

NASA's
Materials and Processes Technology Information System
(MAPTIS):

*How it relates to
Sustainable Aerospace Advanced Manufacturing and
Sustainable Materials Management*

Presentation by
Sam Higuchi; Staff Engineer
NASA-HQ Environmental Management Division
and
Christina C. Hudson
SAIC

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Session 1B – National and International Regulatory Impacts on DoD Operations:
Refining the Goals of DoD's Strategic Plan for 'REACH'

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14. ABSTRACT Our poster shows how MAPTIS relates to Sustainable Aerospace Advanced Manufacturing and Sustainable Materials Management. MAPTIS is a ?pre-Milestone B? design-engineering tool. MAPTIS provides materials and manufacturing processes information to design-engineers. One component of MAPTIS provides Environmental-Safety-Health (ESH) information on regulated materials, most notably information on materials regulated by the European Union?s ?REACH? and U.S. ESH regulations. MAPTIS?s ESH component is a powerful way to do Pollution Prevention ?at the Source?. The presentation will provide an overview of: (1) the importance of MAPTIS and the ESH component to the U.S. Aerospace Sector; (2) the relevance of MAPTIS and the ESH component to National and International initiatives; (3) the process for keeping MAPTIS and the ESH information current.					
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NASA'S MATERIALS AND PROCESSES TECHNOLOGY INFORMATION SYSTEM (MAPTIS)

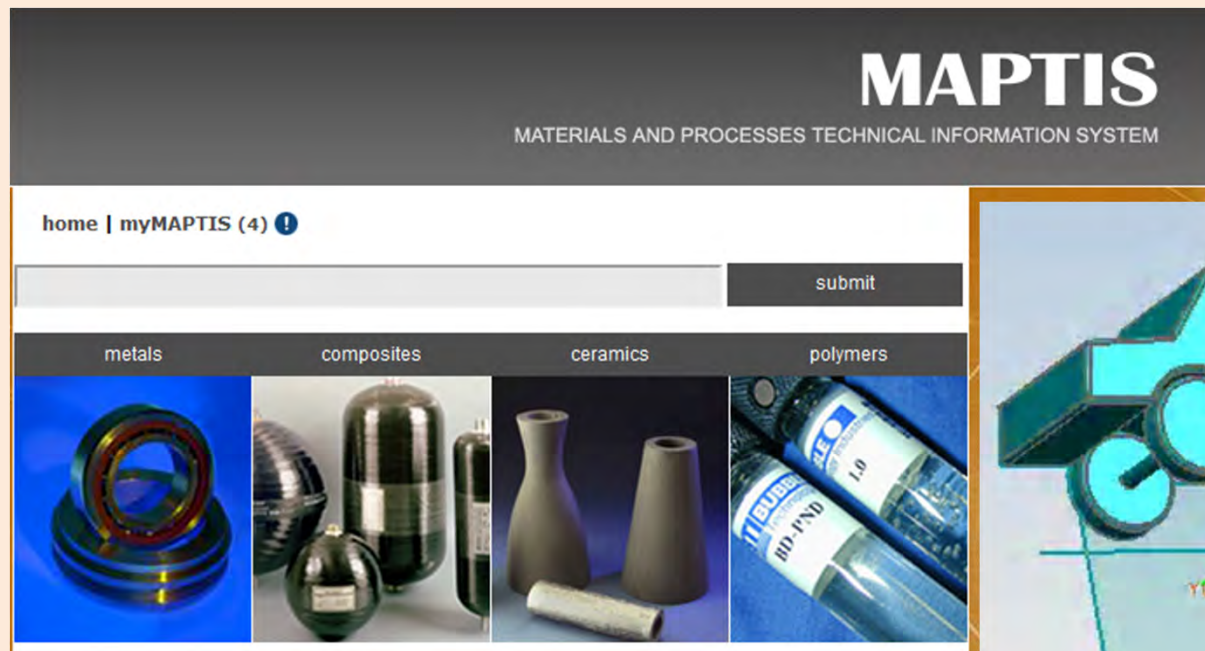
ISAMU HIGUCHI
National Aeronautics and Space Administration, Headquarters
300 E Street, SW
Washington, DC 20546-0001
(202) 358-0149
shiguchi@nasa.gov

CO-PERFORMER: Christina C. Hudson (SAIC)

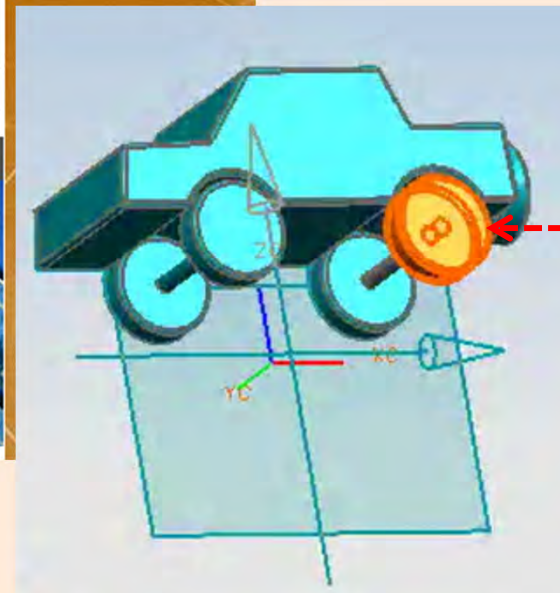
Our poster shows how MAPTIS relates to Sustainable Aerospace Advanced Manufacturing and Sustainable Materials Management.

MAPTIS is a “pre-Milestone B” design-engineering tool. MAPTIS provides materials and manufacturing processes information to design-engineers. One component of MAPTIS provides Environmental-Safety-Health (ESH) information on regulated materials, most notably information on materials regulated by the European Union’s ‘REACH’ and U.S. ESH regulations. MAPTIS’s ESH component is a powerful way to do Pollution Prevention “at the Source”. The presentation will provide an overview of: (1) the importance of MAPTIS and the ESH component to the U.S. Aerospace Sector; (2) the relevance of MAPTIS and the ESH component to National and International initiatives; (3) the process for keeping MAPTIS and the ESH information current.

NASA is about creating for the future using design-engineering tools to enhance sustainable use of materials and sustainable manufacturing processes



MAPTIS: Materials and Processes Technical Information System
MAPTIS is a NASA Materials Science & Materials Engineering Portal

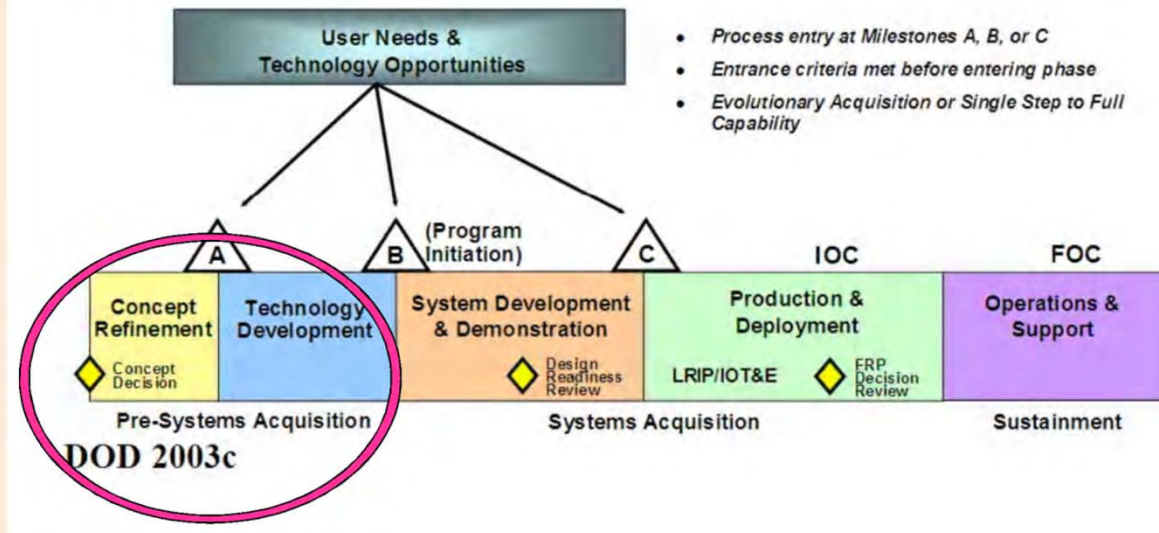


MAPTIS can be used to locate design problems before they become product problems.

MAPTIS can be used to find the right materials and the right manufacturing processes to give the right performance for the right applications so as not to endanger humans or the planet.

MAPTIS is (in DOD Terminology) **pre-Milestone B:**

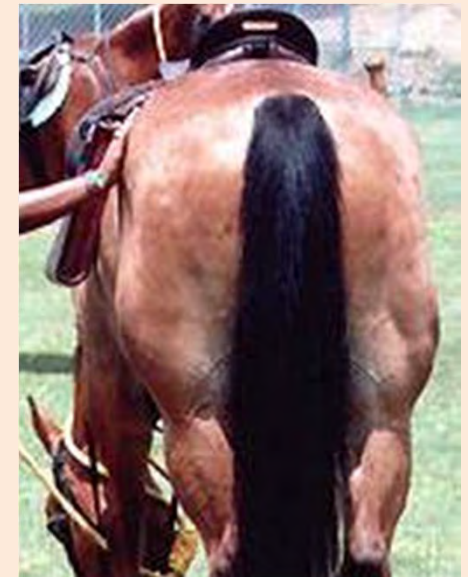
“Technical Requirements, before Milestone B”



http://www.expressnightout.com/printedition/PDF/EXPRESS_10062011.pdf

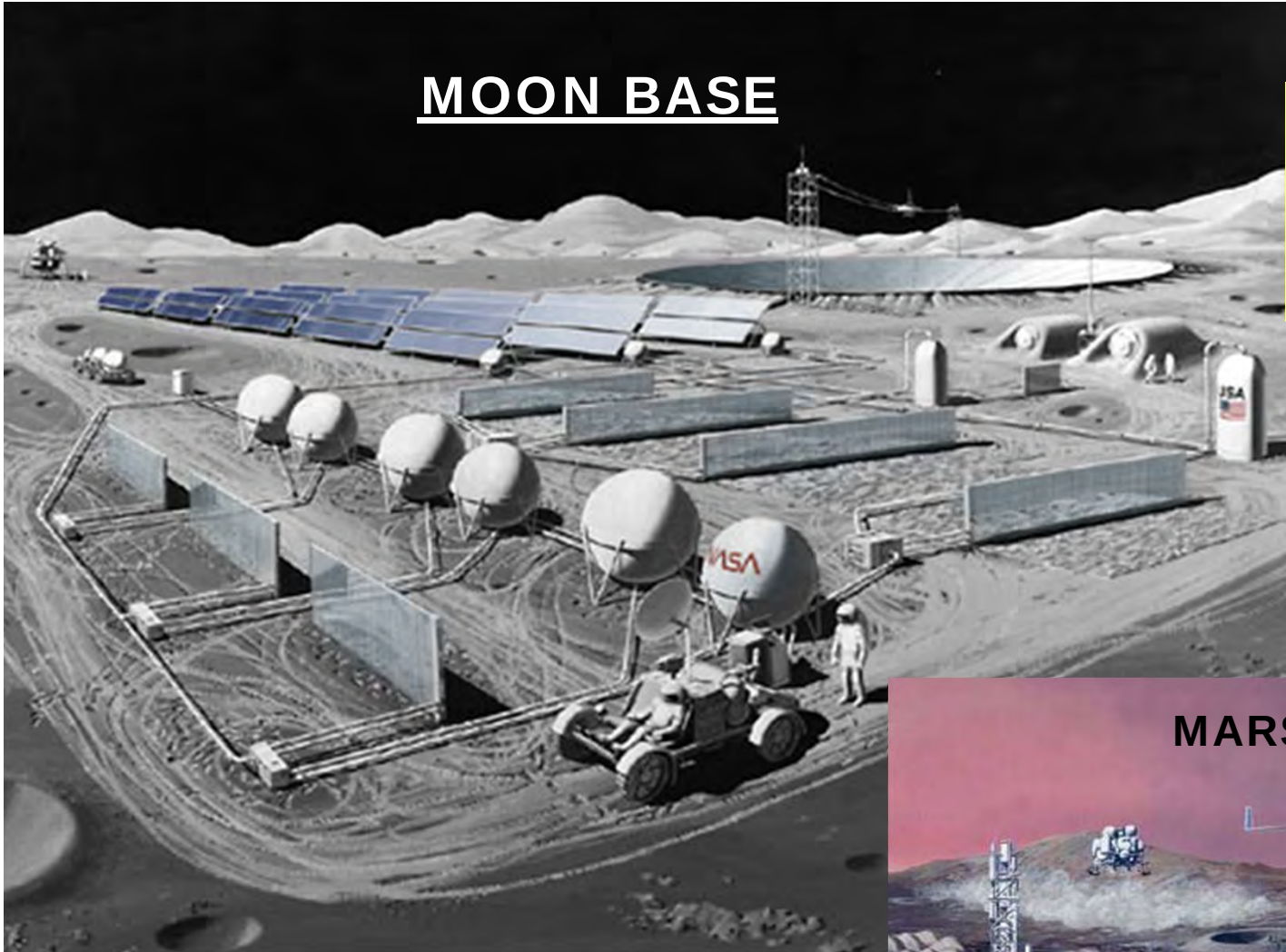


<http://www.msa.md.gov/msa/mdmanual/01glance/symbols/images/1198-1-542b.jpg>



http://apps.atlantaga.gov/citycouncil/Members/ctmartin/gallery_photos/images/YF-horse3_jpg.jpg

MOON BASE



REMOTE SITE RESEARCH: *"THE DREAM"*

MARS BASE



http://www.nasa.gov/centers/glenn/images/content/101885main_C91_08781_516x387.jpg

http://www.nasa.gov/centers/glenn/images/content/101903main_C88_11517_516x387.jpg

ANTARCTIC BASE



MATERIALS MANAGEMENT

REMOTE SITE RESEARCH: *"THE REALITY"*

www.cep.aq/default.asp?casid=6896

[http://web.archive.org/web/20051125095443/
www.antarctica.ac.uk/About_BAS/Cambridge
/Divisions/EID/Environment/fb_before.jpg](http://web.archive.org/web/20051125095443/www.antarctica.ac.uk/About_BAS/Cambridge/Divisions/EID/Environment/fb_before.jpg)

<http://response.restoration.noaa.gov/pribilof/>

ARCTIC BASE



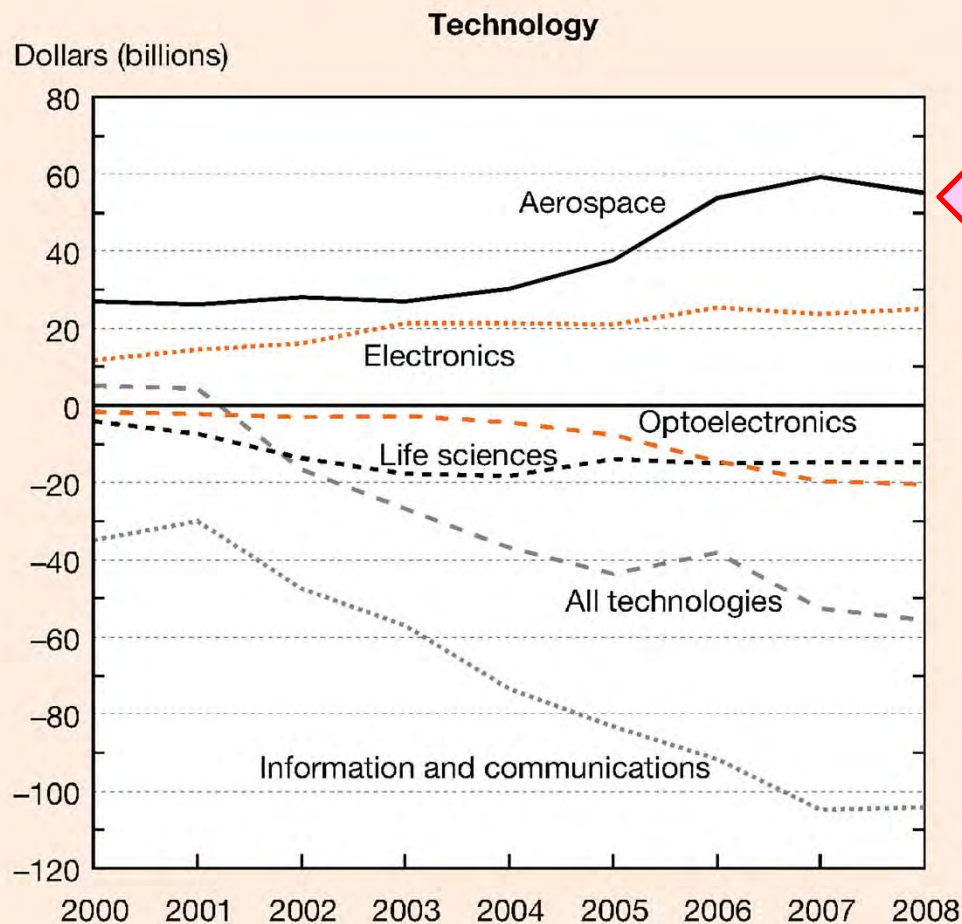
How Important is the US Aerospace Industry?

- 1) Positive U.S. trade balance only exists for two of the five High-Technology areas*
- 2) Greatest positive contributor to the Trade Balance is the U.S. Aerospace Sector

* US Trade Balance for Five High-Technology areas defined by OEDC

(National Science Board - National Science Foundation (2010) Science and Engineering Indicators 2010, Chapter 6: "Industry, Technology, and the Global Marketplace", page 6-37,

at URL: <http://www.nsf.gov/statistics/seind10/pdf/c06.pdf>)



**US Trade Balance
Only positive for:**

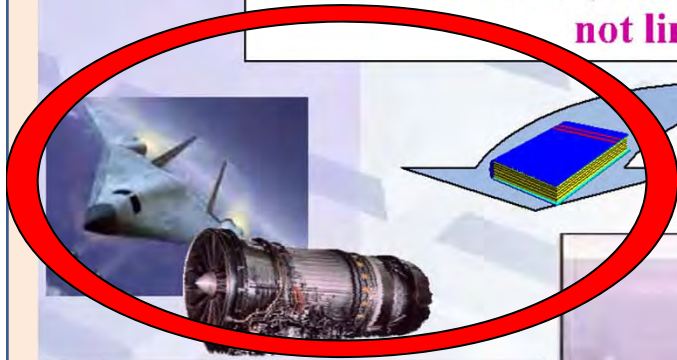
- 1) Aerospace ~\$55B
- 2) Electronics (includes Avionics) ~\$25B



What is the Problem?

Cost - Schedule - Performance
MAPTIS as part of the solution

Materials efforts (new compositions, processing, manufacturing) are not linked with the design process.



Materials Engineer

Systems Design

- Materials Input from “Knowledge Base” of Data (Data Sheets, Graphs, Heuristics, Experience, etc.)
- System/Sub-System Design is Heavily Computational and Rapid
- Clean Sheet of Paper to Engine Design - 30 Months
- Well Established Testing

Leo Christodoulou DARPA DSO (2007)
“Accelerated Insertion of Materials (AIM)”

Materials

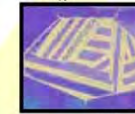
Development

- Highly Empirical
- Testing Independent of Use
- Existing Models Unlinked

Process Design

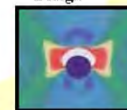


Transformation Design



1.0 μm

Micromechanics Design



0.1 μm

Quantum Design

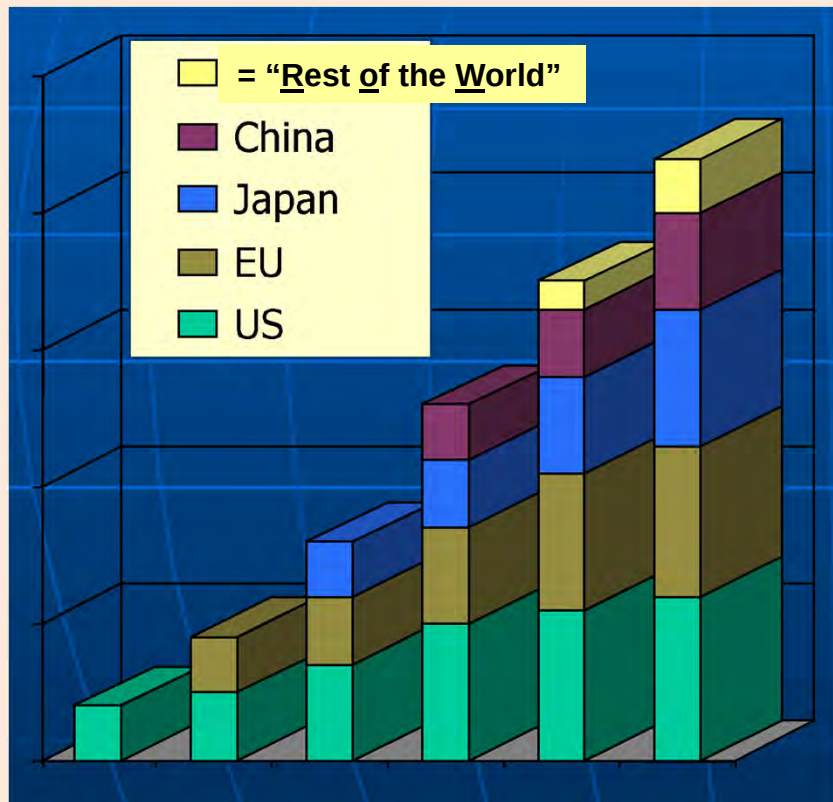


0.1 nm

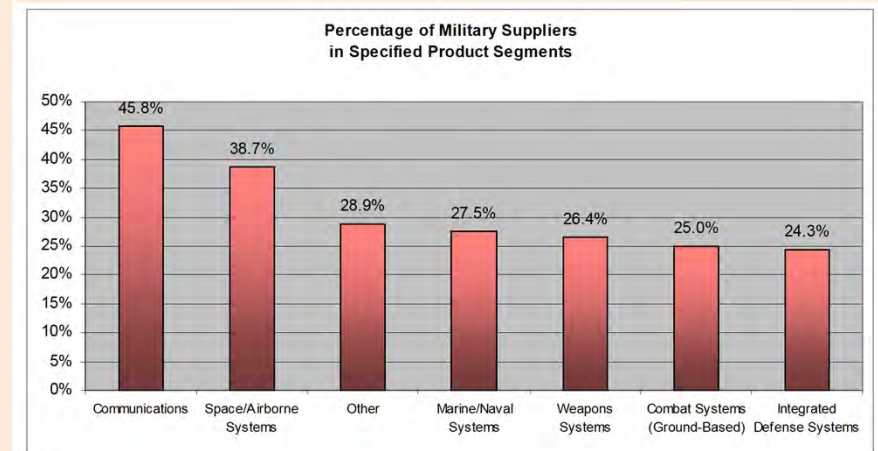
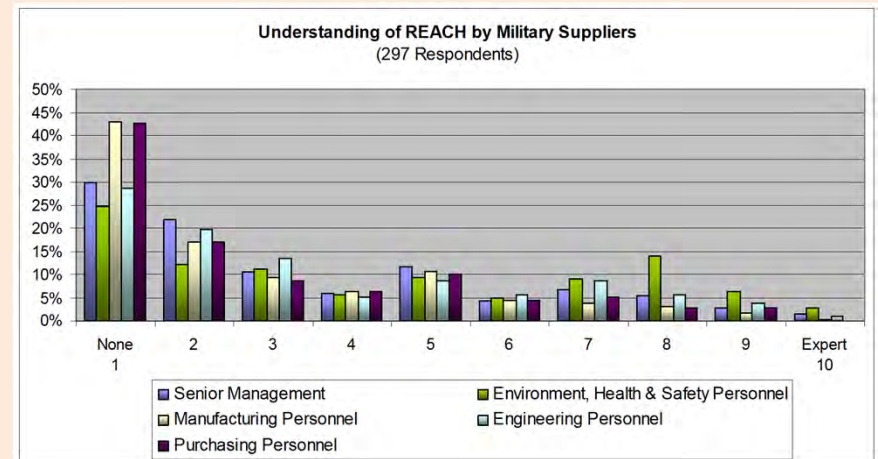
“New commercial products today have a faster development cycle For example, jet engines are now developed in 30 months rather than 60, largely because of improved computational design tools.” NRC (2001) Materials in the New Millennium, at page 10.

2001 Increasing Global Regulations; and 2008 Lack of Understanding About REACH, U.S. Survey

Apparent "Market Failure" to understand the importance of REACH to the U.S.



Brian Sherwin (CSP co-Founder, EORM / President, ESHconnect) &
Jen Jeng (Associate EHS Consultant, EORM) (October 2001)
"SESHA Academic Lecture Series: Design for Safety/ Design for the Environment in the Semiconductor Industry"



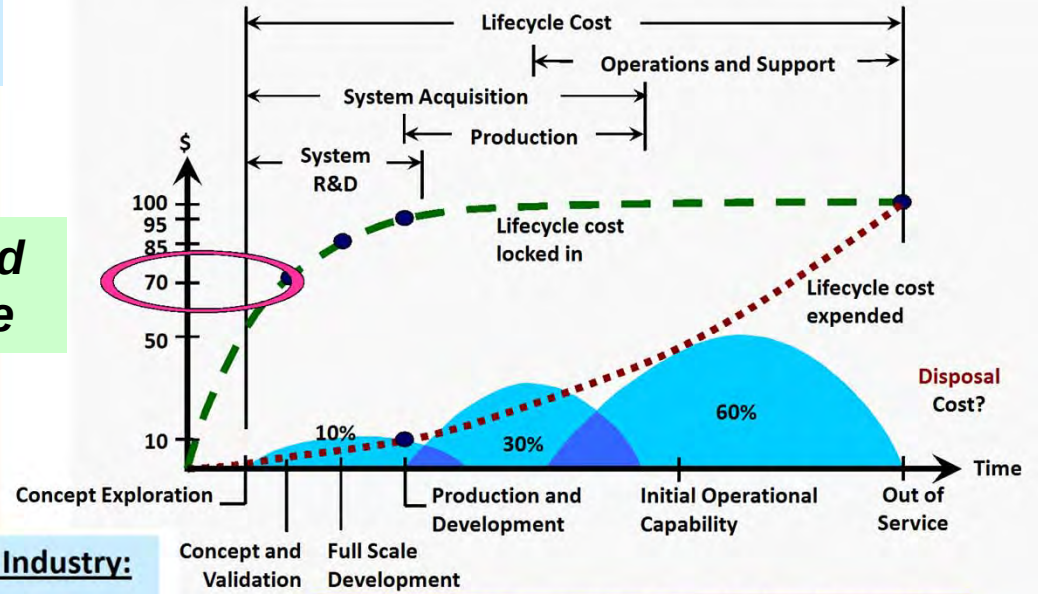
Note: at a 95 percent confidence level, this sample segment has an error margin of ± 5.87

IPC Market Research (2008) "Results of IPC Survey on REACH Preparedness in the North American and European Electronic Interconnect Industry"

Cost locked in by Phase, and Cost of Change by Phase

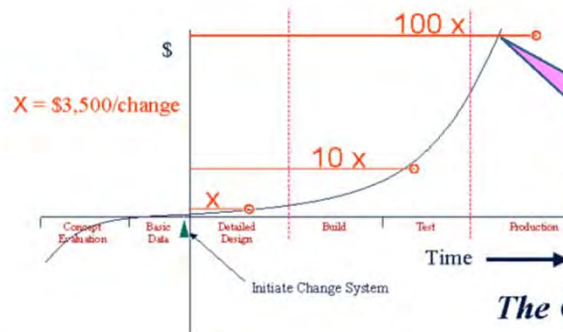
70% of Costs Locked in by Concept Phase

Percentage of Cost Locked In by Phase



From W. J. Larson & L. K. Prance (1999) *Human Spaceflight: Mission Analysis and Design*

The Cost of Change

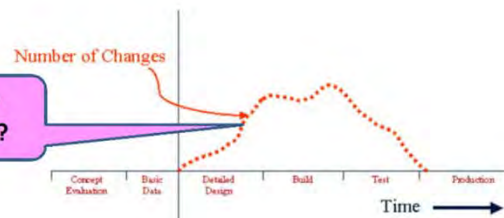


Aerospace Industry: Change Order Cost Gavin Finn (1998)

1) \$350,000 per "Production Stage" Change Order!!

The Cost of Change

2) One material selection error, but how many change orders to correct the error?



Aerospace Study Average Cost per Change

(G, Finn)

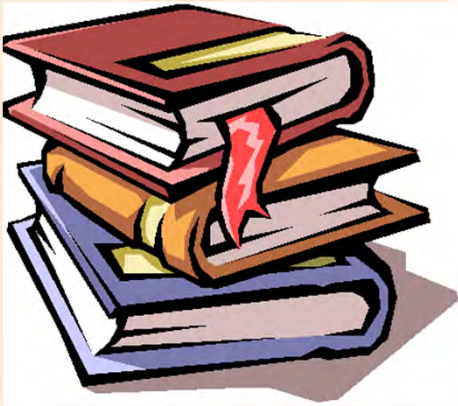
- 1) \$3,500 Design Phase
- 2) \$35,000 Build Phase
- 3) \$350,000 Production Phase

Gavin A. Finn (Prescient Technologies) (1998) "Design Quality - A Prerequisite To Integration Of Design And Manufacturing" at the "NIST - Design/ Manufacturing Integration Workshop: Standards and Implementation Issues"

prescient

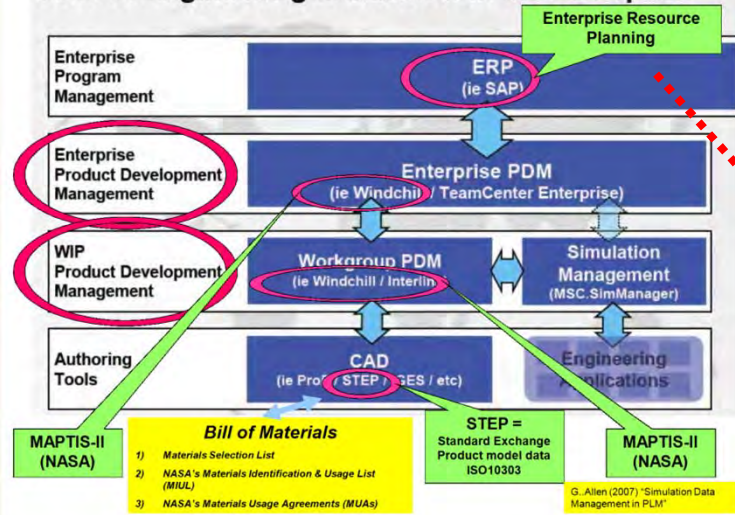


“Leap-Frogging” Technology



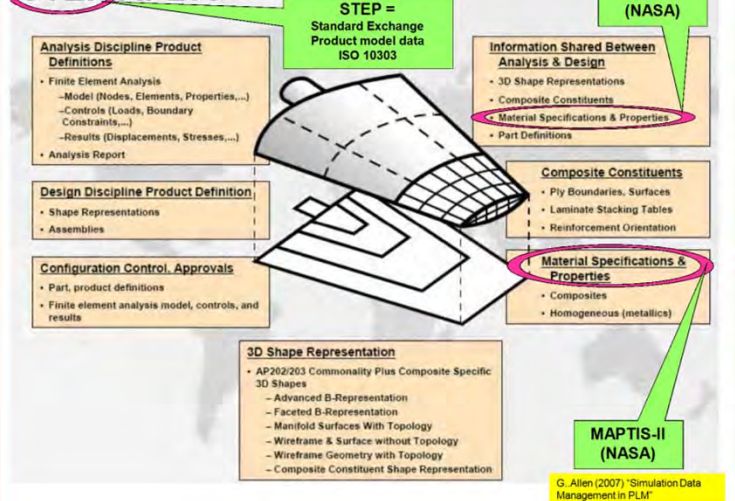
2

Role of Engineering Simulation in the Enterprise



1

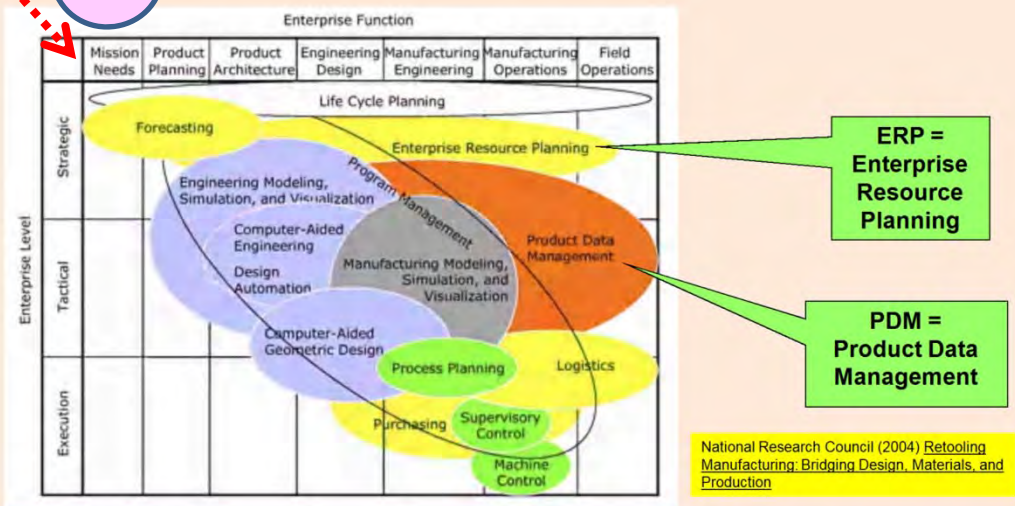
STEP AP209



MAPTIS and Making Decisions and Controlling Resources (including costs)

- 1) Design Engineer (CAD)
- 2) Project/ Program Manager (PLM/ PDM)
- 3) Corporate Executive/ Senior Manager (ERP)

3



National Research Council (2004) Retooling Manufacturing: Bridging Design, Materials, and Production

Interoperability of AEE Tools

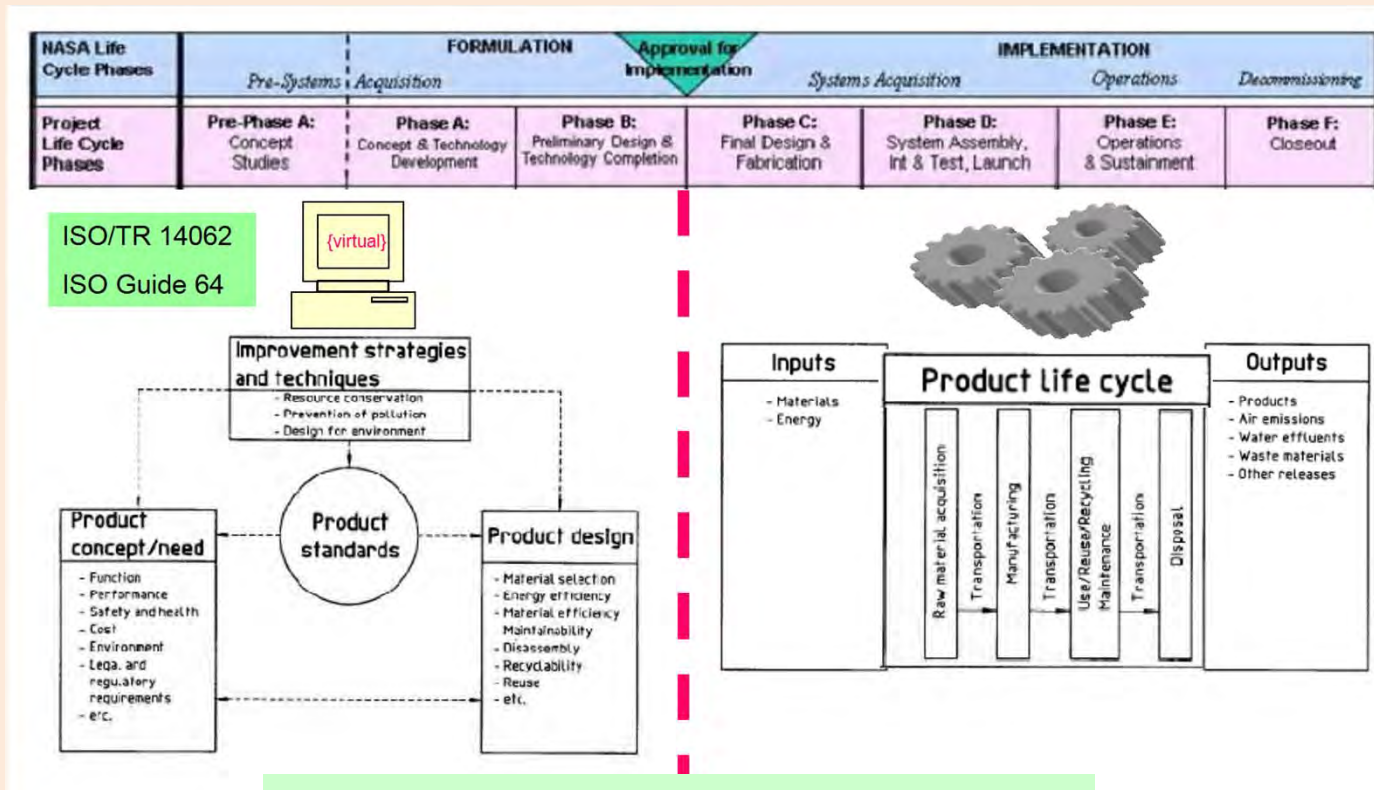
	CAD	CAE	CAM	PDM
CAD	STEP AP203	STEP AP209	STEP NC	
CAE	STEP AP209	STEP AP209		
CAM	STEP NC			
PDM				STEP PDM

<http://www.sei.cmu.edu/reports/03tr013.pdf>

Company	Siemens	Dassault Systemes	PTC
CAD	UG-NX	CATIA	Pro/Engineer
PDM/PLM	Teamcenter	Matrix One and Enovia	Windchill

MAPTIS and Sustainable Materials Management Opportunities:

Product (Project, Program) Lifecycle Management (PLM)



CROSS-CUTTING STRATEGIES* --

“Technology Roadmap Strategies”:

* K. Geiser (2001) *Materials Matter*

1. **Detoxification**
2. **Dematerialization**
3. **Decarbonization**

National Initiatives and NASA Technology Initiatives And MAPTIS



MAPTIS can implement concepts that have the potential to significantly contribute to:

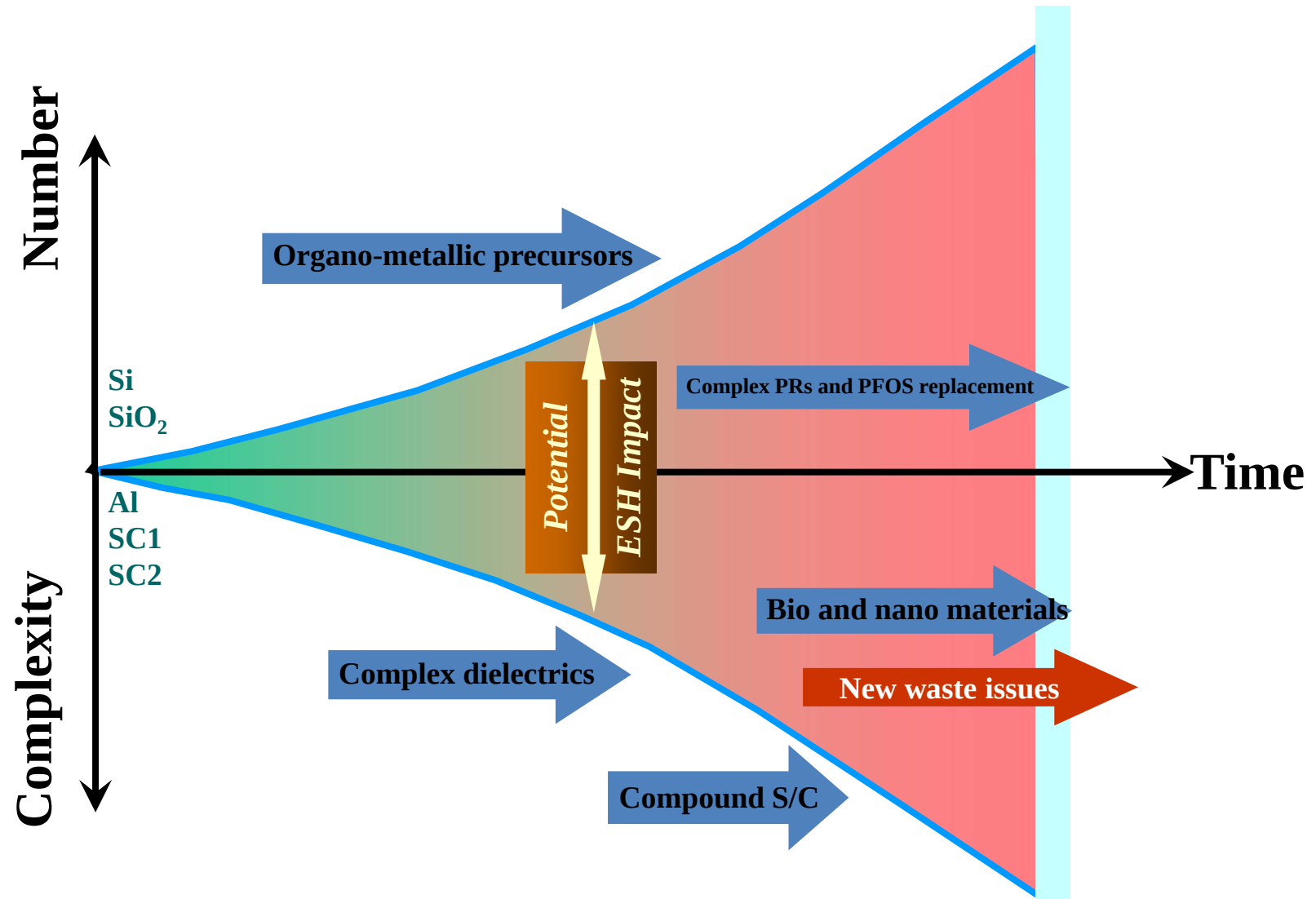
- National Advanced Manufacturing Initiative
- National Materials Genome Initiative



MAPTIS can implement concepts that have the potential to significantly contribute to:

- NASA Space Technology Grand Challenge
- NASA Technology Roadmap for Materials
- NASA Technology Roadmap for Information Technology

Potential Risks of Introducing New Materials



F Shadman (May 2008) EPA Science Forum:
Environmental Challenges and Opportunities in Nano-
Manufacturing (Semiconductor Manufacturing)

MAPTIS

Public-Private Activities



Spacecraft Materials Consortium

Gary Pippin FFRDC – Aerospace Corp/Boeing (2010)
 "Spacecraft Materials Consortium" (In attendance on 9 Nov
 were: Rob Cox, Sopo Yung, Rick Serwecki, Don Jaworske,
 Debbie Waters, Gary Pippin, Steve Warrthal, Matt Presley, Julia
 Yefimenko, Ivonka Palusinski, Mina Finckendor, and Kelly Trautz)

09 Nov 2010

The Material Data Management Consortium (MDMC)

Managing critical data in aerospace, defense, and energy.

The Material Data Management Consortium (MDMC)



Key industry sectors: [Aerospace](#), [defense](#), and [energy](#).

The Material Data Management Consortium (MDMC) is a unique collaborative project focused on developing and applying software to manage mission-critical materials data in the aerospace, defense, and energy sectors.

aviation, engineering, defense, health, and industry.

Members

ASM International
 AWE
 Boeing
 Honeywell Aerospace
 GE—Aviation
 GE—Energy
 Lockheed Martin
 Los Alamos NL
 NASA Glenn Research Ctr
 NASA Marshall SFC
 Northrop Grumman
 Oak Ridge NL
 Raytheon
 Rolls Royce
 US Navy
 US Army Research Labs
 Williams International

s industries. It is also vital that
 red users, and that data is fully

ts stringent requirements for

The Materials Strategy Software Consortium is a collaborative project that defines and applies new software to manage materials data and meet the challenges of material selection, substitution and cost optimization.



Benefits include reducing overall manufacturing costs, mitigating the risks associated with global engineering, and improving product quality.

Emerson Electric
 Moen Inc. (Fortune Brands)
 TRW Automotive
 NASA
 DePuy
 Ethicon Endosurgery
 Baker-Hughes
 Sulzer
 Rhodia
 Granta Design

The Materials Strategy Software Consortium



For any organization with an interest in materials selection, substitution and cost optimization

The Materials Strategy Software Consortium is a collaborative project which defines and applies new software to manage materials data and apply it to the challenges of material selection, substitution and cost optimization.

t/new

market analysis

- **Material Substitution »**
Tools to identify—and understand the implications of—candidate substitutes for materials which are withdrawn, obsolete or unavailable.
- **Coating Selection »**
Data and software to support the systematic, rational selection of coatings and coated materials

The Environmental Materials Information Technology (EMIT) Consortium

The Environmental Materials Information Technology (EMIT) Consortium is a collaborative project that develops and applies materials information technology solutions to assist design around environmental constraints.

Two key focus areas are:

- Restricted substance regulations (such as REACH)
- Eco design to meet objectives such as reduced energy or carbon footprint

Members

EADS Astrium
 Emerson Electric
 Eurocopter
 Honeywell
 NASA
 NPL
 Rolls-Royce
 US Army Research Labs

The EMIT Consortium



The Environmental Materials Information Technology Consortium is for any manufacturing organization.

The project develops and applies materials information technology solutions to assist design around environmental constraints.

STOP