# What is Known and What is Hype? Understanding the State of AR/VR Training Effectiveness

**NDIA Human Systems Conference**

**June 15-16, 2022**

**Jim Belanich**

**Emily Fedele**

**Frank Moses**

Effort supported by Air Force Research Laboratory, Airman Systems Directorate, Warfighter Interaction and Readiness Division (AFRL/RHW) in support of the Commander Air Combat Command's (COMACC) migration to Proficiency Based Training

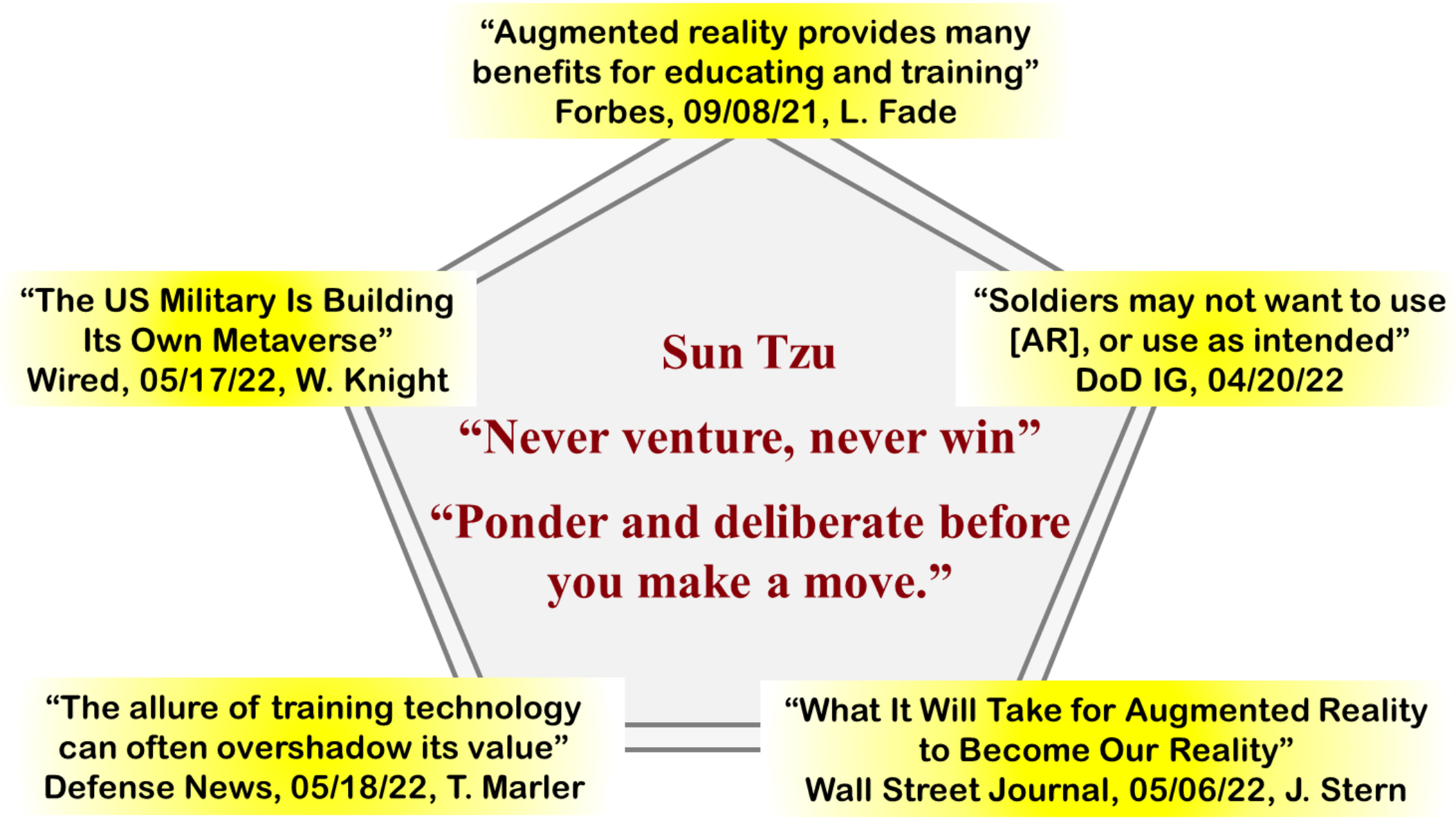
# Project Background and Objectives

- **Research Question**: What does the current empirical evidence indicate about the use of AR and VR for training?

- Objectives:
  - **Review** current research (qualitative and quantitative) on applications and effectiveness of AR/VR
  - **Document** the state of the science, art, and practice in AR and VR
  - **Organize** results into a framework and searchable knowledge base
    - Knowledge base for use with the evolving state of general purpose and military education/training
    - Search structure for personalized searches to satisfy specific needs
    - Can be used to identify research gaps

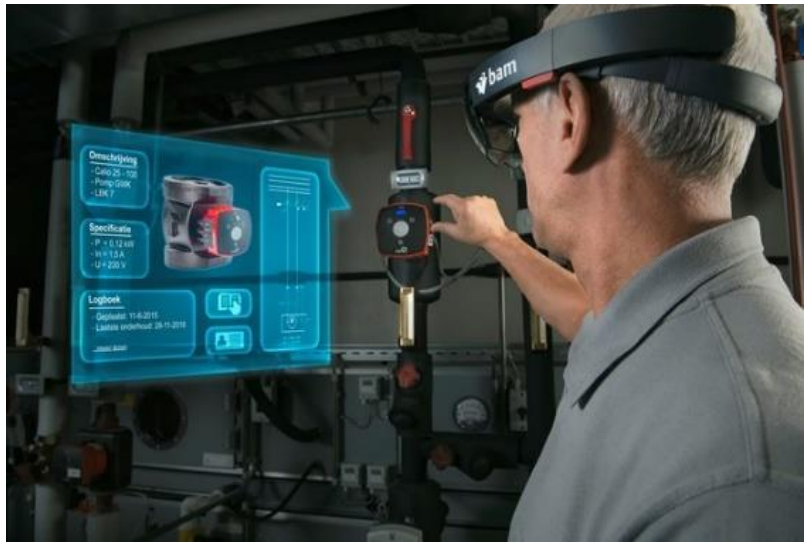
- Work coordinated with Aptima's development of a searchable, web-based repository for sharing ARVR training assets and lessons learned, for the Air Force

# Hype, Hyperbole, or the Honest Truth



# There are many different types of AR and VR

**AR examples**




**VR examples**

Each with their own strengths and weaknesses

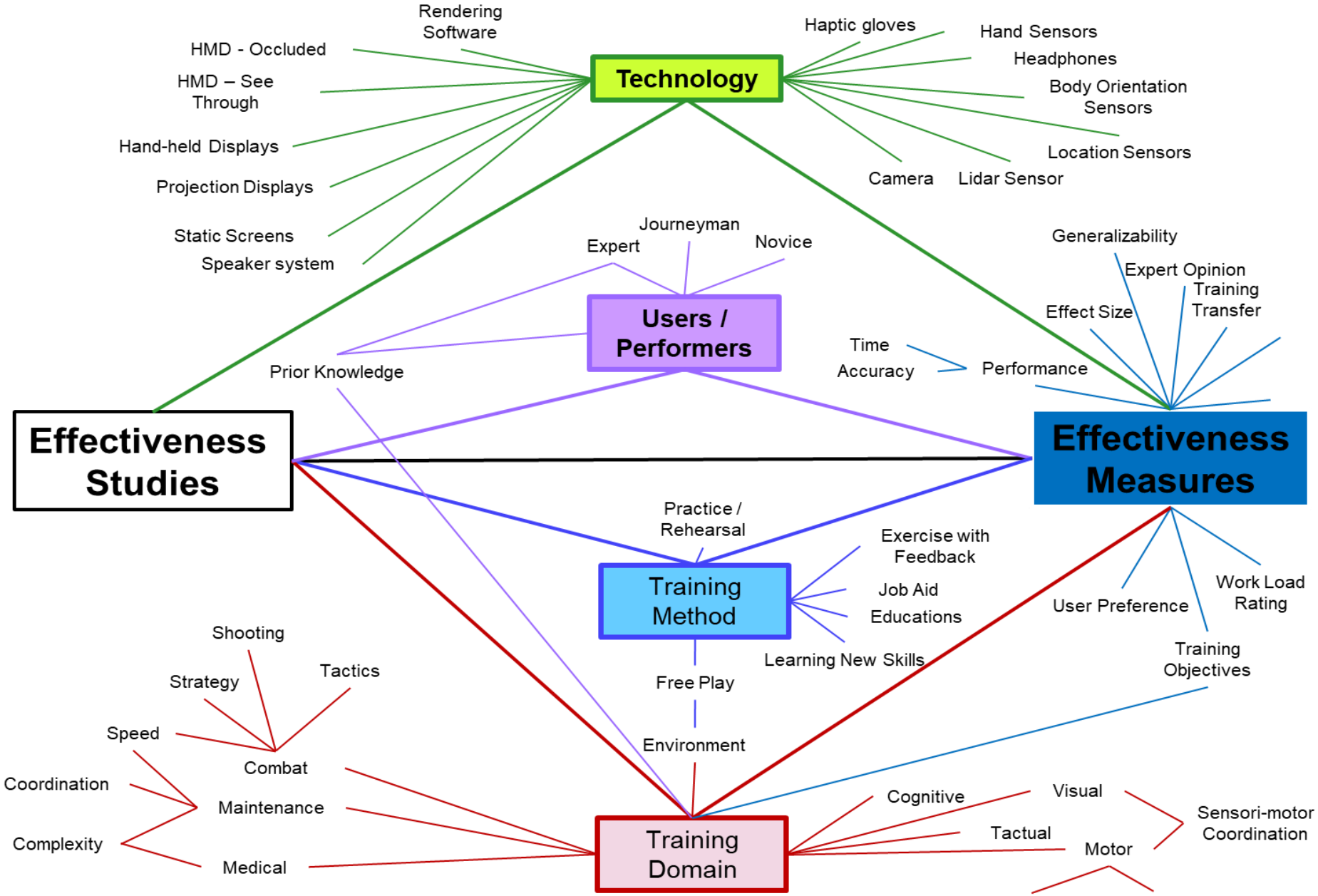
# Complexities of AR/VR Training Effectiveness

- **Meta-analyses** suggest different ways that AR and VR technologies may be effective for training

- **Varied research interests and specialties** present a challenge to determining AR/VR effectiveness: a) computer scientists and engineers focus on technology; b) training developers focus on instructional methods; and c) domain specialists (e.g., medical, military, and construction) focus on their discipline

- **Research Literature** provides uneven descriptions and findings from one study to another. Initial set of reviews found studies lacked details such as:
  - Descriptions of users' task experience (26% of studies)
  - AR/VR technology experience (28%)
  - Performance measures (29%)

# Making Sense of the Science



# Framework Components to Build a Knowledge Base

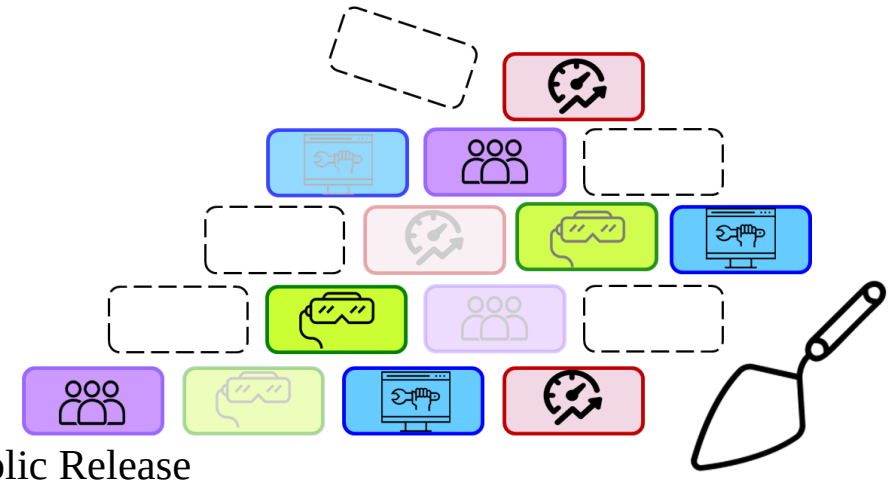
**What technology is being used?**

**Who is the performer?**

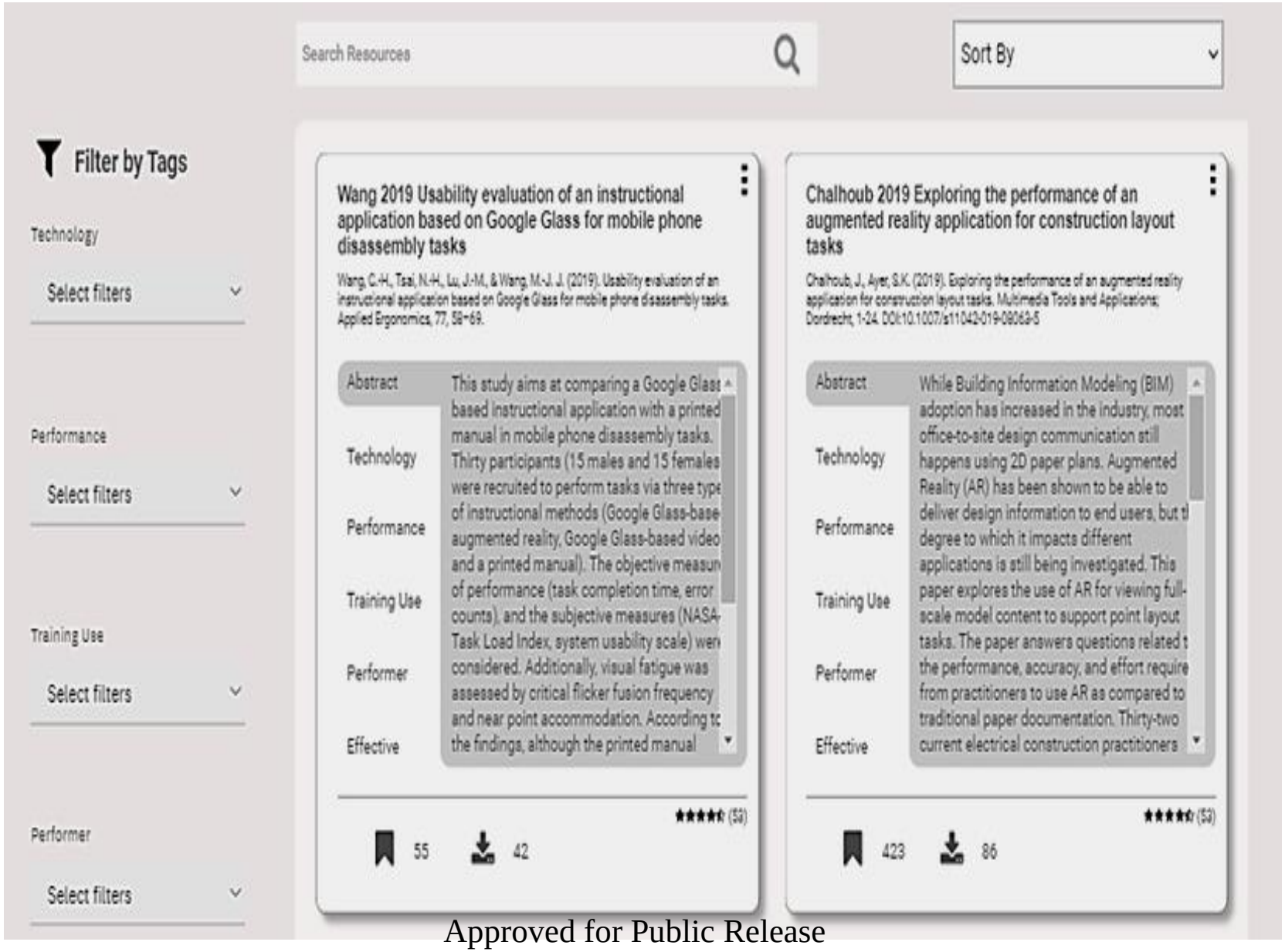
**How will the system be used?**

**What is the performance?**

**Is it effective?**

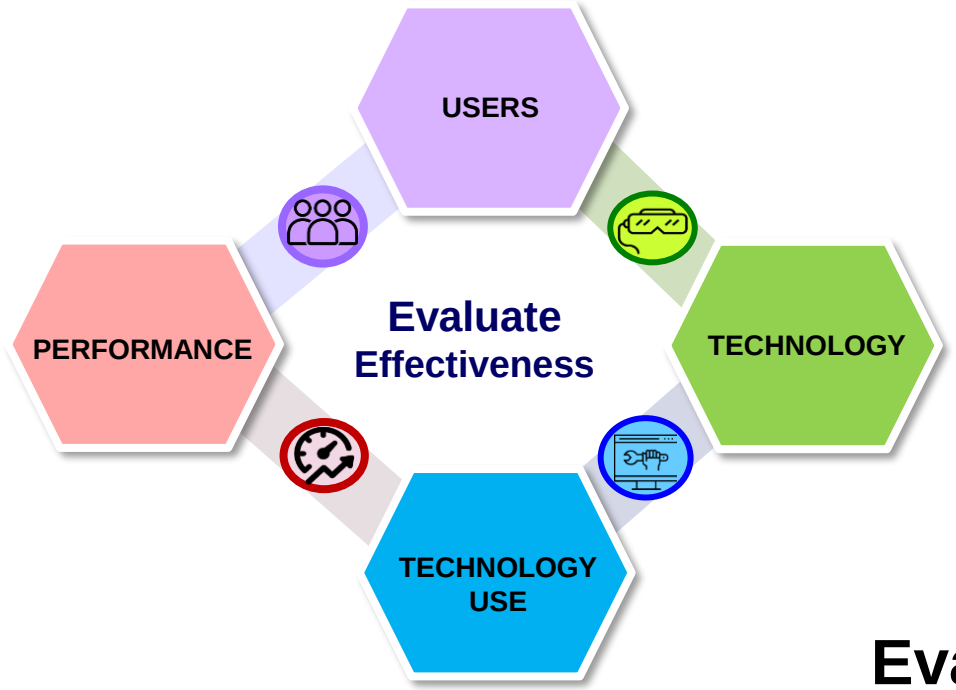


# Knowledge Base on AFRL's AR/VR Repository (in development, currently holds 64 studies)



# Concept of Knowledge Base Queries

**Handheld tablets (technology) have been used to train what activities (performance)?**




## Output (7 studies)

- Anatomy and medical procedures (2)
- Assembly/maintenance and construction (3)
- Data visualization(1)
- Detection of buried explosives (1)

## Evaluate the Output

- Relevance
- Strength of evidence
- Reproducibility

# Technology Occurrences in Knowledge Base

## What technologies have been assessed?

Frequency of Technologies

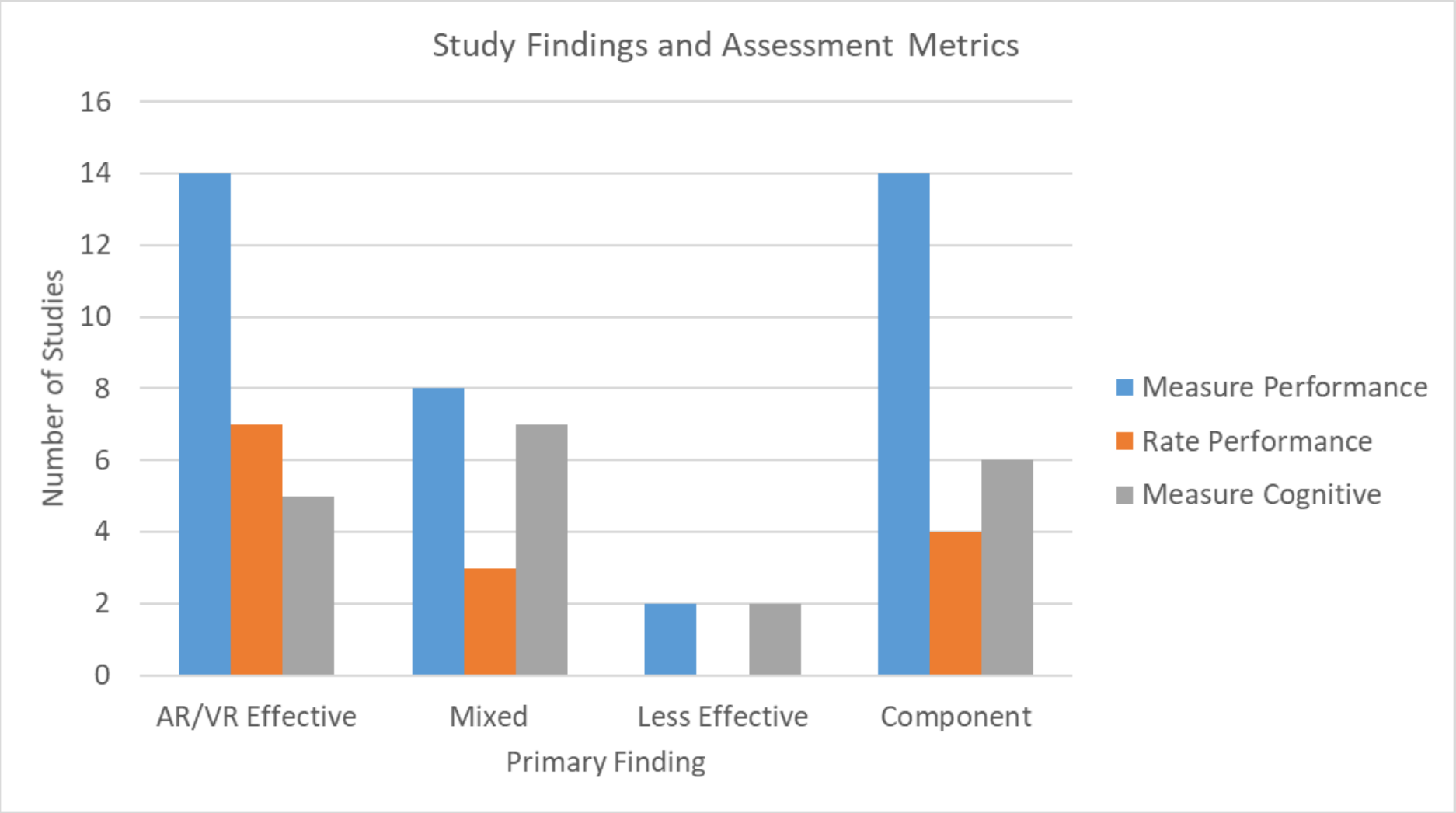
| Technology | N=64 |
|---|---|
| Occluded HMD | 32 |
| Hand Tracking | 31 |
| Head Tracking | 24 |
| Computer Monitor Display | 18 |
| See-through HMD | 14 |
| Tracking of equipment | 12 |
| Handheld tablet or Phone | 7 |

Gaps (Low Frequency)

| Technology | N=64 |
|---|---|
| Identification of environment | 1 |
| Haptic Feedback Gloves | 1 |
| Eye Tracking | 1 |

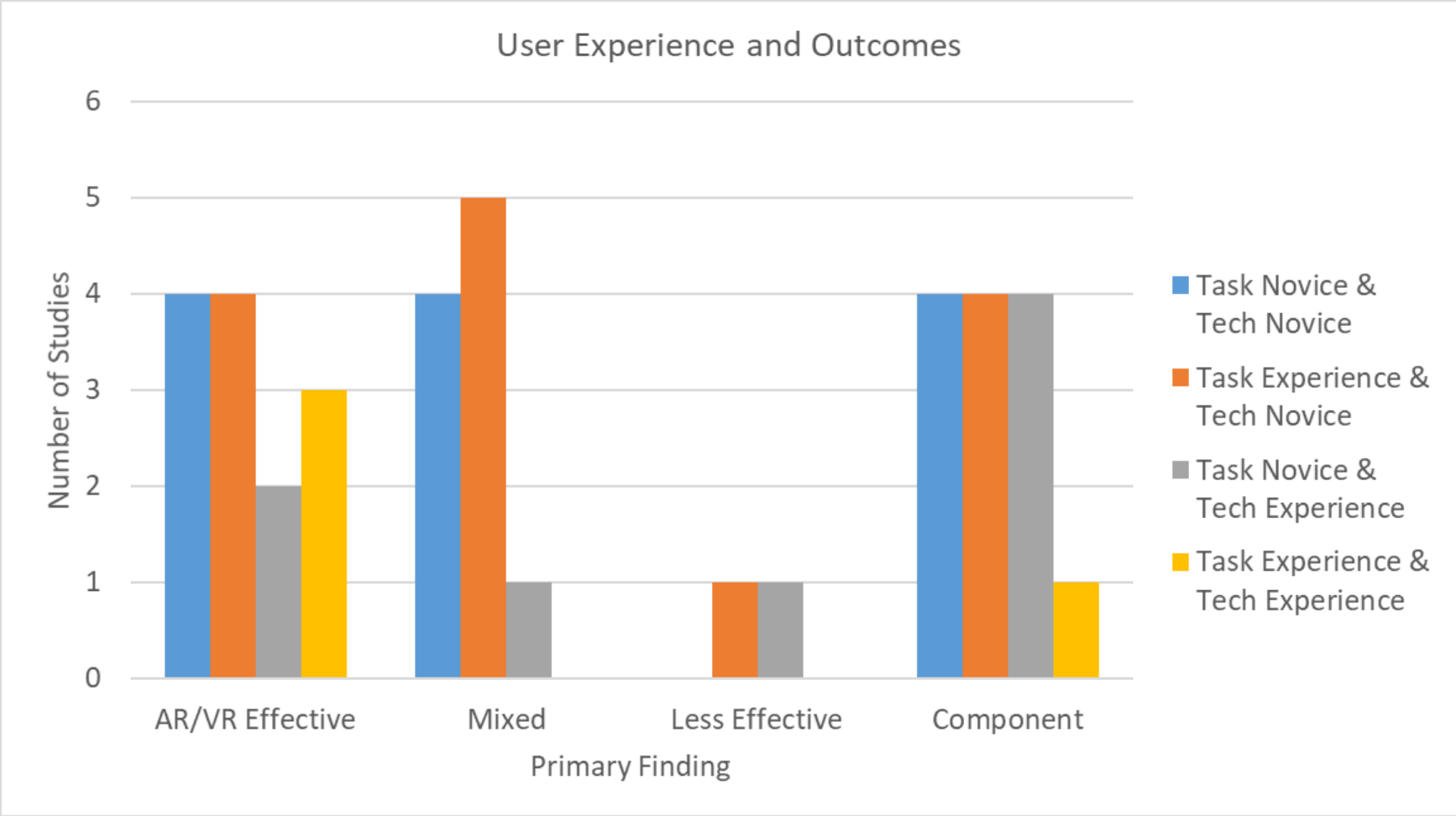
# Extracting Initial Findings from Knowledge Base

## How have studies assessed outcomes?



# Extracting Initial Findings from Knowledge Base

## Influence of user's level of experience with the task and technology




26 studies did not clearly describe users' prior experience with technology or task

# Extracting Findings from Knowledge Base

**How can occluded head mounted visual displays be incorporated into training with the inclusion of automated feedback?**

Knowledge base returns 8 studies, nuance to findings:

- 2 studies comparing VR to traditional
  - Immersive VR outperformed conventional training on transfer tests
  - Developmental VR training effective, but not as effective as traditional
- 4 studies comparing VR features:
  - Matching sensory stimulation with feedback influences effectiveness (2)
  - Intelligent tutoring capabilities improve training outcomes
  - Types of locomotion in VR influences usability and performance
- 2 studies describe benefits of VR Training
  - VR training can save costs and enhance safety
  - Effectiveness of training driven by usability, presence, and usefulness

Queries identify relevant information for user's specific needs

# Contact Information

Dr. Jim Belanich
Institute for Defense Analyses
730 East Glebe Road
Alexandria, VA 22305
jbelanic@ida.org
703-845-6606

Dr. Winston “Wink” Bennett, Readiness Product Lead
Airman Systems Directorate, Warfighter Interactions and Readiness Division, 711 HPW/RHW
2620 Q Street, Wright Patterson AFB, OH 45433
winston.bennett@us.af.mil
937-938-2550