

# Connected Worker

Empowering Manufacturing's  
Frontline Workforce



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## INTRODUCTION

Over the last decade, the way we relate to our world has changed. Ubiquitous internet and smart devices have ensured that we're connected all the time.

The change was almost imperceptible at first. But surely enough, in 2020 there are few aspects of our lives that aren't connected. We order food with our smartphones, catch up with our friends and family on social media, and download apps for almost everything.

Until recently, however, this was not the case in manufacturing.

Workers could use a satellite connected GPS or a map app to navigate to work. But when they got to the plant, they'd collect data on a whiteboard. Or go about complex assemblies with paper work instructions.

This guide will serve as an introduction to the connected worker. We'll cover:

- Basic facts about the connected worker in manufacturing
- Types of connected worker
- Benefits of connected worker technologies
- Use cases
- Case studies
- How to pick a connected worker solution that works for you

By the end, you'll understand exactly how the connected worker can transform your operations. And you'll have the tools to pick a solution that will work for your operations.

## CHAPTER 1

# What is the Connected Worker?



# CONNECTED WORKERS

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Integrated into their  
environment through  
connective technologies

The connected worker is any worker integrated into their environment by connective technologies.

Here's what that means for manufacturing.

Most professions have a suite of software tools that help them do their work better. Connected worker technologies, however, go further than software. Connective technologies actively exchange data with other devices and machines in a work system. With both hardware and software components, connective technologies contextualize a manufacturing worker's action within a broader system in real time. This means that workers are embedded within instrumented, responsive systems.

The supportive role that connected worker technologies play means that workers can do more. This is why the phrase “connected worker: is often used interchangeably with [“augmented worker.”](#)

The result is better decisions, right-the-first-time outcomes, and safer workers. Not to mention better data at the end.



## Connected Worker in Manufacturing

While most industries have a version of the connected worker, it's especially important in manufacturing. Manufacturing work is challenging, and it's changing quickly. Connected worker technologies ensure that workers can rise to the complexities of their tasks. In this section we'll break down how a volatile, digitizing manufacturing industry has led to the connected worker.

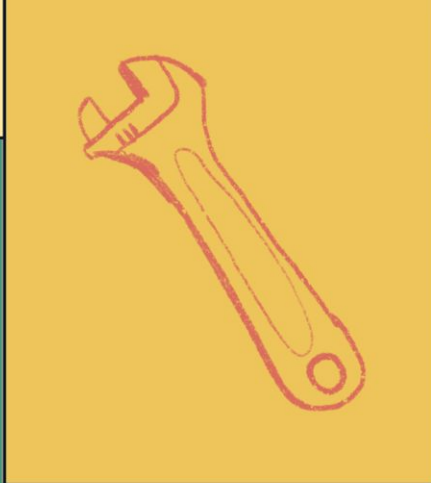
### **Types of Connected Worker**

When you think of a connected worker in manufacturing, what comes to mind? Is it an operator? A field technician? If you're like most, you probably thought of some kind of front line worker.

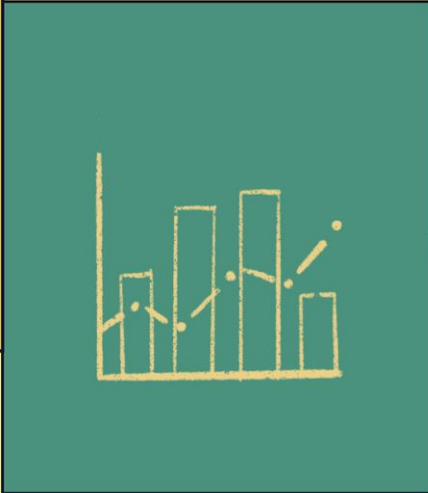
Connected worker technologies can benefit the whole team, though. From shop floor to c-suite, connected worker technologies empower the whole organization.



Connected operators are supported by working systems that respond to their actions in real-time



Digital technologies help connect field workers to information and support they need



Connected engineers have visibility into essential production KPIs in real time. Agile, application-based platforms make it possible to act on them.



The name of the game here is visibility. Executives might not be on the shop floor every day but they are able to use that data to drive strategy and make more informed decisions.

## Types of Connected Workers

- **Operators:** Connected operators are supported by working systems that respond to their actions in real-time.

This kind of support comes in many forms. It could be digital work instructions. Or inline quality assurance and quality control with IoT. It could come in the form of dashboards that show operators where WiP is in a multi-station process. Or it could be communication tools that let a machinist send a notification when something goes wrong. It's also automated error proofing, and computer vision systems that respond to an operator's actions intuitively. The options are endless.

How you connect your operators will depend on the needs of your operation.

- **Field Workers:** Field technicians have a unique set of needs. Their work can be immensely complicated. It's performed under difficult conditions.

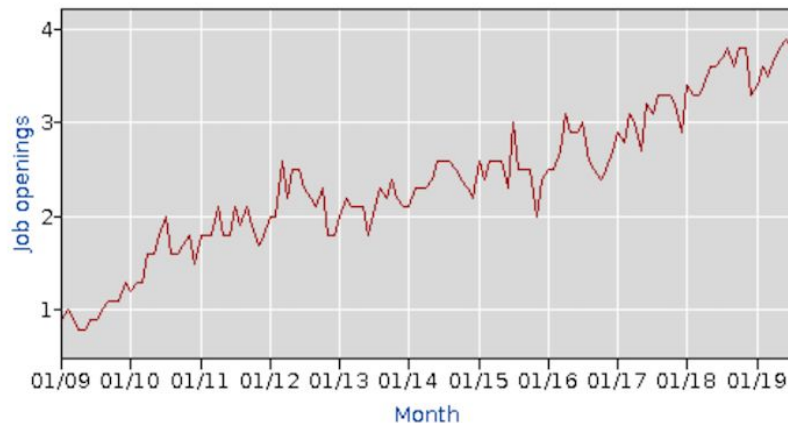
Digital technologies help connect field workers to information and support they need. Whether it's schematics accessible on a mobile phone or a line out to a centralized help center, field workers shouldn't have to feel stranded.

- **Engineers:** Modern manufacturing systems can be extremely flexible. As a result, it's crucial that engineers are able to make changes to software, hardware, and workcell arrangement as necessary. Connected engineers have visibility into essential production KPIs in real time. Agile, application-based platforms make it possible to act on them.

- **Executives:** The name of the game here is visibility. Connected processes generate data. Executives might not be on the shop floor every day embedded in processes themselves. But they are able to use that data to drive strategy and make more informed decisions.

## Closing the Skills Gap

There's a bigger reason manufacturing needs the connected worker. More than ever, manufacturers are struggling to fill open positions.



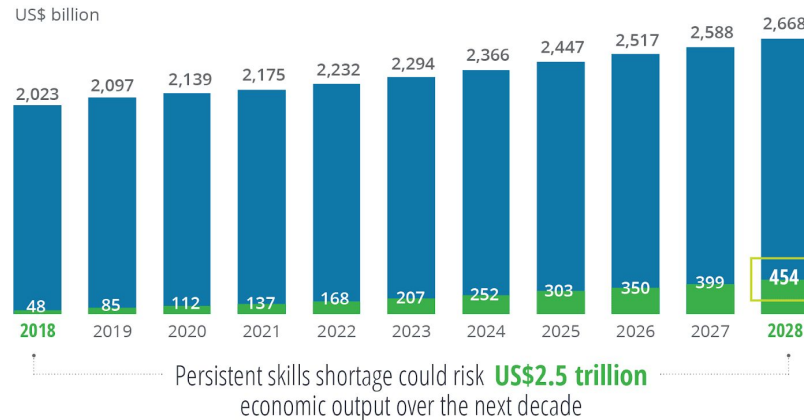
This is partially a result of a skills gap, or a lack of alignment between the skills necessary to do a job and the skills in the workforce.

Connective technologies can help close the [skills gap](#). Connective technologies give workers the information they need, when they need it. They prevent them from making the most common types of human error.

As a result, connected workers are able to do more advanced tasks sooner. This means less time spent training, and better results across the board.

### Skills shortage could put US\$454 billion of manufacturing GDP at risk in 2028 alone

■ US manufacturing output/GDP ■ Manufacturing output/GDP at risk due to skills shortage



Note: 2017 base year.

Source: Data from BLS and Oxford Economics Model, Deloitte and Manufacturing Institute skills research initiative.

Deloitte Insights | [deloitte.com/insights](https://deloitte.com/insights)

## Changing Nature of Work

The last reason manufacturing needs the connected worker is this: Manufacturing work is changing fast.

Digital technologies have changed the game. Workers at every level now need a greater facility with digital technology, data analytics, and systems thinking to succeed.

Yet these are skill sets that can take a career to master. Connected technologies make it possible for manufacturing workers to adapt to the new reality of manufacturing work. They empower them to make data driven decisions, improve processes at the system level, and digitally network their operations without extensive specialized training.



## CHAPTER 2

# Benefits of Connected Workers



### Robust Error Proofing

Humans make mistakes. No technology can change human nature. They can, however, respond to human action in real time, preventing workers from making unintentional errors.

### Improved Visibility Into Frontline Work

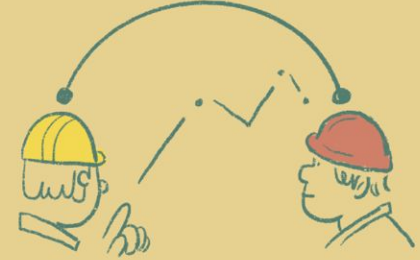
Most manufacturers have cycle time data. But what happens between the start and end of a process can be a mystery. Connective technologies provide granular data and full visibility into frontline work.

### More efficient, collaborative manufacturing systems

Connected workers work more efficiently and collaboratively, leading to systems that produce more with less waste overall.

### End-to-end process datasystems

Workers are often a blindspot in industrial systems. Connected workers generate data as they work. This translates into full process visibility--from raw materials to finished product.



# Benefits of Connected Workers

There are many benefits to connected workers. Here's a quick list of some of the most important.

- **Safer workers** – Connected workers are less likely to make mistakes, and connective technologies can help identify unsafe conditions.
- **Better in-the-moment decisions** – Good decisions are the product of good information. Connected technologies make sure workers have all of the information they need.
- **Improved visibility into frontline work** – Most manufacturers have cycle time data. But what happens between the start and end of a process can be a mystery. Connective technologies provide granular data and full visibility into frontline work.

- **Mission-critical information and standardized work at your fingertips:** By connecting to central knowledge bases and support staff, connected worker technologies put all the necessary information at a worker's fingertips.
- **Real-time communication:** Minutes matter. Connected workers can notify a supervisor or call for support within critical windows.
- **Robust error-proofing:** Humans make mistakes. No technology can change human nature. They can, however, respond to human action in real time, preventing workers from making unintentional errors.
- **More efficient, collaborative manufacturing systems:** Connected workers work more efficiently and collaboratively, leading to systems that produce more with less waste overall.

- **End-to-end process data:** Workers are often a blindspot in industrial systems. Connected workers generate data as they work. This translates into full process visibility—from raw materials to finished product.
- **Simplified Asset Management:** Connective technologies help you visualize your whole fleet and deploy resources where necessary.
- **Aging Workforce Support:** Maximize the tacit knowledge experience workers bring supporting them through digitization.
- **Attracting a younger workforce:** Millennials and Gen Z expect connected workplaces. Connected worker technologies can help bring fresh perspectives into manufacturing.

## CHAPTER 3

# Connected Worker Technologies

# Connected Worker Technologies



## Platforms

Helps engineers design applications for their unique challenges. Makes it possible to control manufacturing processes by creating new connections between devices, machines, and applications

## Interfaces

Enables workers to share information and interact with their surroundings in more immersive ways

## Smart Sensors & IoT Devices

Able to communicate data in real time and provides a more holistic overview of industrial processes, including workers.

## Cloud & Edge Computing

Able to communicate data in real time and provides a more holistic overview of industrial processes, including workers.

The connected worker is possible because several technologies have matured at the same pace. Let's break down exactly which advances make the connected worker possible.

## Platforms

IIoT platforms are systems that connect shop floor processes with back end systems. As such, they're important tools for connecting workers.

Platforms help engineers design applications for their unique challenges. They make it possible to control manufacturing processes by creating new connections between devices, machines, and applications. As a result, platforms are a crucial tool for connecting workers to their processes.



# Interfaces

Interfaces in manufacturing today aren't limited to traditional on-machine human-machine interfaces.

In many plants, there are tablets at assembly benches, and mobile devices in the pockets of workers. Further, some modern HMIs are now capable of running complex manufacturing applications. If we take interfaces at its definition—a point where two systems meet—tools like IoT sensors and computer vision are also interfaces for interacting with manufacturing systems.

These interfaces enable workers to share information and interact with their surroundings in more immersive ways.

## Smart Sensors and IoT Devices

Industrial sensors are more and more able to communicate data in real time. These sensors provide a more holistic overview of industrial processes, including workers.

Together, these sensors are an important part of modern IIoT infrastructure.

## Cloud and Edge Computing

Behind the connected worker are two technologies that facilitate connection in the first place. Cloud computing makes it easier than ever to process heavier computational workloads. And edge computing reduces latency and improves network performance by moving tasks to network endpoints.

## Wearables

With Industry 4.0, sensors have gotten smaller and more flexible. Now, many sensors fit directly onto the bodies of workers. This means that workers can attach sensors—sometimes they're even embedded in personal protective equipment (PPE)—that collect environmental and biometric data about worker health and performance unobtrusively.

## Mobile Devices

Just as we run consumer applications on our phones, it's increasingly possible to access industrial applications from a smartphone.

Wherever a worker goes, the information they need goes with them. Whether it's standard work, machine status, or digital work instructions, mobile phones are emerging as a manufacturing technology.

## CHAPTER 4

# Connected Worker Use Cases in Manufacturing

## Process Visibility



Gives management a clear picture of individual performance and creates a full, end-to-end picture of manufacturing processes

## Distributed Workforce



Connective technologies make it easier to manage a distributed workforce and standardize performance across plants and lines

## Machine Monitoring



Connects engineers to their entire fleet with real-time OEE and machine state dashboards and machine terminals allows operators to log issues

# Connected Worker Use Cases in Manufacturing

## **Process Visibility**

Process visibility applications give management a clear picture of individual performance. This creates a full, end-to-end picture of manufacturing processes.

## **Machine Maintenance**

When OEMs send technicians to work on machines, they should have access to information for every contingency.

## **Distributed Workforce**

Standardizing performance across plants and lines is always a challenge. Connective technologies make it easier to manage a distributed workforce.

## **Inline Quality**

Connected workers have the tools they need to make sure every part that leaves the line meets quality standards.

## **Dynamic SOPs**

Work instructions should respond to worker actions and needs in real time. Connected SOPs help workers access the information they need, report defects in line, and capture critical process data.

## **Machine Monitoring and On-Machine Terminals**

Machine monitoring connects engineers to their entire fleet with real-time OEE and machine state dashboards. On machine terminals let operators log critical job and machine information as issues arise.

## CHAPTER 5

# Case Studies: Connect to Empower



The best way to see the impact connected workers make is to look at how real manufacturers are connecting their workforce.

## Connecting Workers for Process Visibility at Nautique

Nautique is a leading high-end boat manufacturer based in Orlando, Florida. Each of their boats passes through a 36 station single piece flow assembly. High-mix and product customization complicate assemblies. Together, nearly 400 workers produce over a dozen boats a day.

Nautique faced a classic workforce challenge. While engineers performed time studies and took data on the shop floor, it wasn't enough to drive continuous improvement. There were too many parts and operators involved to track reliably with manual data collection. As Process Engineer Drew Pope noted, "The manual collection of information really wasn't providing enough data for us to make data-driven decisions."

Nautique used Tulip to build process visibility applications and connect their workforce. These apps track operator activities as they unfold in real time. Nautiques engineers are able to use the data taken by these connected worker applications to measure aggregate and individual performance in real-time.

By connecting their workforce, Nautique was able to better understand their production processes and make targeted improvements.

The results from connecting their workers speak for themselves. Nautique achieved:

- 30% reduction in cycle time
- 7% increase in production
- And \$500,000 in annual savings

The takeaway here is that connected worker technologies give management and engineers the information they need to pursue the most meaningful improvements.

## Connecting Distributed Workforce at Staymobile

Staymobile is an INC 500 provider of computer, chromebook, and mobile device repair and service solutions. Staymobile's core customers are school districts, government agencies, and enterprises located across the United States.

Because of their dispersed customer base, Staymobile has many locations across the country. This led to an equally distributed workforce. Their aggressive goals for growth and quality required that they standardize procedures across all locations.

Yet Staymobile struggled to standardize work across locations. Paper-based work instructions were difficult to follow, and made it difficult for engineers to verify technician compliance. Often, multiple versions of the same work instruction were in use at different locations, leading to inconsistently executed procedures and avoidable mistakes. Paper made it impossible to collect the data they needed to optimize repair procedures. Staymobile needed a solution that would enable them to automate and centralize data collection, configure location-specific processes, and standardize procedures.

Staymobile decided that the solution was to connect their workforce with standardized work instruction applications. With Tulip, Staymobile technicians have instant access to the latest version of SOPs for each device and repair type. Now, all of their technicians have instant access to standard work and searchable device manuals.

Each application automatically collects data for every repair, making it possible for Staymobile's engineers and operations managers to constantly revise and improve procedures.

"These are KPIs that have been historically immeasurable in my career," EVP of Staymobile Rob Lennox said, "If I didn't have a resource sitting on the line with a stopwatch, I couldn't collect that granular level of data."

"With Tulip, we can enable the workstation's capabilities to change by deploying new functionality to change systemically," Lennox continued, "We can do it almost overnight. And we can do this to meet changing customer demand."

By connecting their workforce with standard work, Staymobile surpassed industry benchmarks for quality. Within months, their first-time-fix-rate (the amount of serviced and repaired items that require no repeat work) fell below 2%.

## Connecting Workers to Balance Lines at DMG MORI

DMG MORI is a leading international manufacturer of machines and machine tools. Their turning and milling machines set industry standards for innovation.

DMG MORI produces many of the spindles for their machines in-house. Each spindle is the result of a high-mix assembly, produced through a single piece flow requiring over a dozen stations.

Traditionally, DMG MORI engineers took data taken by hand on paper forms. This slowed the analysis of errors and made it difficult to track WiP across the spindle line.

DMG MORI used Tulip to take a connected worker approach to improve visibility and increase efficiency on the spindle line.

Using Tulip work instruction and process visibility applications, DMG MORI connected their workers to the tasks they were performing. All operators had instant access to rich-media standard work within the applications, reducing errors and speeding assemblies. Further, the step and cycle time data collected by the applications allowed DMG MORI to track WiP in real time. To improve line performance, they chose to display production targets and hourly rates on dashboards. This let the whole factory see exactly where each spindle was in the flow, and enabled the engineers to balance lines to make sure they met every target.

In less than 2 months, DMG MORI's connected worker strategy saw impressive results. They include:

- 62% reduction in reported defects
- 20% increase in production
- 10% reduction in failures
- 4 weeks time to value

## CHAPTER 6

# How to Pick a Connected Worker Solution



# How to Pick a Connected Worker Solution



There are a wide variety of connected worker solutions currently on the market.

Determining which is right for you can be challenging. In the previous section, we looked at some of the ways Tulip customers are connecting their workforce. While Tulip works for most manufacturers, it's not necessarily the right tool for everyone.

In this section we'll help make the vetting process a little easier by sharing 7 questions to help you narrow your search.

# 1. Who are you connecting?

This may seem simple, but it's so important. Who, precisely, do you want to connect? Your answers will lead you down different paths. Are you looking to connect operators on complex assemblies? Field workers who need support from remote sites? Are you an OEM who needs to equip your technicians with maintenance info? Engineers charged with improving industrial processes? Management who need better data to make more informed business decisions? All of the above? None of the above?

Better yet, can you think of a specific individual in your operation who could benefit from connection?

Identifying who you're connecting sets a foundation for the solution review process. It helps you access needs, desired outcomes, and potential roadblocks early.

Your answer will obviously depend on your operations. But the better you can answer “who?” the easier time you’ll have identifying “what next?”

## 2. What are they doing?

Another seemingly trivial question that’s anything but. You can think of it as an extension of the previous question.

What, exactly are your workers doing? What will connectivity enable them to do better? Here it helps to go beyond the generalities of “assembly” or “machine maintenance” and consider what happens during an assembly or repair. Will they need their hands for their work (useful for ruling out solutions that require constantly interacting with a screen)? What tools are necessary? What materials need to be at every station? What would prevent them from doing that work?

If you can provide a granular inventory of every human process and its constituent tasks, the easier it will.

### 3. What information do they need to do their job?

This requires taking stock of processes and outcomes. It can also be asked in the negative to equal effect: What information, if lacking, will prevent a worker from doing their job?

Do operators need ready-to-hand access to manuals and schematics? Would it help them to see videos of particularly tricky procedures? Or are you looking to connect engineers with higher-level process data to empower their initiatives?

Identifying the information workers need can help you pick the right platform for providing it.

## 4. What systems do they interact with? What systems are they embedded in?

This question can help you see the ways that workers are part of larger processes. It's useful for thinking about the extent to which workers need to be connected to be effective. What software do they interact with? What sensors and IoT devices are involved? Which machines are involved? Where are there contingencies in the processes?

Connected workers are always a part of manufacturing systems. Clarifying the role they play can simplify which new technologies you introduce.

## 5. How do their actions influence the work that gets done?

This cuts to the heart of worker contributions to manufacturing processes.

(And this still comes back to the fundamental question, “Who?”).

What is the result of human action on your manufacturing lines? Machine changeovers? Assembled products? Quality assurance? I could keep going but you get the idea.

If you can identify the contributions of humans, you can pick a connected worker solution that optimizes human performance.

## 6. How prone are they to error? What kinds of errors?

Human error isn't reducible to human performance. It's a consequence of poor system design.

So it helps to ask, "Where are workers making mistakes?" What kinds of mistakes are they making? What's the root cause?

A little goes a long way in identifying places where you protect your workers against the most common forms of human error.

## 7. What data will make a difference for you?

Remember that connected worker solutions aren't just about making humans more efficient. They're also important for creating a record of human action.

For this reason, you should ask which data will make a difference in your operations. What do you want to know? What do you currently know? What data is difficult to take with your current technology?

Data is power, and connected worker solutions are a crucial tool for collecting the data that matters most to you.



## CONCLUSION

**T**hroughout this guide, we've introduced you to many of the ways that connected workers are transforming manufacturing.

What I hope is clear by this point is that the connected worker isn't a future state aspiration. It's a concept that forward looking manufacturers are using to create value on their shop floor.

The trick is to identify a clear use-case that offers a strong return on low initial investment.

If you're interested in how the connected worker can transform your operations, [get in touch](#).

**Tulip**, the Manufacturing App Platform, is empowering the world's leading manufacturers to improve the productivity of their teams, the quality of their output, and the efficiency of their operations. With Tulip's no-code platform, manufacturers can empower those closest to operations to digitally transform their shop floors and gain real-time visibility into the people, machines and processes involved in production--all in a matter of days.

Learn more and try Tulip risk-free for 30 days at [tulip.co](https://tulip.co).

