

## HOW 5G AND COMPUTE EDGE WILL TRANSFORM FRONTLINE WORKERS' JOB INSTRUCTION WORKFLOW

A frontline worker at a large semiconductor manufacturer has just been warned of a pressure profile trending in the wrong direction which threatens a managed chemical process and could damage product. She has been trained on what to do but she is working in a new area of the plant and needs a refresher. So she heads off to find the paper binder outlining the Out-of-Control Action Plan (OCAP). She has little time to retrieve the information, map it to what's happening on the line, and take the appropriate corrective actions before material will be damaged.

In many continuous production processes, such as semiconductor manufacturing, frontline workers need to implement OCAPs. These events are not necessarily always as dire as their acronym suggests, but they do require immediate action and can occur regularly. And these events are not limited to manufacturing industries; similar events can occur in energy, utilities, defense, and transportation industries as well. Traditional response procedures today, even at some of the most advanced facilities, direct workers to find the paper binder that outlines the mitigation steps and the appropriate responsive actions. This approach is fraught with issues ranging from the challenges of keeping reference and instructional information



updated to the limitations of incorporating sensor data for accelerating diagnostics. And when in a remote location, workers do not always have immediate access to this information.

## THE FUTURE OF WORK IS NOW

It should be no surprise that digital transformation is providing new tools to address such scenarios. Simply digitizing information and storing it in the cloud (Azure or other) or making it available on a tablet are big steps in the right direction – provided connections and access to this information is assured and fast enough. Companies such as Taqtile, with their spatial computing solution, are addressing these issues on the next level. Taqtile's Manifest solution makes job instruction information, used for task guidance and training, maintenance, and diagnostics, accessible from a head-mounted spatial computer, such as HoloLens 2 or Magic Leap One, as well as from tablets and mobile phones. Information that can be accessed from this platform is more than a digital manual as it can be enhanced by

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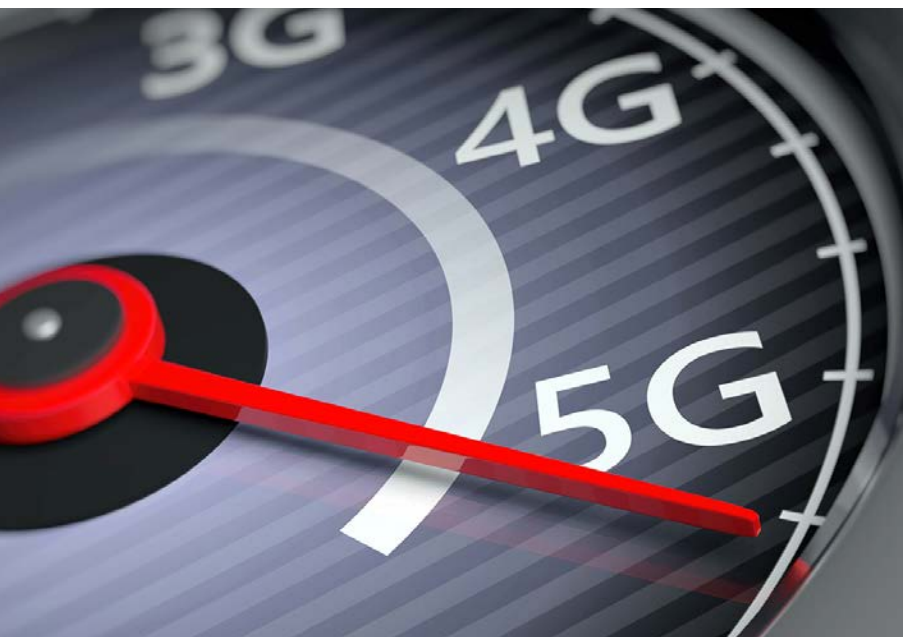
incorporating audio, video, spatial indicators, and animated 3D models as well as overlaid real-time, IoT, sensor data and alerts. Adding real-time communication and collaboration to the solution with their newly released, Manifest Connect, equips, and empowers frontline workers to perform the most complex tasks quickly, consistently, and safely.

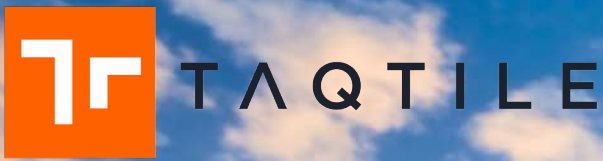
However, quick, reliable access to this data - often from remote locations - is absolutely required for the adoption and use of such tools - without it, workers will grow impatient and frustrated. This is why 5G, the latest generation of wireless telecommunications connectivity, is quickly emerging as a critical technology to enhance such solutions. The promise of 5G, which is being rapidly deployed this year in US, Canada, and South Korea, offers many benefits to users of Taqtile's Manifest and similar solutions.

### 5G CONNECTIVITY BENEFITS

First and foremost, 5G network architecture is expected to be fundamentally different from previous generations. These networks will be more software-defined, virtualized and in many cases cloud-native and integrated with public cloud resources. Intelligence, data analysis, and cloud computing resources will move closer to the endpoints. One need only look at the large cloud players to see evidence of this change. Amazon's Wavelength product extends AWS compute and storage to 5G networks. Microsoft's recent acquisition of Affirmed Networks provides the infrastructure to mobile operators to build 5G cloud-native networks at dramatically reduced costs. The disruption from Reliance JIO's and Rakuten Mobile's introduction of cloud-native architectures for their mobile networks is further evidence that 5G networks will offer new technical capabilities as well as new business models.

Indeed, business model changes with 5G connectivity could be quite significant to manufacturing, distribution and other enterprise vertical markets. Today, traditional pricing per endpoint can be prohibitive for deploying wireless connectivity to tens of thousands of devices. "At \$10 per device per month, outfitting an oil field in Texas with wireless sensors on pipelines and machinery doesn't make sense", says Jim Brisimitzis, Managing Partner of the 5G Open Innovation Lab "Especially when those sensors may only cost \$10." But with a cloud approach, and charging per consumption, paying for sensor





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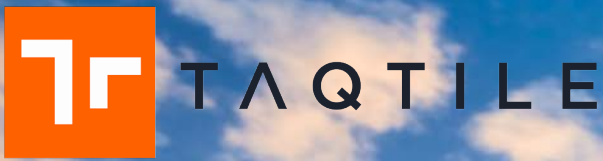
data egress only, could be game changing. Now a frontline worker, responsible for the maintenance of this oil field and equipped with Taqtile's Manifest platform will have access to much more real-time data to locate and react faster to any problem or potential problem areas.

The new 5G network architecture will also make cloud storage and compute capabilities and services such as speech dictation, remote rendering and communication available at the edges of the network – closer to the machines that are supplying or using these capabilities. Companies like Vapor.io and others are co-locating and orchestrating essentially mini-data centers near radio towers to make resources much closer to the devices that require connectivity. This will enable new devices and applications such as autonomous vehicles and city-scale IoT deployments. It will also allow AI applications to communicate with machines with lower latency for real-time monitoring and control. We can expect new capabilities using the power of deep learning neural networks in the cloud that will assist frontline workers in making smarter and faster decisions while also keeping people and equipment safer. And Taqtile's Manifest will provide the heads-up display capability to leverage these capabilities to react from anywhere in their manufacturing environment to anticipate machine maintenance or address diagnostic scenarios.

### 5G + CLOUD + AUGMENTED REALITY

5G technology and its utilization of cloud-based edge computing capabilities is expected to lower latency of wireless connections to as little as <10MS, a delay that is virtually undetectable by humans. This will enable scenarios such as those described above where real-time sensor data can be incorporated with instructive, diagnostic information within a headset display to allow faster decision making and hands-free task completion. It will also enable new ways to collaborate. Consider the gains in productivity when a less experienced worker can share live video from her headset to that of a more experienced colleague for feedback and recommendations that might be delivered by video as well. Lower latency also means that sensor data can be delivered in a more timely fashion at the point of work when can be crucial in scenarios where workers or machines need to react immediately and every second counts. Or the decrease in latency could simply mean faster access to maintenance instructions at a speed that matches that of flipping through a physical manual.





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Once the connection is made, 5G promises to provide higher wireless bandwidth than ever before. Many early deployments are clocking 10x faster speeds with multi-Gbps peak rates. This is just the type of throughput that would insure a seamless and undisrupted user experience for a frontline worker streaming audio and video enhanced reference content to their headset display or accessing an animated 3D machine model for maintenance work. Having access to a machine model that could be exploded and explored, from a headset display while the frontline worker is located at the machine, is something that has not been possible with previous generations of wireless connectivity technology. Another scenario that will be enabled by this increased throughput is simulations with true digital twins. With increased sensor data flowing over 5G networks into platforms like Manifest, engineers, designers or equipment manufacturers will have a true real-time representation of their physical equipment to aid in design and process improvements, resource optimization, preventative maintenance and. The decreases in down-time and increases in productivity will be significant.

5G Networks are generally expected to be more secure than their predecessors. More user authentication, more data encryption are good examples of the increased security capabilities inherent in these networks. On-premise, private cloud deployments with 5G connections to public clouds will increase security as well. IP and sensitive data will stay onsite within a company's secure infrastructure but benefits of cloud computing such as deployment and scalability will be realized. And more compute intensive services which are typically found in public clouds such as speech to text or remote rendering can still be utilized with the increased bandwidth and reliability of the 5G connections. Finally, 5G promises increased capacity and reliability so that more devices will benefit from connectivity. 5G's spectrum band approach will segment the capacity and connections – lower band spectrum will be adequate for IoT sensors, while devices such as a headset streaming two-way video and holograms, which will require a lot more bandwidth, will benefit from a dedicated higher band spectrum. But all devices will harmoniously live on the same network and connectivity will be faster and more reliable. This increased capacity enabled by 5G is what will allow companies to fully exploit and scale solutions such as Taqtile's Manifest.

## SMART WORKPLACE FLEXIBILITY

With faster, more reliable 5G connectivity and more throughput, many companies will be incented to replace more costly wired networks or less reliable Wi-Fi networks. They will be able to send more data from more machines, devices and sensors to the cloud. In fact, the huge number of 5G connected sensors will enable what many are expecting in terms of a seismic shift in manufacturing and calling Industry 4.0. The modern, smart factory and smart plant will be much more modular. Manufacturing lines will be built up, repurposed, and modified much more frequently and faster based on real-time, inventory levels or dynamic signals of demand. The improved flexibility in production, machine availability, and over all machine effectiveness and utilization will lead to big increases in productivity not possible prior to 5G.

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However, complexity will be introduced with this flexibility. More machines sending data, more configurations of manufacturing lines, more wireless sensor data coming from all new and different places in the manufacturing lines will provide data not only related to the manufacturing process or products but also about the machinery and equipment conditions and quality. Manufacturing environments could look and act differently from week to week, if not day to day. Frontline workers will need to be armed with new tools.

So as 5G enables these new capabilities within and across many industries, including manufacturing, energy and utilities, defense and transportation environments, it will also enable new tools such as Taqtile's Manifest solution. Frontline workers will be empowered with access to all this new data from all these sensors from remote locations in new ways such as through light-weight headset displays. The next generation of data-assisted, frontline workers will be able to visualize machine maintenance instructions on the fly or adjust the production of a machine from anywhere on a factory floor. Workers will be empowered, and **everyone will be an expert!**

