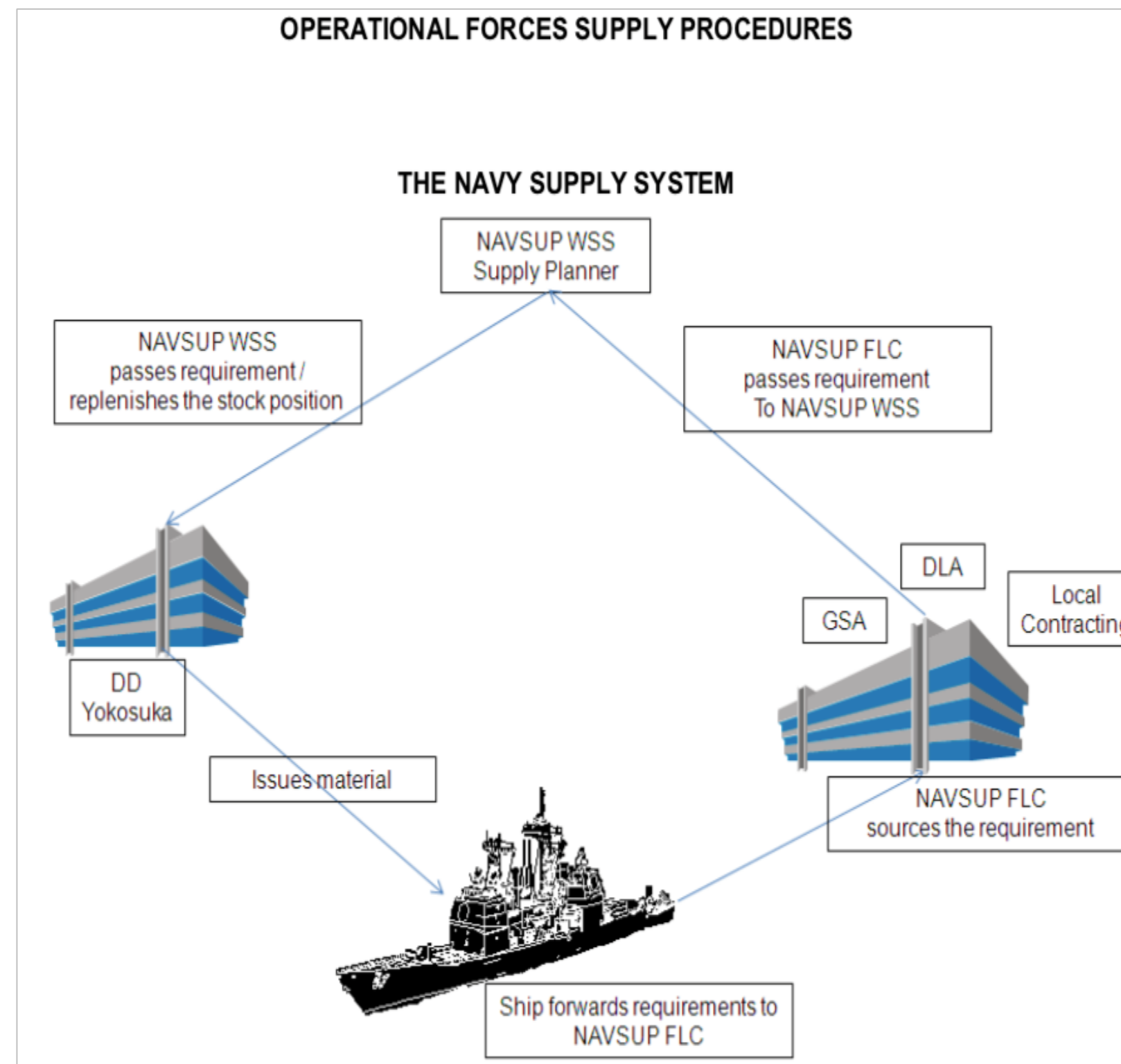


## U.S. NAVY'S FIRST ADDITIVE MANUFACTURING AT SEA; LESSONS LEARNED AND BEST PRACTICES

### Traditional Manufacturing Concept



UNCLASSIFIED

**DON Additive Manufacturing/3D Printing Vision**

- Enhanced warfighting capabilities through employment of designs not otherwise possible
- Increase readiness through the production of obsolete or long lead-time items, at or near the point of need
- Rapid development of new capabilities through prototyping
- 21st Century Civilian and Warfighting workforce empowered to innovate

**Enhanced Capabilities**  
 Additive manufacturing will be integrated into weapon system designs in order to field capabilities that outperform those that use conventionally manufacturing techniques only.

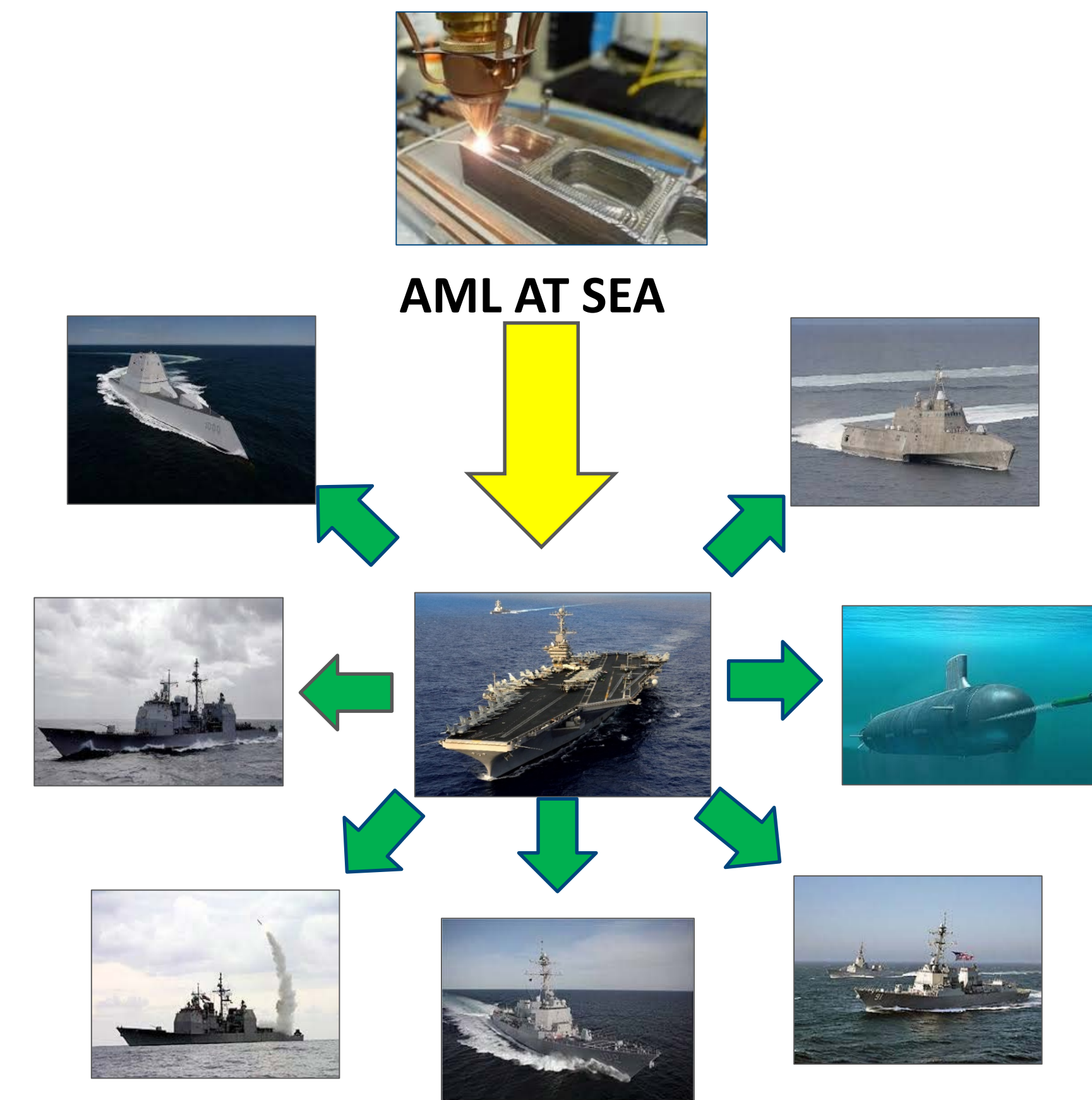
**Mission-Tailored, On-Demand Warfighting Systems**  
 Sailors, Marines and civilians will be trained to rapidly build and adapt systems tailored to specific missions in order to meet emerging warfighting requirements.

**Agile Supply Chain**  
 Our supply chain will be transformed from a physical to digital inventory. The Navy and Marine Corps will leverage a global, distributed digital manufacturing infrastructure that is able to scale and surge to produce the right part, at the right time, in the right place.

**Energetics**  
 Customized munitions and explosives will be printed afloat and ashore, greatly enhancing our Naval supremacy in the areas of speed and flexibility.

**Expeditionary Sustainment**  
 Forward-deployed personnel will be able to better maintain and enhance their warfighting systems. Whether it's a Forward Operating Base ashore or a repair shop afloat, AM will bring more capability closer to our deployed operational forces.

### Additive Manufacturing 3D Printing Supply System



USS John C. Stennis (CVN 74)  
 Navy's First at sea AM Lab

NAVSEA

OPNAV

### Research Process Plan



### Knowledge Value-Added (KVA) Methodology

\*Change, Knowledge and Value are Proportionate\*

Input **X** → Process **P** → Output **Y**

#### Fundamental Assumptions of KVA

If  $X = Y$  ( $P(X) = Y$ ) no value has been added.

$\alpha$  = is a measurement of the value added by the investment.

"Value"  $\propto$  "Change"

"Change" can be measured by the amount of knowledge required to make the change.

So, "Value"  $\propto$  "Change"  $\propto$  "Amount of knowledge" required to make the "Change".  
 (Principle of replication)