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Air Power in a Disruptive World

# The Human/Machine Interface: Operational Decision-Making

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# Background

- *"Speed is the essence of war. Take advantage of the enemy's unpreparedness"* – Sun Tzu
- Decision superiority is a key element to (future) conflict
  - Complex decision space will require focus on technologies that mitigate limitations on human sensory and cognitive capacity.
  - Must develop trust in AI and its reliability through exposure and transparency
- Commercial investment exceeds DOD in some key technologies
  - Leverage, apply to military domains, fill gaps where no commercial solution
- Available to challengers as well; cannot ignore

# AI Arms Race

- “Artificial intelligence is the future, not only for Russia, but for all humankind.  Whoever becomes the leader in this sphere will become the ruler of the world.” – Vladimir Putin, Sep 2017
  - Artificial intelligence will be able to replace a soldier on the battlefield and a pilot in an aircraft cockpit - Viktor Bondarev (former commander of Russia’s Aerospace Force and Chairman of the Federation Council Defense and Security Committee) Nov 2017

- China’s State Council issued plan to lead the world in AI by 2030; “Next Generation Artificial Intelligence Development Plan” - Jul 2017
  - Highlights an approach of military-civil fusion (or civil-military integration) to ensure that advances in AI can be rapidly leveraged for national defense
  - Pursue advances in big data, human-machine hybrid intelligence, swarm intelligence, and automated decision-making, along with in autonomous unmanned systems and intelligent robotics

# Force Design

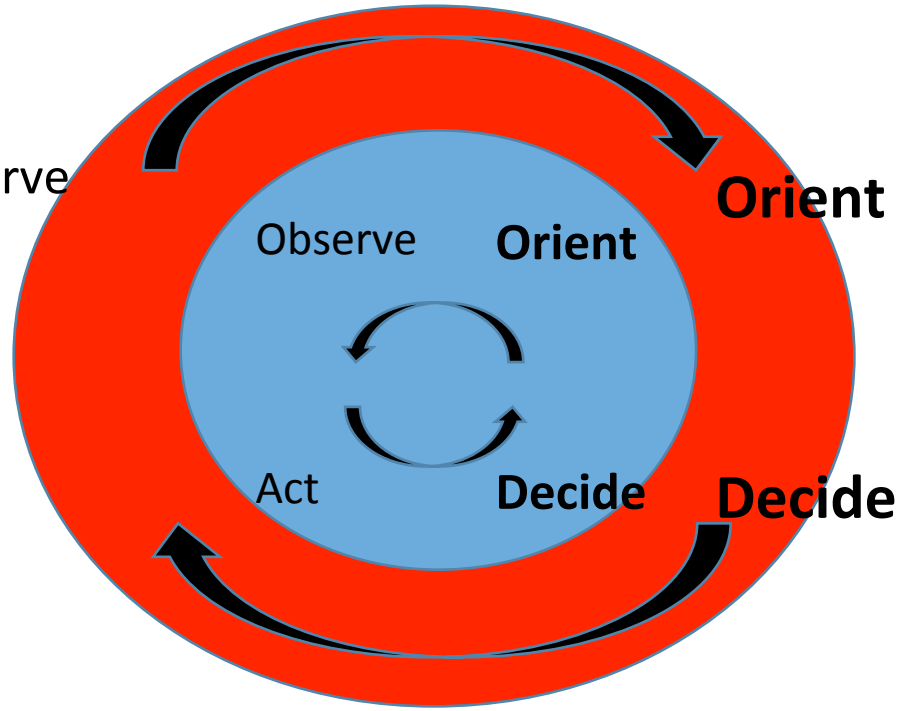
- Outpace adversary decision speed
- Enhance battlespace awareness, decision speed, and dynamic synchronized actions
- Computer aided data fusion, info analysis, present warfighting options… enable decision speed
- Automated, intelligent analytics and AI designed to improve Commander/Warfighter resource allocation decisions…providing COA analysis, planning, automated synchronization, as a means of creating effective human-machine teaming

# OODA vs OODA

Traditional investment

Observe

Act




- Decision superiority
- Man-machine teaming
  - AI, visualization
  - Big data, COAs

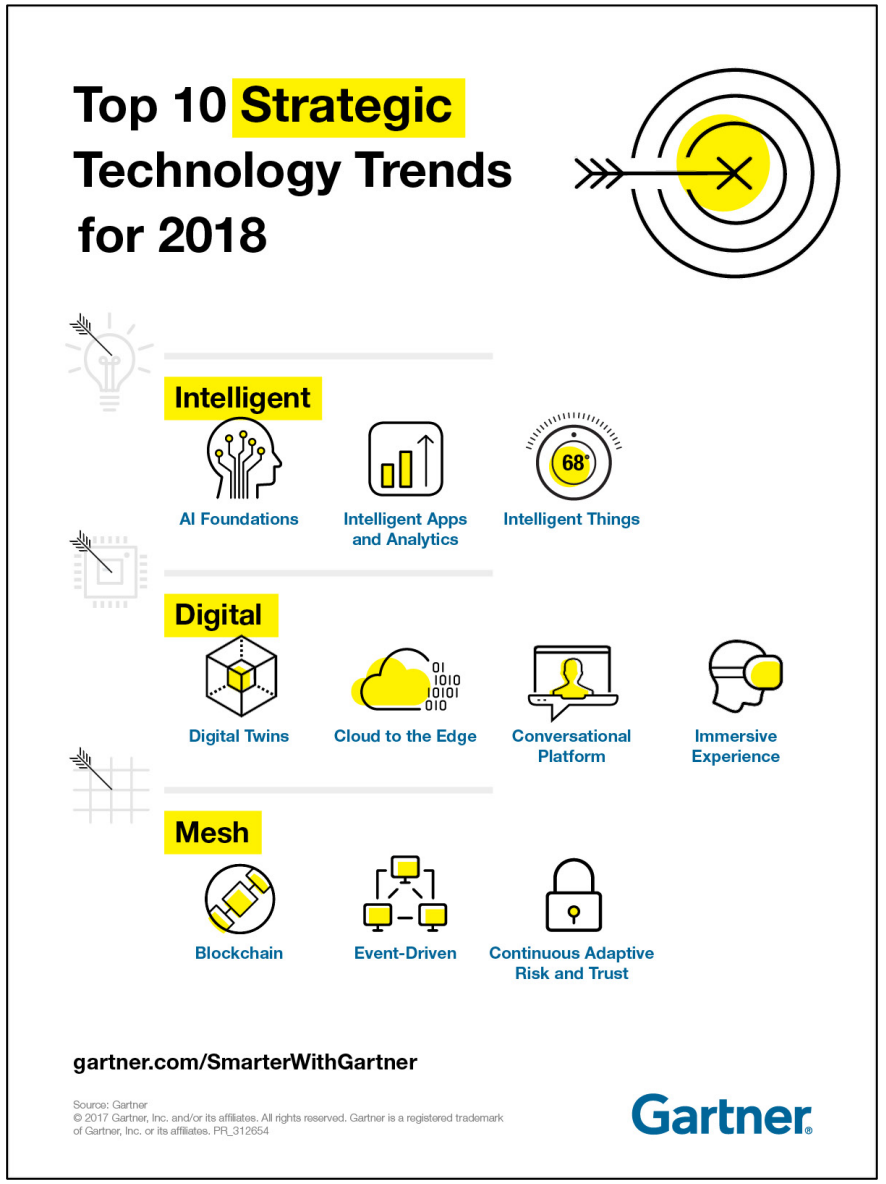
- Keep in orient phase
- Introduce “false” decisions

# AI-assisted decision-making: Platforms to Personal Assistant

- Russia builds lethal autonomous weapons systems despite UN ban
  - Intelligent unmanned sentry platforms (UAV, UUV, UGV), swarm behavior
  - Combining models with 3D virtual environment to optimize joint force operations (eg - helicopters, tanks, drones, and robots) Russian Kronstadt Group
- Advancements in Chinese AI have the capacity to support military command and control, intelligence deduction, advance combat training and military readiness, tailor and scale cyber and information operations (CSIS, CNAS)
- **China's plan to use artificial intelligence to boost the thinking skills of nuclear submarine commanders** (South China Morning Post)
  - An AI assistant could support Commanders by assessing the battlefield environment, estimate risks/benefits of combat maneuvers (even suggesting moves not considered by the vessel's captain), and recognize threats faster and more accurately than human operators.

# The Intelligent Digital Mesh

- Intelligent: How AI is seeping into virtually every technology and with a defined, well-scoped focus can allow more dynamic, flexible and potentially autonomous systems.
- Digital: Blending the virtual and real worlds to create an immersive digitally enhanced and connected environment.
- Mesh: The connections between an expanding set of people, processes, devices, content and services to deliver operational outcomes.
- Data to Decision, Fleet Tactical Grid, Multi-domain C2
  - Sensors, networks, data, knowledge, decisions



# Decision support technology

- The current wave of progress and enthusiasm for AI has been driven by three mutually reinforcing factors: the availability of big data which provided raw material for dramatically improved machine learning approaches and algorithms, which in turn relied on the capabilities of more powerful computers. – Dec 2016 White House report
- Task vs data representation
- Supervised (classification), unsupervised (pattern analysis)
- Deep learning neural network
  - Value, policy optimization
  - Rational reasoning (IBM, Google)
  - Memory augmented (deliberative; Differentiable Neural Computer)
- Imitation learning (Simulated data)
- Reinforcement learning (Deep Mind - Alpha Go Zero, OpenAI - DOTA 2, selfplay)
- **Transfer learning**

# User Interface (UI)

- Enders Game, Star Trek, Interstellar, Minority Report, Watson, Alexa, chat bots, Hololens
- Computer's job: interpret the user's instructions, process the data, present to user.
- Human's job: provide Commander's intent, understand the information presented in context of intended goals or surrounding environment.
  - Moving away from designing Graphical User Interfaces (GUIs), which require the user's full attention, and moving towards designing less obtrusive interaction
    - proactively initiate conversation about goals
    - limit interaction to a few natural questions and responses
    - factor in a large number of observations and assumptions
    - present with the results
- Ipad vs laptop, mobile apps
- Conversational, visual, tactile/haptic
- Personalized UI/AI

# Operational human-machine decision-making

- Cognitive, netted, distributed force (manned/unmanned systems, BM, MDC2)
- Algorithmic or prototype warfare (speed of software development)
  - **Human judgment will remain essential, but decision allocation between humans and machines will be shifting**
- Man-machine teaming (Centaur or R2D2 at individual, platform, AOC/MOC)
  - Human expertise/experience, workload, pace, complexity
  - AI-assisted learning, COA generation, decision-making
- Trust, transparency, training
- Live, Virtual, Constructive (LVC)
  - AI assist blue with complexity/scale: training, T&E, ops rehearsal, force/TTP design/validation
  - AI augment/supplant red/white force, dynamic adaptation of force behaviors, environment
- **Extend speed of command, decision superiority**
  - **Computer, network, (sensor) data…knowledge, learning, decisions**

# Discussion