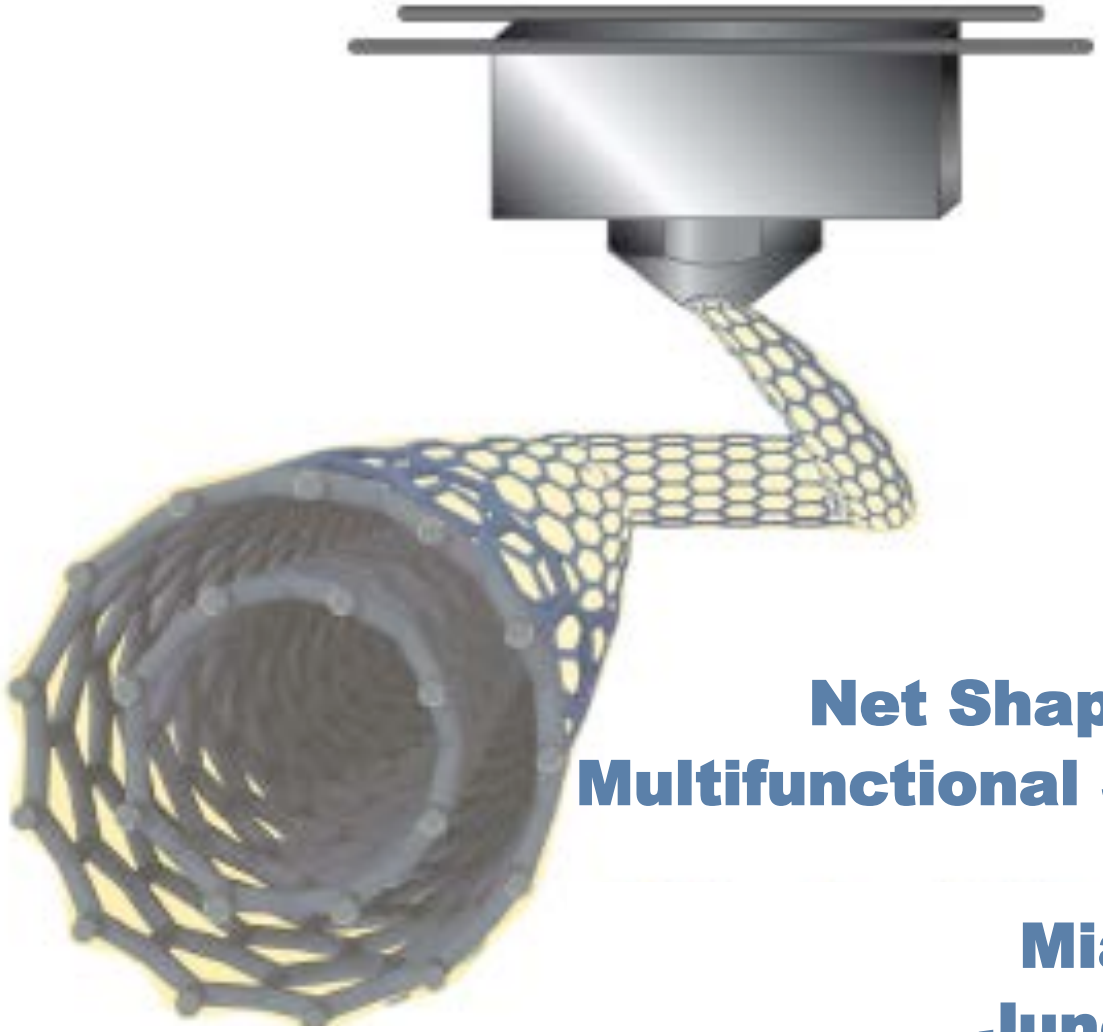
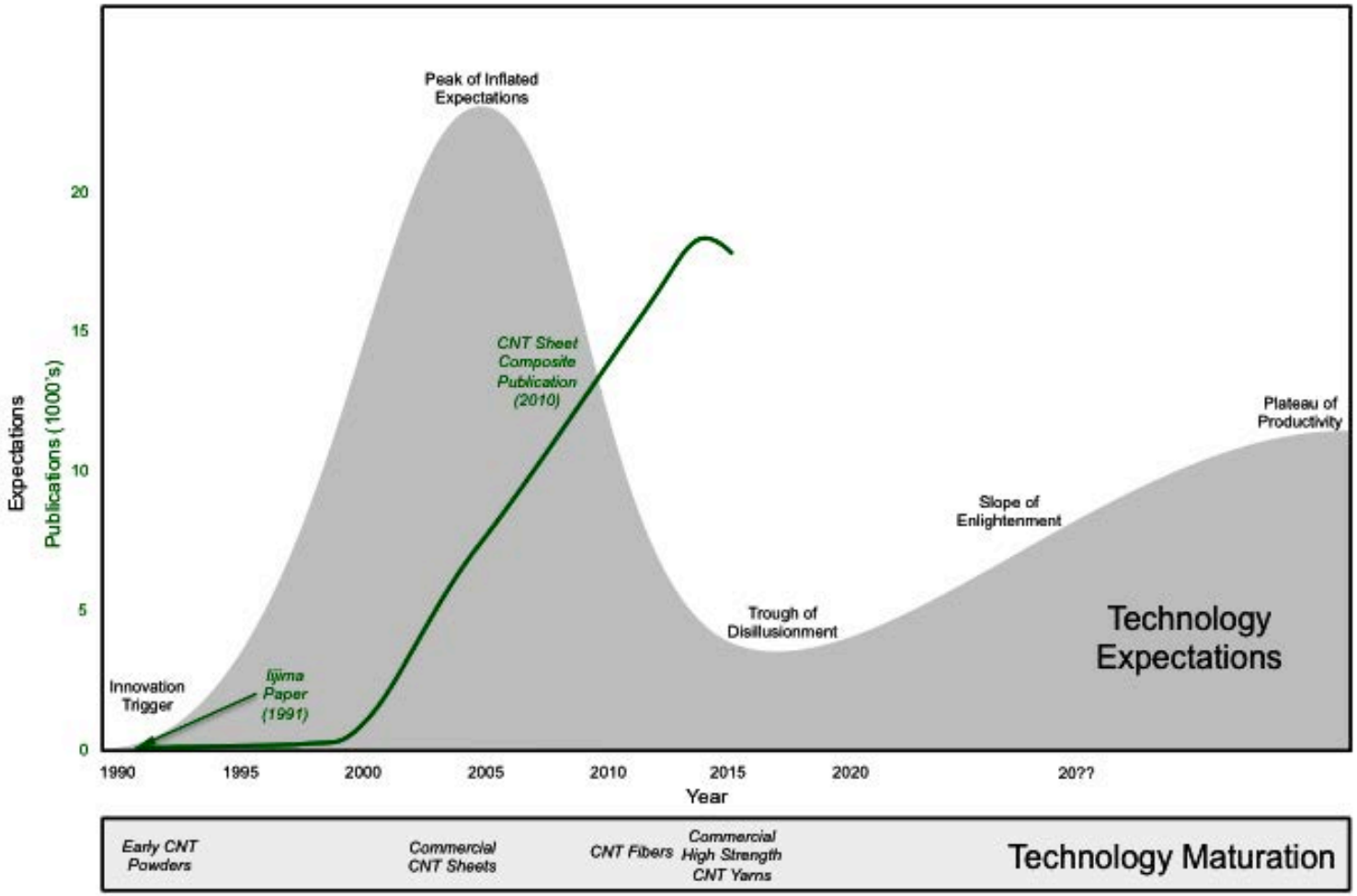


Net Shaped Aerospace Multifunctional Structures Workshop

Mia Siochi

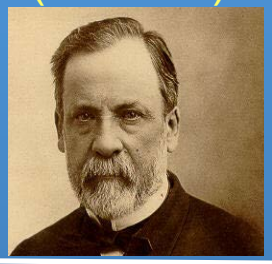
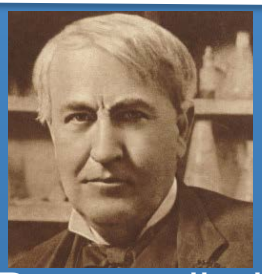
June 9, 2015

Carbon Nanotube Gartner Hype Cycle



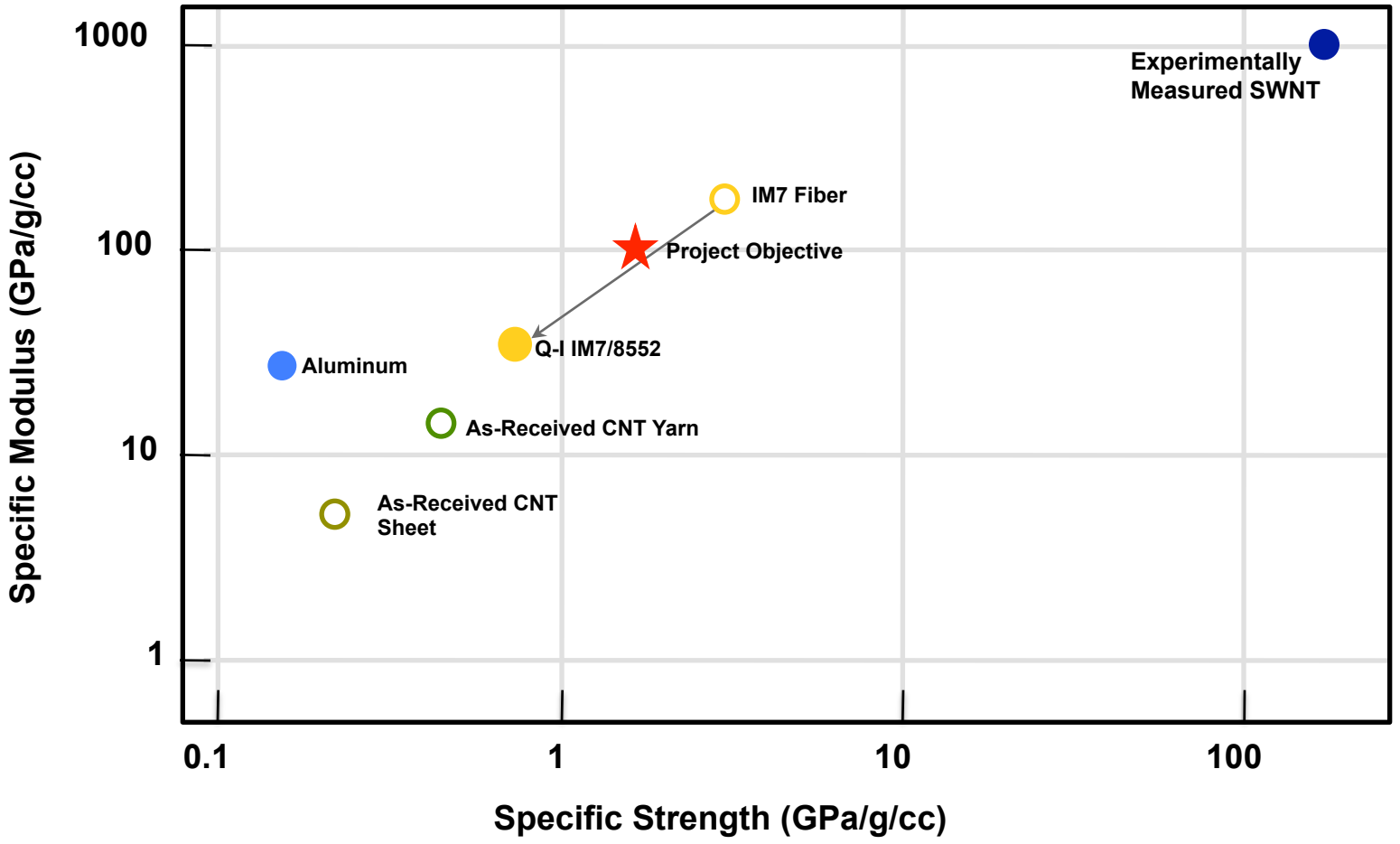
Accelerated Technology Maturation thru Use-inspired Basic Research

Considerations of use?

Quest for fundamental understanding?	No	Yes
Yes	Pure basic research (Bohr) 	Use-inspired basic research (Pasteur) 
No		 Pure applied research (Edison)

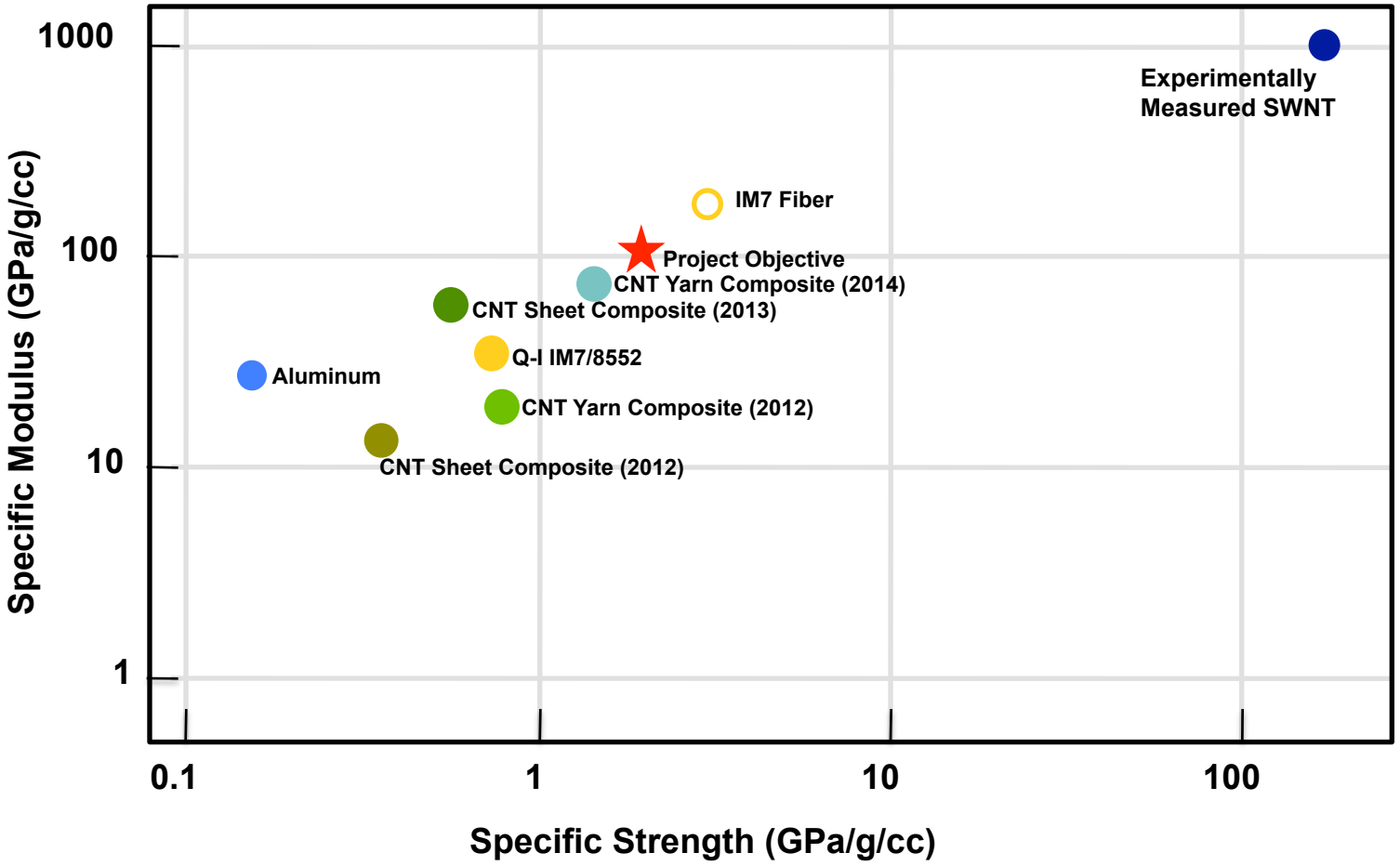
Donald E. Stokes, Pasteur's Quadrant: Basic Science and Technological Innovation, 1997.

Nano to Macro Challenge

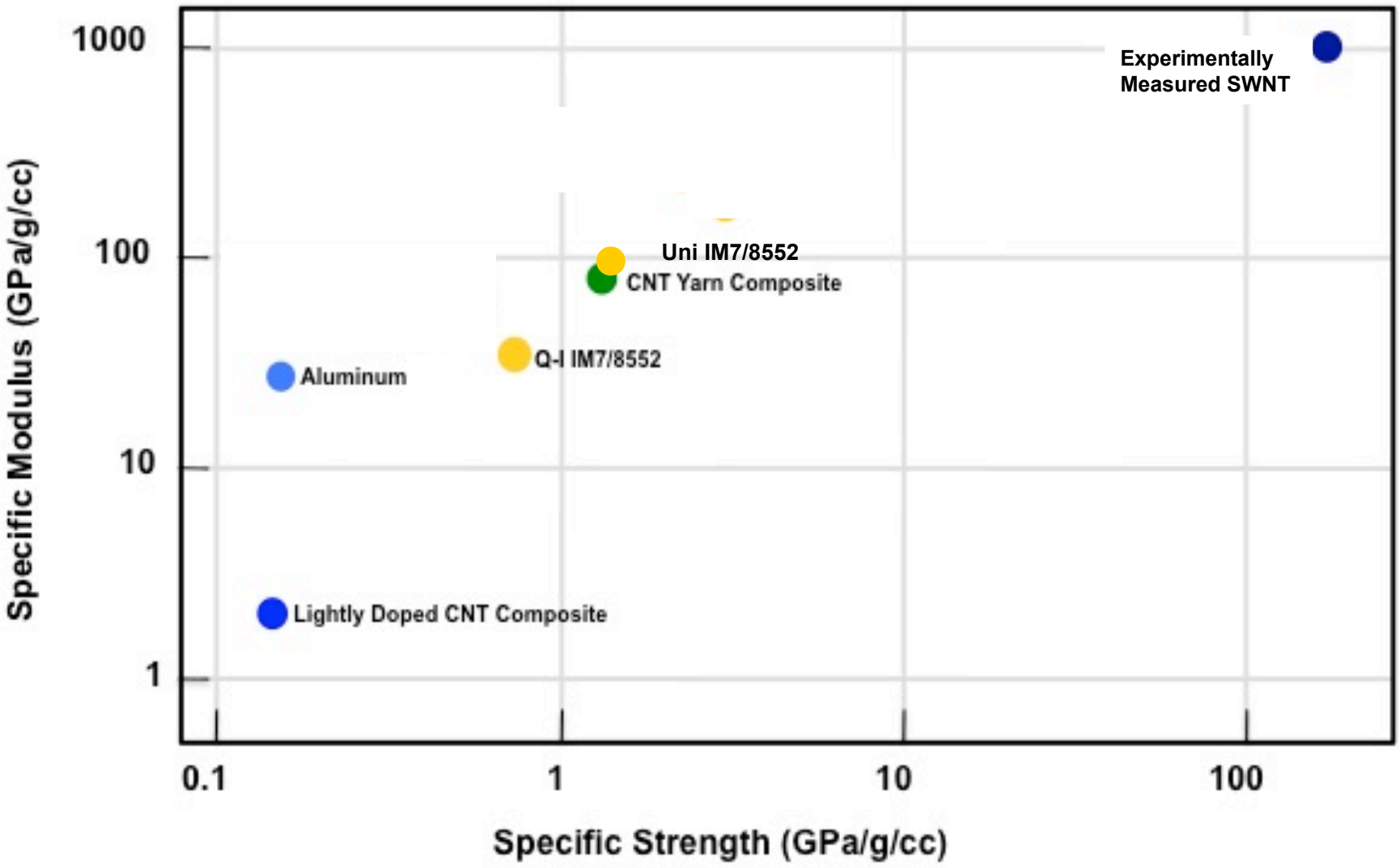


- Available materials have starting mechanical properties inferior to other SOA materials.

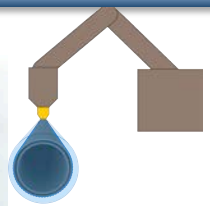
Progress in CNT Composite Properties

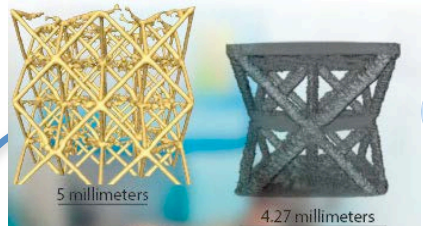


How is Structural Nano Different?



Coupling Technologies





Topologically Optimized
Multifunctional Component

Boeing 787

CNT Yarn

3d Printer

Carbon Fiber

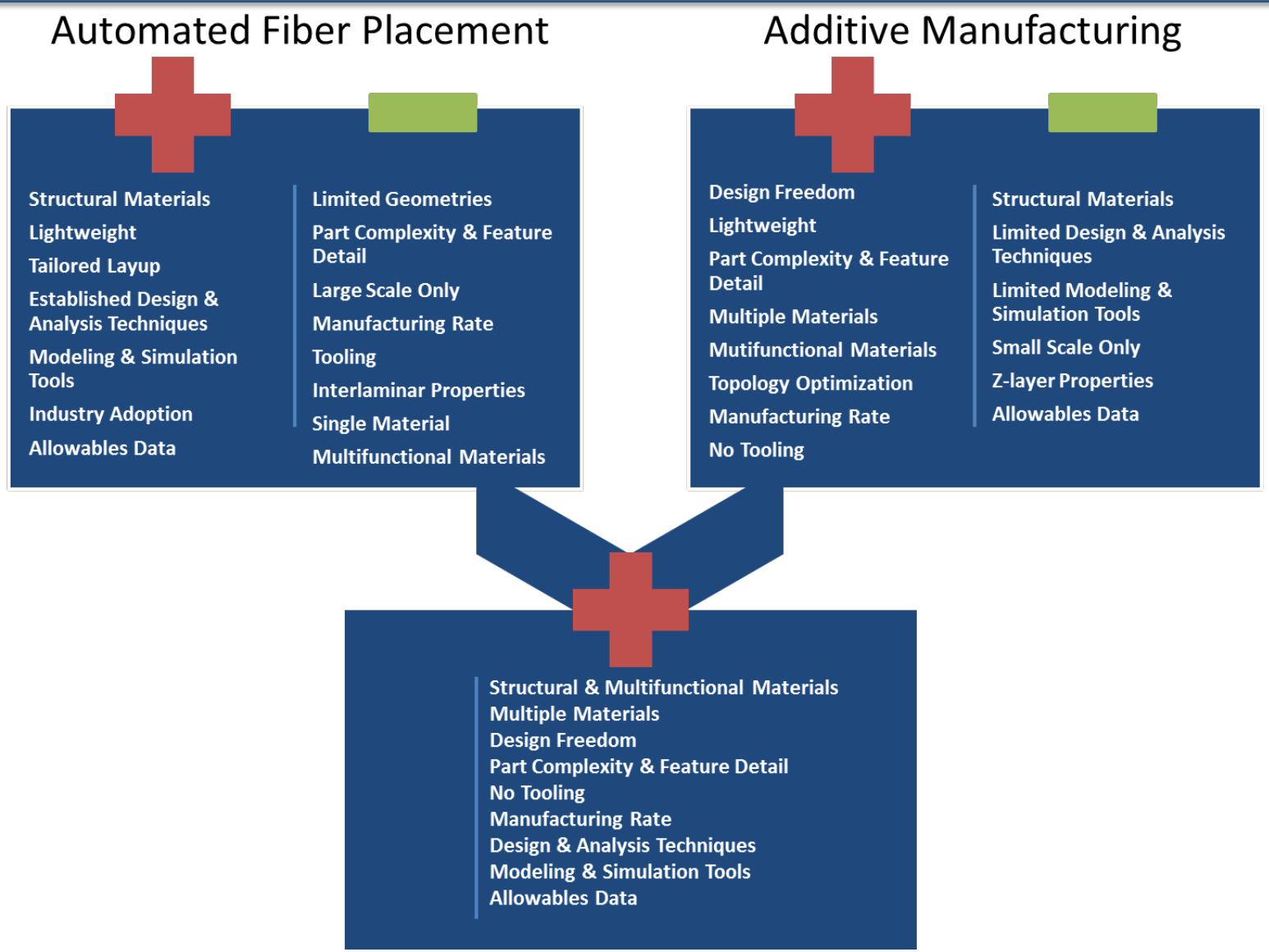
Robotic Composite Manufacturing

Technology Maturation

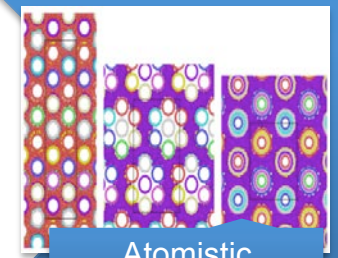
1958 1991 2012 2016

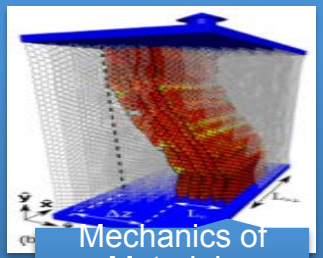
All non-NASA images from: http://www.usa.gov/directory/federal/

Best of Both Worlds

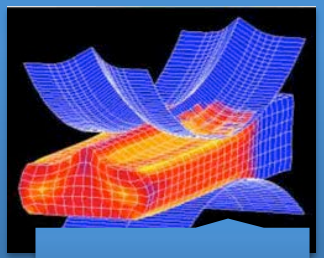


Workforce Capability – Accelerated Technology Maturation Using Multidisciplinary Approach

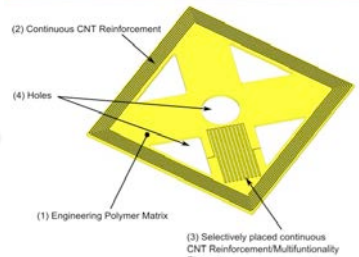

Atomistic Modeling


Mechanics of Materials Modeling

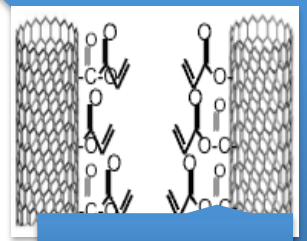

Topological Optimization

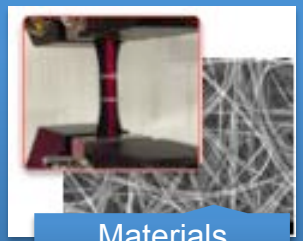

Process Modeling

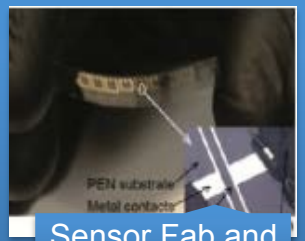

Systems Analysis

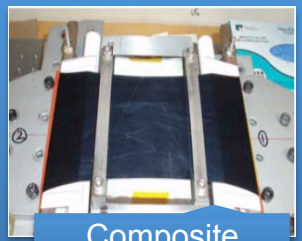


Multifunctional Component


Chemistry


Materials Characterization

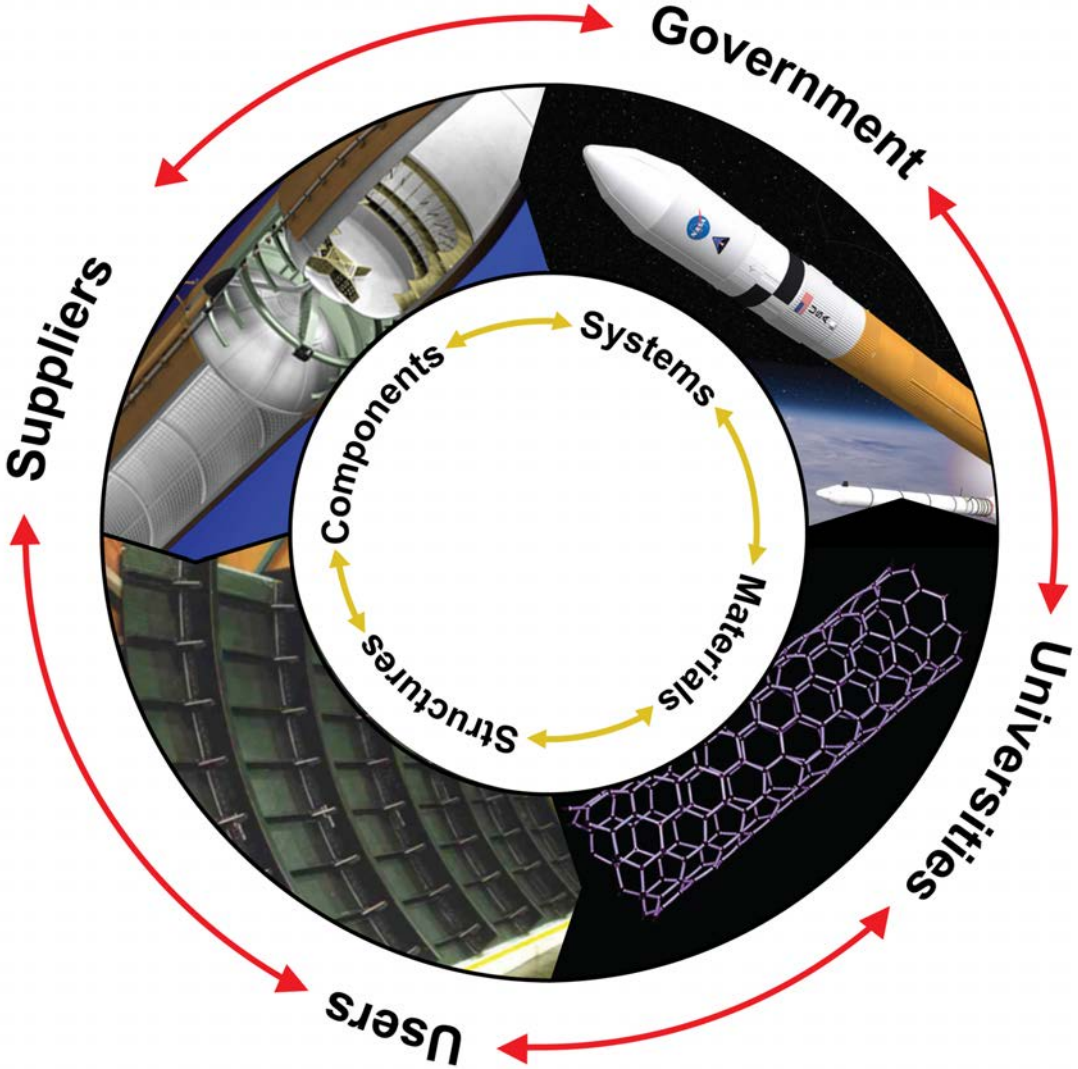

Sensor Fab and Characterization


Composite Processing


3d Printing

Accelerate Technology Insertion with Focused Development Across Relevant Disciplines

Accelerated Technology Maturation thru Technical Community



Team with Technical Leaders … Stop Reinventing Everything

Workshop Objectives

- Engage technical leaders in the field in candid discussions
- Survey state-of-the-art in additive manufacturing
- Explore how to couple materials and manufacturing advances to enable net shape multifunctional structures
- Identify barriers for insertion of additively manufactured components
- Chart a path for strategic insertion of net shape multifunctional components in high payoff applications

Net Shaped Aerospace Multifunctional Structures Workshop
Agenda

June 9-10, 2015
NASA Langley Research Center
Hampton, VA 23681-2199

June 9

7:00 am	Registration opens	
7:45 am	Opening	Donna Speller Turner
8:00 – 8:15 am	Welcome remarks	Jill Marlowe
8:15 – 8:45 am	Intro/Workshop Objectives	Mia Siochi
8:45 – 9:15 am	Additive Manufacturing and Materials for Space Systems	Slade Gardner (Lockheed)
9:15 – 9:45 am	USAF Applications and Perspective	Jeff Baur (AFRL)
9:45 – 10:00 am	Break	
10:00 – 10:30 am	3d Printing of Aerospace parts	Ed Herderick (GE Aviation)
10:30 – 11:00 am	Additive Manufacturing of Aerospace Components	John Waldrop (Boeing R&T)
11:00 – 11:30 am	Heterogeneous Materials for Electrically Functional Structures	Ken Church (nScrypt)
11:30 am	Closing for morning session	Donna Speller Turner
11:45 am – 12:50 pm	Lunch	
12:50 – 1:00 pm	Load bus for tour	
1:15 – 1:45 pm	EBF3, ISAAC, 3d Printing Lab – B1232	
1:50 – 2:00 pm	Transit to B1267A	
2:00 – 2:45 pm	Incubator tour – B1267A	
2:45 – 3:00 pm	Transit to B2102	
3:15 – 4:15 pm	Breakout session	
4:15 – 4:45 pm	Report out	
4:45 pm	Adjourn	
6:30 pm	Group dinner at Tucano's	

Net Shaped Aerospace Multifunctional Structures Workshop
Agenda

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June 10

7:00 am	Registration opens	
7:45 am	Opening	Donna Speller Turner
8:00 - 8:30 am	Advanced Manufacturing Materials and Technologies at ARL	LJ Holmes (ARL)
8:30 – 9:00 am	ORNL Perspective	Lonnie Love (ORNL)
9:00 – 9:30 am	Material Feedstock Concepts to Achieve Aerospace Quality Components	Brian Rice (UDRI)
9:30 – 10:00 am	Break	
10:00 – 10:30 am	Additive Manufacturing and Architected Materials	Chris Spadaccini (LLNL)
10:30 – 11:00 am	Certification	Michael Gorelik (FAA)
11:00 – 11:30 am	Computational Modeling of CNT Composites	Kris Wise
11:30 am	Closing for morning session	
11:45 am -12:45 pm	Lunch	
1:00 - 1:30 pm	Lessons from CNT Composites Preparation/Processing	Bert Cano/Brian Grimsley
1:30 - 2:00 pm	Value of Systems Analysis in Technology Assessments	Jamshid Samareh
2:00 – 2:15 pm	Break	
2:15 – 3:15 pm	Breakout	
3:15 - 4:00 pm	Report out	
4:00 – 4:15 pm	Next steps	
4:15 pm	Adjourn	

Breakout Sessions Questions

1st Day

1. **What is the industry's candid perspective on the role that AM can play?**
   a. **Advantages and disadvantages of AM**
   b. **Challenges/barriers for technology insertion/acceptance**
2. **Gaps in state of the art -- aerospace?**
3. **Areas of highest payoff**
4. **What's the future direction for AM – timeframe – 1, 5, 10**

2nd Day

1. **What role can gov't labs play in advancing AM?**
2. **What are opportunities for collaboration?**
   a. **Common problems that can benefit from collaborative efforts?**
3. **Assessment of strengths in capabilities that LaRC – do we need to ask Jill about what question to ask. (Nano, AM, Nano used AM)**
4. **Assessment of strengths in capabilities that LaRC can bring to the table in collaborative partnerships?**
5. **Suggestions for design challenge that would be of interest to the community given the objective of the incubator.**