Manufacture – the Challenge to the DoD

Alan Shaffer

2 May 2024

Manufacture – The Conundrum

- **While Getting Stronger, US Manufacture has lost ground in a world perspective**

- **Critical Industrial Sectors For DoD Where Manufacture is weak:**
  - **Shipbuilding**
  - **Semiconductors**
  - **Printed Circuit Boards**
  - **Others**
- **Great Power Competition**
  - **China progressing faster than US in some critical Defense Tech**
  - **China adept at borrowing others intellectual property**

- **Pace of DoD Capability Fielding is Too Slow**

- **Several Possible Solutions—**
  - **Change the way DoD buys things (process change)**
  - **Use Tech Based Manufacture Advancement**

The "Equation"

Weakened Manufacture Sector +
Enhanced Potential Adversarial
Velocity >>
Pace of Delivery of US (Allied)
Capability F(DoD Process, DIB
Capacity, Manufacture Tech)

Has to be changed

" The private sector and open markets have been, and will continue to be, a vital source of our national strength and key driver of innovation. However, markets alone cannot respond to the rapid pace of technological change, global supply chain disruptions, nonmarket abuses by the PRC and other actors, or the deepening climate crisis. ==Strategic public investment is the backbone of a strong industrial and innovation base in the 21st Century global economy"== (Page 14)

NATIONAL SECURITY STRATEGY

OCTOBER 2022

THE WHITE HOUSE
WASHINGTON
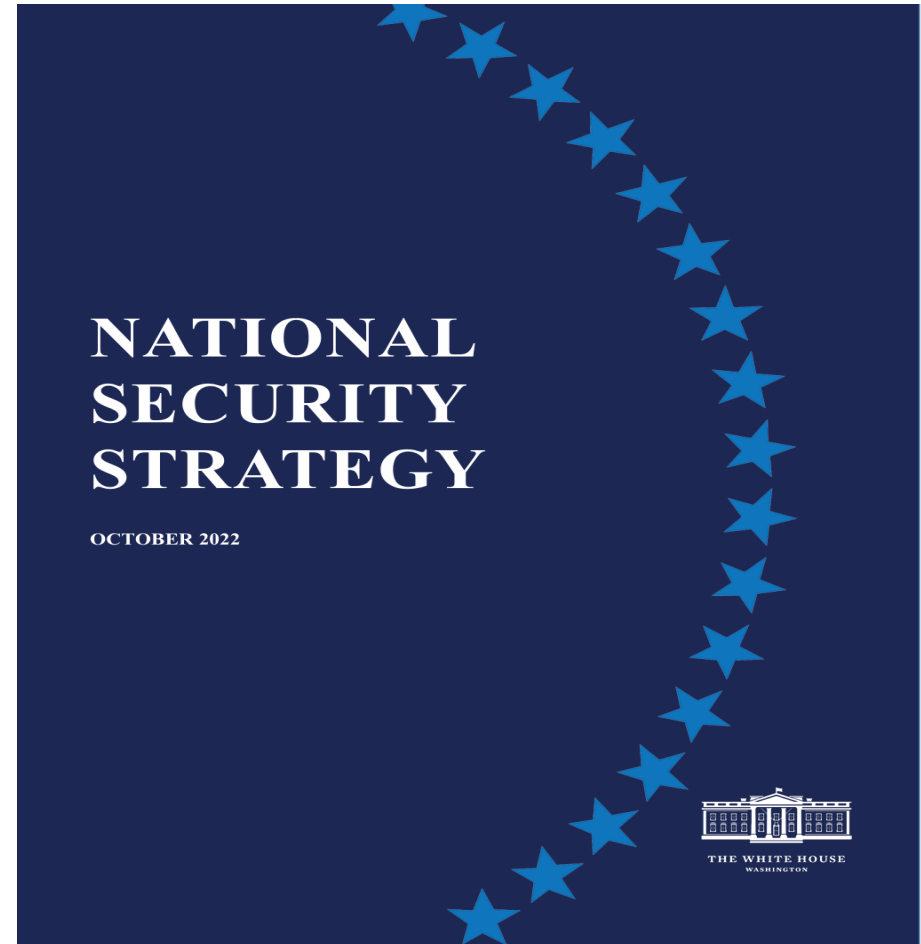
This Strategy Opened the Door to Government Investment

US National Security Strategy
October 2022

"Our World is at an Inflection Point. The NSS will advance Americas Vital interests and Lead with American Values"

"The PRC has the intention, and increasingly the capacity to reshape the international order into one that favors China"

Technology is Central to today's geopolitical competition

Work With Partners to:
1. Pioneer New Medicines
2. Increase Food Production
3. **Strengthen Manufacture**
4. Secure Energy without Fossil Fuels

Secure Historic Investment
1. Clean Energy
2. Microelectronic
3. Biotechnology
4. R&D in General
5. Focus also on STEM s

Promote Foundational Technology
1. Microelectronics
2. Advance Computing and quantum
3. Artificial Intelligence
4. Biotech **/ Bio Manufacture**
5. Advanced Telecomms
6. Clean Energy

NATIONAL SECURITY STRATEGY

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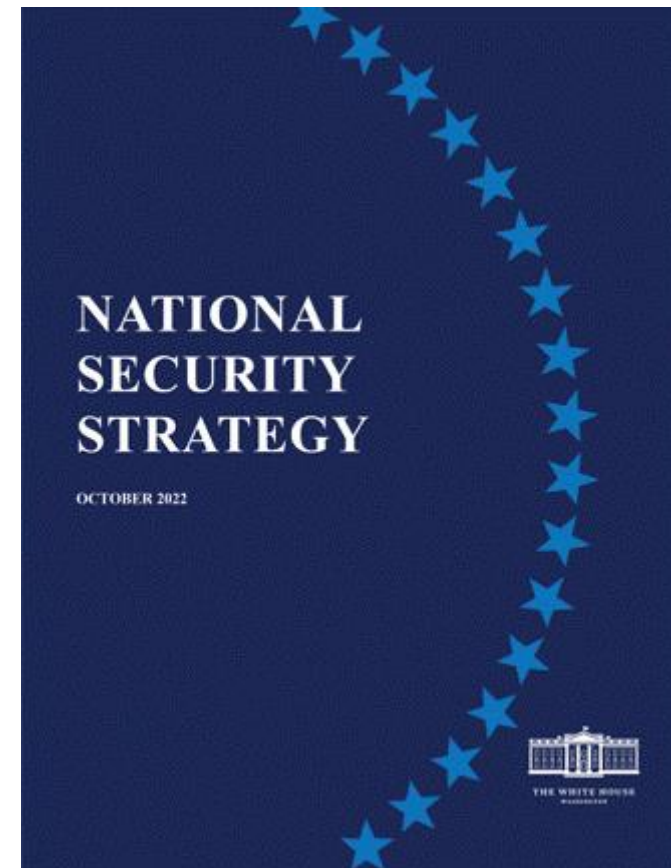
The Bedrock—Digital Backbone that is Open, Trusted, and Secure

National Defense Industrial Strategy
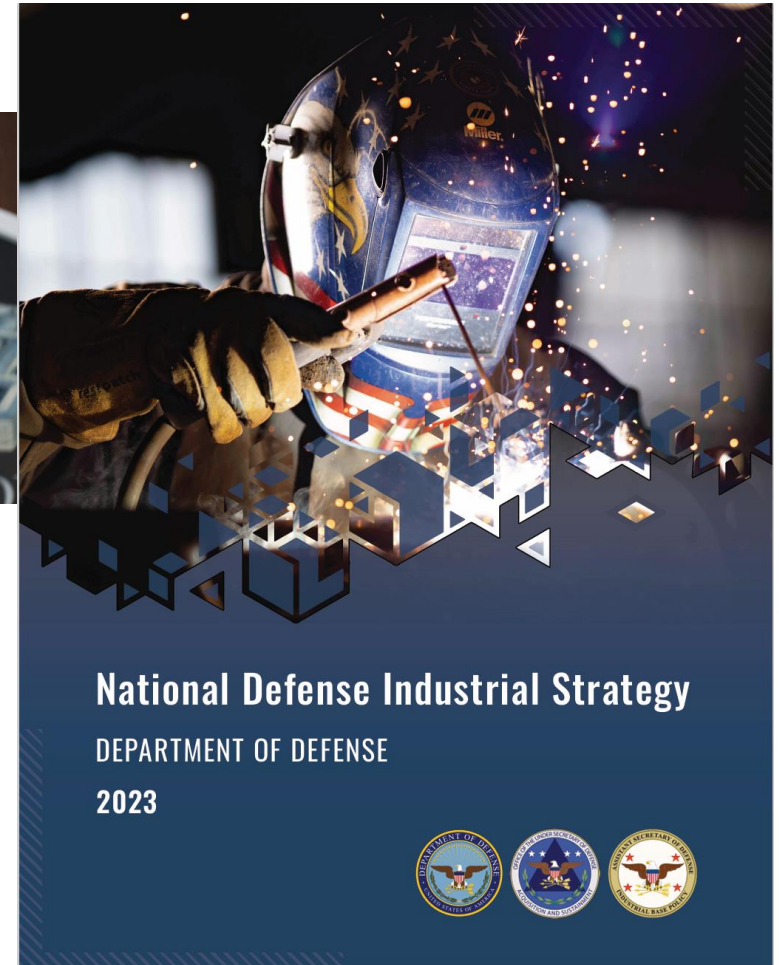# (Released Jan 2024)

National Defense Industry Strategy:

"The nation needs to rally to the common defense"

"NDIS is a call to both the public and private sectors for focused, dedicated efforts to build and secure the industrial capability and capacity necessary to ensure our military has the materiel available to deter our potential adversaries, and if necessary, defeat them in battle. This call to action may seem a great cost, but the *consequences* of *inaction or failure are far greater*."[1]

Quote From Dr. Bill LaPlante Undersecretary For Acquisition and Sustainment
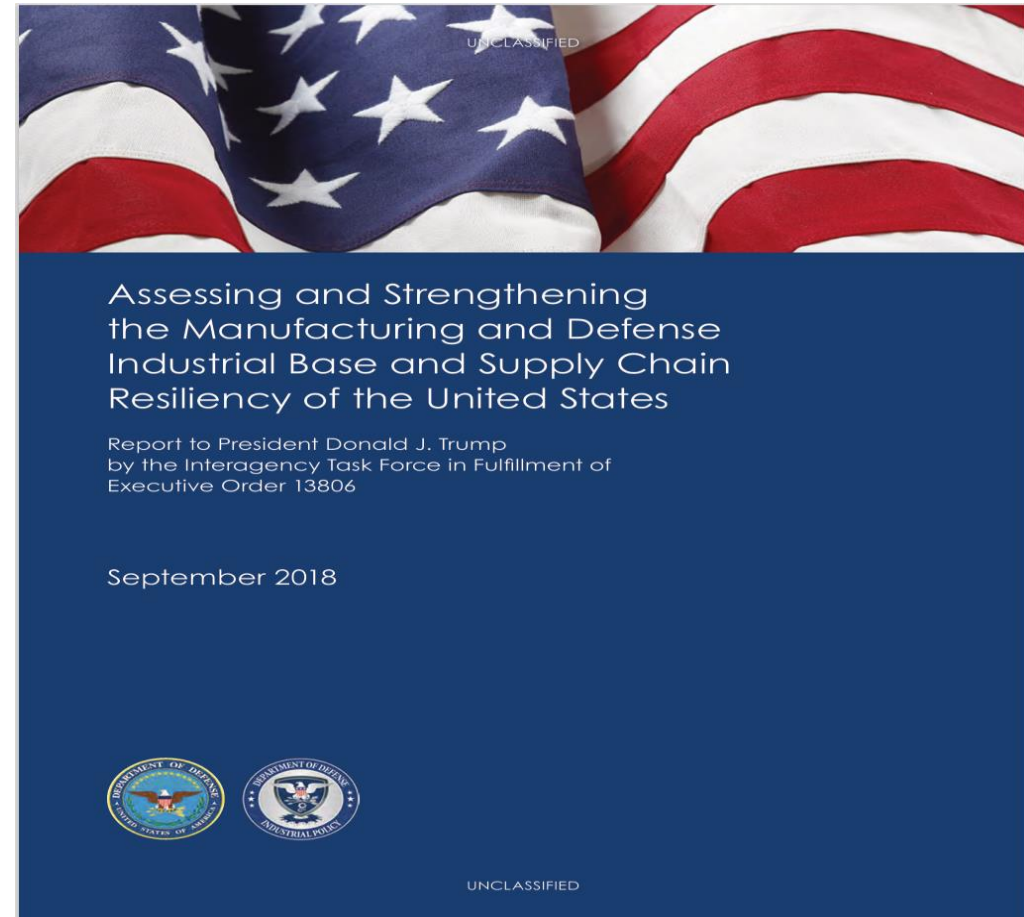
https://www.politico.com/news/2023/12/02/draft-pentagon-strategy-china-00129764

National Defense Industrial Strategy
DEPARTMENT OF DEFENSE
2023

This Strategy Directs Expansion of Industrial Base—Can Manufacture Keep Up?

- Assessed the Domestic and International Manufacture and Defense Industrial Base
- Had 5 Macro Forces; three in Manufacture
  - Decline in US Manufacture Base Capabilities and Capacity
  - Industrial Policies of Competitor Nations
  - Diminishing US STEM and Trade Skills
- Conclusion: Need Stable Funding, Public-Private Partnerships, and Workforce Renewal[1]

UNCLASSIFIED

Assessing and Strengthening
the Manufacturing and Defense
Industrial Base and Supply Chain
Resiliency of the United States

Report to President Donald J. Trump
by the Interagency Task Force in Fulfillment of
Executive Order 13806
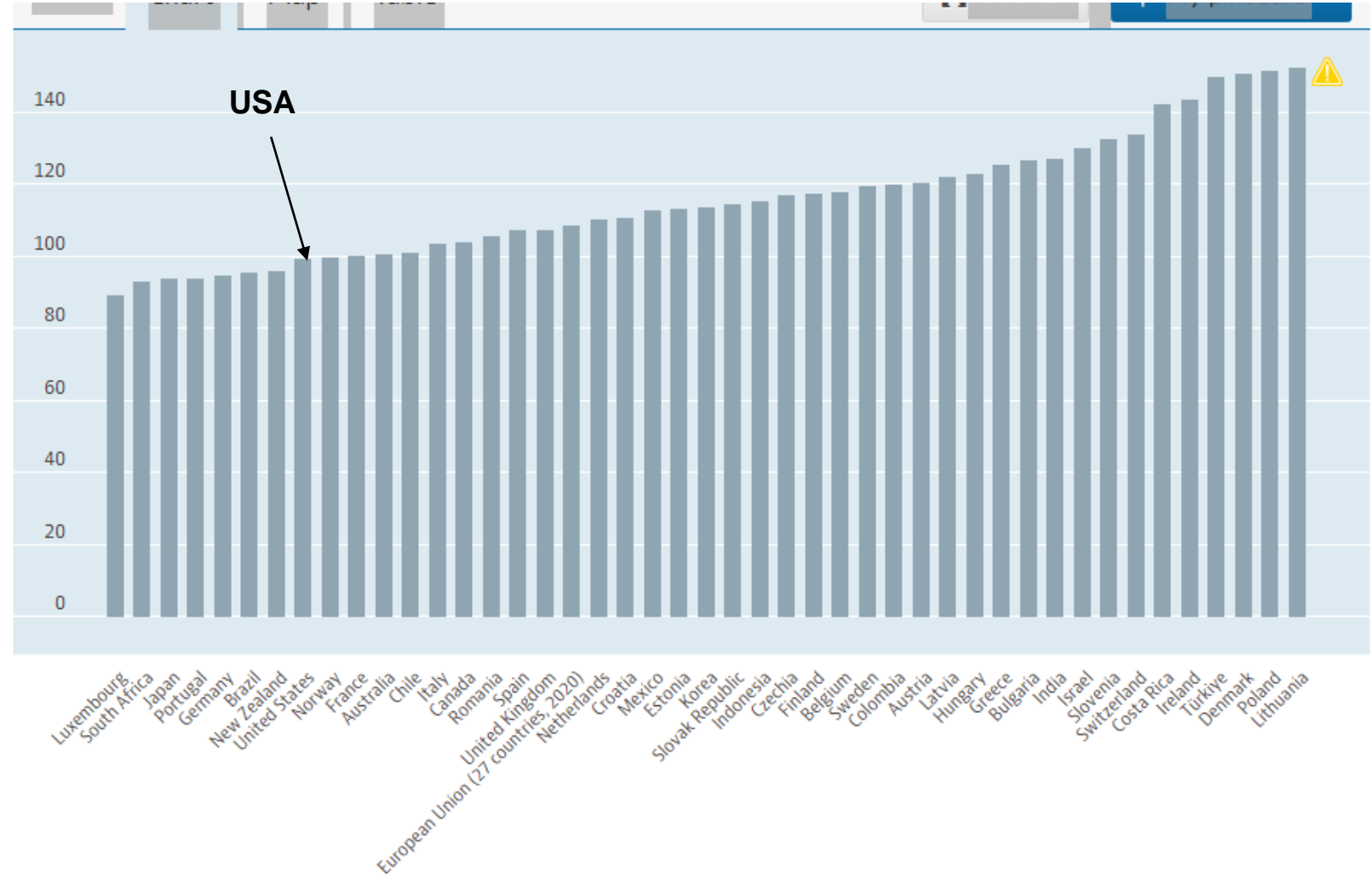
September 2018

UNCLASSIFIED

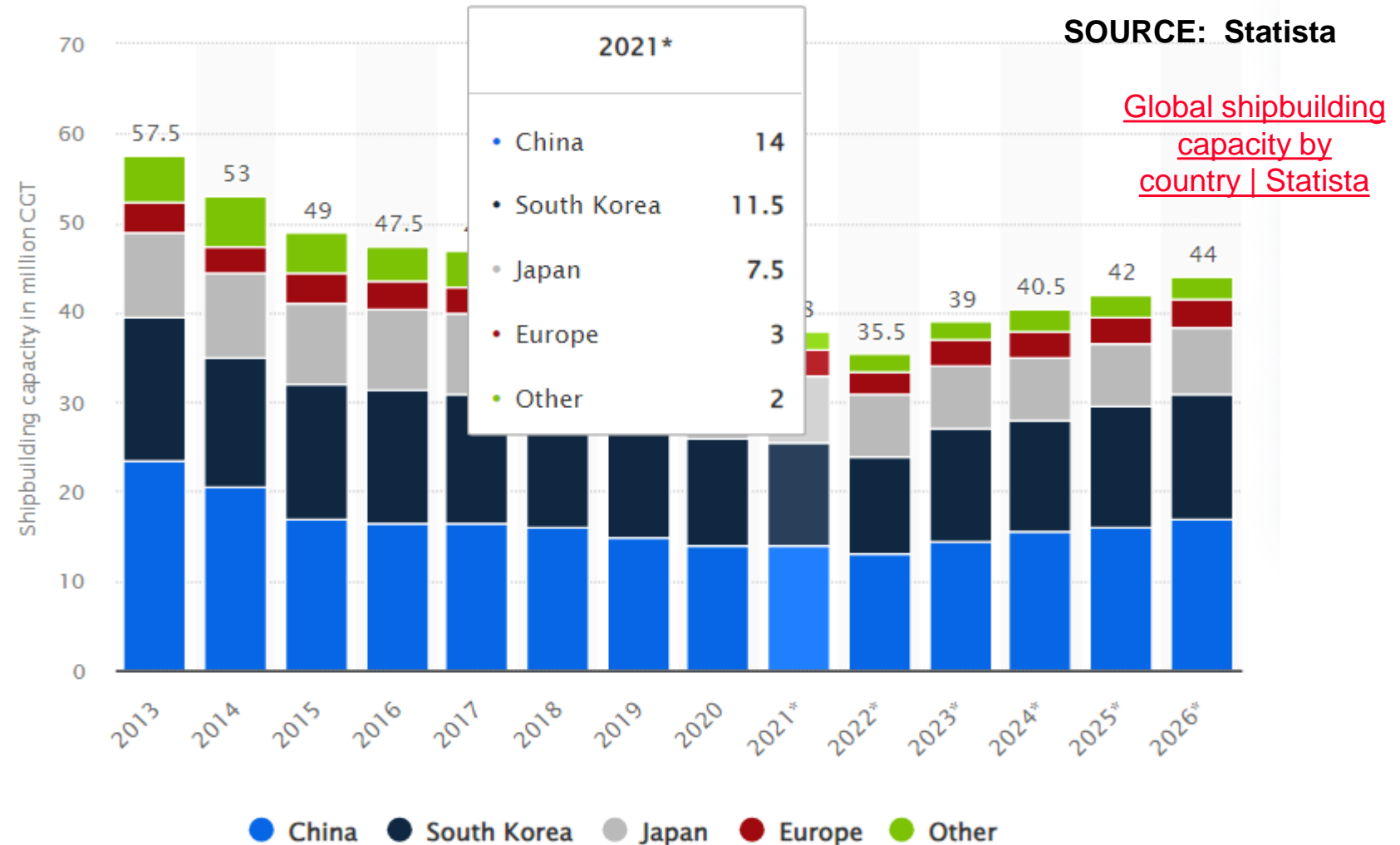**This Report Opened the Door to Shoring Up Supply**

Manufacture—A World View

- **From Office of Economic Cooperation and Development Data Base, 2024**

- **Growth or Decline in Manufacture Output from 2015 to Q3 2023 (2015 = 100)**

- **USA – 99.3**

- **Korea – 113, India –126**

- **Lithuania, Poland, Turkey, Denmark, Ireland, Costa Rica all Above 140**

Shipbuilding—A World View

- **Shipbuilding is Even Worse for the US**

- **Over 90% of tonnage delivered each year come from China, Korea, or Japan**

- **United States in "Other" (Less Than 2%)**

Global shipbuilding capacity by country | Statista

2021*	
China	14
South Korea	11.5
Japan	7.5
Europe	3
Other	2

Legend: China · South Korea · Japan · Europe · Other

Shipbuilding capacity in million CGT

Values shown on bars: 57.5, 53, 49, 47.5, 39, 35.5, 39, 40.5, 42, 44

Years: 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021*, 2022*, 2023*, 2024*, 2025*, 2026*

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SecNav Del Toro and Co-Production of Ships

Results of a 45-Day Study of State of Navy Shipbuilding

- **First Columbia Class Submarine Projected to be 12-16 Month Late**
- **Blocks 4 and 5 of Virginia Class Submarine Projected to be 36 and 24 Months Late**
- **First Constellation Class Frigate is 36 Months Late**
- **Future Aircraft Carrier Enterprise is Projected to be 18 to 26 Months Late**

- **Reasons Not Given, but Ship Yard Capacity, Workforce, and Continuing Supply Chain Issues Are Mentioned**

- **Simply, Navy Goal to Grow the Fleet Size Are Impacted by Manufacture Delay**

- **In Dec 2020, US Navy had 297 Ships, Smaller than Congress Goal of 355 in 2018 NDAA**

From Breaking Defense, 23 April 2024
"SECNAV floats idea of co-production with foreign shipyards"

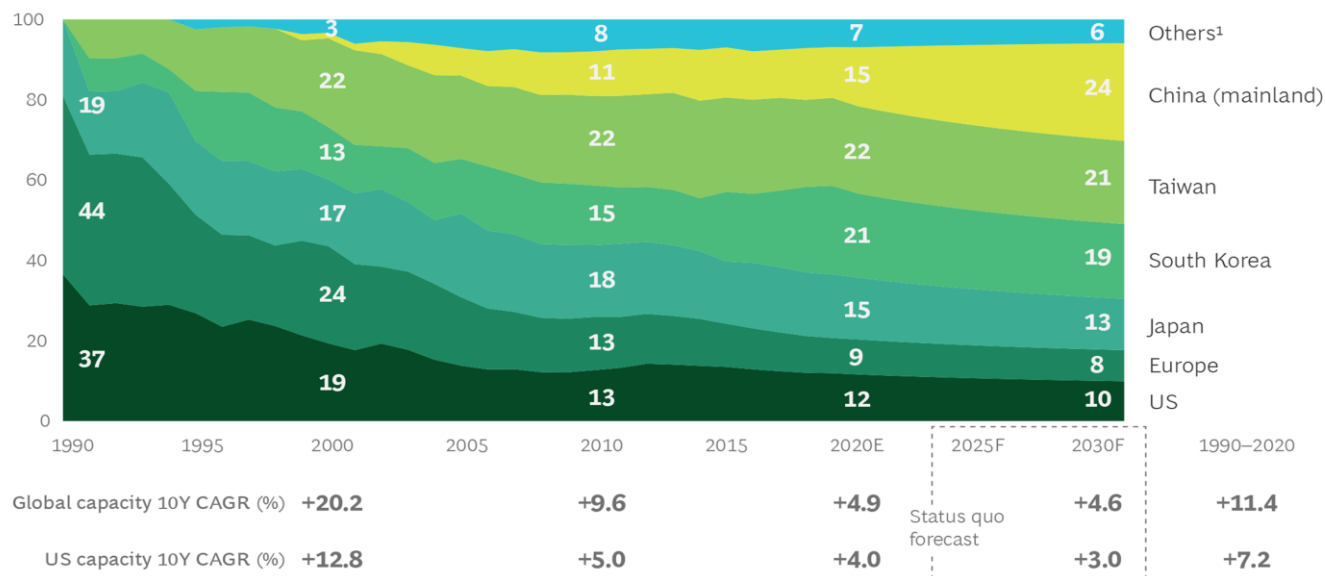**Implicit—US Does Not Have Sufficient Shipbuilding Capacity**

- US Share of Manufacture dropped from 37% in 1990 to 12% today

- US uses 25% of global production

- US uses over 50% non domestic semiconductors

- This is National Security Issue

- The Chips Act is Trying to Address with $52B over 5 Years……But:
    - S Korea Pledged $450B
    - Taiwan < $100B
    - PRC ~$100B

Exhibit 2 - Growth in US Installed Capacity Has Been Outpaced by Asian Countries

Global manufacturing capacity by location (%)

Location	1990	2000	2010	2020E	2030F
Others[1]	3	3	8	7	6
China (mainland)		22	11	15	24
Taiwan	19	13	22	22	21
South Korea		17	15	21	19
Japan	44	24	18	15	13
Europe		13	13	9	8
US	37	19	13	12	10

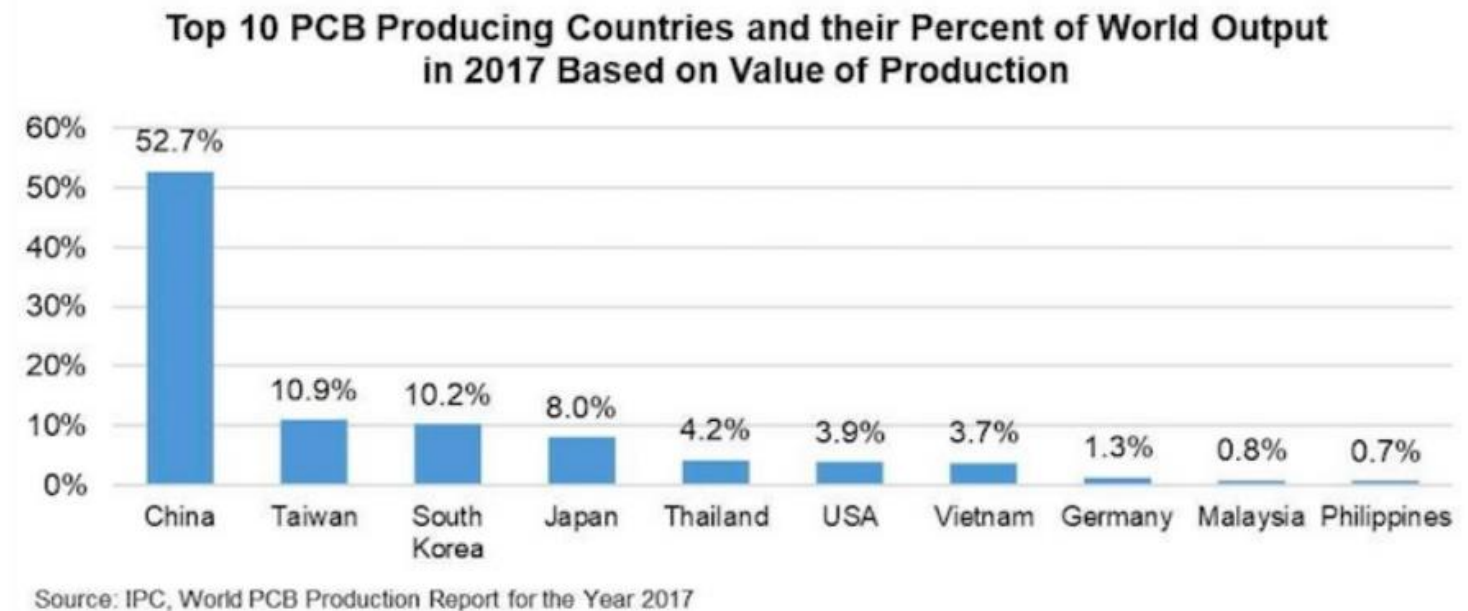|		2010		2030F	1990–2020
Global capacity 10Y CAGR (%)	+20.2	+9.6	+4.9	+4.6	+11.4
US capacity 10Y CAGR (%)	+12.8	+5.0	+4.0	+3.0	+7.2

Status quo forecast (2025F–2030F)

Sources: VLSI Research projection; SEMI second-quarter 2020 update; BCG analysis.

Note: All values shown in 8" equivalents; excludes capacity below 5 kwpm or less than 8".

[1] Includes Israel, Singapore, and the rest of the world.

The Diminished Share of US Printed Circuit Board Manufacture

- While the Data is old, the numbers have not changed much

- US Spending $52B to create semiconductors

- Very little on Printed Circuit Boards

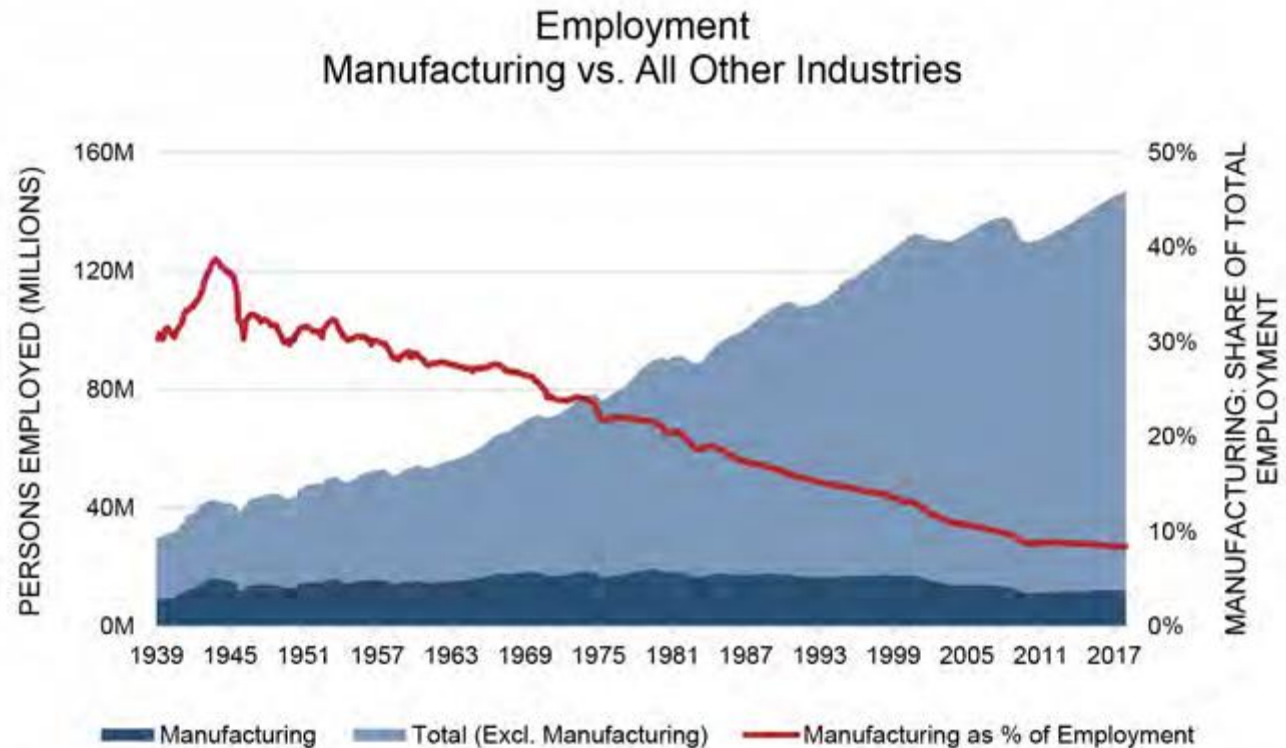- So Domestic Chips will be mounted on foreign (Chinese) PCBs

Top 10 PCB Producing Countries and their Percent of World Output in 2017 Based on Value of Production

Country	Percent
China	52.7%
Taiwan	10.9%
South Korea	10.2%
Japan	8.0%
Thailand	4.2%
USA	3.9%
Vietnam	3.7%
Germany	1.3%
Malaysia	0.8%
Philippines	0.7%

Source: IPC, World PCB Production Report for the Year 2017

US Is Short on Semiconductors, and the Boards to Mount them On

Manufacture Workforce in US in Decline

- Section 13806 Examined Manufacture Workforce

- A lot of this Decline is in Response to Automation

- But Specialty Technicians are also in short supply

- Need more Schools Like the Newport News Apprentice School—Run With/By Huntington Ingalls

Employment
Manufacturing vs. All Other Industries

Manufacturing   Total (Excl. Manufacturing)   Manufacturing as % of Employment

Source: U.S. Bureau of Labor

Figure 12: A Sharp Relative Decline in Manufacturing Employment in the U.S. Economy

Great Power Competition

- **Why it Matters**

  - **China Military Modernization Outpacing US**

  - **China Navy >> US Navy Number of Ships**

  - **J-20 Third Nation With 5th Gen Fighter**

  - **President Xi has Stated China will Be Strongest by 2049**

  - **US Manufacture Needs To Become More Agile**

- **2023 Report by Australian Strategic Policy Institute**

  - **China Leads World in 37 of 44 Critical Technologies**

- **Last China 5 Year Plan—Manufacture is Central**

From the Economist, 15 March 2018

David Parkins

Microelectronics Are The Base in The Battle For Digital Supremacy

Theft of Intellectual Property

- World Trade Organization Estimates (2018) that China Borrows Between $250B and $600B IP per year.

- William Evinina, Director, National Counter Intelligence and Security Center, Said: China IP Theft Costs the US $500B / Year (July, 2022)

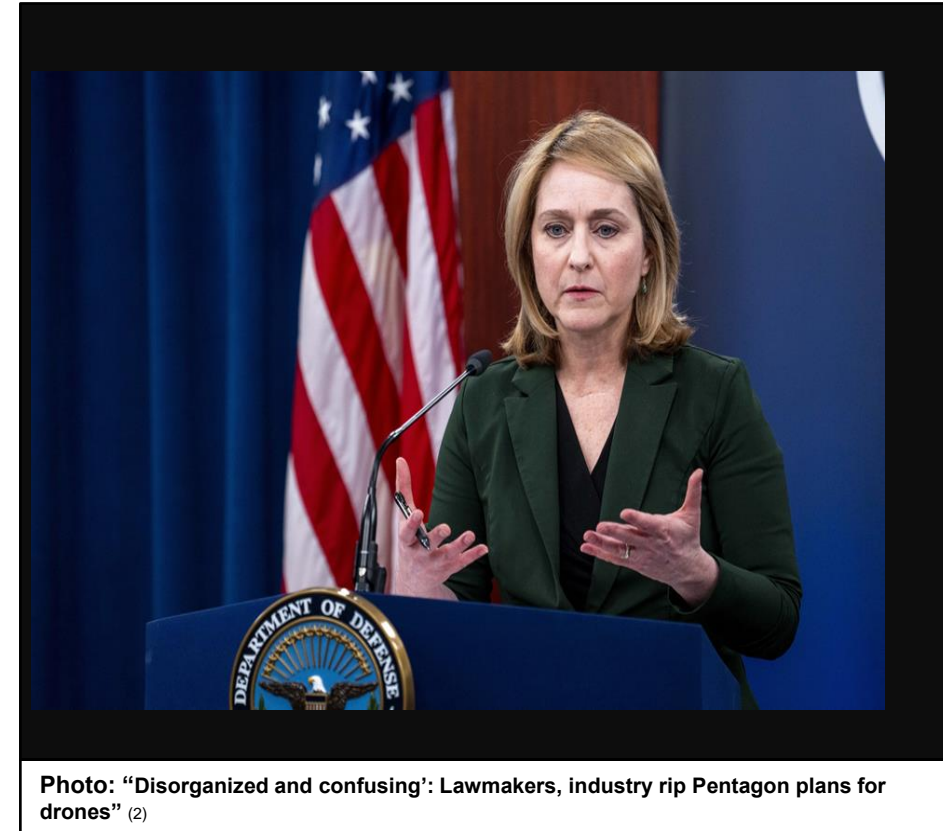- Microelectronics Very Susceptible to Reverse Engineering, So Presume They Are Doing So to Narrow the Gap

For National Security Applications (to include Infrastructure, Economic Sector), How Much Does Having a Secure Domestic Source Matter?

"………Warfare is Changing"

- **DoD is driving toward commercial innovation to counter the strategic pacing challenge of the PRC**

- **DSD Hicks – "Defense Innovation Unit (DIU) is accelerating the U.S. military's adoption of commercial technology to strengthen national security……Projects DIU has helped integrate into the DoD include**
  - **Air defense;**
  - **Virtual training for pilots;**
  - **Augmented reality for warfighters; and**
  - **Hybrid space architecture"**[1]

- **SD/DSD are "focused on accelerating the adoption of leading commercial technology throughout the military and growing the national security innovation base"**[1]

Photo: "Disorganized and confusing': Lawmakers, industry rip Pentagon plans for drones" [2]

Deputy Secretary Kath Hicks speech in Silicon Valley, 12 Dec 23

(1) https://www.defense.gov/News/Releases/Release/Article/3615717/readout-of-deputy-secretary-of-defense-kathleen-hicks-visit-to-silicon-valley-c/
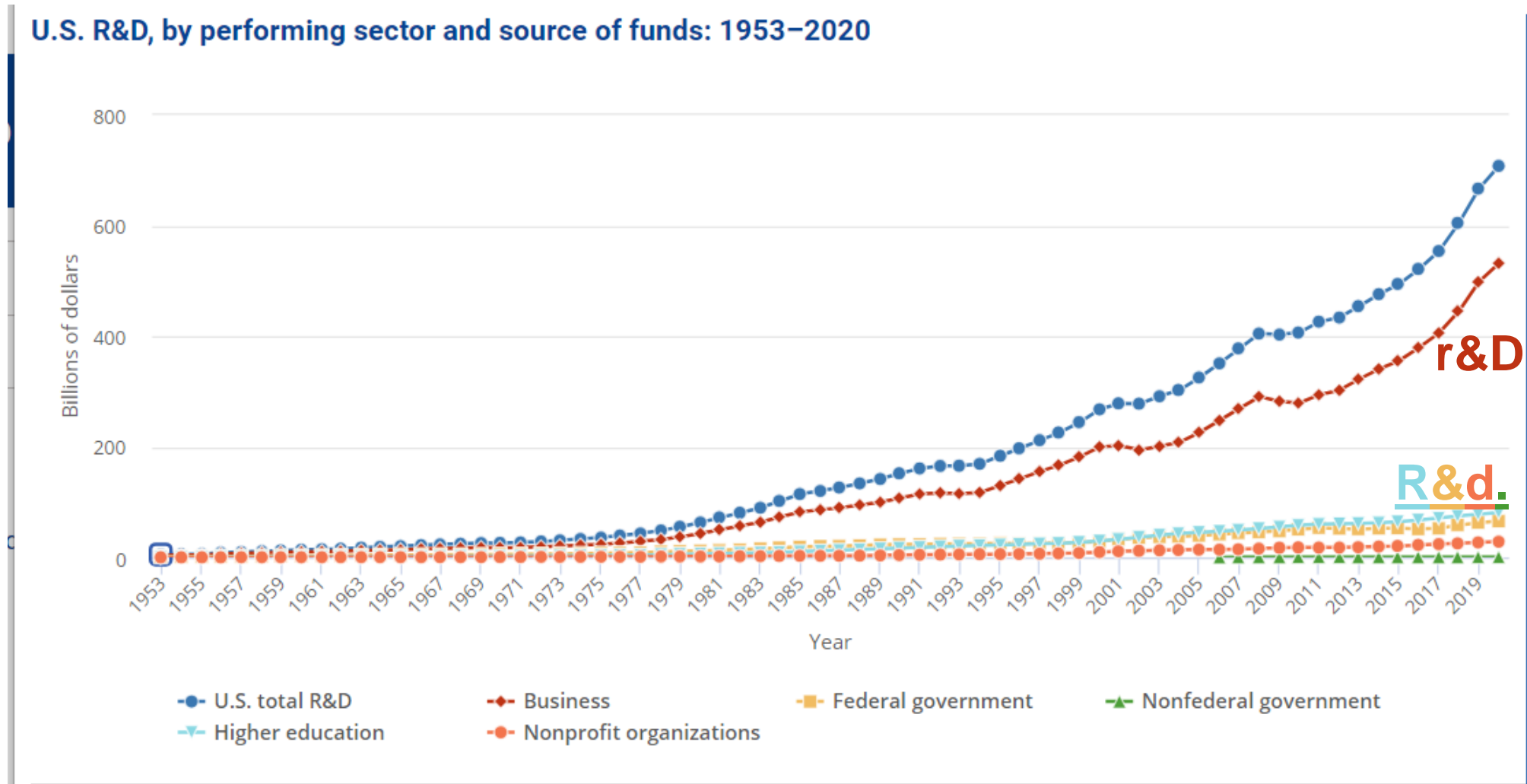(2) https://www.politico.com/news/2023/12/17/pentagon-drones-replicator-program-funding-00132092
(3) https://www.diu.mil/latest/implementing-the-department-of-defense-replicator-initiative-to-accelerate

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The Evolution of R&D Performers, US 1953-2019

U.S. R&D, by performing sector and source of funds: 1953−2020

Legend: U.S. total R&D · Business · Federal government · Nonfederal government · Higher education · Nonprofit organizations

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What Did The Atlantic Council Say About Innovation Adoption

Challenges

1) Outdated R&D Model – resulting in DoD unable to effectively apply leading technologies to weapon systems.

2) Long Timelines and Inflexible Execution - difficult to insert new tech to effectively respond to changes

3) ==Fewer Companies Providing Defense Solutions - reduced competitive pressure increase costs & decrease innovation==

4) Valleys of Death - disconnected ecosystem, program constraints, & funding constrains tech transition

5) ==Hamstrung Workforce – lack of DoD leaders with industry background==

6) Program-centric Acquisition – responsiveness to changes constrains the ability to insert innovative technology

7) Cumbersome Reporting from DoD to Congress

8) Limited Understanding of Emerging Technology

Recommendations

1) Introduce a new capability portfolio model

2) Consolidate program elements

3) Reset reprogramming authorities

4) Modernize the DoD to align with the twenty-first century industrial base

5) Strengthen alignment of capital markets to defense outcomes

6) Incentivize tech companies to do business with the DoD

7) Modernize budget documents

8) Establish bridge fund for successfully demonstrated technologies

9) Scale the Space Development Agency model

10) Modernize the DoD's requirements system

Accelerate the DoD's ability to adopt cutting-edge technology from commercial and defense sectors and deliver high-impact operational solutions to the Warfighters.

Atlantic Council Report: COMMISSION ON DEFENSE INNOVATION ADOPTION 24Jan2024
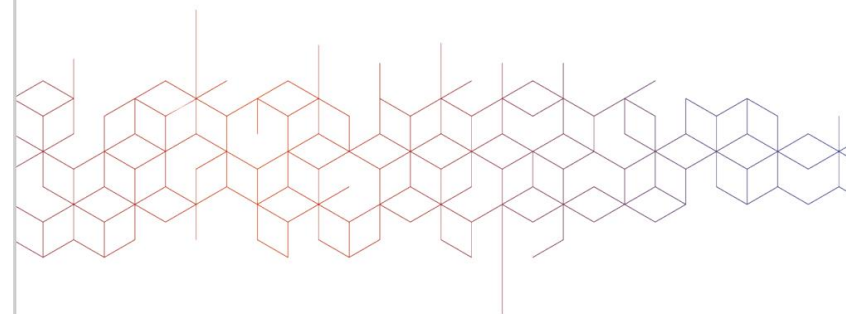
USD(R&E) Shyu

- **Three Pillars**
  - **Focus on the Joint Fight**

  - **Create and Field Capabilities at Speed and Scale**

  - **Ensure the Foundations of Science and Technology**

  - **Second Point Needs a Manufacture Base "Fit For Purpose"**

NATIONAL DEFENSE SCIENCE & TECHNOLOGY STRATEGY 2023

UNITED STATES DEPARTMENT OF DEFENSE

Enable the Delivery and Sustainment of Secure, Resilient, and Preeminent Capabilities

- <mark>Deliver Integrated Capabilities at Speed and Scale</mark>
  - <mark>Produce and Field at Scale</mark>
  - Use Red-Blue Mission Threads

- Protect and Sustain the Force
  - Expand Partnerships
  - Focus: Quick Deployment to Denied Areas

- Foster a Resilient and Robust Industrial Base
  - Build and Maintain a Robust Supply Chain
  - Link the Defense Industrial Base to Commercial
  - Partner with State and Local Government
  - Invest in a First Class Workforce

Estimated breakdown of global rare earths supply: Refined supply by region, 2021 (%)

- Africa
- Asia (excl. China)
- Australia
- China
- Europe
- North America

2%
13%
85%
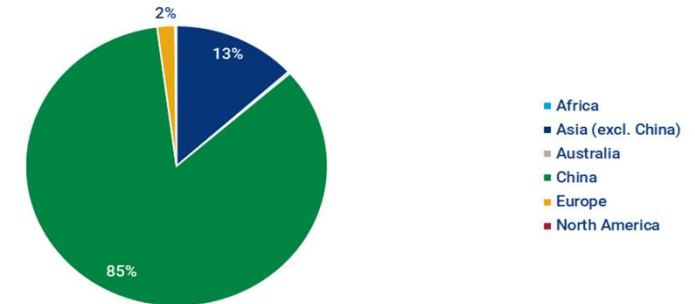
Source: Roskill, a Wood Mackenzie business. Note: full-year estimate

- **A Manufacture Base That Has Declined Over Time**
- **Time To Field Has Grown With System Complexity**
  - **U-2 (Kelly Johnson)**
    - **Approved Nov 1954—first flight 1955**
  - **Minuteman (1960s)**
    - **R&D Program Approved 1958, IOC 1962**
  - **F-35 (JAST; 1990s)**
    - **Started 1995, IOC 2015**
  - **Sentinel (2020's)**
    - **Aug 2017 – Contracts to Boeing / NG**
    - **Proposed 2030 IOC**
- **Great Power Competition Increasing**
- **Increased Use of Commercial Products**

What Needs to be Done?

Some Ideas To Address the Challenge

- **Build Demand** Through Greater Employment of Multiyear Procurement for Defense Critical Items
  - Work with Congress to Build Trust
- **Acquisition Process Reform** (Manufacture and Field When Ready, Not Perfect)
  - Adopt Truly "Open Systems Architectures"
  - Adopt Digital Engineering
  - Adopt Software Testbed for All Software Dependent Programs
- **Enhance "Friendshoring"** to Build the Manufacture Base Over Greater Number of Providers
- **Focused Manufacture Technology Development**
  - Autonomy / Autonomous Lines
  - Expand Additive Manufacture
  - Develop / Employ Artificial Intelligence
  - Digitize Manufacture Process
  - Employ Data Analytics to Supply Chain
- **Address Workforce Through**
  - Technician Training
  - Defense Acquisition University

All Interesting But Not Sufficient

- **Most Innovation Arguments Do Not Solve the Problem, Which Industry Likes**
- **DoD Can't Buy Capabilities with Rigid Requirements, Long Time Lines**
- **Break this Approach by**
  - **Shorter Requirements (Initial MRAP Requirements were 1 Page)**
  - **Mandating Open Systems Architectures** *(Think How Industry does fielding)*
  - **Mandating Digital Twins (***Auto Industry Has Adopted Digital; 3-4 years from paper to Delivered Model***)**
  - **Mandating Agile Software Development Test Beds** *(Kessel Run Developed in Months, not years)*

"Better is the Enemy of Good Enough"

**Admiral Sergey Gorshkov
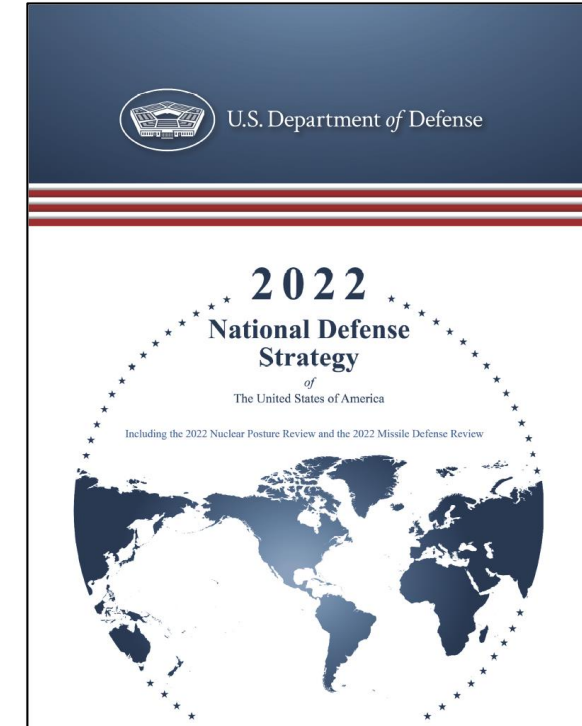Admiral of the Fleet
Chief of Soviet Navy 1965-1985**

. **Dod**

US National Defense Strategy
27 October 2022

Priorities:

- **Defend the Homeland, paced by multi-domain PRC threat**

- **Deter strategic attacks against U.S., allies, and partners**

- **Deter aggression, but be prepared to prevail in conflict, prioritizing PRC in Indo-Pacific, then Russia in Europe**

- **Build resilient Joint Force and defense ecosystem**
  - **Withstand, fight through, recover from non-kinetic and kinetic disruption**
  - **Includes climate impacts, pandemics, transboundary threats**

Methods:
  - **Integrated deterrence**
  - **Campaigning**
  - **Building enduring advantages**

- **Focus on 14 Critical Technologies**

U.S. Department of Defense

2022
National Defense Strategy
of
The United States of America

Including the 2022 Nuclear Posture Review and the 2022 Missile Defense Review

Key themes: Deterrence; joint all-domain warfare; resilience; prototyping and exercising; rapid fielding

"Accelerate, Change, or Lose"

- "If we don't change – if we fail to adapt – we risk losing the certainty with which we have defended our national interests for decades…." (1)
- The Air Force could abolish certain working groups and other governing organizations that add "more time than value." (2)

- "We could all use more manpower, more money and more time. But leaders cannot wait for perfect conditions to act or make a decision, because perfect conditions will never exist." (2)
- "My strategic approach of 'Accelerate Change or Lose' explains the 'why'…….."It is all of us ... our talented Airmen … that are key to cutting unnecessary bureaucracy, recognizing and understanding our competition, and thinking of creative ways we can reshape the design of our Air Force. (3)

"Victory smiles upon those who anticipate the change in the character of war,
not upon those who wait to adapt themselves after the changes occur."
— Giulio Douhet

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So What

Lincoln Should Understand these Shifts, Systematically Review Customer Base

- Is the Ratio Prototypes to Technology Right?

- If DoD is Going Commercial, Should Lincoln Enhance This?
  - What Does Lincoln Bring To Them?

- Is the Mix of Hardware Based Prototypes and "IT/AI "… Right?

- Does Lincoln Need to Enhance Emphasis on Non-Traditionals?

- Does Lincoln Have a Role in Bridging the Valley of ?