7,000 in travel expenses per use.

- **Improvements to productivity, efficiency, and industry knowledge retention.**
  AR solutions for remote assistance deliver all-round benefits. Industry experts approaching the end of their careers can circulate the knowledge they have accrued to more people in less time and with a more efficient delivery method. Unplanned down-time at plants, which would previously have severely impacted productivity, can be resolved more rapidly. This is especially true at remote sites, where personnel on the ground may lack the specialized knowledge required to fix niche components. After Russian petrochemical firm Sibur partnered with Brochesia to enhance its production processes, the firm achieved efficiency improvements in its manufacturing process. These improvements were especially pronounced during COVID-19, where experts were not able to visit Sibur sites in person.

- **Easy connection to remote expertise.**
  Although utilizing remote expertise is not a new idea, AR solutions have significantly improved user experience and minimized risks associated with carrying out tasks. Phone calls, address books, asset information documents, work instructions, webcams and pictures sent over email have been rolled into a unified product such that accessing remote expertise is a seamless experience, even in situations where communications infrastructure is limited.

- **Better worker safety.**
  In safety-critical industries, two-way communication between remote experts and in-person workers can add an extra layer of precaution. AR solutions can be used in tandem with safety measures such as lockout-tagout procedures to consolidate hazard awareness. Past incident and inspection reports, job hazard analysis and information about the area or environment can be assimilated to highlight potential risks and which mitigation activities should be undertaken. Customers using HMDs can perform hands-free maintenance work, reducing motor-skill related accidents, while time-sensitive repairs to potentially dangerous equipment can be completed faster. Linde, an industrial gases and engineering firm, integrated Fieldbit's AR offering to resolve safety-critical issues faster, enhancing strategies to avoid industrial accidents during gas production.

- **Access to just-in-time learning and training for enhanced productivity as well as safety.**
  Training in industrial environments requires hands-on demonstrations, where experienced workers walk junior employees through complex work tasks. Remote assistance removes the need for senior staff to be on hand and streamlines the training process. National Oilwell Varco recorded 70% improvements in productivity using Librestream Onsight Connect for just-in-time learning between offshore and onshore locations. Experts gain a real-time insight into the trainee's field of view and can guide them to avoid common or dangerous errors, while the trainee has greater autonomy over their learning from the offset. Just-in-time learning can also be supplied to seasoned workers who perform complex tasks on an irregular basis, who can consult with remote experts rather than revising processes through work manuals.

- **Decreased environmental footprint through elimination of unnecessary travel.**
  In addition to the money saved from eliminating travel to service calls, AR solutions for remote assistance reduce the environmental impact as travel by car or plane can be avoided. Firms who prioritize minimizing their greenhouse gas emissions should consider AR solutions for remote assistance as a sustainable option moving forward.

The Augmented Reality Solutions For Remote Assistance Market Is On A Growth Trajectory

The nascent market for industrial AR solutions has picked up pace in the past five years as hardware and software capabilities have developed. Acquisitions and partnerships have expanded the market while appetite for remote content delivery through AR solutions has risen. COVID-19 has spurred interest and adoption of the technology, but innovation will drive continued growth, as key capabilities receive incremental improvements alongside new functionality which employs AI.

Future Innovation In The Augmented Reality For Remote Assistance Market Is Led By AI

The AR market is evolving around the incorporation of AI which will automate work tasks. Operational improvements can be unlocked through a combination of AI and IoT data streams. Currently, only a handful of AR for remote assistance firms use this data in combination with machine learning algorithms and artificial intelligence to provide users with automated prompts or contextual information. Buyers should assess whether the direction of innovation for a vendor runs parallel with their own. Future innovation includes:

- **Predictive analytics which notify users of common errors based on historical data.**
  Workflows can be improved through AR software enhanced with AI. A macro view of historical data can display which steps in a complex workflow are most likely to result in a remote assistance call, while a granular view can display at which stage individual workers experience issues completing a task. Predictive analytics based on this data could notify users of more challenging steps in processes or provide them with contact details for remote experts who specialize in whatever task is being performed. AI can also be used to give contextual visual information while users interact with machines. Atheer, Kognitiv Spark and Librestream have integrated an AI component within their AR software: Kognitiv Spark and Librestream have incorporated computer vision, which can automatically recognize certain objects, while Atheer have deployed AI to automate repetitive work tasks. Each firm has plans to deepen AI integration in the future.

- **Virtual assistants which can answer industry-specific questions.**
  Prior to a remote assistance call, AI-powered virtual assistants could provide information to users about specific machinery, components, locations or other work task related queries. Vendors are looking at developing virtual assistants to facilitate database searches for relevant work records or other pertinent information through voice commands. The aim is for this technology to remediate the ongoing issue within industry of knowledge management, as employees could access a variety of industry-specific information with ease.

Buyers Of Augmented Reality Solutions For Remote Assistance Should Consider Four Criteria To Find The Best-Fit Vendor

Given the range of solutions in the AR for remote assistance market, buyers must scrutinize which vendors match their requirements. To ensure they receive the best-fit solution, buyers must consider:

- **Vendor's ability to scale the solution from pilot projects to multiple sites at an enterprise level.**
  COVID-19 precipitated the investment of industrial firms in AR solutions for remote assistance so that they could maintain normal operations. Buyers at larger firms should assess the scale on which their chosen vendor has previously implemented AR solutions. Several firms offer standard packages which range from a single user to enterprise level. These include AMA, Librestream, oculavis, RE'FLEKT and Vital Enterprises. If firms are considering investing in HMDs alongside AR software, partnerships between hardware and software firms must be reviewed, as software vendors who act as resellers of hardware can expedite implementation at scale.

- **Evaluating vendor capabilities based on industry and use case.**
  Buyers must assess remote assistance providers based on their respective industry and the use cases they will yield the greatest value from. In industries where workers will regularly discuss confidential information on calls, such as defence firms, security will be a primary concern. Kognitiv Spark has made security features a central part of the RemoteSpark platform, a move informed by its implementation with the Canadian Navy and Canadian Army. Trimble's deep integration with project management technologies makes the Trimble PULSE Remote Expert a good fit for construction firms. Firms who operate in regions with limited communications infrastructure such as locations for oil and gas or mining should prioritize low bandwidth and offline functionality, from vendors such as Librestream and RE'FLEKT. The same capabilities will be central to the remote inspection and surveying use cases as remote areas often lack strong internet connectivity.

- **Vendor innovation strategy and product roadmap.**
  To ensure investment in AR solutions for remote assistance provides long-term benefits, buyers should investigate the direction of innovation for each vendor. Buyers planning to integrate AI into their industrial processes should consider vendors who are developing these capabilities, such as Atheer, Kognitiv Spark and Librestream. For firms where work tasks regularly require handsfree actions, AI virtual assistants go hand-in-hand with remote assistance solutions. In industries where automation is less of a priority, buyers would yield more value from vendors who plan for iterative improvements to key functionality, as firms look to continuously enhance features such as offline mode and conference calls as use cases for the solution evolve.

- **Integration and future tech developments afforded by vendor's partner ecosystem.**
  Buyers should evaluate vendor partnerships which facilitate rapid implementation and expand the capabilities of AR for remote assistance solutions. If buyers choose HMDs for remote content delivery, vendor partnerships with HMD firms such as Epson, Microsoft, RealWear and Vuzix will yield long-term improvements as the software is developed with the hardware in mind. Firms with existing enterprise asset management systems, maintenance management systems or customer relationship management software should consider vendors who facilitate integration with their AR offering through partnerships. In industries where the spatial mapping of AR offers more utility, vendor partnerships with AR firms such as Unity and Wikitude will aid the development of these capabilities over time.

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