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PREPARING FOR THE FACTORY
OF THE FUTURE WITH
VUZIX M300
SMART GLASSES

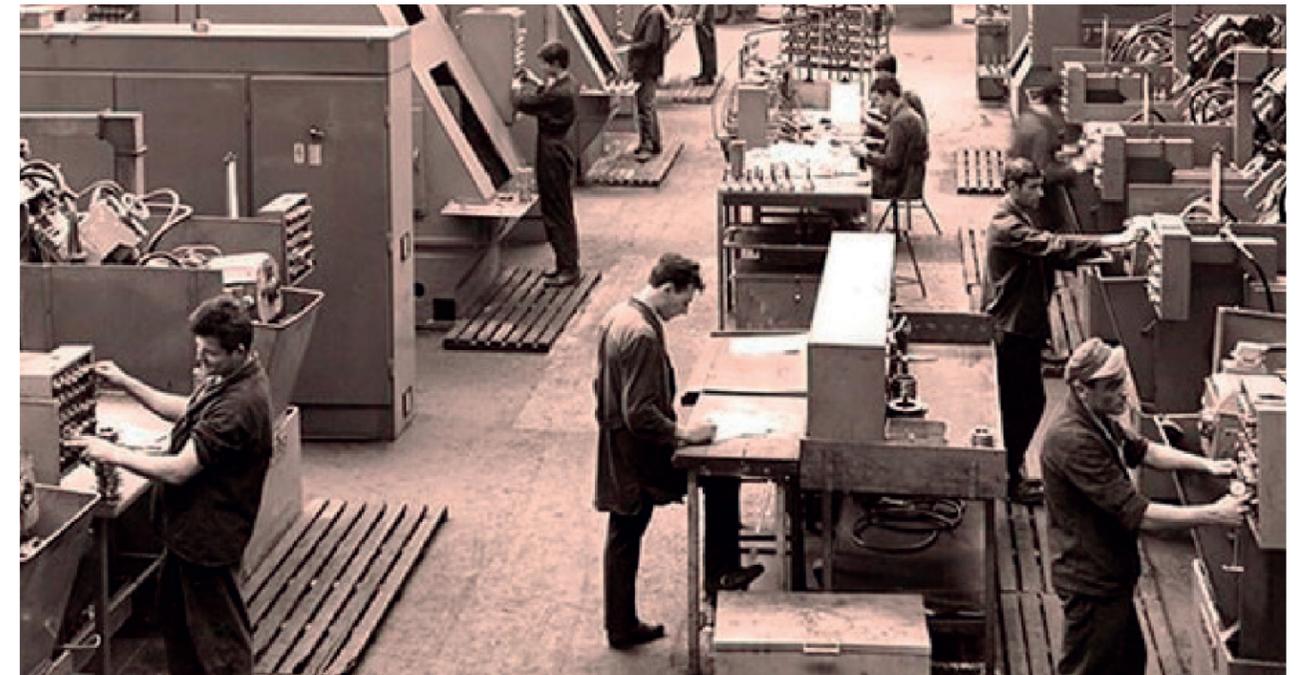
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1 Introduction: State of manufacturing

Today's manufacturers face change on multiple fronts: A technological renaissance is giving rise to the Industrial Internet of Things (IIoT) and forcing the industry to transform the look, systems and processes of the modern factory. At the same time, domestic and global pressures along with a changing workforce call for new approaches to workforce development, even a reexamination of the human worker's role in the factory. The industry's driving factors, however, are unchanging: **Since the dawn of the Industrial Revolution, manufacturers have turned to technology in pursuit of faster production, higher quality, and reduced costs.** Now, they must figure out how to turn challenges into opportunities by embracing digital disruption. They must decide where, not if, to invest in emerging technologies if they are to thrive within ever-smaller time frames, match customer expectations, and stay competitive.



GKN Car Components Factory Floor, 1950s.



At its height, the Ford "Rouge" employed more than 100,000 people. Ford cars were completely assembled from the chassis up on a moving conveyor, and then driven off the line under their own power.



Modern assembly line photo

Top challenges and factors driving technology adoption in manufacturing



GROWING SKILLS GAP

It is estimated that over the next decade **3.4 million manufacturing jobs are going to be vacated or created in the U.S. alone, yet only 1.4 million are likely to get filled due to the unavailability of skilled manpower.**¹ There are several factors contributing to this skilled labor crunch, including the baby boomers reaching retirement age, habits of millennials, advances in technology, and the stigma still carried by blue collar jobs.

As career veterans leave the factory, manufacturers are struggling to attract and retain millennials to replace them. And though millennials are now the largest talent pool, they're also a generation drawn to more corporate industries, turned off by outdated technology, and inclined to change jobs every three years.

DOMESTIC AND GLOBAL PRESSURES

It's hard to ignore the **political backlash against globalization on both sides of the Atlantic.** Despite modernization, industrial manufacturing in the Western World has been on the decline, with more and more factories moved overseas to take advantage of cheaper labor and raw materials. But changes within the geopolitical landscape could reverse that trend, exacerbating the skills gap and escalating the need to speed up new employee training. Manufacturers will have to be capable of quickly adapting to new industry regulations and trade policies affecting their distributors and suppliers.

¹ Source: The Manufacturing Institute

² Source: Forrester Research

INCREASING AUTOMATION

Robots and Artificial Intelligence (AI) are expected to displace 7% of the American workforce by 2025.² That doesn't mean, however, that the human touch will completely disappear from the plant floor. Robots are gradually taking over repetitive and dangerous tasks, but complex and expensive unmanned technology cannot match human capabilities like human dexterity and innovation everywhere in the factory.

Although the industry isn't headed towards full automation, the role of the manufacturing worker is evolving. Some jobs are becoming obsolete, and the workforce will need technological support to keep up in an increasingly automated world.

CONSTANT DEMAND FOR LEANER MANUFACTURING

The use of printed work instructions and computers stationed away from the point of action, remote experts that must travel to address problems, and training that occurs separate from production give rise to inevitable errors and inefficiencies in manufacturing operations. While mobile technologies have helped to somewhat speed up operations and improve quality, **truly lean manufacturing has not yet been achieved.**

2 Real-life pain points inside the manufacturing plant



PRODUCTION

Whether building appliances or aircraft, modern manufacturing involves humans and machines working together to assemble hundreds or thousands of parts in precise order as quickly and accurately as possible. **The hitch is that in the age of customization, assembly isn't standardized.** Several kinds or variations of a product are usually manufactured in a single facility, requiring varying instructions, workflow interruptions to check printouts or two-dimensional screens, and waiting for outside help to resolve issues.

In many facilities, workers retrieve and record data away from the line (walking back and forth) or their work instructions are hard-to-follow PDFs that soon become outdated. **Even with a hand-held mobile device, there is a lag between getting the right information and completing a task, which leads to mistakes.**

TRAINING

To learn to work on multiple lines in the plant, new hires typically undergo lengthy, classroom-style, manual-based training. **This is passive learning** – reading pages of technical information, receiving verbal instructions, watching a demo, etc. – **and not suitable for a multigenerational workforce.** Younger employees accustomed to getting information in just a few clicks are unlikely to respond to a sit-down, instructor-led training course. Alternatively, active learning (on the job) has been proven highly effective and would allow new workers to train while contributing to the plant's overall productivity.





THE ROLE OF THE INDUSTRIAL WORKER IS EVOLVING, AND THE COMBINATION OF SMART EYEWEAR AND AUGMENTED REALITY WILL BE CRITICAL TO THAT EVOLUTION.

QUALITY ASSURANCE

Repetitive motion and delays in assembly, devices not ergonomically up to the task, and unsatisfactory training methods don't just hurt productivity; they also create a **perfect storm for errors** that QA workers must catch before products leave the plant. Inspectors might memorize checklists, use written documentation or manually log findings on a computer, but these methods leave room for miscommunication and oversight. As a result, steps are mistakenly skipped and defects go uncorrected down the line. **Despite the uptake of modern mobile solutions, inspection failures still occur; impacting safety, customer service and the company's bottom line.**

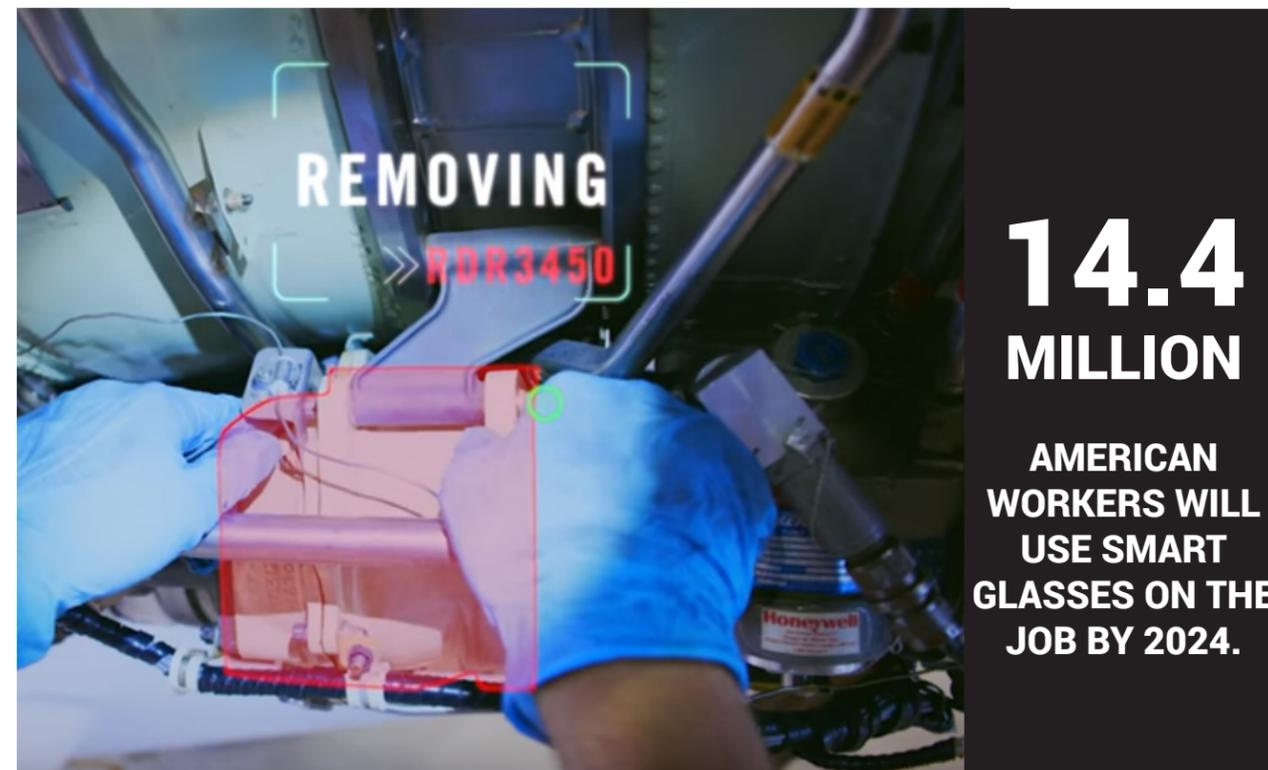
MOBILITY IN THE FACTORY TODAY

Over the last several years, manufacturers have incorporated tablets, smartphones and laptops into their operations. While these devices have delivered greater speed and accuracy, they've also shown themselves to be distracting, hand-tying, and not durable enough for some manufacturing environments.

As manufacturers put sensors on equipment and automate large areas of their operations, the last piece of the puzzle is the workforce: The role of the industrial worker is evolving, and the combination of smart glasses and Augmented Reality (AR) is going to be critical to that evolution.



3 The next generation of mobility in manufacturing: Vuzix M300 Smart Glasses on the plant floor



Smart augmented reality glasses are disrupting enterprise mobility, allowing users to work heads-up and hands-free and remain situationally aware at all times. Smart glasses are simple to operate, highly accessible tools for receiving task-based information, recording and validating data, and showing one's work to others in real time. They provide optimum mobility to the wearer and, as the user interface for AR, **deliver better real-time capabilities and information than earlier mobile devices.**

What sets smart glasses above even industrial-grade tablets – what makes them the superior tool for manufacturing workers – is their form factor. The innovation lies in **taking information off the 2D screen and out of workers' hands, and putting it in front of their eyes right where, when, and how they need it.** Multiple modes of interaction, including classic buttons, swipe pad, voice commands and gestures, allow for seamless operation of smart glasses in all kinds of work environments and scenarios.

Smart glasses enable:

- **Hands-free access to information** (an organization's systems of record, machine data, schematics and graphics, step-by-step instructions, checklists, videos, etc.)
- **Real-time, see-what-I-see communication** (for remote collaboration and support)
- **Hands-free, point-of-view documentation** (audio and visual)
- **Object and image recognition** (for barcode scanning, text and number reading, part identification, step verification, etc.)

These capabilities are essential to the advancement of the manufacturing workforce and to the growth of the manufacturing sector as a whole. Forrester Research predicts 14.4 million American workers will use smart glasses on the job by 2025.³ **In manufacturing, workers will use these tools to interact with the rest of the smart factory and assume their role in the Industrial Internet of Things.**

Vuzix M300 Smart Glasses: Connecting the worker to the smart factory



With a form factor that compliments how workers move around the factory and a user experience that enhances job performance, smart glasses promise to address many of the manufacturing industry's major pain points. When it comes to navigating the increasingly crowded enterprise hardware market, wearability is key. **In this respect, there is no more ergonomically versatile device with a better track record than Vuzix M300 Smart Glasses.**

Purpose-built and field tested for enterprise, the Vuzix M300 is the most wearable and secure pair of smart glasses on the market today. Multiple mounting options and a catalogue

of well-thought-out industrial accessories make the device universal: Left or right eye dominant? Wear safety gear on the job? Vuzix M300 frames can be adjusted for left or right eye use, mounted onto a hard hat, headband or safety eyewear, and worn with prescription lenses or no lenses at all.

Years of feedback from real Fortune 1000 companies who piloted and adopted Vuzix M100 Smart Glasses went into the M300's supremely ergonomic, rugged and flexible design. The result is a device that reliably delivers the ROI you seek, that can be used by teams of varying needs, and that can be quickly deployed in any working environment with a platform of essential applications or the help of a Vuzix VIP Partner.



FAST SPECS OF THE FEATURE-PACKED VUZIX M300:

MAIN: Intel Atom core processor Android 6.0 OS (compatible with thousands of existing Android apps) large internal storage (2GB system RAM, 64GB internal flash memory) full-color monocular display

OPTICS: nHD color display 16:9 aspect ratio FOV equivalent to a 5-in. mobile device screen seen at 17 in. >2000 nits (brightness) 24-bit color

ADVANCED CONTROLS: Voice (multilingual), customizable buttons, and touchpad with gesture controls

INTEGRATED HEAD TRACKING: Apps know the direction and angle of the user's view at all times, providing unprecedented situational awareness

SENSORS: Inward- and outward-facing proximity sensors gyroscope & accelerometer

CAMERA: HD camera records, stores and plays back still pictures and video, and can be used for text and image recognition auto-focus, image stabilization & flash

AUDIO: Ear speaker and dual noise canceling microphones

ROBUST CONNECTIVITY: Bluetooth and Wi-Fi; can pair with Android or iOS devices or connect wirelessly to the Internet

DURABILITY: Ruggedized against water, dirt and dust

BATTERY: 2-12 hours of operation depending on choice of external battery

FLEXIBLE ERGONOMICS: Supports left or right eye use multiple adjustable (industrial) mounting options

ACCESSORY LINE: Accessories like lens-less, prescription-ready and safety frames, hardhat and headband mounts, swappable on-frame batteries, and more expand functionality to suit any work environment



Applications for Vuzix M300 Smart Glasses in manufacturing

The comfort and capabilities afforded by the M300, along with the power to visualize information in augmented reality, have been applied by real manufacturers to simplify steps and provide real-time information and guidance to workers throughout the manufacturing plant, including in:

COMPLEX ASSEMBLY

Vuzix M300 Smart Glasses equipped with AR software are ideal for complex manufacturing processes that involve variation and long checklists. **On the assembly line, workers wearing M300 can use voice commands to view step-by-step instructions, diagrams and other guiding information superimposed on real-life assemblies.** Different voice commands or barcodes can bring up unique assembly instructions for custom orders.

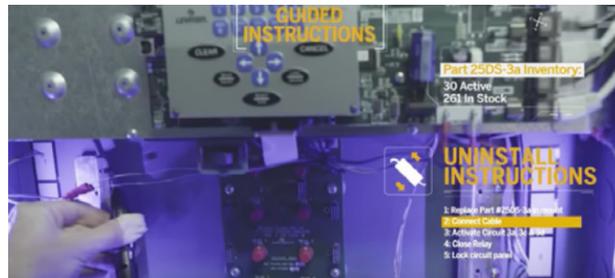
This hands-free instructional support directly in the worker's field of view (FOV) speeds up production, cuts error rates, and improves safety. Employees are able to work faster with first-time quality, shave off tens of thousands of hours a year in the assembly process, and avoid safety pitfalls like repetitive motion and error-induced accidents. Visual recognition technology provides another layer of quality control by "looking" through the M300's built-in camera to validate each step of the assembly.



MAINTENANCE AND REPAIR

Vuzix M300 improves the servicing of manufacturing equipment by providing hands-free information, facilitating live remote support, and even using simple artificial intelligence to detect issues. Engineers can view real-time machine data and 3D models, detailed instructions from a backend system, or video tutorials overlaid on top of real machines to aid in repairs. The technology is also capable of "listening" for abnormal sounds like a whirring or high pitch and automatically creating an associated maintenance order.

The M300 has been used to live stream a manufacturing technician's view of a situation to a remote expert, who looks through the tech's eyes in order to verbally guide him through the correct maintenance procedure. Reduced travel and faster issue resolution improve uptime, saving millions of dollars annually and extending the careers of the industry's most experienced workers.



AUGMENTED REALITY HAS BEEN FOUND TO BE A MORE INTUITIVE AND EFFECTIVE LEARNING METHOD COMPARED TO INSTRUCTIONAL MANUALS OF VIDEOS. IT'S ALSO PREFERRED BY MILLENNIALS.

QUALITY INSPECTION

Once a product reaches QA, workers can use Vuzix M300 Smart Glasses integrated with the manufacturer's quality management system (QMS) to pull up inspection checklists, verbally confirm actions, take audio notes, call other technicians, and instantly upload their findings.

The heads-up, hands-free form factor allows quality inspectors to move around and do hands-on testing. **Instead of filling out forms or typing up reports, they're able to objectively document issues upon discovery using the glasses' camera.** Inspection workers can use AR overlays to spot defects; or visual recognition and AI can do the detection automatically, taking human judgment out of the equation. The QMS updating in real time ensures inspectors don't repeat one another's work and defects are addressed faster.

TRAINING

Augmented reality has been found to be a more intuitive and effective learning method compared to instructional manuals or videos.⁴ It's also preferred by millennials, a generation that grew

up on video games and computers in schools. AR-enhanced training programs minimize training costs and requirements for manufacturing workers; allow fast, on-the-job training; and capitalize on experienced workers' knowledge through telepresence and first-person training material.

With AR, manufacturers are folding training right into production: New employees can be deployed immediately, wearing M300 to guide them through step-by-step instructions and fool-proof visual aids overlaid on the very parts and equipment they need to learn to assemble and operate. Veteran staff can also use the smart glasses to record videos of intricate assemblies, exception handling and other procedures, creating valuable training material that shortens the learning curve for their replacements.

Smart glasses are already in use by some of the world's largest manufacturers, including major car companies. **The automotive industry is a great case study for smart glasses: High variability on the vehicle assembly line presents a classic manufacturing challenge that cannot be solved by automation alone.** The complex exception handling processes involved in automotive assembly call for a device capable of enabling workers of all skill levels to deal with variability.

⁴ Source: Columbia University



4 Case study: Streamlining automobile inspection with Vuzix M300 Smart Glasses

Automotive plant workers operate complex, high-value assembly lines, where quick repetition and variation due to customization are the biggest threats to their productivity. Variation is also the reason that despite advances in automation, the most important factor in building and testing a quality car is still the human touch. To work at optimal speed and efficiency, auto workers need ready access to instructions, real-time communications, and the use of both hands while performing complicated custom configuration and exception tasks.



1,000+

UNITS ARE
MANUFACTURED
IN A DAY, WITH
A NEW VEHICLE
COMING DOWN
THE LINE EVERY
90 SECONDS.

QUALITY INSPECTION AT GHI

Let's consider GHI, a company based on one of the top luxury automobile manufacturers in the world. GHI sells over 20 distinct models of vehicles. In one of its U.S. plants, over 1,000 units are manufactured in a single day, with a new vehicle coming down the line every 90 seconds. Car buyers can customize GHI models to their personal needs and preferences, choosing from different body styles and paint colors, as well as different convenience, performance, entertainment and safety options. Thus, workers in the GHI plant essentially receive brand new assembly instructions and inspection checklists every 90 seconds.

CHALLENGE

Although the overall assembly process may be similar for different variations of a vehicle, the differences in parts do have a functional impact—it's important to install the right wheels

on the right vehicle, and to check that the wheels are correctly installed.

Previously, quality control workers at GHI used vehicle barcodes to pull up tailored inspection checklists on an offline PC. After testing, they recorded their results on the computer, located a short walk away from the assembly line. With the old technology, employees often missed items to be inspected or ended up working off outdated information, repeating the work of another inspector because the QMS failed to update in real time. **GHI found that introducing tablets did not prevent these issues, as the devices were easily misplaced and broken.** And while an automated solution could accurately test some elements like proper door installation, a human would still be required to test out other features.

To improve speed and efficiency in the quality control process, GHI wanted to identify new tools and technologies that would allow workers to be hands-free while doing hands-on inspection tasks, eliminate walking time, better manage the challenges posed by customization, and prevent the need for rework.



SOLUTION

Imagine if every item a worker needed to inspect on a vehicle were right in her line of sight as she tested out the different parts and features. Imagine she could fully inspect the car without missing any defects the first time and convey her findings to the appropriate departments in real time with one application on one device: The Vuzix M300.

RESULTS

Adopting Vuzix M300 Smart Glasses along with quality assurance software has enabled three game-changing capabilities for GHI inspection workers:

1. Hands-free access to the factory's quality management system
2. On-the-spot documentation and real-time reporting of defects
3. See-what-I-see communication with other employees and technicians

The PC program used by GHI workers required them to report defects using set options from a pull-down menu. As it wasn't possible to describe defects in detail, it was common for the person responsible for correcting an issue to misinterpret the inspection report. But now upon discovering a defect, an inspector wearing Vuzix M300 Smart Glasses can immediately and rather effortlessly create an audio report, as well as photograph the problem and forward the information to the appropriate personnel using simple voice commands and without leaving the vehicle—a much more precise method of documentation. In addition, he can record a video of a malfunctioning part or video call another engineer to take a look at the defect. The inspection results are instantly updated in the plant's QMS, greatly helping rework and speeding up issue resolution.



The technology has created a new and improved workflow: Employees are now able to view vehicle-specific checklists in front of their eyes during actual inspection. The convenience of having inspection plans right on the line instead of having to walk to and from a computer terminal has reduced the likelihood of forgetting an item. Workers can move freely around the vehicle, using both hands to do things like open the trunk or test the gear shift; and inspection is done faster and more thoroughly, with the M300 directing the worker to each checklist item and enabling instant confirmation of each step.

CONCLUSION

Using Vuzix M300 Smart Glasses, GHI employees are able to complete inspections two minutes faster compared to the prior PC system. That may not seem like much of a savings but when the process is performed around 100 times a day, GHI saves over 1,000 hours a year in just one factory. In addition, accuracy in inspection has increased to nearly 100%. So, should defects make it past AR-empowered workers in assembly, they are documented with ease, speed and precision in QA. **GHI believes the Vuzix M300 is a cost-effective solution that has potential to greatly simplify processes across its operations by delivering timely, heads-up information and hands-free capabilities to workers all over the factory.**





5 Learn more: The future of the M300 in the factory and beyond



While advanced sensors, data analytics, and artificial intelligence are shaping up to greatly improve manufacturing operations; additive manufacturing, advanced materials, and automation are redefining physical production and reorganizing the factory. The last piece of the puzzle is the workforce: **A factory cannot truly be smart until the human on the line is connected and to do that workers literally have to wear technology.**

As standard manufacturing tools and workflows become incompatible with the pace of the modern factory and the learning style of the next generation of plant workers, Vuzix M300 Smart Glasses are connecting human workers with smart machines, critical knowledge sources, and one another in assembly, quality control, training, procurement, and more. Beyond the manufacturing plant, the M300 is being worn to replace hand-held devices and paper documents in the field, on the building site, in the warehouse, along the supply chain, in the office, and even at hospitals.

It cannot be overstated just how revolutionary a hands-free, heads-up form factor is for industrial workers. **Within the crowded smart glasses sector, the Vuzix M300 stands out thanks to its ergonomic design, long track record, and range of capabilities made possible by key software partnerships and device accessories.** As we saw in the automotive case study, the introduction of the M300 to critical business processes can drive significant operational efficiency gains and corresponding cost savings, including shorter task completion times, accelerated employee training, reduced error and rework rates, improved safety, and minimized downtime.

Vuzix has over 20 years of experience in wearable display devices. In addition to hardware design and production, those years of experience include thousands of conversations, pilot programs, and deployments with Fortune 1000 companies. **Today, the Vuzix M300 is one of the most widely deployed devices of its kind across the globe, digitally transforming businesses in the widest variety of use cases for any single wearable device.**

To learn more about improving existing workflows and opening new opportunities for your business with Vuzix M300 Smart Glasses, visit:
www.vuzix.com



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