LOCKHEED MARTIN

UNIVERSITY OF MARYLAND

ADDITIVE MANUFACTURING (AM) SUPPLIER CHALLENGE

Advanced Manufacturing Technology

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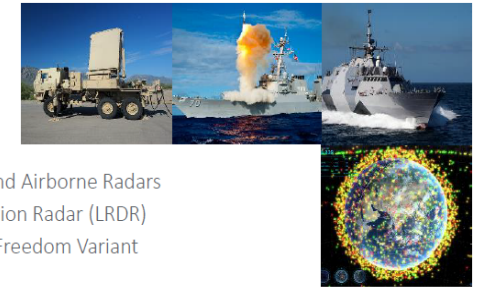
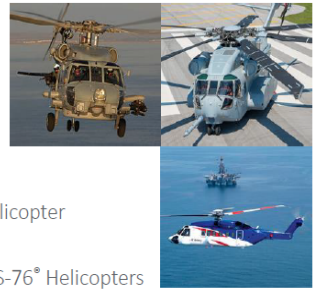
Broad Portfolio of Solutions

Integrated Warfare Systems & Sensors



- Aegis Combat Systems
- Electronic Warfare
- Ground-Based, Naval and Airborne Radars
- Long Range Discrimination Radar (LRDR)
- Littoral Combat Ship – Freedom Variant
- Space Fence
- Laser Systems

Sikorsky



- MH-60 SEAHAWK®
- UH-60 BLACK HAWK
- S-97 RAIDER™
- VH-92A Presidential Helicopter
- CH-53K King Stallion
- Commercial S-92® and S-76® Helicopters

Training and Logistics Solutions

- Military Live, Virtual & Constructive Training
- Performance-Based Logistics
- Test Environments

C6ISR

- K-Max
- C4ISR
- Acoustic Sensors
- Cyber Solutions
- Precision Navigation
- Aerostats and Lighter-Than-Air Systems
- Undersea Systems

- Unmanned Undersea Vehicles
- Unmanned Aircraft Systems

Additive Manufacturing – Mission & Vision

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ADDITIVE MANUFACTURING

Accelerating the implementation and use of Additive Manufacturing across the Lockheed Martin Enterprise

Use additive manufacturing where it makes sense to develop & build innovative discriminating technology solutions that drives competitive advantage, disrupts the market and delivers continued value to our customers.

LM Digital Design and Manufacturing

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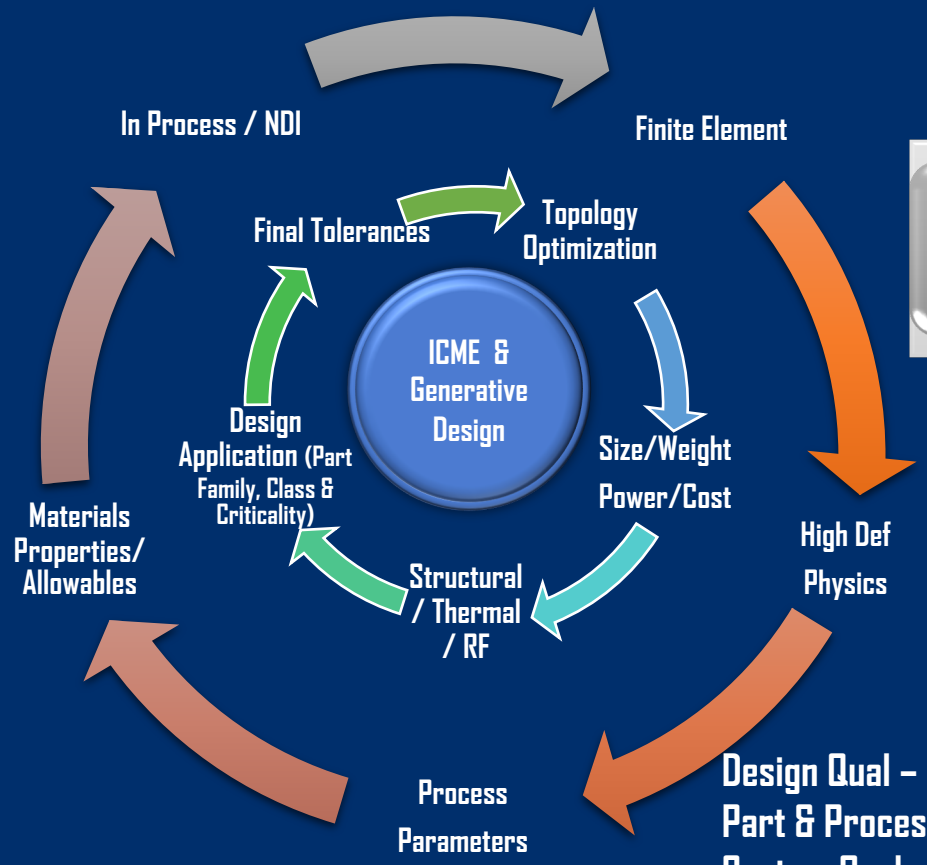
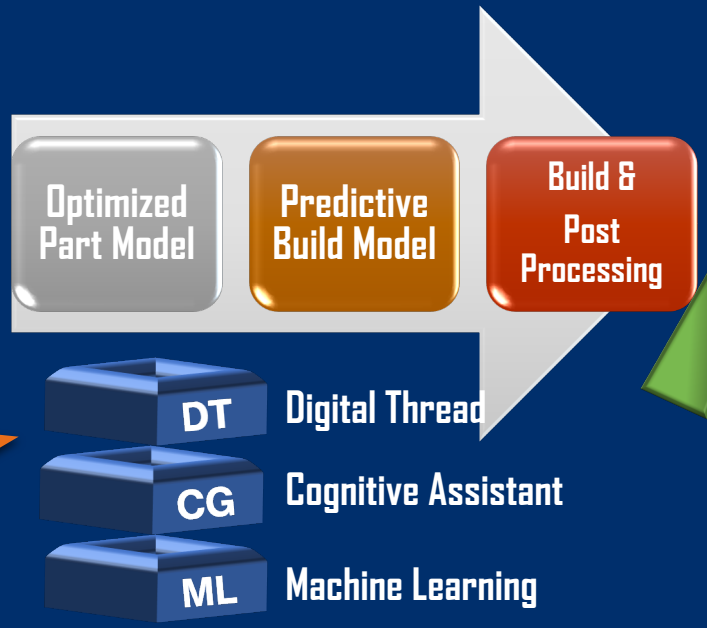
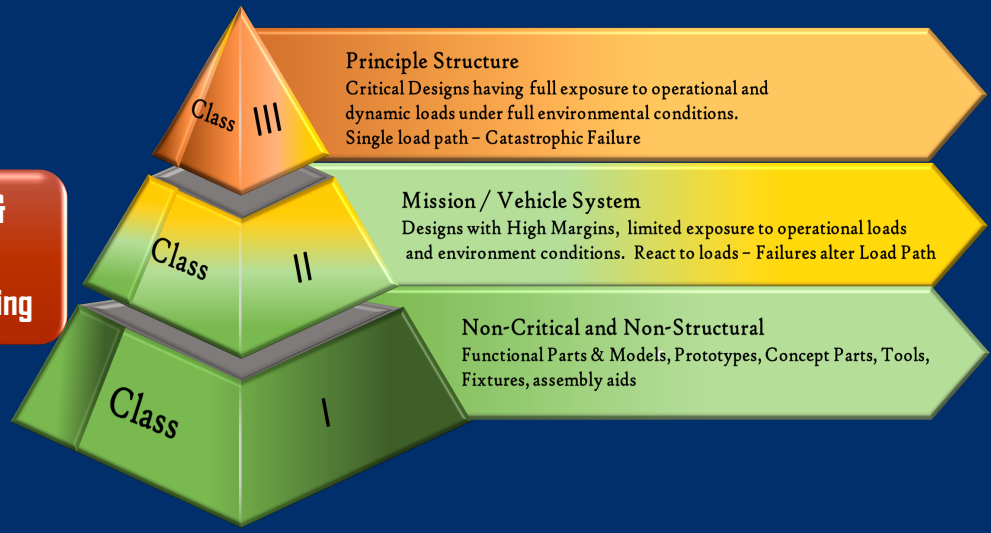
ICME modeling and Generative Design tools that take materials, process, functional, environmental and program data to pre build AM parts layer by layer and look for any design, material or process flaws before we hit the start button.







Design Qual – did we design it right capturing and exceeding all customer requirements.
Part & Process Qual – did I build right – Does it meet and function as the design intended and can I repeat it.
System Qual – does it work in the next higher assembly as intended without causing failure or unintended consequences.
Platform Qual – does (NAVSEA, NAVAIR, NASA, FAA…) accept the part onto the platform for general deployment.

Additive Manufacturing – Expectations

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- Additive Metal powders for AlSi10Mg, 6061, 7000 series like materials, Ti-64 and Inconel
- Additive Polymers: Ultem 9085, PEEK/PEKK, reinforced polymers

- Demonstrate established AM Manufacturing process, procedures and production control documentations
- Demonstrate materials handling and safety
- Explain your cyber security practices for protecting sensitive and proprietary customer data

Lockheed Martin L-PBF Process Requirements (example)

- Metal Powder Requirements
- Used powder
- Build platform/plate & Recoater
- Process Control Document (PCD) / AM Process Routing.
  - L-PBF build parameters.
  - Software control
  - Build report.
- Powder handling and storage.
- Training.
- Preventive maintenance and calibration.
- Post Process Machining and Finishing
- Heat treatment.
- Sampling and testing.
  - Tensile properties.
  - Chemical composition.
  - Bulk density.
  - Hardness.
  - Build density.
- Quality.
- Workmanship.
- Non-destructive inspection.

AM POSITIONING AT LM

Technical Focus Areas:

- Materials evaluation/data library
- Standards development
- Qualification / certification
- Designing / producing more parts, more critical parts, different materials, different technologies
- Digital manufacturing ecosystem

Business Focus Areas:

- Distributed manufacturing model
- Mitigate DMS, mission degraders
- Business model based on TDPs & manufacturing
- Digital thread (control tower)

Applications:

- Tooling & Fixtures
- Prototyping
- New AM Designs (DfAM)
- Legacy Part Redesigns
- Trainers
- Repairs/Reconditioning
- Future – electronics +++

3D Printers:

LM has more than 200 printers

- ~211 polymer, 13 metal
- ~134 hobby class, 77 industrial polymer, 13 metal
- ~8 large scale (> 4'x4'x4')