

# Digital Augmentation of DoD Operations

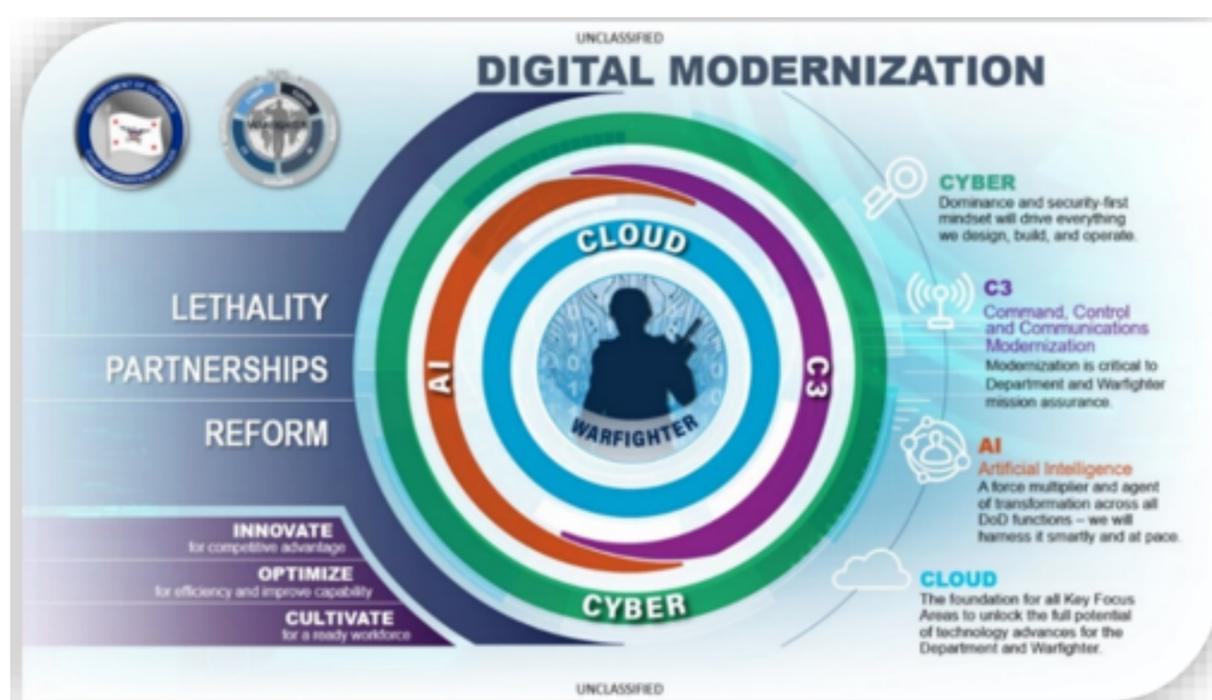
For a more lethal joint force on the base and in the field.

## EXECUTIVE SUMMARY

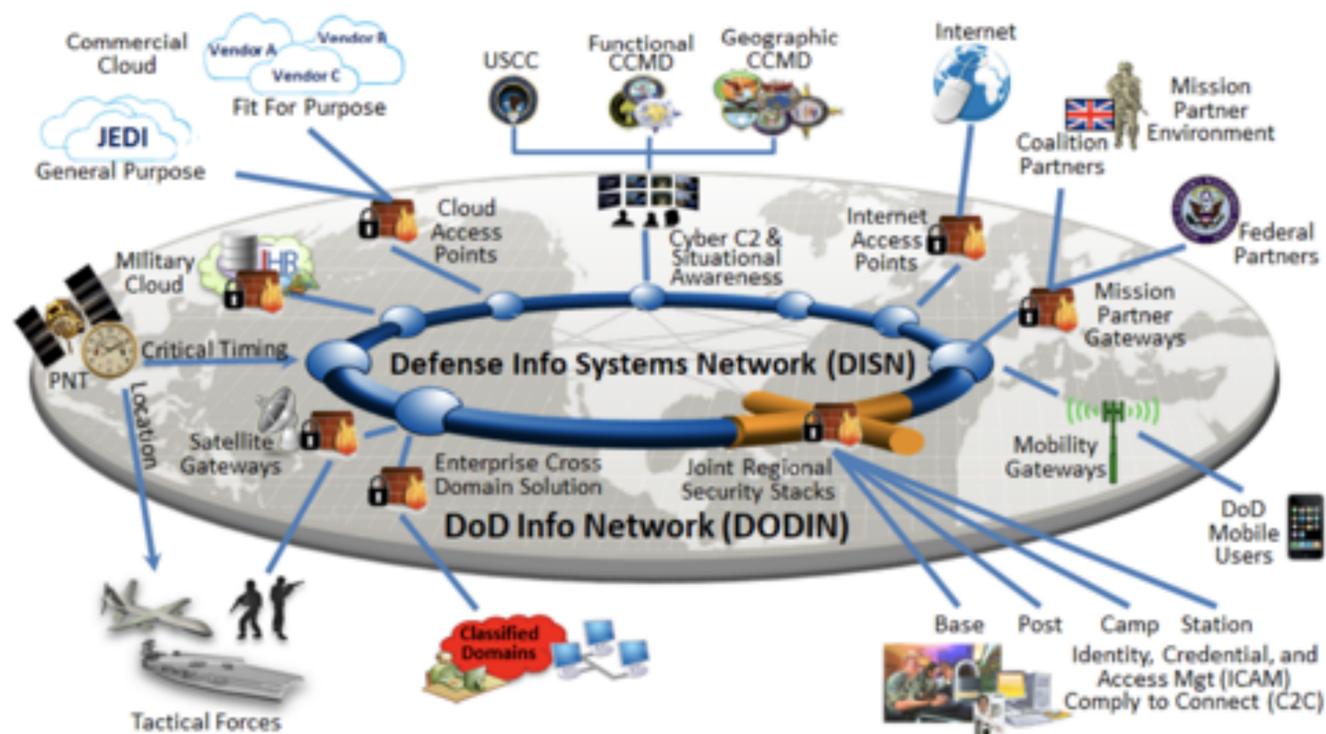
The United States' national defense strategy is focused on building a more lethal force, where digital modernization is a cornerstone. Leveraging data is a key enabler for artificial intelligence and related technologies that are key to improving combat power and creating leap-ahead capabilities. Taqtile's augmented- and mixed-reality software product, Manifest, fuses data from four domains (service member, place, machine and procedure) to create digitally augmented operations on the base and in the field for a more lethal joint force. Manifest presents relevant data to service members as they execute tasks and updates the sources of data in real-time with progress updates and sensor readings to maintain the single source of truth for the artificial intelligence and related technologies required to evolve and adapt quicker than our adversaries.

## BACKGROUND: US DEPARTMENT OF DEFENSE DIGITAL MODERNIZATION STRATEGY

The US DoD Digital Modernization Strategy (July 2019) provides a roadmap to support implementation of the National Defense Strategy lines of effort through the lens of cloud, artificial intelligence, command, control and communications and cybersecurity. The figure below summarizes the strategy, which lists the four priorities: Cybersecurity, Artificial Intelligence (AI), Cloud and Command, Control and Communications (C3). The Digital Modernization strategy has four primary goals: (1) Innovate for Competitive Advantage (2) Optimize for Efficiencies and Improved Capability (3) Evolve Cybersecurity for an Agile and Resilient Defense Posture, and (4) Cultivate Talent for a Ready Digital Workforce.



Supporting the digital modernization strategy, the Joint Information Environment (JIE) is a framework comprising a set of discrete initiatives developed and delivered as funded to support continual, comprehensive Department-wide IT Modernization and advance DoD information superiority in a common, coordinated way. JIE implements a new joint cybersecurity capability, improves networking capabilities for fixed and mobile users, institutes several new DoD-wide IT services, modernizes technology through coordinated refresh efforts, meets mission partner information sharing requirements, and improves access to data. The figure below summarizes the scope of the JIE effort.



## MANIFEST - A KEYSTONE FOR DIGITALLY AUGMENTED DOD OPERATIONS

Taqtile's Manifest leverages AR, cloud computing, and LTE/5G networks to remove operational silos. With unprecedented integration, Manifest supports the DoD digital modernization strategy goals by augmenting operations on the base and in the field for a more lethal joint force. It does this by augmenting service member cognition, reducing cognitive stress, and capturing operations data in real-time. The platform aggregates critical elements of operational systems to do more with less... and do it better:

- **Procedures.** Experts document procedures. Workers execute them. Management evaluates results and performance leading to continuous improvement.
- **Service Members.** Regardless of skill level and experience, institutional knowledge, expert assistance, and team collaboration is enabled and available – whenever it is needed.
- **Places.** Traditional physical barriers disappear. Work gets done at the same speed and quality regardless of individual, team, or equipment locations.
- **Machines.** Workers interact with equipment, sensor, and IoT data in real-time and then data is integrated with enterprise-wide systems for archiving

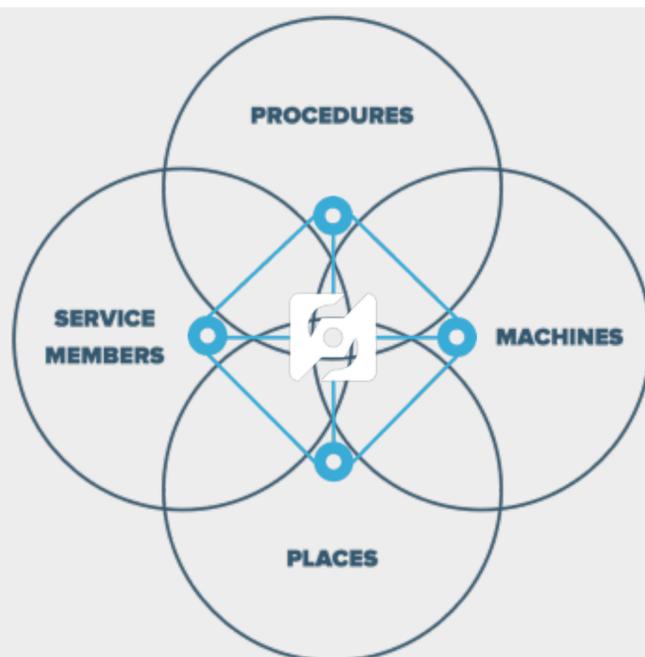
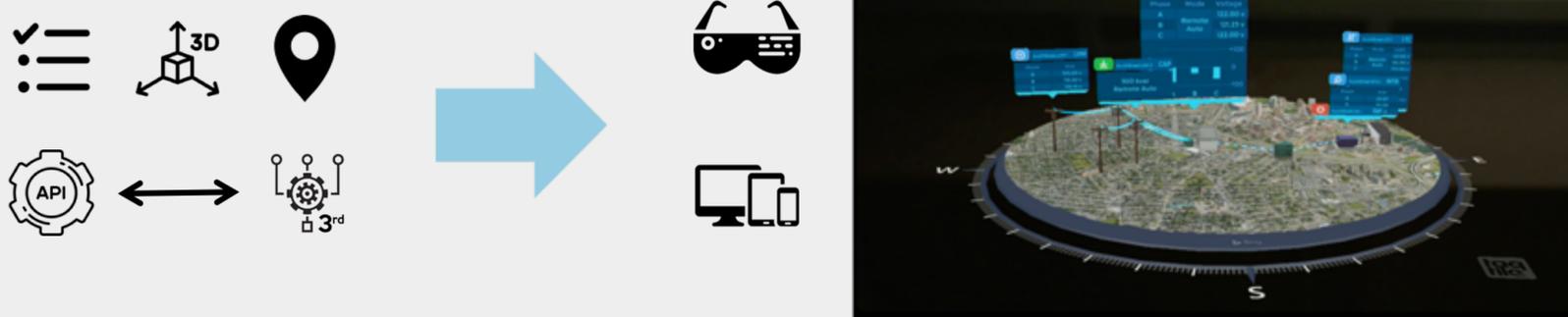


Figure 1: Manifest unites four data domains to augment DoD operations

More precisely, Manifest is a software suite for deskless work that supports digital transformation. It does this by capturing expert process-based knowledge, integrates with key sources of data and fuses the information into an intuitive augmented- and mixed-reality format to create digitally augmented workflows. The software includes the ability for deskless workers to reach-back for assistance using built-in remote assistance. Key workflow data is captured in real-time to update the sources of data so that the leaders in “mission control” can monitor progress and adapt tactics. (Fig. 2)



**Figure 2: Manifest utilizes APIs to display sources of data within a spatial context to support mission control.**

Organizational knowledge is leveraged because domain and process experts capture their specialized knowledge enabling deployment to service members who follow the workflows to complete complex and unfamiliar tasks efficiently. These digitally augmented workflows can be authored and executed across a number of supported hardware devices. (Fig. 3)

Multi-Device Authoring

Knowledge & Information

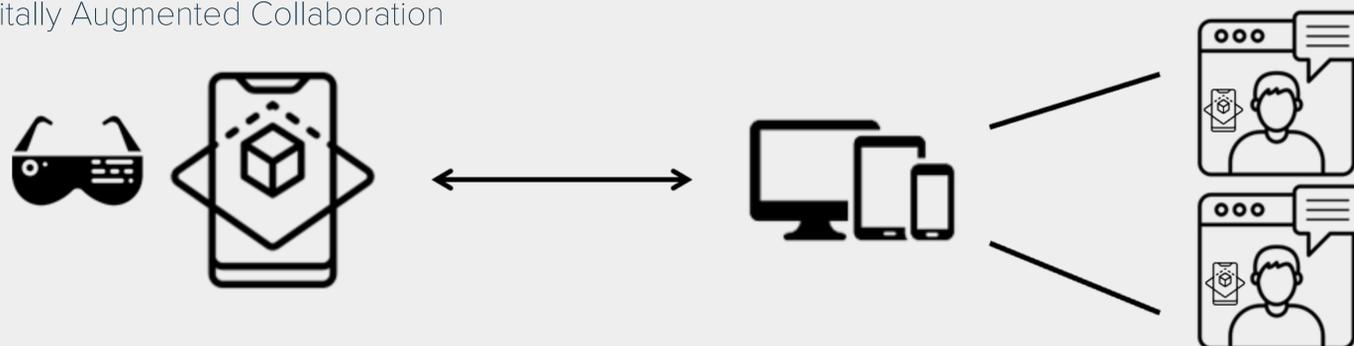
Augmented & Digitized Workflows



**Figure 3: Manifest enables subject matter experts to document their knowledge**

Service Members can work independently or collaborate and share workflows with teammates (Fig. 4). Integrated communications capabilities allow workers to reach out to experts whenever they run into unforeseen problems. Audio, video, and text chats as well as video sharing allows experts to remotely obtain context and offer guidance. With the Manifest open API, IIoT/IoMT, SCADA, and PLC data can be integrated to provide real-time sensor data, and warnings within the service member’s field of view so faster and better decisions can be made while performing procedures.

Digitally Augmented Collaboration



**Figure 4: Manifest has integrated features enabling Practitioners to reach-back for procedural support.**

Manifest boasts several key features and benefits that make it the unparalleled platform for digitization of defense operations, see Table 1.

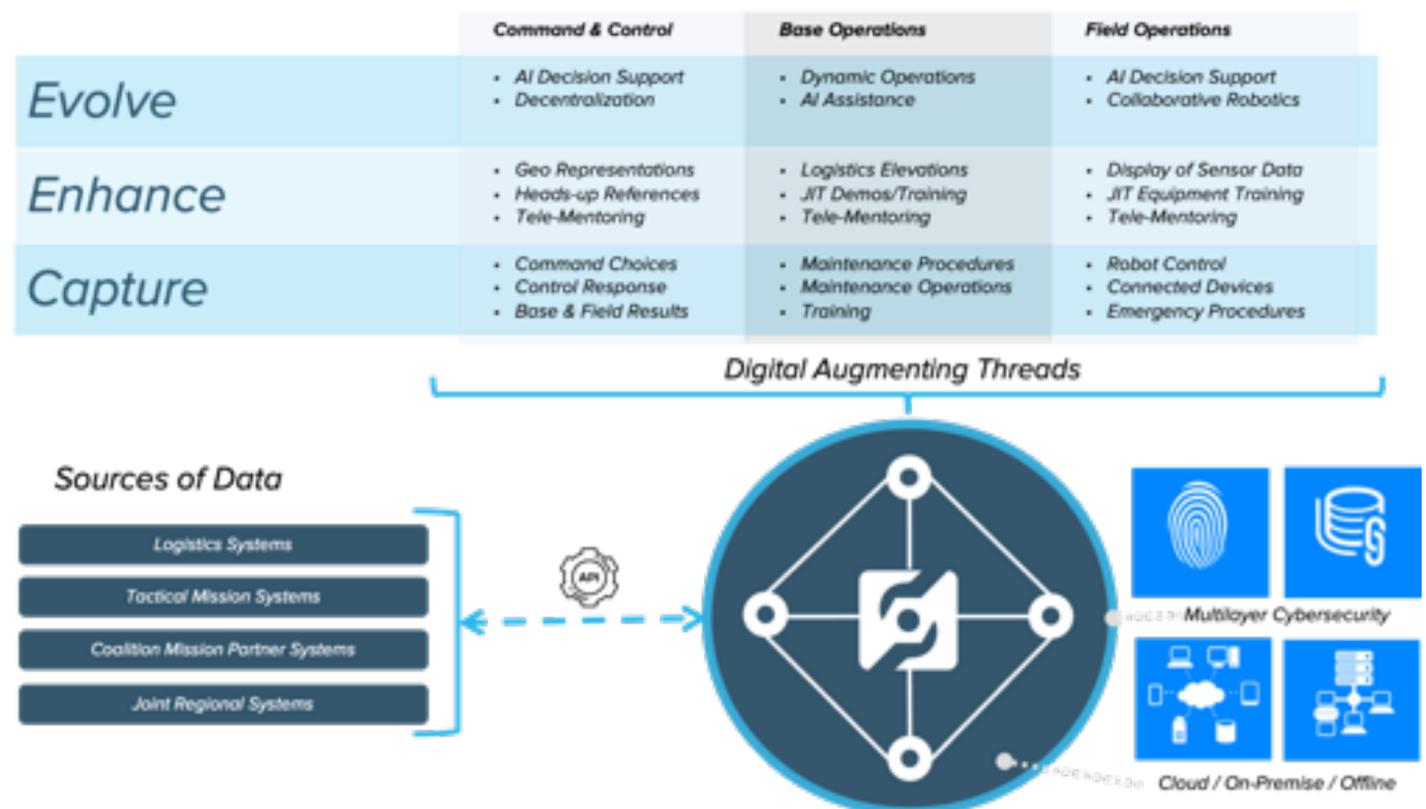
**Table 1: Manifest feature set enables uninterrupted workflow everywhere, every time**

FEATURE	BENEFIT
Multi-Layer Security	Enterprise-grade access control, encryption, and location-level data capture control at the application level.
Flexible Deployment and Administration	Cloud, on-premise, hybrid, offline
Fully Integrated Team Collaboration & Remote Assistance	Teams able to execute jobs whether collocated or remote with task orchestration and visibility. Locate the right expert the first time while sharing visibility of the job or issue at hand.
Multi-Device	Utilize a variety of form factors and devices best suited for the use case and environment. Manifest runs on browsers, iPads, Android phones, RealWear monocular HMDs, and mixed-reality HMD's like Magic Leap and HoloLens.
Integrated Sensors/IoMT	Visualize live sensor data to better inform operators and create rules based on equipment telemetry to keep gear and personnel safe.
PDF Viewing	Display entire technical manuals and documents and/or bookmark specific page references pertinent to the in-process task.
In-situ Authoring	Turn spatially-enabled devices into content-creation engines that capture step-by-step procedures over real-world environments and equipment without need of 3D CAD or programming skills.

Because Manifest offers Integrated Digital Augmentation (IDA), service members have real-time access to all the necessary data to make life-saving, split-second decisions and are able to obtain support from remote experts or pre-documented instructions to carry-out complex tasks. The augmented workflows support elegant distributed collaboration by presenting the relevant data within the field of view of the medical provider while simultaneously showing what they are seeing with the reach-back support. Manifest therefore augments cognition, reduces cognitive stress, and captures operations data in real-time.

## ADAPTIVE OPERATIONS FROM DIGITAL THREADS

Manifest weaves together digital threads that can capture, enhance and evolve operations across command and control, base operations and field operations (Fig. 5). It creates the digital threads by using APIs to integrate with the most important sources of data, such as Logistics, Tactical Mission, Coalition Mission Partner and Joint Regional Systems.



**Figure 5: Manifest connects service members with sources of data to create digital threads across defense operations.**

## MANIFEST IN A 5G/MEC/PRIVATE WIRELESS SCENARIO 5G NETWORKS AND MULTI-ACCESS EDGE COMPUTING (MEC) – KEY ENABLERS FOR MANIFEST

As next generation 5G and EDGE compute architectures drive the proliferation of sensors throughout operations, teams need access to this massive volume of data to better manage their resources. Highly available, highly secure 5G networks allow mission control the ability to remotely access and measure how their teams are performing in the field, which allows them to respond faster than ever before. These technological advancements drive massive gains in productivity, and offer entirely new opportunities for additional training, remote treatment and surgeries.

High speed connections to these sensors require MEC/5G solutions delivered by platform providers, telco carriers and private wireless companies. Today, Taqtile Manifest runs natively on MEC installations such as Microsoft’s Azure Stack Edge and Nokia’s NDAC system, both of which provide significant performance enhancements over traditional Wi-Fi/4G. Manifest, running in a MEC/5G environment, takes advantage of the lower latency/higher availability connections and can power higher resolution video group chat for stronger collaboration opportunities between teams, as well as improved 3D model rendering speeds. On MEC/5G, Manifest can enable thousands of IoT sensors to report actionable data feeds in real-time in over a much broader geographical area, resulting in more accurate and thus safer decision making. Manifest on MEC/5G can also deliver much higher security through network slicing where only pre-determined parts of an application can connect with the internet, resulting in a safer data exchange between team members and backend systems. All of this results in practitioners becoming more connected to the support network, where their actions aided by the use of Manifest helps them perform to a higher degree of safety and efficiency and become part of the holistic process of digitized operations. Finally, as part of a digitized operations team, service members using Manifest can benefit from onsite machine-learning driven analytics for predictive operations and processes, resulting in performing the right task at the right time.

### HIGH-VALUE USE CASES

Manifest demonstrates highest value in complex and/or high-pressure scenarios, especially where systems of systems need to work flawlessly or when processes are sensitive. Figure 6 combines these perspectives to suggest four high-value use cases: equipment setup & maintenance, mission control, dynamic workflows and just-in-time training. Platforms and equipment are growing in complexity and prevalence, making it difficult to maintain proficiency for those that must keep their knowledge current. Alternatively, managing distributed operations that involve flawless interaction between humans and machines is the nature of “Mission Control”, where lifesaving decisions must be framed correctly, good alternatives identified and the data available to support decision choice made available. “Dynamic Workflows”, where a service member needs to switch and hand-off tasks intermittently, place high demands on cognition. Lastly, from the Matrix, “do you know how to fly this thing?”, “not yet”... “Just-In-Time Training” for rapid upskilling.



Figure 6: Manifest augments service member cognition and decreases cognitive stress in several scenarios

## MANIFEST'S GROWING TRACK RECORD FOR DEFENSE APPLICATIONS

**2017 - 2019**

**USAF YOKOTA AIR BASE & MCCHORD AIR BASE – 730 AMSS**



U.S. AIR FORCE

Test and evaluation of Manifest for field-based USAF propulsion mechanics. Final study report demonstrated a 92% reduction in errors utilizing Manifest compared to the extant method of following T.O.'s for L1-L5 propulsion mechanics performing maintenance tasks.

**2018 - 2019**

**USAF SHEPPARD AIR BASE - 82ND TWO**



U.S. AIR FORCE

1-year Manifest pilot to evaluate and experiment with AR-based training and operations for jet engine and facilities maintenance.

**2019**

**US NAVY COMSUBPAC - LIFE CYCLE ENGINEERING**



Manifest selected by LCE to deliver proof-of-concept mixed-reality augmented work instructions and training for Sea Coaches overseeing US Navy submarine and tender maintenance in Guam.

**2020 - 2021**

**US ARMY FORT HOOD – ARMY APPLICATION LABS SBIR PHASE I**



Conducted a Phase I SBIR using Manifest and HoloLens to demonstrate use of augmented work instructions and fault flagging/resolution for motor pool operations and maintenance at Fort Hood.

**2020 - 2021**

**ROYAL AUSTRALIAN NAVY**

**NAVY**



Proof-of-concept using augmented reality work instructions over real maritime equipment as well as 3D digital twins. Deployed a production ready Manifest infrastructure environment on Microsoft Azure Government Cloud instance in Australia. Resulted in Manifest being the only approved AR work-instruction for Australian Defense at this time. Currently transitioning to production deployment for the Royal Navy.

**2021 - 2023**

**US ARMY FORT HOOD – ARMY APPLICATION LABS SBIR PHASE II**



Rapid and Scalable Digital Augmentation Software (RASDAS) builds on its successful Phase I program to create an integrated digital augmentation solution that can scale within Army maintenance operations by digitizing fault mitigation workflows, reducing dependence for a fiducial marker for tracking of vehicle in 3D space, creating a bridge to enable integration with GCSS Army, and implement permissions-based viewing of work instructions.

**2017 - 2019**



**US NAVY COMSUBPAC - BOOZ ALLEN HAMILTON**

Manifest selected by Booz Allen Hamilton (prime) and evaluated as a solution to improve resiliency of maintenance and training at remote locations. DFARS assessment and 'approval to proceed' achieved for AWS instance of Taqtile Manifest.

**2019 - PRESENT**



**NEW ZEALAND DEFENSE FORCE (ARMY) TRENTHAM MILITARY CAMP**

Army Trade Training School performed an assessment of Manifest resulting in a >50% reduction in errors when using AR work instructions vs paper-based, instructor-led training. Manifest was evaluated by new armored vehicle maintainers in the classroom, on training benches, and in the garage on Rheinmetall Defense HX60 troop carriers. The solution was subsequently deployed by NZDF and is still in use.

**2020 - 2021**



U.S. AIR FORCE

**USAF DYESS AIR BASE – RAPID SUSTAINABILITY OFFICE SBIR PHASE II**

3D Media (prime) selected Taqtile Manifest software to support their SBIR Phase II project for the USAF Rapid Sustainability Office (RSO). Efforts included creating and evaluating AR work instructions for the 7th Bomb Wing on a B1-B Lancer aircraft at Dyess AFB. Phase II extension awarded and includes obtaining ATO for Manifest within USAF flight line maintenance ops.

**2021 - PRESENT**



**US ARMY JBLM 5G AR/VR TRAINING – US ARMY PEO STRI**

Manifest selected by Booz Allen Hamilton (prime) as part of the multi-vendor JBLM 5G AR Application Prototype to evaluate maintainer training capabilities over a 5G cellular network deployed within a simulated brigade-level operating theater.

## ABOUT TAQTILE

As companies around the world race to realize the promise of Industry 4.0, the deluge of new technology can be overwhelming and companies can struggle to understand where to begin. Taqtile, and our Manifest solution can provide a solid first step along the journey of fully digitizing operations by enabling deskless workers the ability to have their effort guided, chronicled and integrated digitally into backend systems, allowing for greater knowledge share, safety and efficiency in maintenance and production. Beginning in 2016, Taqtile has worked tirelessly to produce and refine a solution that helps provide focus for companies looking to enable the “last mile” of their workforce. By focusing on enabling the deskless worker, Taqtile completes the digital circle of People, Process, Product, and Places and empowers companies to create a holistic system where all constituents are truly connected.

**Experts matter.** We believe the increasing complexity of industrial machinery, combined with retiring experts, means that experts matter more today than they ever have. We have made it our mission as a company to make everyone an expert and we accomplish this by giving them knowledge when and where they need it.

**We make Manifest.** A platform to harness, distribute and apply what you know. Manifest gives deskless workers instant virtual access to, and step-by-step guidance from, your most experienced technicians and trainers anywhere, anytime.

## RESOURCES

### Contact:

Kelly Malone

Chief Customer Officer

kelly,malone@taqtile.com

+1.206.227.4419

[Company website](#)

[Case studies & product videos](#)

[Detailed Manifest overview](#)

[Fort Hood Abrams Tank Digitizing Work](#)

[Fort Hood Abrams Tank Digitally Augmented Work](#)

[Fort Hood Abrams Tank Integrated Remote Assistance](#)

[Taqtile & Manifest in the news](#)

[Forbes article featuring Taqtile customer PBC Linear's use of Manifest “Augmented Reality: The New Knowledge Management”](#)