Drone Manufacturing Supply Chain Risks
Rapid Growth of the Drone Industry-
An Overview of the Risk Landscape

This presentation will discuss the current and future state of AI, Quantum drones, and autonomous systems. This includes the intended and unintended consequences, future uses, and misuse of such technologies.

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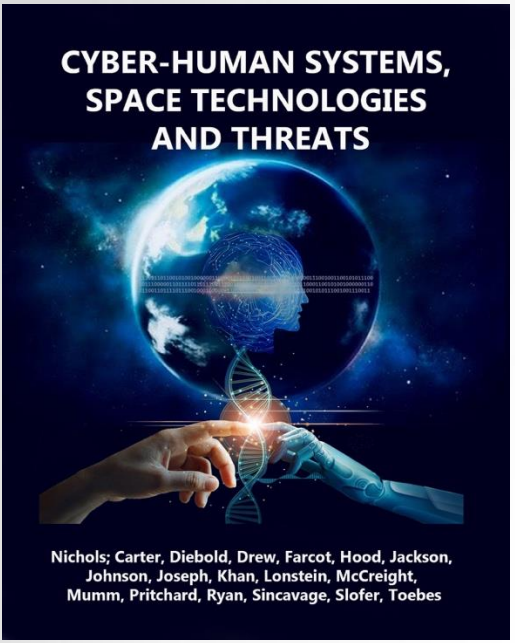
Aug 2025

Dr. Hans C. Mumm



How to harmonize the speed of innovation and change with the human spirit's need for leadership™

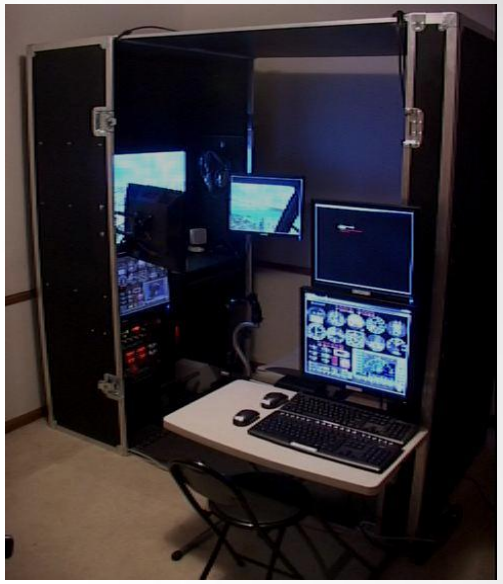
Member-Kansas State University (KSU)
Unmanned Aerial Systems (UAS) Board

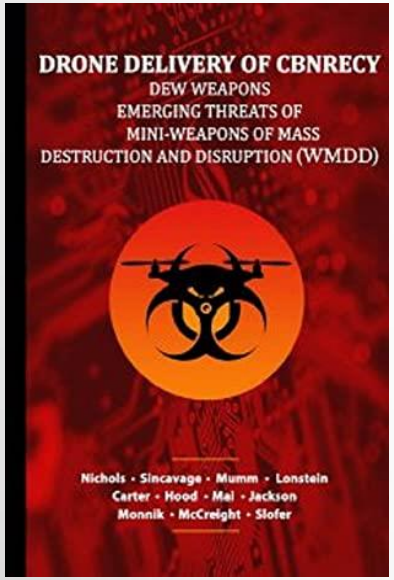
IEEE SA
STANDARDS ASSOCIATION

Quantum Security Alliance

PennWest CALIFORNIA

Chair-SC5-Self Healing Architecture Subcommittee-Cyber Security for Next Generation Connectivity Systems





What is a Supply Chain Risk?

- Risks affecting any part of the supply chain
- Categories: operational, geopolitical, cyber, environmental
- Potential impact on cost, quality, and timelines

Drone Manufacturing Overview

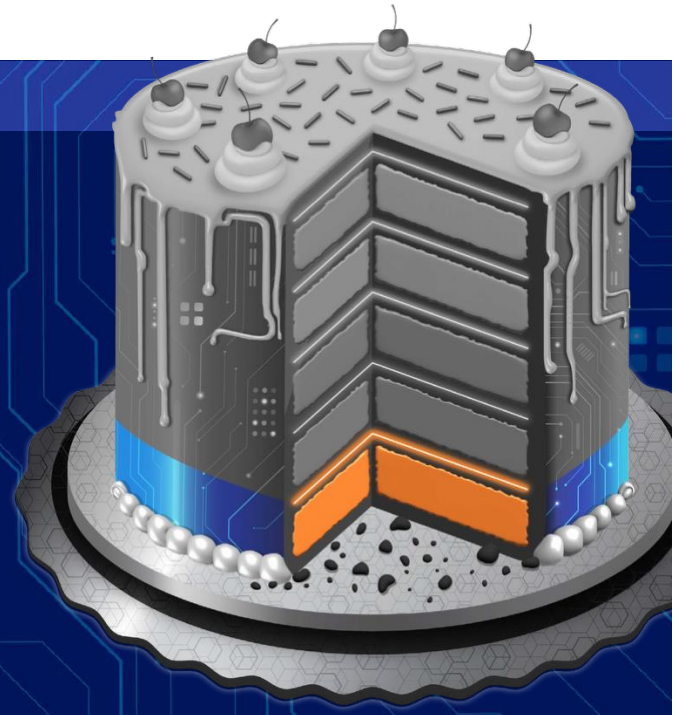
- Components: flight systems, GPS, sensors, batteries, software
- Manufacturing flow: design → sourcing → assembly → testing
- Complexity from global suppliers

Layer One: SCRM Strategy

*The first layer of the cyber cake is **Supply Chain Risk Management (SCRM)**. SCRM is a systematic process for managing supply chain risk by identifying susceptibilities, vulnerabilities, and threats throughout the supply chain and developing mitigation strategies to combat those threats, whether presented by the supplier, the supply product and its subcomponents, or the supply chain itself. The supply chain refers to the network of organizations, people, and activities involved in the production and delivery of a product or service.*

Core SCRM Cookbooks

1. Title 10 USC Section 3252, Requirements for Information Relating to Supply Chain Risk, *https://www.govinfo.gov/content/pkg/USCODE-2023-title10/pdf/USCODE-2023-title10-subtitleA-partV-subpartB-chap223-sec3252.pdf*
2. DoDI 5200.44, Protection of Mission Critical Functions to Achieve Trusted Systems and Networks, *https://www.esd.whs.mil/portals/54/documents/dd/issuances/dodi/520044p.pdf*
3. DFARS Subpart 239.73, Requirements for Information Relating to Supply Chain Risk, *https://www.acquisition.gov/dfars/subpart-239.73-requirements-information-relating-supply-chain-risk*



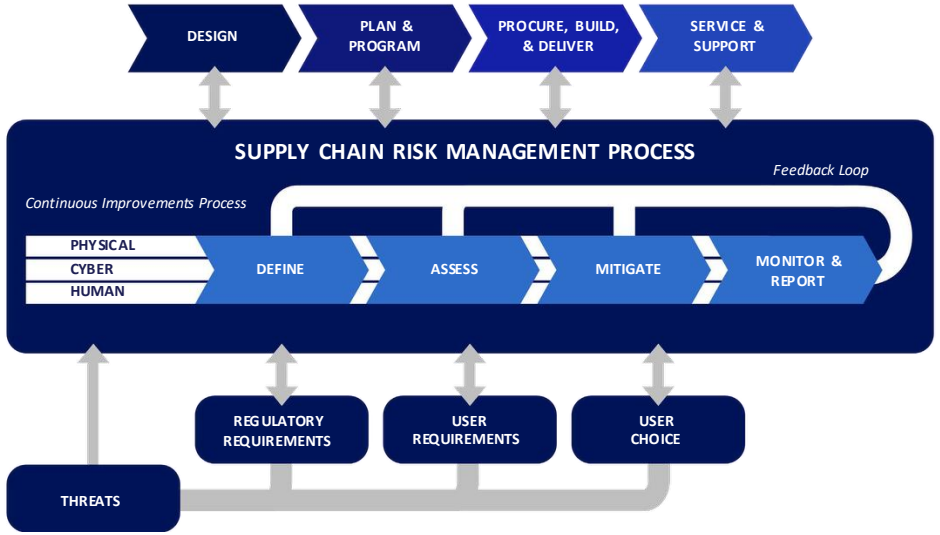


Figure 4: Supply Chain Risk Management

The Supply Chain Risk Management (SCRM) process is an essential component of overall risk management and helps organizations to define potential risks and vulnerabilities in the supply chain, assess the likelihood and impact of these risks, develop strategies to mitigate or manage these risks, and monitor and review the effectiveness of these strategies, as seen in Figure 4.

The figure also illustrates how the process is influenced by various external factors such as threats, legislative requirements, voluntary compliance to environmental risks, user requirements and choices. After defining, assessing, and mitigating risks across the physical, cyber, and human aspects of the supply chain, the process involves a feedback loop for continuous improvement ensuring resilience and minimizing potential disruptions. To be most effective, this approach should be integrated into the asset's lifecycle which begins in the design stage and follows through to service & support.

SCRM is important to protect United States' national security interests and minimize disruptions to military operations by ensuring the integrity and reliability of critical systems and components. By doing so, organizations can safeguard sensitive technologies and intellectual property, and enhance the resilience of global logistics and supply chains.

Key Suppliers and Dependencies

- Semiconductors: Taiwan, South Korea
- Lithium-ion batteries: China
- GPS modules: US and EU
- Overreliance on single-source suppliers

Global Supply Chain Structure

- Suppliers across China, the USA, Taiwan, and Europe
- Complex networks and interdependence
- Logistics and lead times are critical

Polling Question - 1

Do you think the US will have access to all supplies required to win in the new world of autonomous wars?

a. Yes
b. No
c. Has not been discussed yet in my office

Ukrainian drone destroys Russian supersonic bomber:

21-Aug-2023

Federal Acquisition Considerations

Environmental and Climate Risks

- Natural disasters (earthquakes, floods), Resource scarcity (rare earths), and Environmental regulations

Ethical Sourcing and Labor Issues

- Labor concerns (e.g., cobalt mining), ESG, and sustainability expectations
- Reputational risks, Weak IP laws in some regions, Counterfeit components

June 6, 2025. Executive Order-Unleashing American Drone Dominance
https://www.whitehouse.gov/presidential-actions/2025/06/unleashing-american-drone-dominance/

July 16, 2025, Pentagon to Increase Low-Cost Drone Production in U.S.

https://www.defense.gov/News/News-Stories/Article/Article/4246987/pentagon-to-increase-low-cost-drone-production-in-us/

Intellectual Property Risks

Potential theft of designs and trade secrets

Bill of Materials: Heavy-Lift FPV Fiber Optic Quadrotor Drone

ID Type & Number	Item	Material(s)	Purpose/Notes	Est. Quantity
Frame & Structure				
1	Structural Arms & Plates	Carbon fiber (woven), epoxy resin	Lightweight, strong frame	~2 m^2 sheet
2	Mounting Hardware	Aluminum/Titanium alloy	Bolts, standoffs, brackets	~100 pcs
3	Vibration Dampers	TPU (Thermoplastic Polyurethane)	Vibration isolation	~8–12 pcs
4	Landing Gear	Nylon or carbon-reinforced plastic	Impact resistance	1 set
Propulsion System				
5	Brushless Motors (4x or 8x)	Copper (windings), silicon steel (laminations), neodymium (magnets), aluminum	High-thrust motors	4–8 units
6	Propellers (13"–28")	Carbon fiber or polycarbonate	Heavy-lift propellers	4–8 pcs
7	Motor Mounts	Aluminum or carbon composite	Secure motor fitting	4–8 pcs

BoM: Heavy-Lift FPV Fiber Optic Quadrotor Drone, Cont.

ID Type & Number	Item	Material(s)	Purpose/Notes	Est. Quantity
Power System				
8	LiPo Battery Cells	Lithium, cobalt, manganese, graphite, aluminum	High-capacity power	1–2 packs (12S, ~20,000–30,000mAh total)
9	Power Distribution Board	Copper, FR4, gold plating	Power routing	1 unit
10	Wiring & Connectors	Copper wire, silicone insulation	High-current wiring	~5–10 m
11	Battery Housing	ABS plastic or aluminum	Protective enclosure	1 unit
Flight Controller & Sensors				
12	Flight Controller PCB	Silicon (MCU), copper, FR4, gold	Main control system	1 unit
13	IMU/GPS/Compass Sensors	Silicon, ceramic, gold	Navigation & stabilization	1–2 modules
14	Barometer/Magnetometer	Silicon, gold, plastic	Altitude & heading control	Included in FC

BoM: Heavy-Lift FPV Fiber Optic Quadrotor Drone, Cont.

ID Type & Number	Item	Material(s)	Purpose/Notes	Est. Quantity
Fiber Optic Data System				
18	Optical Fiber Cable	Silica (core/cladding), polyimide coating	High-speed data/video	~10–20 m
19	Fiber Connectors	Plastic or metal (ST, LC, SC)	Data interface	4–8 pcs
20	Optical Transceivers	Silicon, gallium arsenide	Converts electrical to optical signals	2–4 units
Communications & Control				
21	Radio Receiver	Silicon, copper, FR4	Flight control link	1 unit
22	Ground Control Transmitter	Plastic, aluminum, silicon, Li-ion	Pilot controller	1 unit
23	Telemetry Module	Silicon, FR4, gold	Data uplink/downlink	1 unit

BoM: Heavy-Lift FPV Fiber Optic Quadrotor Drone, Cont.

#ID Type & Number	Item	Material(s)	Purpose/Notes	Est. Quantity
Cooling & Protection				
24	Heat Sinks / Cooling Fans	Aluminum, copper	For ESCs and VTx	4–6 pcs
25	Protective Covers & Canopy	Polycarbonate, ABS	Protect electronics	1 set
Assembly & Misc.				
26	Fasteners & Screws	Stainless steel, aluminum	General assembly	~200 pcs
27	Solder	Lead-free solder alloy	PCB/electrical connections	~100 g
28	Adhesives	Epoxy, Loctite	Structural & thread-lock	~50–100 ml
29	Vibration Isolating Tape	Rubber/silicone	For electronics damping	~2 m

BoM: Heavy-Lift FPV Fiber Optic Quadrotor Drone Optional Add-ons (for advanced builds)

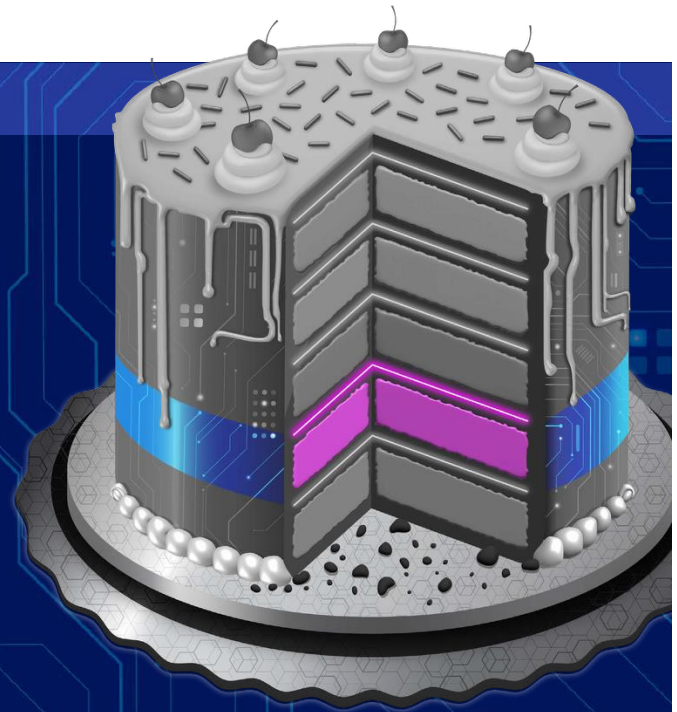
#ID Type & Number	Item	Material(s)	Purpose/ Notes	Est. Quantity
LiDAR Unit	Gallium arsenide, silicon	Obstacle sensing		
Optical Flow Sensor	CMOS, glass	Indoor stability		
LED Navigation Lights	Gallium nitride/phosphor	Visibility & status		
Payload Release	Servo (metal, plastic)	For delivery/release mechanisms		

Layer Two: C-SCRM Strategy

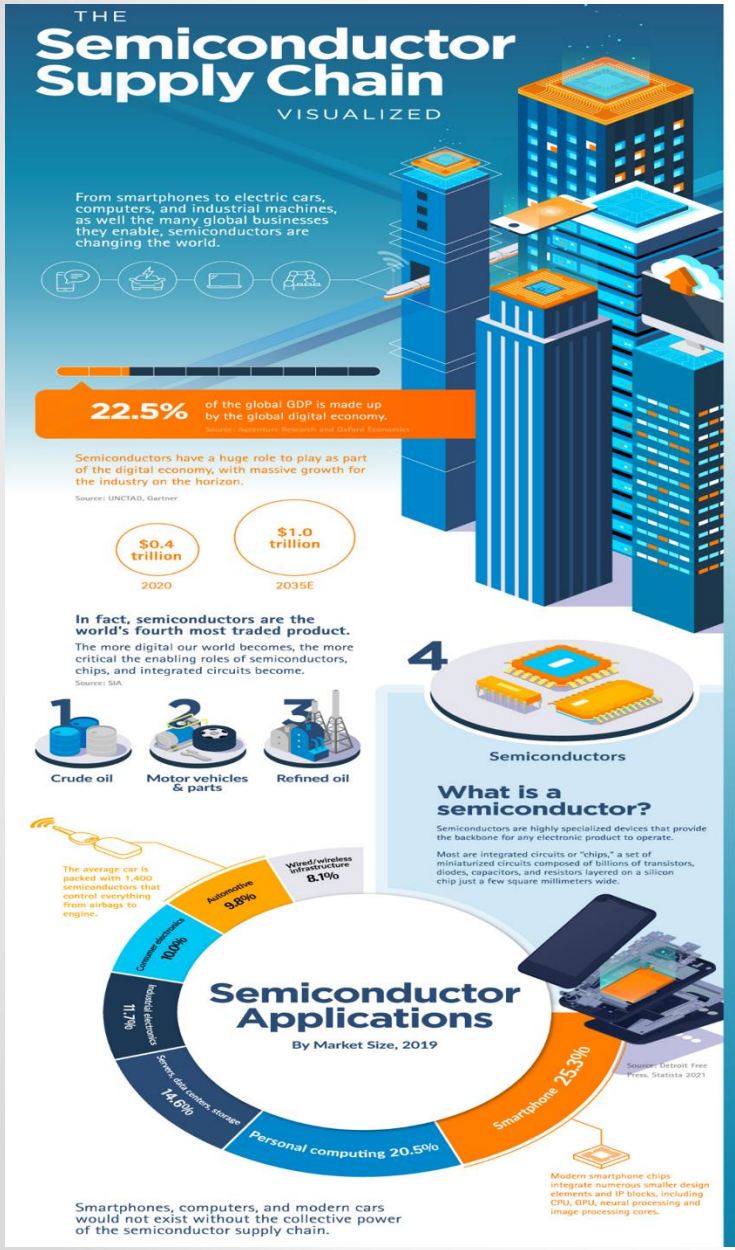
Cybersecurity Supply Chain Risk Management (C-SCRM) *is the next layer in the cyber cake and complements the flavors of the below layer, SCRM. In today's digital landscape, C-SCRM is a critical subset of SCRM that specifically focuses on managing the cyber-related risks and threats associated with the supply chain, such as data breaches, malware, and other cyber attacks.*

Core C-SCRM Cookbooks

1. NIST SP 800-161, Cybersecurity Supply Chain Risk Management Practices for Systems and Organizations, https://csrc.nist.gov/pubs/sp/800/161/r1/upd1/final
2. NIST SP 1326, NIST Cybersecurity Supply Chain Risk Management: Due Diligence Assessment Quick-Start Guide, https://csrc.nist.gov/pubs/sp/1326/ipd
3. NIST SP 1305, NIST Cybersecurity Framework 2.0: Quick-Start Guide for Cybersecurity Supply Chain Risk Management (C-SCRM), https://csrc.nist.gov/pubs/sp/1305/final
4. DoD Strategy and Implementation Plan for ICT and Services Supply Chain Risk Management Assurance, https://dodcio.defense.gov/Portals/0/Documents/Library/ICT-ServicesSupplyChain-RMA.pdf
5. DoD Information and Communications Technology Supply Chain Risk Management Home Page, https://cyber.mil/ict-scrm



Semiconductor Supply Chain



How do semiconductor chips make their way from concept to consumer?

The answer:
An integrated semiconductor supply chain that involves thousands of companies and millions of people around the world, forming the backbone of today's digital economy.

Stage 1
Design
Semiconductor chip designs are created for either specific or general product usage.

Stage 2
Manufacturing
Front End
Silicon wafers are processed through a complex and extensive series of manufacturing steps.
Each wafer is then diced into multiple chips (devices).

Stage 3
Manufacturing
Back End
Chips are assembled into packages to form the electronic components that can be mounted onto circuit boards.
Packaged chips are then tested under different electrical and temperature conditions.
ASE is the market leader in assembly and testing services as well as a leading electronics manufacturing service (EMS) player.

Stage 4
End Product Integration
Chips are integrated by EMS and OEM companies to create end products.
$0.58 trillion
Global market size for EMS and ODM in 2020.
1.04 trillion
Semiconductor chip units shipped in 2020.

Stage 5
Consumption
End products are shipped to companies, retailers, and consumers worldwide for a growing number of applications.

End products:
Mobility & connectivity · Personal computers · Cars · Servers & storage drives · Smart homes · Smart medtech · Industry 4.0, smart factories

Location
- Fabless semiconductor companies
- Electronics manufacturers
- Independent design companies
- Foundries
- Captive Factories (IDMs)
- Outsourced Semiconductor Assembly & Test (OSATs)
- Original Equipment Manufacturers (OEMs)
- Electronics Manufacturing Service (EMS)

Integrated Device Manufacturers (IDMs)
While the foundry model separates semiconductor manufacturing steps to different companies, IDMs traditionally manufacture their own chips.
IDMs also rely on the foundry model to supplement a portion of manufactured devices.

From starting production to integrating in finished products, semiconductor production can take months.
Components for a chip can travel more than 25,000 miles by the time of final product integration.
Source: IC Insights, ASML, Accenture

SPOTLIGHT
Where ASE Fits In
Every company in the semiconductor supply chain has a unique role.
Positioned as a critical link in the chain, ASE is the leading global provider of semiconductor manufacturing services in assembly and test.

30% of the global OSAT market share in 2021
3T+ trillions of chips manufactured
37+ years fueling the high growth electronics industry

Markets Enabled by ASE and Semiconductors
5G
Artificial Intelligence (AI)
Internet of Things (IoT)
Automotive
Smart Factories
Quantum Computing
Data Processing

Semiconductor
Package/Module Integrator
System OEM
Content/service
User

Application-specific
Outsourced Semiconductor Assembly & Test (OSATs)
Electronics Manufacturing Service (EMS)
Design · Assembly · Test · Materials · Components · Logistics

ASE, alongside every semiconductor industry player, is enabling the present and empowering the future.
Semiconductor chips form the brains of every single electronic device transforming our world. The semiconductor industry collectively delivers the computing power and system performance necessary for a safer, healthier, and more sustainable planet.

Presented by ASE GROUP
Via @fklivestolearn
NYSE: ASX
aseglobal.com

VISUAL CAPITALIST

More Threats and Risks

Cybersecurity Threats

- Firmware vulnerabilities
- Data interception risks
- Examples: DJI concerns, US bans
- Importance of secure software/firmware

Geopolitical Risks

- Sanctions (e.g., Entity List)
- Political instability is affecting sourcing
- Example: chip export restrictions
- Trade wars (US-China)

Supply Disruptions

COVID-19 Complications

- COVID-19: factory shutdowns, shipping delays
- Ukraine conflict: raw material shortages
- Global ripple effects

Regulatory and Compliance Risks

- FAA, FCC, ITAR regulations
- Licensing, documentation, audits
- Risk of non-compliance: fines, bans

Supply Disruptions-Innovation and New TTPs

- [redacted] is designed to target shorter-range rockets that larger systems are unable to detect.
- [redacted] is designed to destroy longer-range rockets.
- [redacted] targets short-to-medium range ballistic missiles.
- [redacted] targets long-range ballistic missiles.
- [redacted] battery, which can intercept missiles inside and outside the Earth's atmosphere. It targets enemy missiles in their final stage of flight, within a range of approximately 150-200 km.
- The [redacted] primary technical limitations include its radar and tracking system flaws, as well as the limited range and speed of its interceptors. These limitations can render the system ineffective against certain types of threats, such as small or stealthy projectiles.

1. Hypersonic glide vehicles (HGVs), which can maneuver and glide at hypersonic speeds.
2. Drone, FPV, multiple autonomous systems programmed to goal seek.

Low Supply Levels Can Cost Lives

https://www.youtube.com/watch?v=D-Ka_rcb5yQ

Polling Question - 2

Will you see an autonomous battlefield in your lifetime?

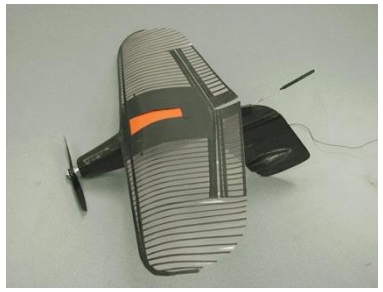
a. Yes

b. No

c. Not with today's technology

New Technologies?

- VTOL UAV & LAH
- Micro Air Vehicle
- USV with BLOS weapons
- UGVs
- Advanced A.I. for Robotics



Vision Force Tactical UAV

- **Max True Airspeed** **135+ kts**
- **Ceiling** **14,000+ ft**
- **Range** **700+ nm**
- **Endurance** **6+ hrs**
- **Payload** **1,000+ lbs**
- **Empty Weight** **1,000 lbs**
- **External Pylons** **2**
- **Fuel Capacity** **100+ gal.**
- **Aux Fuel Capacity** **100+ gal.**
- **Internal Volume** **25+ cu.ft**
- **Rotor Height** **8 ft**
- **Rotor Diameter** **21 ft**
- **Aircraft Length** **21 ft**

Standard

- 15 inch Sensor Ball
  - EO/IR, Low Light
  - Laser Designator
- Multi-Purpose Pylons
- 9 Mb/s Data Link
- Wide FOV Pilot Camera
- Triple Screen Display

Unmanned Wingman/Scout

- Advance Artificial Intelligence
- Autonomous Capabilities
  - Formation Flying
  - Collision Avoidance
  - Navigation
  - Threat Avoidance
  - Threat Reactions
  - Attack Tactics
  - Target Nominations
- One or Many UAVs with an attack helicopter
- Minimum Comm. or Comm.-out capability
- Demonstrated in simulation

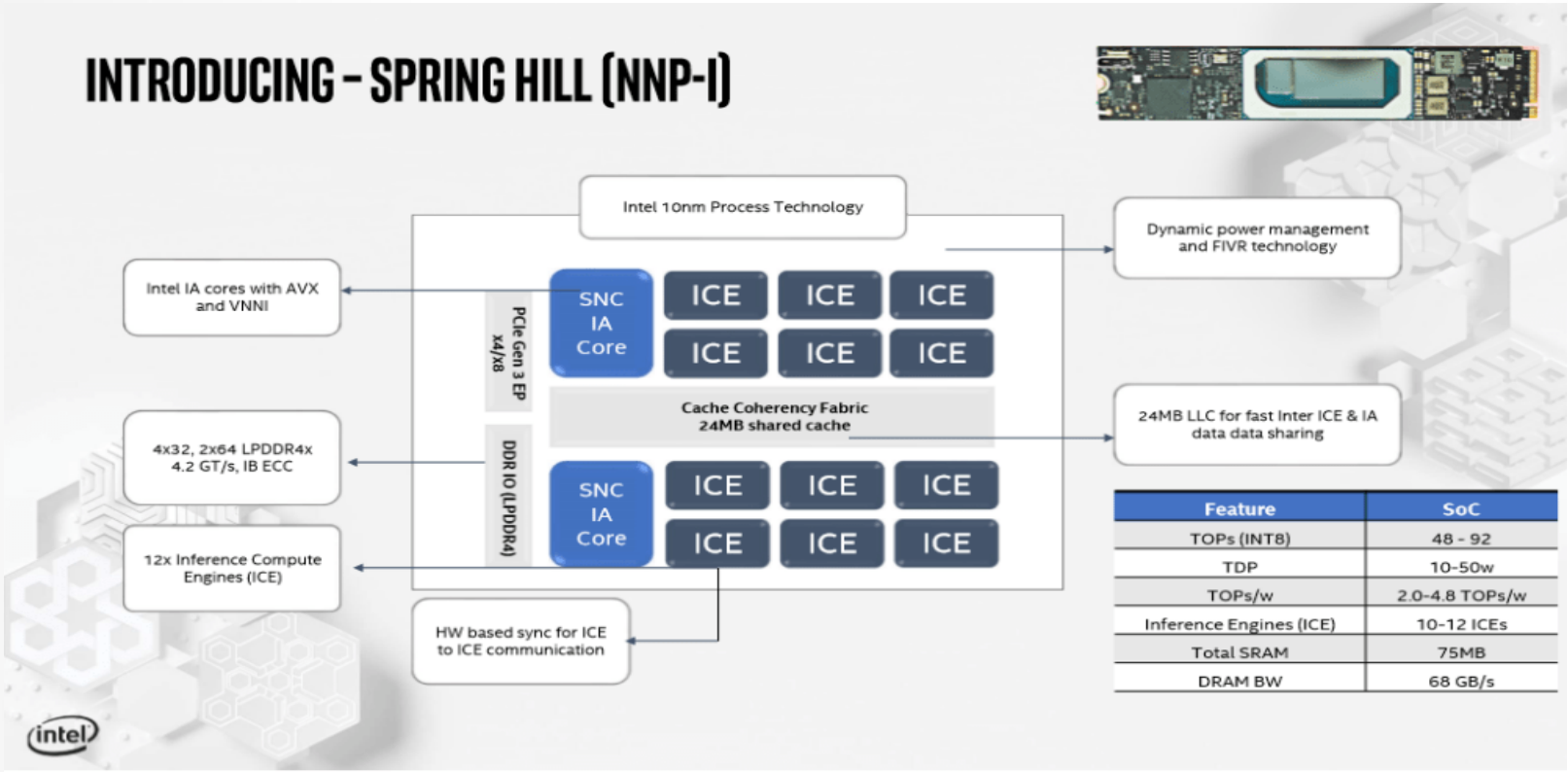
Risk Assessment Matrix

Risk ID #	Risk Description	Likelihood	Impact	Risk Rating	Mitigation Strategy
R1	Shortage of rare earth metals	High	High	Critical	Diversify suppliers, build reserves, invest in recycling
R2	Dependency on overseas electronics	High	High	Critical	Domestic sourcing, strategic partnerships
R3	Geopolitical tensions	Medium-High	High	High	Geographic diversification, scenario planning
R4	Cyberattack on supply chain	Medium	High	High	Zero-trust, audits, SBOM
R5	Logistics disruption	Medium	Medium	Medium	Multiple logistics providers, predictive analytics

Risk Assessment Matrix, Cont'd

Risk ID #	Risk Description	Likelihood	Impact	Risk Rating	Mitigation Strategy
R6	Counterfeit components	Medium	High	High	Supplier vetting, traceability systems
R7	Regulatory changes	Low-Medium	Medium	Medium	Compliance teams, agile sourcing
R8	Manufacturing shutdown	Low	High	Medium	Backup facilities, continuity plans
R9	Skilled labor shortages	Medium	Medium	Medium	Upskilling, remote hiring
R10	Loss of IP	Medium	High	High	NDA enforcement, vendor assessments

Intel Unwraps its First AI Chip: Spring Hill



Feature	SoC
TOPs (INT8)	48 - 92
TDP	10-50w
TOPs/w	2.0-4.8 TOPs/w
Inference Engines (ICE)	10-12 ICEs
Total SRAM	75MB
DRAM BW	68 GB/s

- The goal is an untethered and mobile environment, thus “AI on the edge.” The implementation requires the development of optimized AI-specific semiconductors
- Ice Lake design to accommodate 12 Inference Compute Engines (ICE)
- Intel and Lenovo have signed a multi-year partnership agreement where both companies will focus on converging high-performance computing (HPC) and artificial intelligence (AI), Aug 7, 2019.
- **US Chips Are Paving China’s Path to AI Superiority and There’s No Easy Fix-Defense One, Jul 5, 2022.

A New Day is Dawning

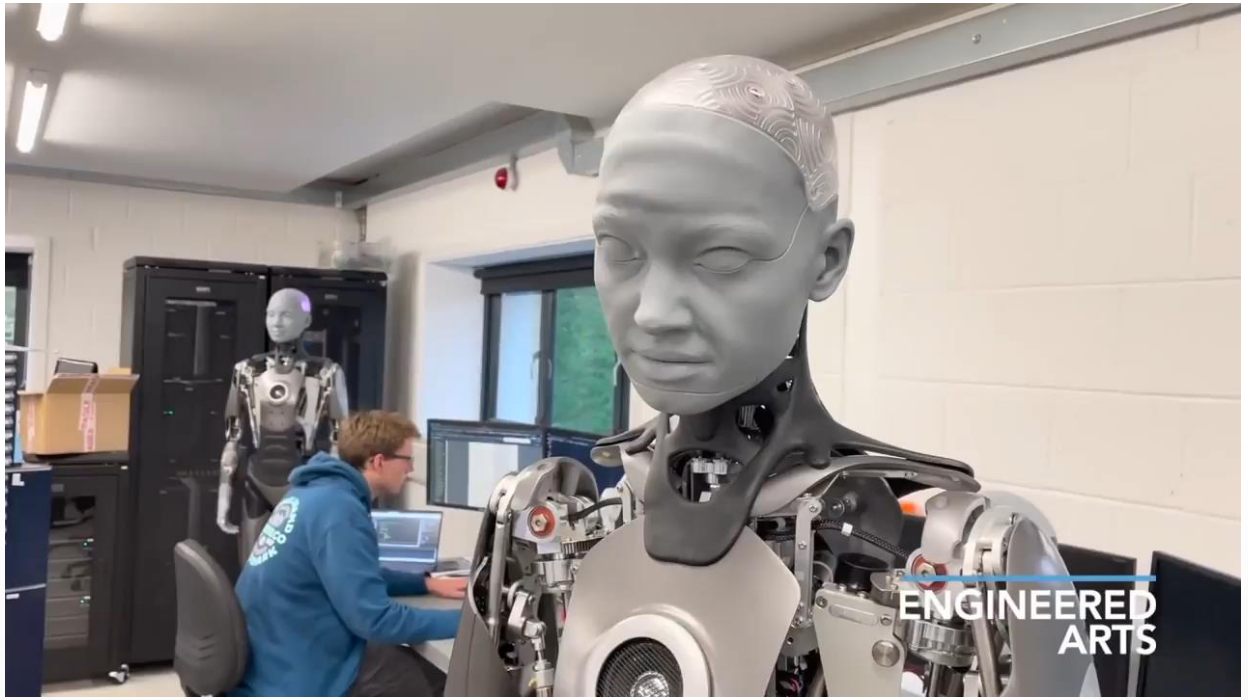
PATS-X drones

The Grain Weevil robot

Robotic dog-Flamethrower

Robotic Weedeater

Ameca and the most realistic AI robots. Beyond Atlas.



Piestro Robotic Pizza Shops

Partnerships for Resiliency

Emerging Technologies for Resilience

- Blockchain for traceability
- AI for predictive analysis
- Digital twins for scenario planning

Government and Industry Support

- Public-private collaboration
- Defense Production Act
- Standard bodies: NIST, ISO

Polling Question - 3

Does the US have a drone supply chain and proper cybersecurity redundancy to withstand another 20-year conflict?

a. Yes

b. No

c. Not with today's technology.

d. Not with current policies, laws, and governance.

Washington D.C.’s Favorite Game- Buzzword Bingo

AI-Machine Augmentation - Deep Learning - Data Science

Data Analytics - Cyber Security (EXPERT) - Block Chain - Smart Contract Technology - Quantum Computing

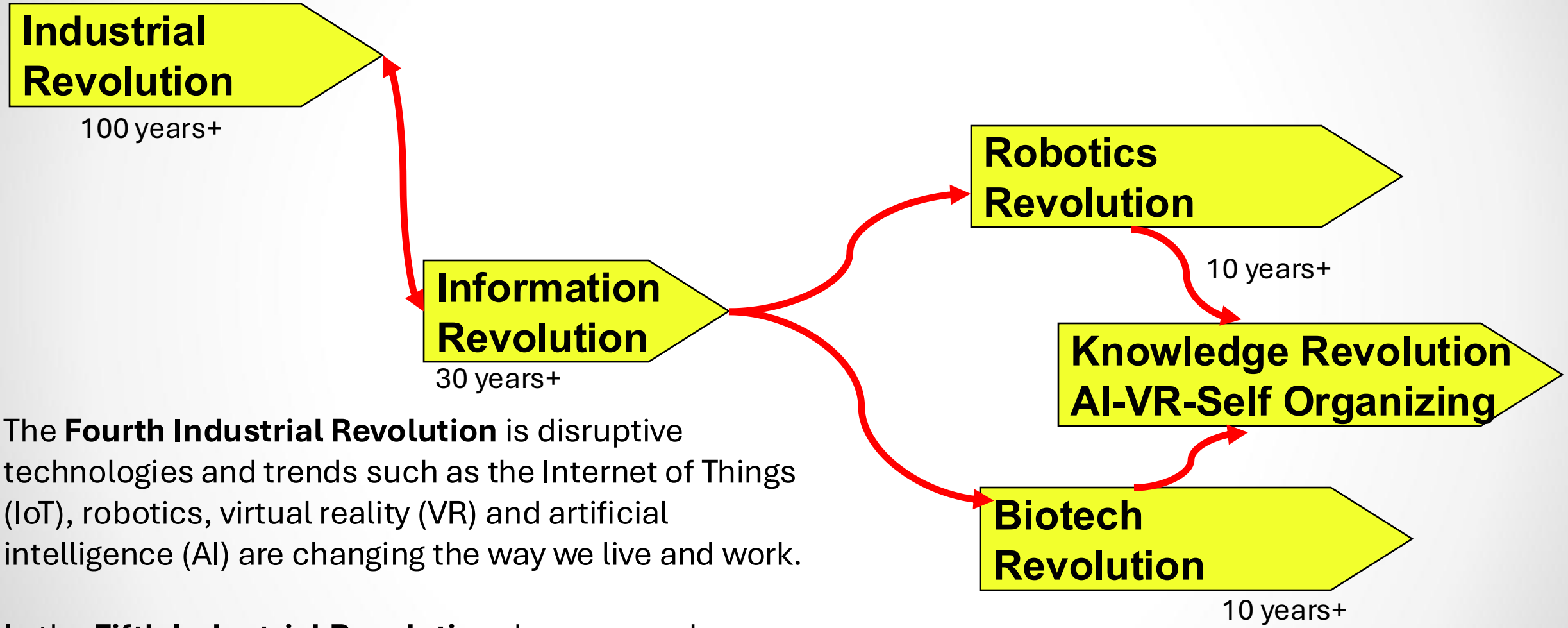
Drone - UAV - Robotics - Terminator - Skynet

Social Media - Social Networking - Anti-Social Behavior

Internet of Things (IoT) - Connected World

- Disruptive Technologies

Accountability in Machine Based Decision Making- The Purposeful Logic in the Next Revolution



The **Fourth Industrial Revolution** is disruptive technologies and trends such as the Internet of Things (IoT), robotics, virtual reality (VR) and artificial intelligence (AI) are changing the way we live and work.

In the **Fifth Industrial Revolution,** humans and machines will dance together, metaphorically.

The Key to Success is Integrating All Autonomous Systems – Air, Ground, Water, Underwater, Humanoids

- Policy
- Governance
- Laws (Crime)
- Ethics
- Human Acceptance
- Insurance Industry

Hyundai puts platooning self-driving trucks to the test

"We will strive to create constructive synergy by sharing our know-how and experiences of developing autonomous driving technology between commercial vehicle and passenger vehicle sectors to expedite level-5 autonomous driving technology."-Hyundai Motor Company

Integrated Autonomous Systems Infrastructure

- Currently, there are eight recognized unmanned autonomous systems: unmanned boats, unmanned air vehicles (including space assets), unmanned submarines, unmanned surface vehicles, free-roaming humanoids, exoskeletons, autonomous cyber systems, and now **nano biologics**.

- Soon, they will communicate and integrate as the autonomous arena adapts from simplistic tasks into a fully integrated architecture.

- Autonomous architectures are outpacing policymakers' and world leaders' abilities to draft and approve policies, laws, and governance necessary for advanced technologies and autonomous systems.

Risk Mitigation Strategies

- Diversify suppliers
- Vertical integration
- Invest in cybersecurity
- Contingency planning

Sudan War Strategy Shifts To The Air As Both Sides Increase Drone Use (July 20, 2025)

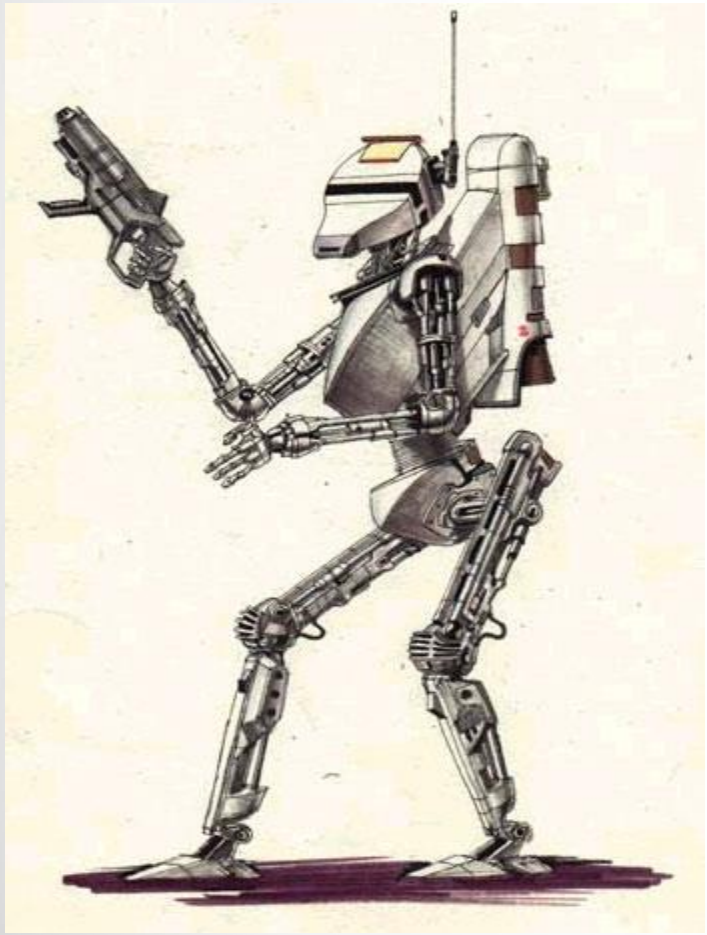
Case Study: DJI-Everyone was Using Them

- US scrutiny over data and security
- Entity List impact
- Market share and public perception
- Resilience strategies used

Future Outlook

- US manufacturing trends
- Limited autonomous systems supply chains. Risk factors are more numerous than our acquisition cycle can effectively address.
- Increased automation and transparency-all eight autonomous systems will integrate into our society and war machines-who commands the resources?

It is an Incredible Time to Be Alive-
Thank You All For Your Time and Attention



Robo Sapiens

As technology advances, it will provide a level of autonomy that enables the vehicle to make some decisions on its own. If you have a weapon on the platform, you will never want to give up control.

Contact Information:

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