

CONNECTED WORKER: HOW THE MANUFACTURING SHOP FLOOR AND FIELD SERVICES ORGANIZATIONS CAN BENEFIT BY EMPOWERING THEIR WORKFORCE

Abstract

Globally, workplaces are undergoing a digital transformation that is redefining the way work is done or supported. Data has moved from an input and reporting entity to a real-time and insightful one that helps businesses take faster and more informed decisions. Improved hardware form factors, faster and wider telecommunication networks, higher bandwidth, embedded technology and advanced software and tools mean that today's workers must not only excel in their tasks, but also must become connected workers who can decipher and make use of data in a meaningful and productive manner.

Introduction - Typical shopfloor or on-site field tasks

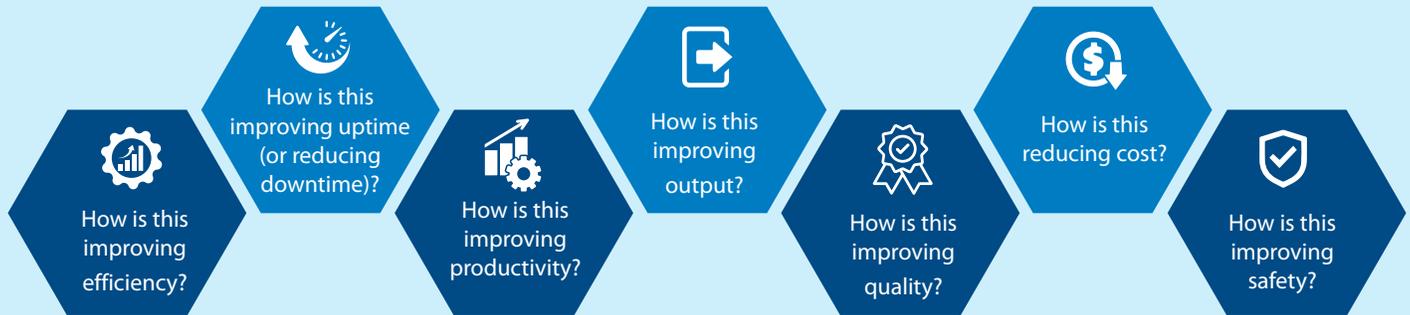
Though several functions are undertaken on the modern shopfloor or in the field, the key ones can be broadly categorized as:

- **Operation** – of tasks that lead to production or installation and quality control
- **Maintenance** – of machines and equipment that leads to longer uptimes
- **Movement** – of parts, assets, equipment, and finished goods or services that leads to just in time (JIT) operations
- **Management** – of people, machines or tools, operations, and data

These functions are carried out by employees who are trained and skilled to deliver their shopfloor or field service tasks. On a

shopfloor, as it is progressively set up and stabilized, the employees and their teams are given new goals to achieve. This also applies to field service staff, for whom installation and commissioning are a part of field service.

However, these goals will also need interventions that help the workforce achieve their goals, and any intervention must answer one or more of the following questions:



Each 'how' will have to be answered with data and substantiated with actions that generate more data to justify the intervention. It goes without saying that data on the shopfloor or in the field is as important a tool as any in the modern era.

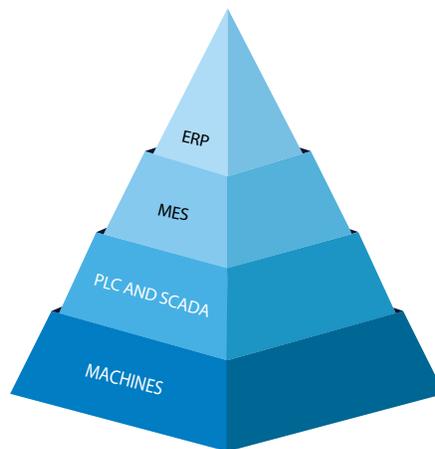
Data on the shopfloor / in the field:

With the evolution of factories and machines and tools, shopfloors and field sites have become increasingly data-centric and data-dependent. The importance of data and its impact cannot be overemphasized. So, let's break down this data.

Data on the shopfloor or field can be classified as:

- Data generated
- Data consumed
- Data reported

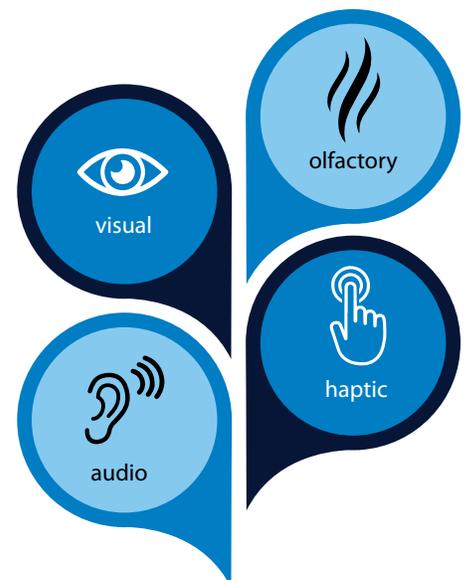
Workers are usually inundated with datasets sourced from different systems and will have to report the data in discrete systems. An enterprise resource planning (ERP) system provides planning and production data, while manufacturing execution systems (MES) breaks down that data to a daily schedule and target. The programmable logic controller (PLC) and supervisory control and data acquisition (SCADA) systems bear the integrated system data and controls, while some



machines have standalone control panels that may not be aggregated at any level and can be accessed only on the machine or line itself.

In the field, a customer relationship management (CRM) system, an inventory system, and a billing system are key to providing and completing quality service to the customer. To add to all these digital and analog sources of data, the workers on the shopfloor or in the field also use their cognitive senses to detect, process, analyze, action, and report any abnormalities they detect:

These multiple data and information layers can overwhelm workers and impact execution of their core tasks as originally defined for their role. This could make the worker inefficient which could lead to an inefficient shopfloor or field service. Organizations must protect themselves from these data pitfalls and intervene to support workers. But how can an organization do that?



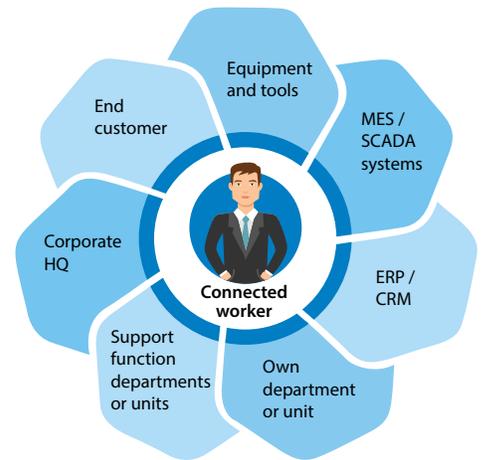
The future – Connected worker

A connected worker is a new-age worker equipped with real-time, insightful data and visualization, on the site (shopfloor or field), through devices that improve product or service quality, improve worker productivity, improve worker safety, expedite decisions, reporting, and compliance.

A connected worker helps an enterprise to generate, extract, and report data from the shopfloor or from the field in real time. The integration of the various services and data sources improves the productivity of the worker, enabling the enterprise to take decisions faster and with more accuracy. One of the key advantages of using a

connected worker is that the number of iterations or attempts required to complete a job or a task are minimized since all queries of the worker can be addressed at the site and in real time. There is no need for the worker to go back to the office or access a wired system for clarifications. The connected worker can access systems or subject matter experts (SMEs) in real time and from the site. The connected worker provides an unprecedented advantage over traditional methods simply by bringing new technology integration with current processes. Instead of moving around in search of data and information, the connected worker can extract what is needed, at site, thereby boosting productivity and efficiency.

A connected worker can be connected by data to all stakeholders in real time –



Equipping a connected worker

A shopfloor worker or a field technician must be equipped with multiple smart devices to transform into a connected worker. These devices have a hardware interface and run multiple types and versions of software. The power of the connected worker lies in the ability to stay connected. Data storage on the cloud, fog or edge computing, and 5G telecom networks play crucial roles.

Let's look at some of the key hardware, software, and technologies available to stay connected.

Hardware



Smart device – Smartphone or tablet

- Smart devices are now ubiquitous with many custom applications and even ERP modules being available on it for easy and prompt access from any location. Data can be synchronized in offline or online mode depending on user requirements and telecom network constraints.



Head- or helmet-mounted devices

- Head- or helmet-mounted devices are equipped with a camera, high-resolution screen display, and voice control features to enable hands-free operation for the connected worker. Realwear's HMT-1Z1 and Vuzix's M4000 are examples of such devices.

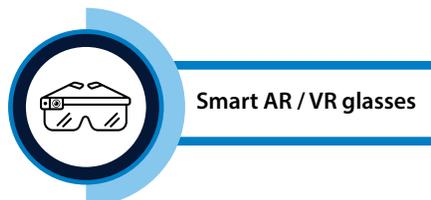


Smartwatch

- In 2019, it was estimated¹ that the socio-economic costs due to work-related injuries were around US\$ 171 billion. Monitoring a worker's location and condition

can help prevent injuries or reduce the impact. Smart watches or belts equipped with sensors, GPS, heart rate monitors, pulse monitors, oxygen level monitors, and other functions help enterprises monitor specific metrics related to worker health and safety. Bosch Anderson² successfully used the Pebble Smartwatch on its shopfloor to improve operator efficiency and productivity by being able to add 122 hours of production through reduced downtime.

- Virtual reality (VR) wearables can provide simulated training to the workers at a site and give access to manuals and technical documentation virtually. Workers at the site can also watch training videos and seek remote assistance from SMEs virtually. Verizon⁴ used AR and VR for more effective new hire training and to enhance employee education, communications, and skills with the aim of enhancing customer experience.



Smart AR / VR glasses

- Mixed reality and augmented reality (AR) can enhance insights, visual graphs, provide key alerts and data (real-time as well as historical) augmented over the shopfloor equipment or asset, and provide workers with data when and where they need it. Infosys helped a Japanese power and utilities client evaluate an augmented reality solution to identify hazardous areas and alert employees. Google Glass 2.0 and Microsoft HoloLens are examples of mixed reality and AR devices. Microsoft HoloLens³ helped Airbus reduce human error significantly and increase the quality, safety, and security of their products.

Software – Integrated and standalone

Connected workers need data and actionable insights to be available to them in real time so that workers can improve on their intervention aspects mentioned earlier. The data from various sources must be presented or aggregated for the connected worker to act upon. In some cases, this might also require standalone custom software or applications that serve the purpose of the intervention.

We list some of the integration services that are required for the connected worker to access data and insights. Infosys offers a wide range of services to integrate applications and data sources and build your connected worker solution.

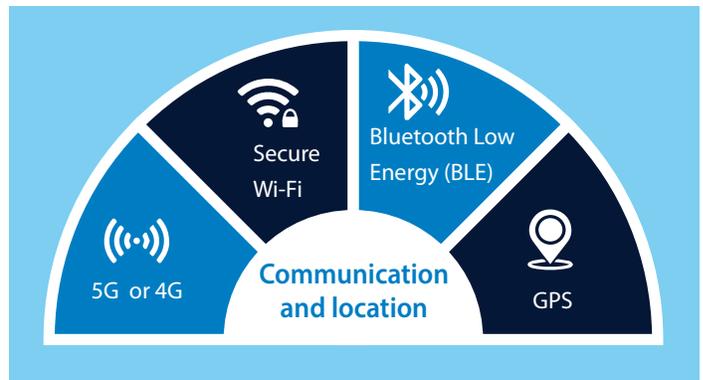
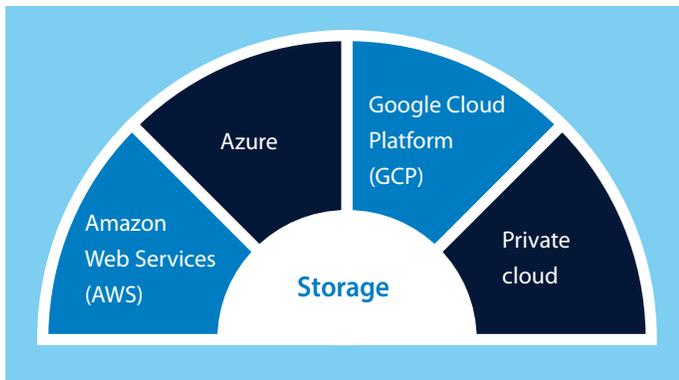
S#	Integration services	Smartphone / tablet	Head- / helmet-mounted	Smartwatch	AR / VR wearables
1	Asset/equipment health APIs	◆	◆		
2	Personnel health and location parameters dashboard	◆	◆	◆	
3	Sensor (IoT) data over AR frameworks	◆			◆
4	Task management apps	◆	◆		
5	VR-based training software	◆			◆
6	Personnel collaboration platforms	◆	◆		◆
7	ERP integration APIs	◆			
8	MES / SCADA integration APIs	◆	◆		
9	Reporting APIs	◆	◆		
10	Alerts and notifications	◆		◆	◆

Technology – A seamless experience

Technology is also a catalyst to augment the connected worker’s capabilities. Data storage, cloud platforms, telecom networks, frameworks, satellite networks will combine to offer a seamless experience for the connected worker. Infosys has

rich experience in establishing the ecosystem for your connected worker solution. The basis of Industry 4.0 was IoT, and its impact will be further accentuated with the adoption of 5G and cloud platforms. 5G will allow factories to expedite their ‘go wireless’ goals, which in turn, will allow for a lot

of shopfloor space to be paid back. This will also require a change in plant layout that will provide more space for the workforce to operate in. Cloud platforms eliminate the need for server rooms, thereby freeing space, and reducing infrastructure oversight requirements.



Use cases for a connected worker

Enterprises may face challenges that can be addressed by a connected worker. We offer some use cases where enterprises can adopt different routes to solve the challenges. More use cases can be identified and addressed based on in-depth discussions.

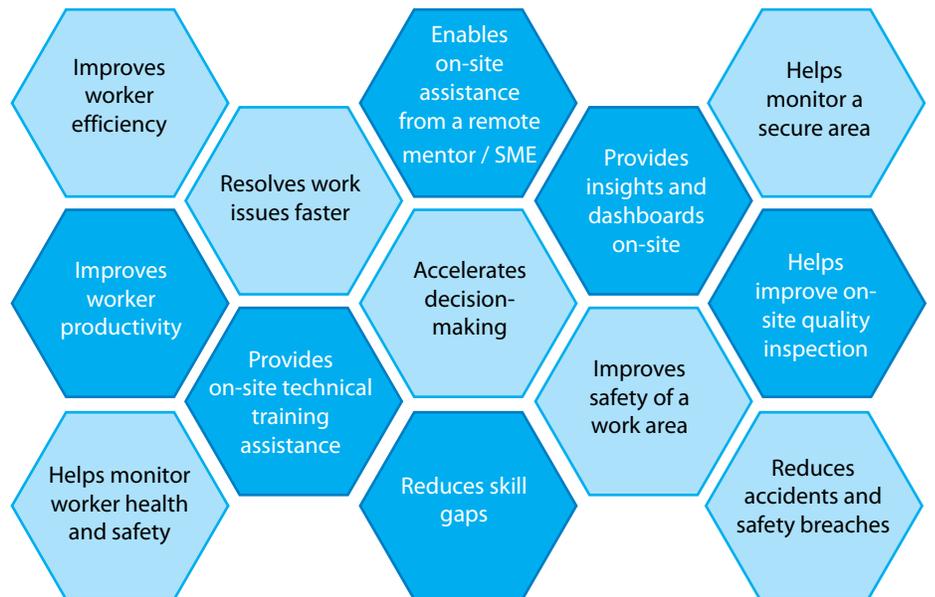
Use case	Description
Track personnel location and movement	<p>a) Vinny, a field service manager, has received a priority request to attend to a complaint about an elevator that has stopped mid-way in a high-rise building. The usual process was for Vinny to send a technician from the nearest office to address the problem.</p> <p>But with the connected worker solution, all the technicians wear smartwatches enable Vinny to monitor their current location in the field and promptly re-assign one of them to attend to the priority request.</p> <p>b) The new CNC lathe machine has developed a snag and the maintenance supervisor has sent John, who has been trained by the lathe OEM, to fix it. However, 30 minutes later, the floor supervisor reports to say that John has still not arrived.</p> <p>After implementing the connected worker solution, John wears a smartwatch with a custom location tracking app that allows the supervisor to trace his current location on the shop floor. He calls John and asks him to report to the CNC station immediately.</p>
Issue alerts when personnel enter restricted areas	<p>a) Janet oversees the task of maintaining high safety standards within the factory premises. However, there are some areas where hazardous chemical waste is stored temporarily, and workers are instructed not to enter. The area is well lit with plenty of warning signs, but she still finds workers wandering into such areas.</p> <p>With the connected worker solution, Janet has geo-fenced the hazardous area. Workers wear smartwatches that trigger an alert when they enter the restricted area. This not only acts as deterrence but also keeps a tab on frequent defaulters.</p> <p>b) George oversees the R&D center, where research is done on future products, and risks of industrial espionage are high. George wants his building maintenance contractor to fix the roof next to the R&D lab but is apprehensive about the contractor's workers straying into the restricted zone. The R&D lab is access-controlled, but George does not want to take any chances.</p> <p>With the connected worker solution, George temporarily issues smartwatches to the contract workers and geo-fences their work area. If any of the workers strays out of the fenced area, an alert is generated, and the contractor is questioned for breach investigation. If the smartwatch is abandoned or worn by another co-worker, the solution can track the anomaly and send an alert.</p>
Guide / navigate personnel to a tagged asset / equipment in large campuses	<p>a) Carl oversees the shopfloor operations at his employer's factory. To improve efficiency, Carl wants to find a way to reduce the time taken for a worker to look for and find the equipment assigned to him.</p> <p>With the connected worker solution, Carl can use a combination of RFID, BLE, and smartphone to help his connected worker to trace the equipment and get to it faster, thereby improving efficiency.</p>
On-site access to training via VR	<p>a) Janice is fresh out of college and has joined the packaging department of a local company. She assists in packaging of different items in different materials and colors, but despite being trained, she has been struggling to cope with the complexity and has been making mistakes that are affecting her team's productivity.</p> <p>With the connected worker solution, Janice can access training modules via AR / VR wearables at her workplace during her breaks. The short online training modules hosted on the cloud are available on her connected worker mobile app. The combination of wearables and her smartphone gives her an immersive training experience. This allows her to quickly get back to work, shortening her learning curve.</p> <p>b) Sunil is a field service technician at a complex healthcare OEM. His company has recently launched a next generation product and provided him with frontline service training. Due to the complexities involved in servicing the new product, the company had to fly Sunil to HQ for hands-on training and SME interactions. However, newer issues keep cropping in the field and the company is struggling to support its field service teams.</p> <p>With the connected worker solution, the company offers Sunil immersive training on the site. The helmet-mounted camera with AR / VR allows Sunil to pick specific training modules for quick on-site reference. This allows him to minimize downtime on the next-generation product that also has an indirect effect on the sales momentum of the new product.</p>

<p>Remote mentoring / advise by SME</p>	<p>a) George, a novice in the maintenance department of his factory, was on the night shift, when the main robotic arm developed a snag. George was asked to work on it since the senior-most technician had to return home due to a personal emergency. George was trained to work but was clearly lacking the experience to fix it. Being Category A equipment, its downtime was tracked by the company, and this put additional pressure on George.</p> <p>With the connected worker solution, George can use his helmet-mounted camera to troubleshoot with an off-duty senior technician over a video sharing collaboration tool. The senior colleague can use his connected worker mobile app and walk George through the critical steps, and together they can fix the issue. The time taken will be considerably lesser than what it would have taken for arranging an off-duty technician to come down to the factory at that late hour.</p>
<p>On-site access to real-time and historical machine data via AR and smartphone</p>	<p>a) Julian is the general manager at a textile plant. He starts his day on the shopfloor by visiting each line and gathering information from each of the line operators. Back in his office, he cross-verifies the floor data with the IoT dashboard. This takes up to an hour. Julian is looking at ways to make this process independent of operators so that they can focus on their tasks while he can independently make assessments.</p> <p>With the connected worker solution, Julian can use the AR function on his mobile app to see the line health and production details in augmented form without disturbing the operators. He can also view the historical data and insights on the shopfloor without having to go to his office. He can take decisions quickly on the shopfloor and free up time for the operators as well as for himself.</p>
<p>Remotely monitor personnel health (parameters)</p>	<p>a) Jose is a supervisor at a trucking company. The previous month, one of his truckers suffered a heart attack while on the road. He had to be air lifted to a hospital for treatment. Doctors said the trucker's high blood pressure went unnoticed and a timely intervention could have prevented a heart attack.</p> <p>With the connected worker solution, Jose can monitor health parameters of his truckers in real time and receive alerts whenever there is any abnormality. This could not only save truckers' lives but could also prevent accidents due to loss of control of the truck if the driver suffers a heart attack.</p>

Impact of having connected workers

As the use cases illustrate, connected workers can radically change the work area whether it is the shop floor or assembly section or the field. Data and information, at the site level and in real time will have an impact on operations. Every enterprise will have processes, tasks, scenarios, and areas where a connected worker can make a difference. Some of these may be known and some may need a business workshop to discover.

A few advantages of a connected worker can be listed as shown on right side



Conclusion

Technology is allowing enterprises to convert workers into connected workers, whether on the shopfloor or in the field. A connected worker helps an enterprise improve quality (product or service), productivity, safety, efficiency, insights, and decisions. A combination of hardware and software allows enterprises to gain better control of data and brings the worker to the center of operations. Another advantage of a connected worker is that workers get empowered when they understand their role and the value that they bring

by staying connected. It boosts worker motivation levels and improves team morale.

Multiple combinations of hardware and software to get connected allow an enterprise to adopt a phased approach toward a connected workforce. With the smartphone and smartwatch becoming ubiquitous, it becomes easier to adopt a connected ecosystem. Also, cloud, big data, and 5G will further accelerate new use cases and create differentiators. Enterprises must seize this opportunity to begin their journey of realizing a connected workforce.



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Avinash has 20+ years of experience in consulting clients across Manufacturing, Resources, Agriculture and Telecom industries on understanding and adopting new technology use cases. He consults in areas of Machine Learning, Internet of Things, AR/VR and 5G. He also has vast experience executing complex transformational projects across the globe.



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Alok has 28 + years of experience working across multiple organizations from Products to Solutions for multiple industry verticals viz. Energy, Utilities, Manufacturing, Mining to Agriculture. He has vast knowledge involves identifying market trends & requirements to convert them into solutions through innovation including creation of business cases for leadership. In his current role as Head of IoT, AI & New Tech for Manufacturing, Resources and HiTech, he partners with customers in their Digital Transformation Journey leveraging multiple technologies from IoT, AI, AR/VR etc. to create innovative solutions which deliver value across their business value chain.

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