

ITEC Advanced Engineering Conference
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Simulation Based Acquisition - Has its Time Come?

Andy Fawkes



Overview

- **What is/was Simulation Based Acquisition?**
- **Historical Context**
- **Relationship with Industry 4.0**
- **Has its Time Come?**



**Georg Wilhelm Friedrich Hegel
(1770-1831)
(Born Stuttgart)**

**“we learn from
history that we do not
learn from history”**

Defence Emphasis



What is/was Simulation Based Acquisition?

The SBA Vision

“an acquisition process in which DoD and industry are enabled by robust, collaborative use of simulation technology that is integrated across acquisition phases and programs.”

US DoD Acquisition Council (1997)

SeBA?

Synthetic Environment Based Acquisition

“The consistent and coherent application of modelling, simulation and SE technology within, and across, both acquisition phases and programmes to facilitate the attainment of the Smart Acquisition goals of faster, cheaper, better”

UK MoD 1990s

Why Then?

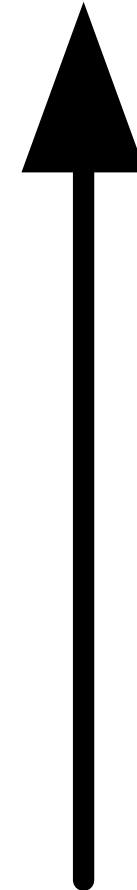
Faster



Cheaper



Better



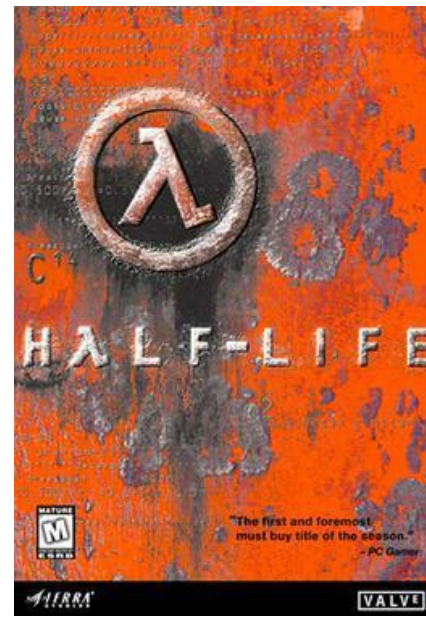
**Modelling &
Simulation
Technology**

1990s - Popular Consciousness

1995 – *Toy Story* Film



1998 – *Half-Life* Video Game



SBA Concepts

Central SBA Technical Concept

- A common set of reference data called a Digital Product Definition (DPD)
 - Data which accurately and completely described the proposed system, its operational context, design, and program data (cost, schedule, and logistics)
 - Accessible through life to all parties involved in the acquisition process in Government & Industry



SBA - Sharing Models and Data

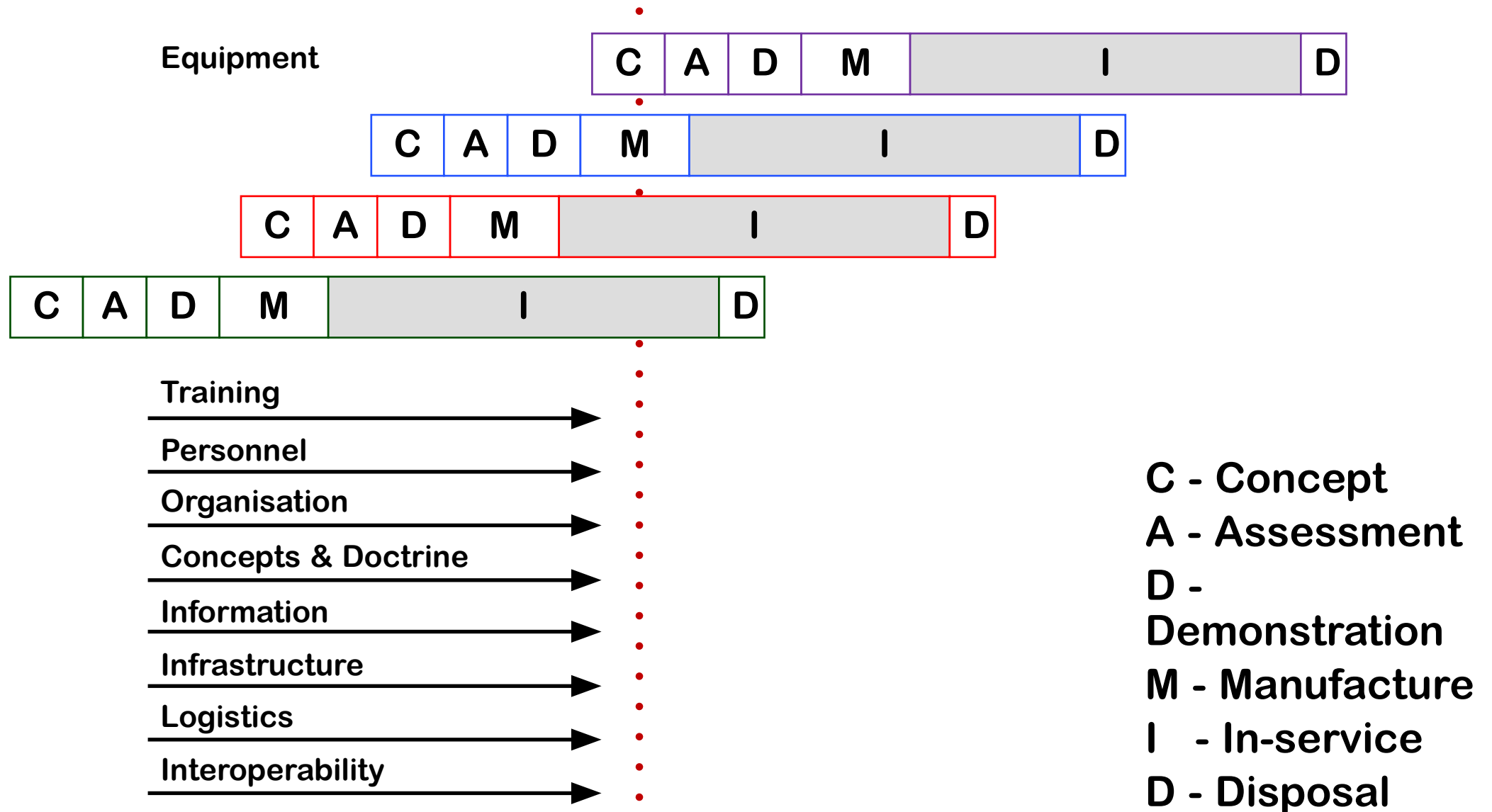
Through the DPD, SBA would enable sharing across:

- **Manufacturing Simulation Software**
- **Manufacturing Facility Simulation Software**
- **Weapon System Software**
- **Training System Software**
- **Cost Analysis Software**
- **Mission Support Software:**
 - Mission Intelligence
 - Mission Planning software
 - Mission Rehearsal
 - Mission Execution
 - Mission Debrief

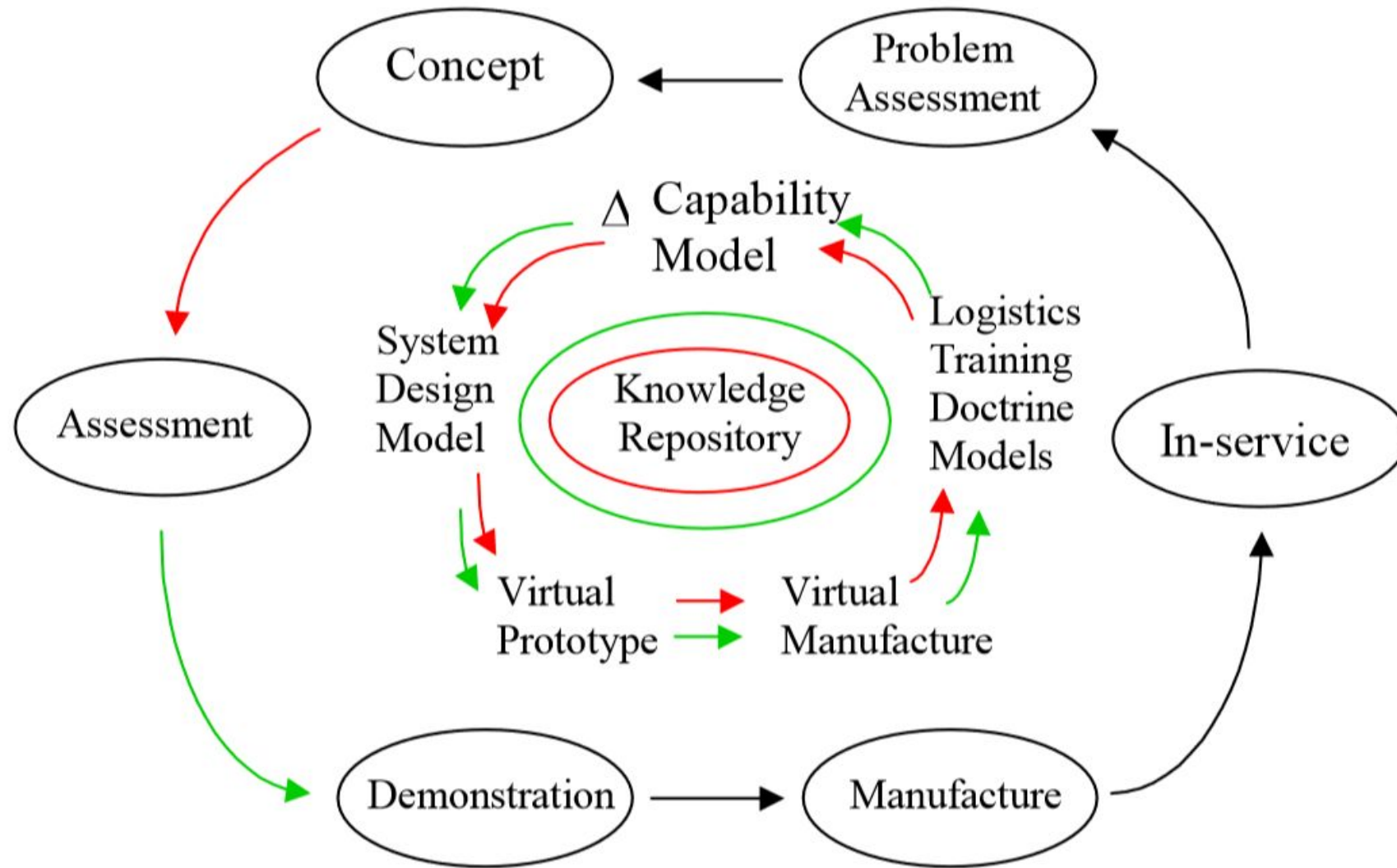


SBA Integrating Military Capability (UK)

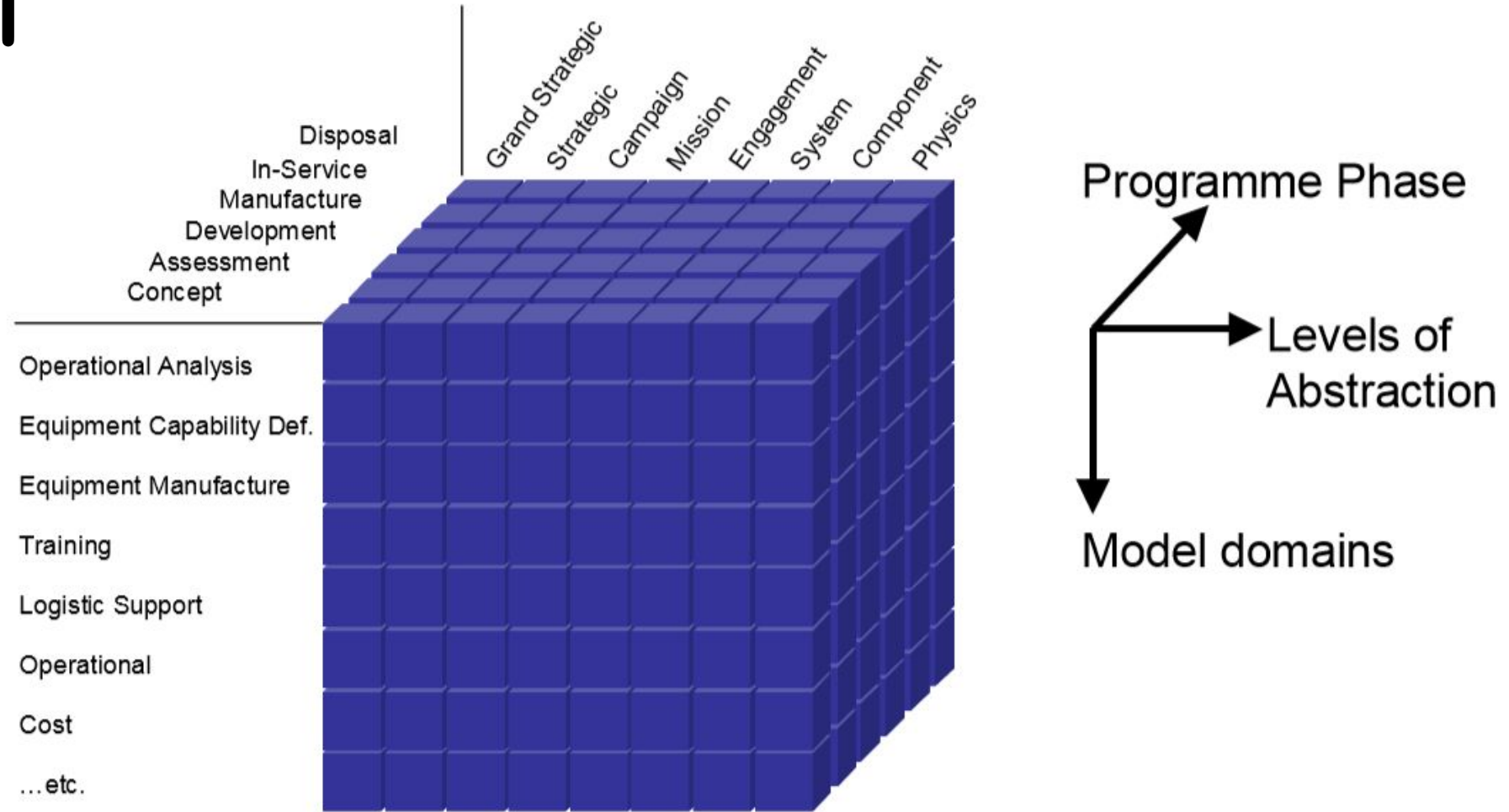
Lines of Development



Temporal Context - The UK “SeBA Wheel”



“The Potential SE Space”



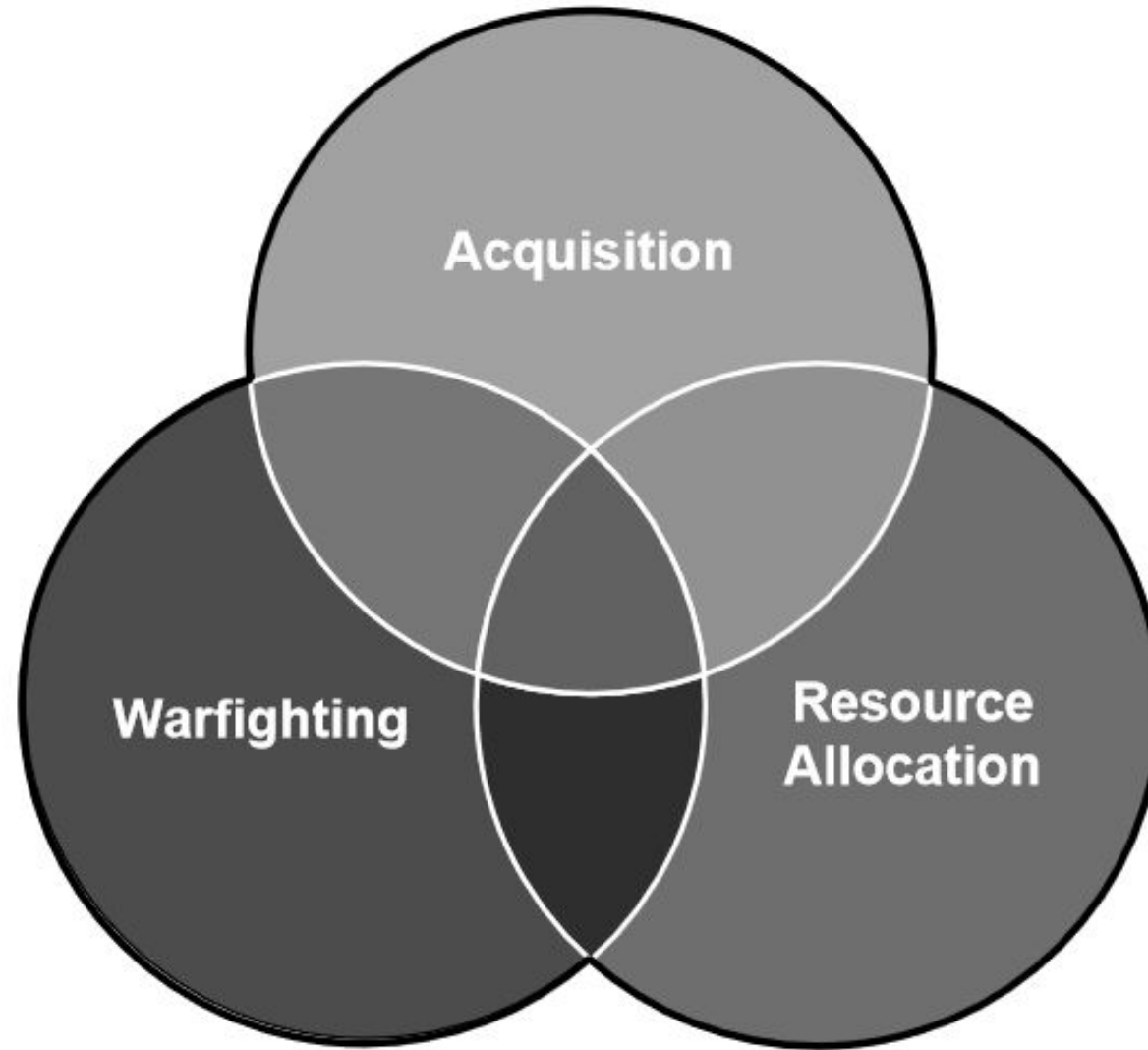
1. A single model will fit in one cube
2. A “Task SE” may well span several cubes
3. The “Enterprise SE” will encompass the whole space

SBA – It's all about Sharing

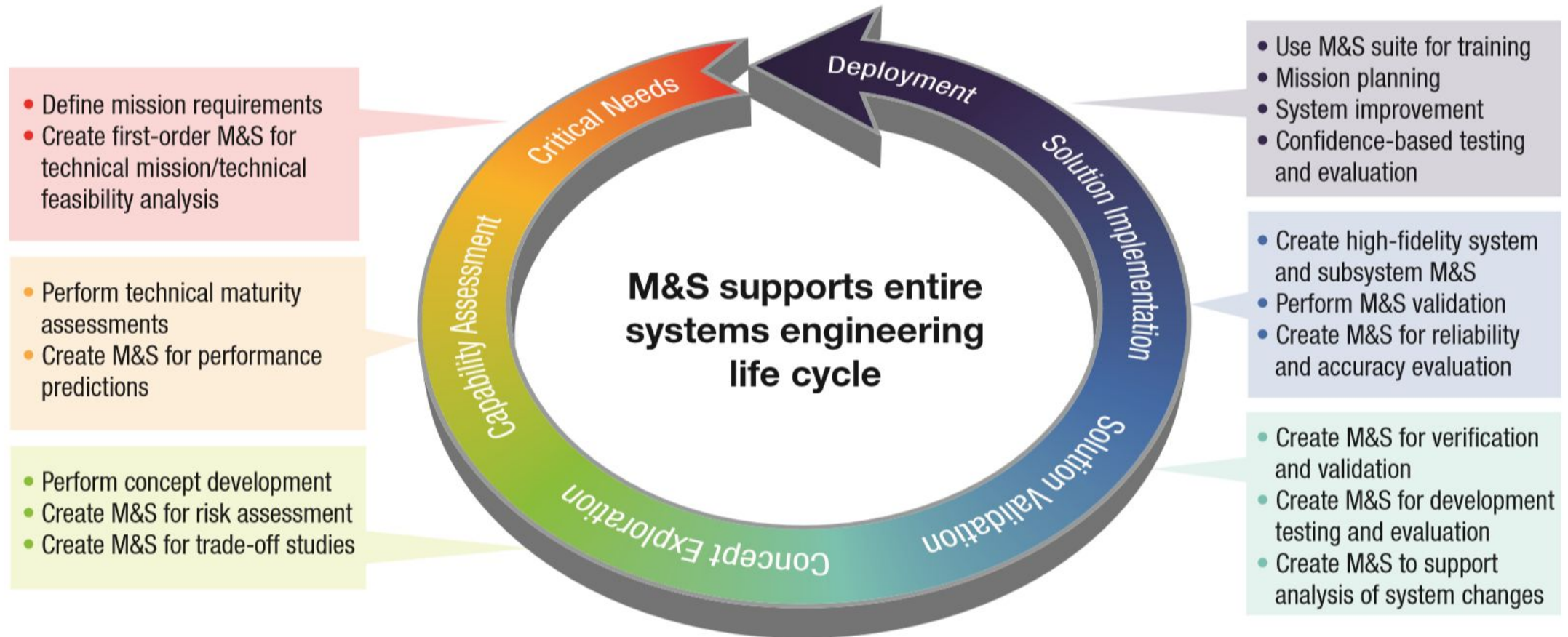
- **Within Projects**
- **Across Projects**
- **Over Time**



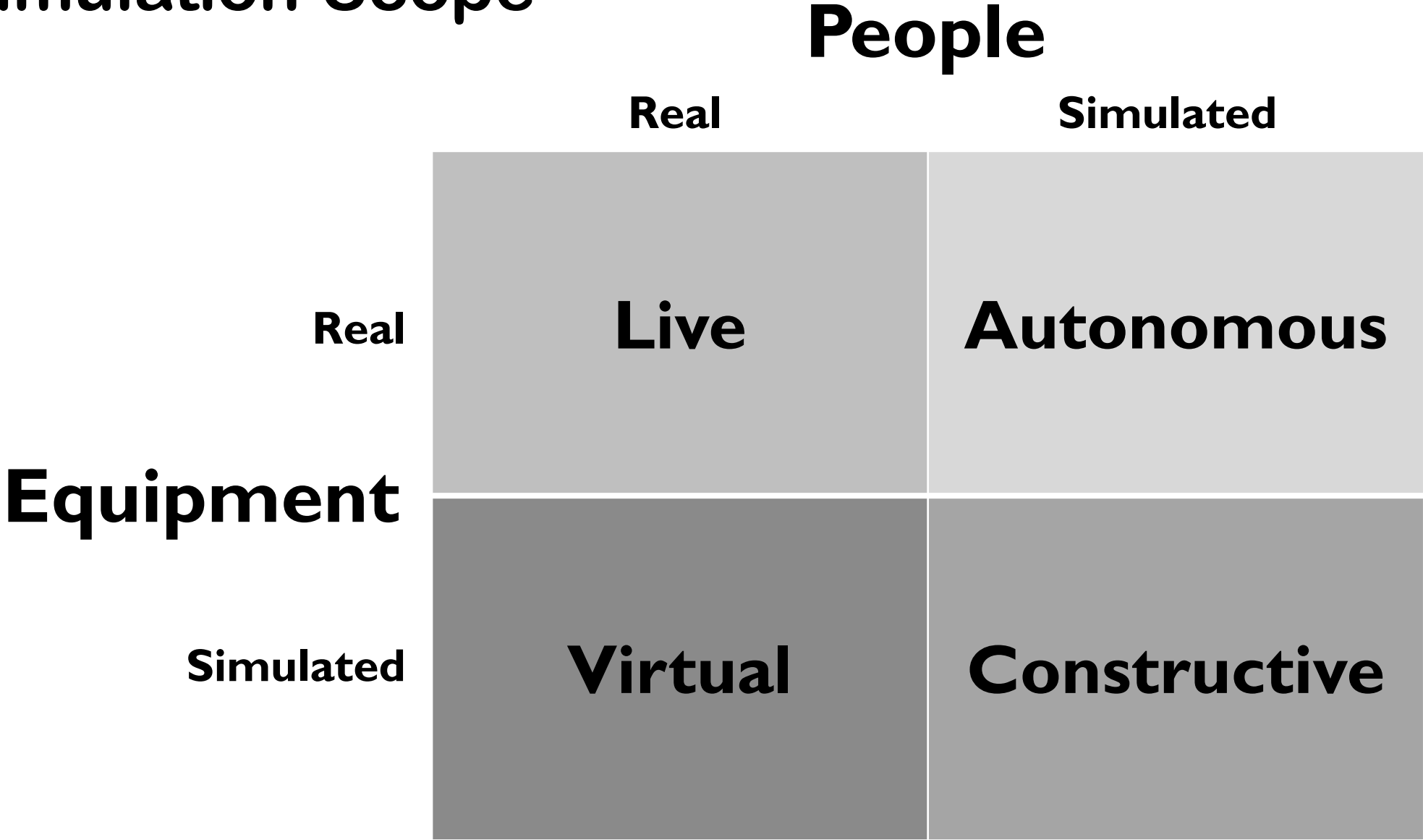
SBA Linking Communities



M&S Supporting the Systems Engineering Life Cycle



SBA Simulation Scope





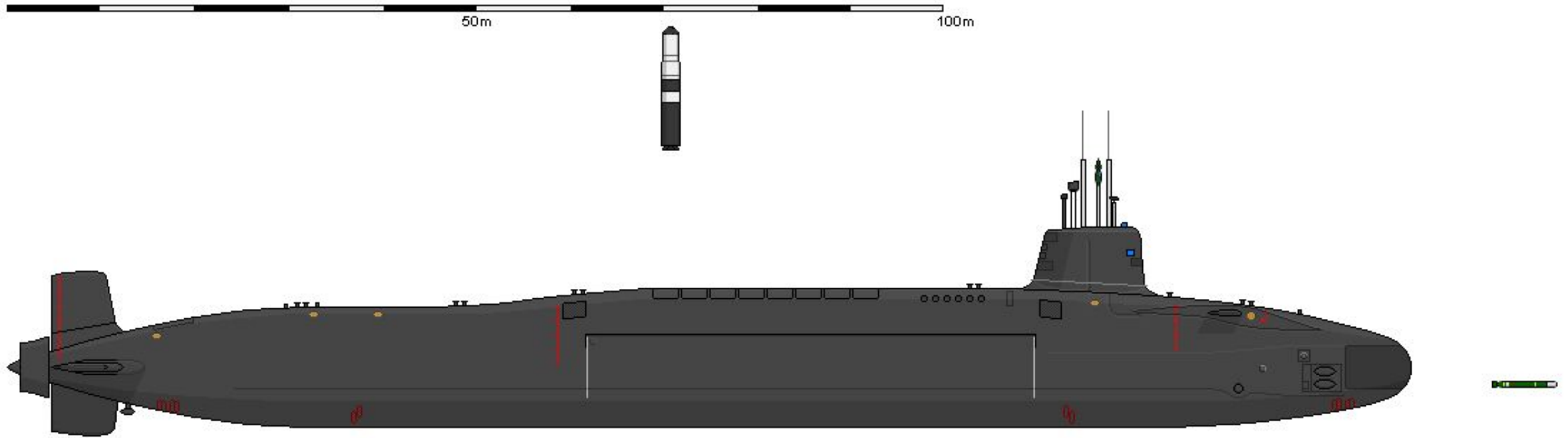
Confused by SBA?

SBA had a Number of Different Messages



Historical Context

UK Vanguard Class SSBN



1980s - 1/5th Scale Perspex Model Supported the Design & Build and Later, Refits

1994 - Joint Strike Fighter (F-35)

General Muellner, JSF Program Manager, sought to use an unprecedented level of M&S to:

- Facilitate fully developed & validated operational requirements**
- Conduct trade-off analyses of critical user defined performance parameters**
- Integrate team of users & developers**
- Evolve requirements over time**
- Reduce future strike systems development, procurement, & support costs**

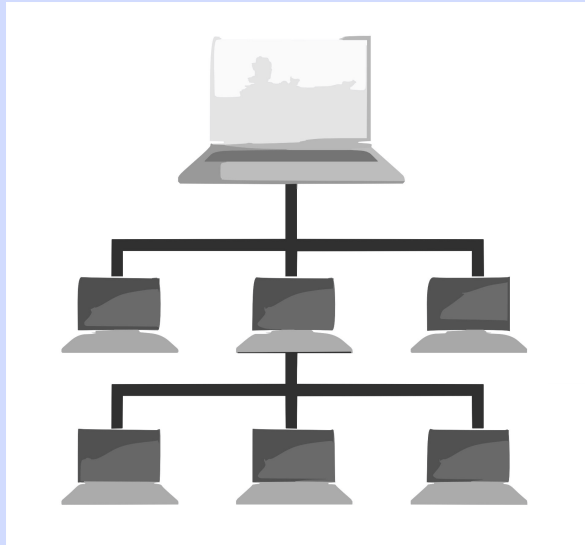
1997 - US DoD Acquisition Council

“an acquisition process in which DoD and industry are enabled by robust, collaborative use of simulation technology that is integrated across acquisition phases and programs.”

The SBA Vision

1998 - SBA Challenges Recognised by DoD

Technical



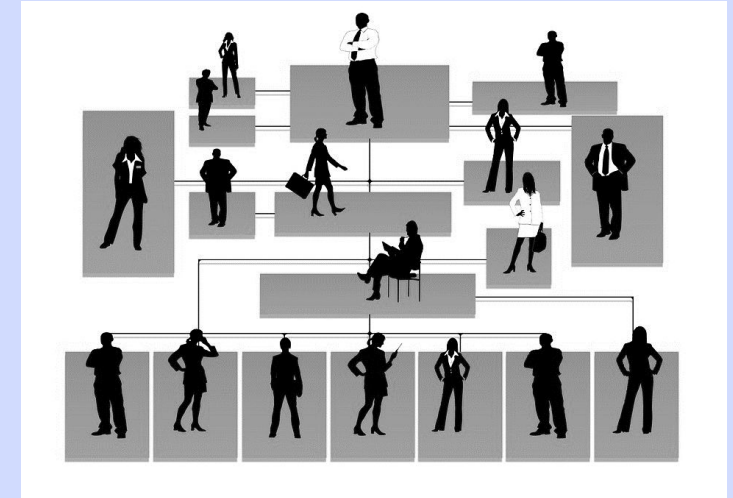
- Interoperability of M&S Tools
- Data Description Availability
- Security/Sensitivity of Data
- Physics-based M&S
- Hardware/Software Limitations
- Variable Resolution

Cultural



- Acquisition Processes
- Incentives for M&S Use
- M&S Workforce
- Acceptance of M&S

Managerial



- OSD and Service Guidance
- Ownership of Data
- VV&A Requirements
- Funding Process
- Use of System Models

UK MoD/Industry SeBA Collaboration

- **National Capability Demonstrators (NCDs)**
 - **FlasHLAmp (1996-98)**
 - **ADSE (1997-98)**
 - **Project Vitesse (1996-99)**
 - **SeBA (99-02)**
- **FOAS (1999-00)**
- **NIREUS (1998-03)**
- **EUCLID 11.13 (2000-03)**
- **NMSG-003 - Feasibility Study on M&S Technology in Support of SBA (2003)**

2001 - Joint Strike Fighter

Lockheed Martin had “achieved a 50 plus percent reduction in acquisition cycle time and cost via M&S, and the savings have been incorporated into our proposal bid”

Mr. Frank CAPPuccio

Vice President JSF, Lockheed Martin Corporation

National Defence Industries Association SBA Conference

June 2001

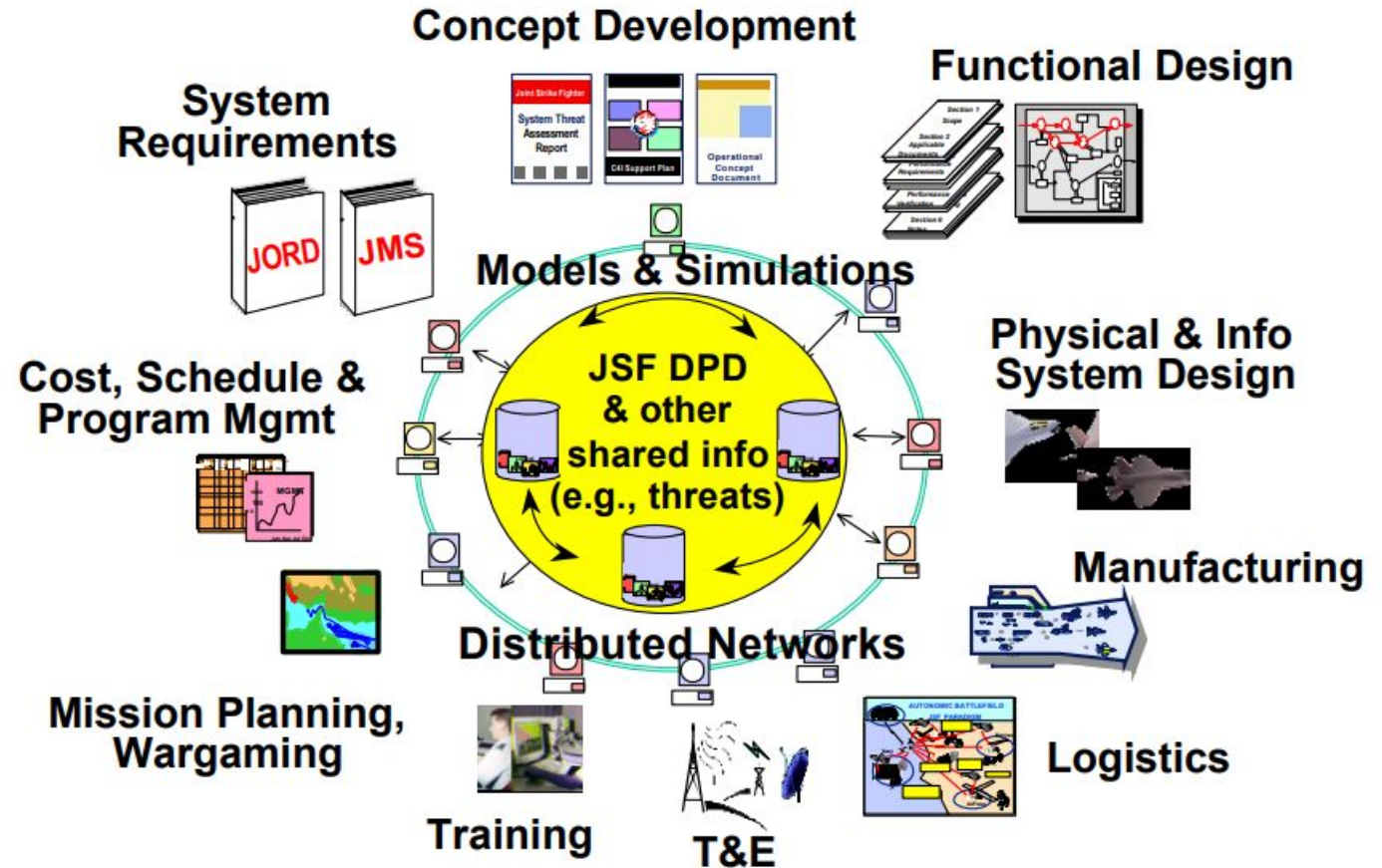
SBA was listed as one of the significant contributors to the saving of one flying prototype

2002 - JSF Digital Product Data



Simulation Based Acquisition (SBA): Shared Info is the Hub of IPPD

(JSF M&S Support Plan Fig. 5-3)



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2003 - SBA In Trouble?



- In 2003, SBA was eradicated from DoD terminology by removing “SBA” from all DoD 5000-series publications, thus vanishing as a distinct DoD initiative
- “The acquisition community appeared to conclude that SBA was over-sold, over-complicated, and misunderstood”

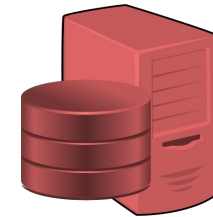
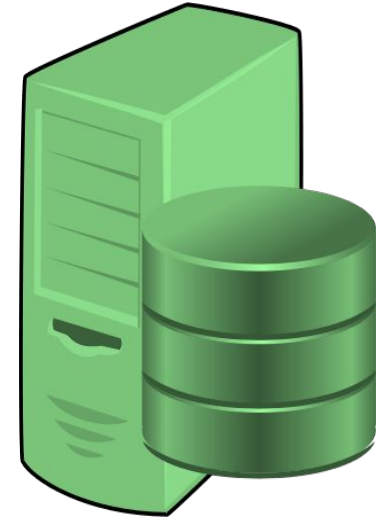
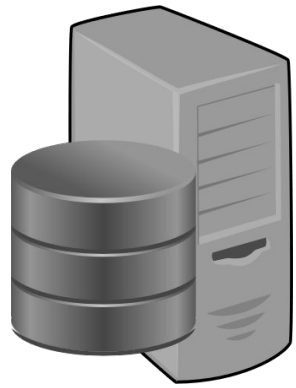
What Went Wrong?

v DoD SBA Challenges

	SBA Challenges		comment
1	Interoperability of M&S Tools		Cross-Domain Weaknesses
2	Data Description Availability		Stovepipe Projects
3	Security/Sensitivity of Data		IPR & Security Challenges
4	Physics-based M&S		
5	Hardware/Software Limitations		
6	Variable Resolution		“Fair Fight” Issues
7	Acquisition Processes		Many other Initiatives
8	Incentives for M&S Use		Spend to Save Challenge
9	M&S Workforce		M&S not Mainstream Skill
10	Acceptance of M&S		Act of Faith?
11	OSD and Service Guidance		Guidance but is it Followed?
12	Ownership of Data		IPR & Security Challenges
13	VV&A Requirements		Guidance Generated but Followed?
14	Funding Process		Stovepipe Funding
15	Use of System Models		Some Progress

Digital Product Definition (DPD) Data

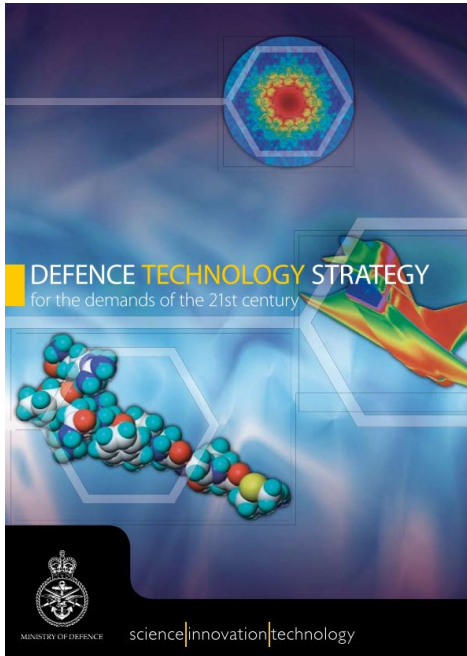
Unconnected - Incompatible - Inaccessible



My Own Experience

- **Confusing Multiple Messages**
- **Confusion with Other Procurement Change Initiatives**
- **General Lack of Knowledge about the Use of M&S**
- **Gulf between “M&S Enthusiasts” & Mainstream Procurement**
- **Weak connections with Training and Simulation Community**
- **Organisational & Funding Stovepipes**
- **Lack of Clear Incentives**

Though SBA Lived On...



UK Defence Technology Strategy (2006)

“MoD will work in collaboration with industry, using existing fora such as the Synthetic Environments Tower of Excellence and initiatives including the Integrated Modelling and Simulation Support for Acquisition (IMSSA) project, to develop a joined-up defence wide modelling and simulation capability”

Naval Air Warfare Center Existing Online SBA Guidance

Simulation Based Acquisition (SBA)

- [DoD Modeling And Simulation Coordination Office \(M&SCO\)](#)
- [Navy Modeling And Simulation Management Office \(NAVMSMO\)](#)
- [Army Modeling And Simulation Office \(AMSO\)](#)
- [Air Force Agency For Modeling And Simulation \(AFAMS\)](#)

SBA VISION

An Acquisition Process in Which DoD and Industry are Enabled by Robust, Collaborative Use of Simulation Technology That Is Integrated Across Acquisition Phases and Programs.

GOALS OF SBA

- Substantially Reduce the Time, Resources, and Risk Associated With the Entire Acquisition Process;
- Increase the Quality, Military Worth and Supportability of Fielded Systems , While Reducing Total Ownership Costs Throughout the Total Life Cycle;
- Enable Integrated Product and Process Development (IPPD) Across the Entire Acquisition Life Cycle.

SBA EXPLAINED

- Revolutionary Acquisition Initiative
 - Emphasizes Modeling & Simulation as a Primary Tool
 - M&S Applied and Sustained Throughout the Life Cycle
 - Virtual Life Cycle Product Validation Before Production
 - Re-use Across Programs & Phases
 - Enables Iterative Development and IPPDs
- Major Impact On T&E Culture and Purpose
 - Digital Representations are Tested
 - Physical Test Articles Are Primarily For Model Verification and Validation
- Major Paradigm Changes in Three Domains
 - Culture. An evolved culture in which enterprise-wide cooperation is the rule and individual technical contributions and innovations are encouraged and efficiently managed. The culture also recognizes and creates incentives for high level tradeoffs both within a system as well as between systems, and without institutional or service imposed barriers.



“Digital Thread” & “Digital Twin”



AVIATION WEEK
NETWORK

AVIATION WEEK
& SPACE TECHNOLOGY

Step INSIDE the next evolution

USAF Selects Lead Programs For ‘Digital Twin’ Initiative

Aviation Week & Space Technology

Graham Warwick

Jan 26, 2015

Digital system models are seen as key to regaining understanding of complex systems

Threading the Needle

Over the years, the U.S. Air Force has come to rely more and more on industry for its technical understanding of the systems it acquires. To reverse that process and bring costs and risks more under its control, the service is experimenting with creating and carrying digital system models through the entire life cycle of a program.

The acquisition process now being piloted has two key elements: the “digital thread,” a model of the system that begins at conceptualization and evolves through its life to retirement; and the “digital twin,” a model of the system as built, including any manufacturing discrepancies, that is used to support the system in service.

F-35 (2018)

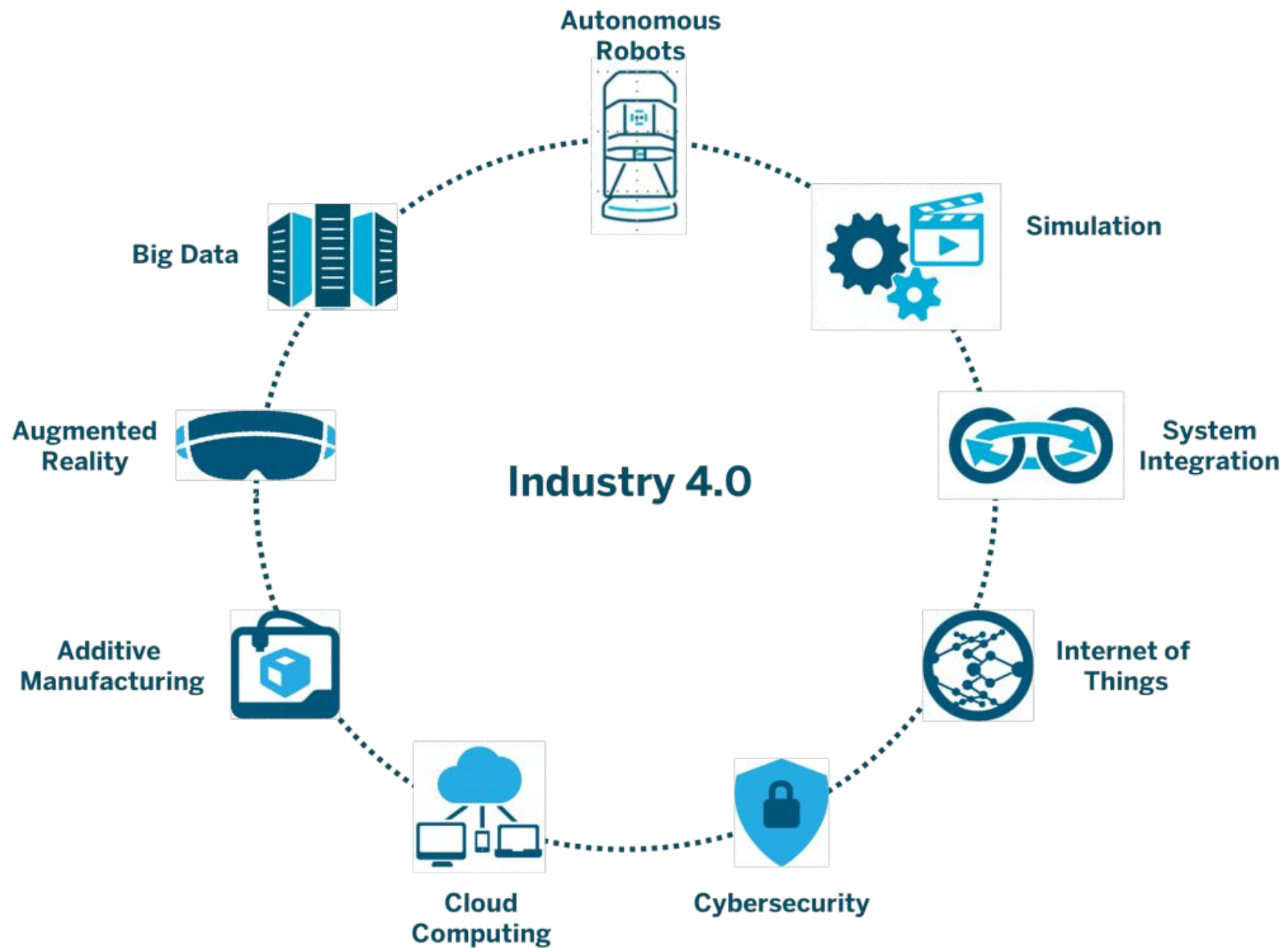


Relationship with Industry 4.0

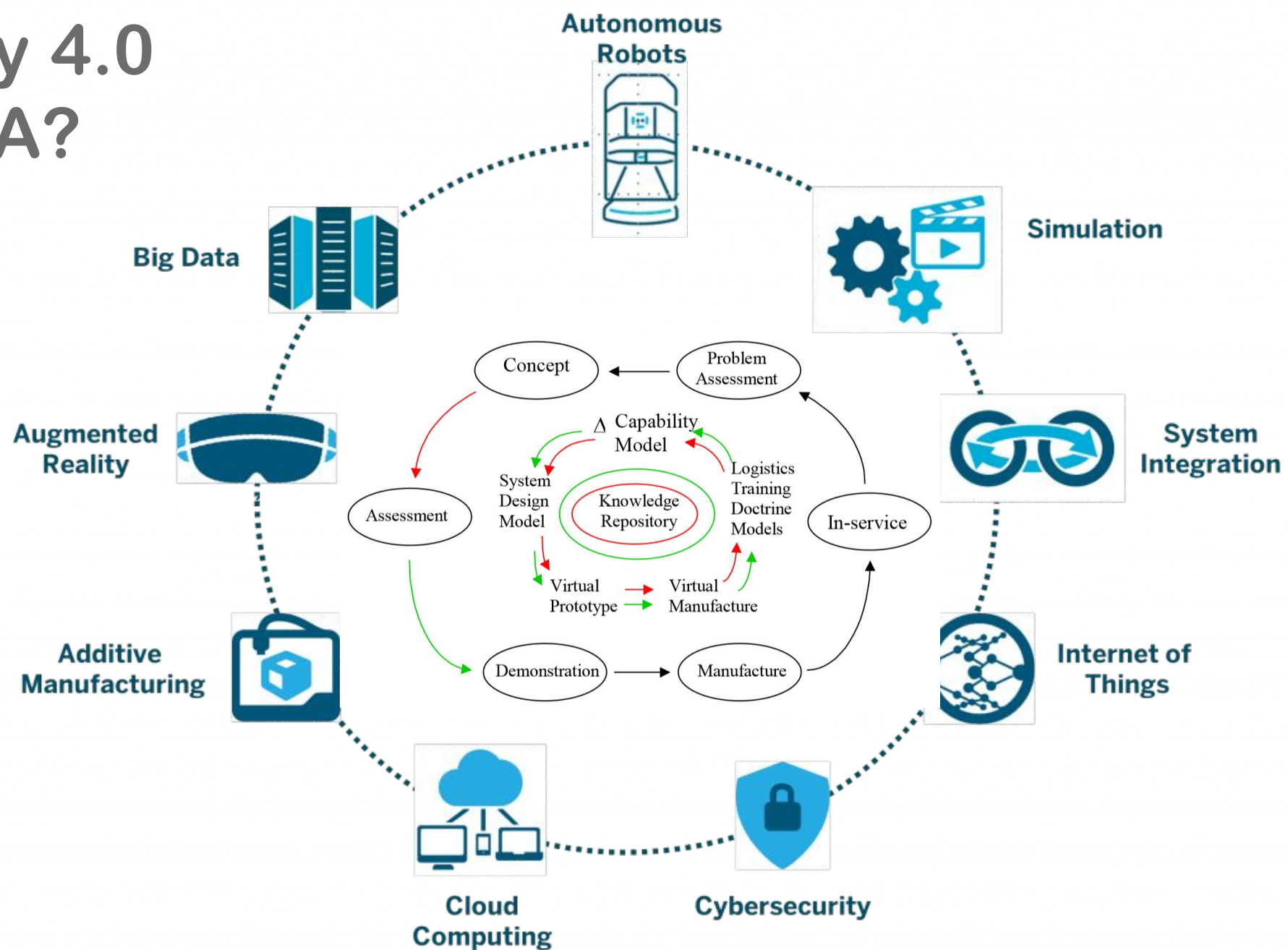
What is Industry 4.0?

We define Industry 4.0 as the next phase in the digitization of the manufacturing sector

McKinsey & Company



Industry 4.0 & SBA?



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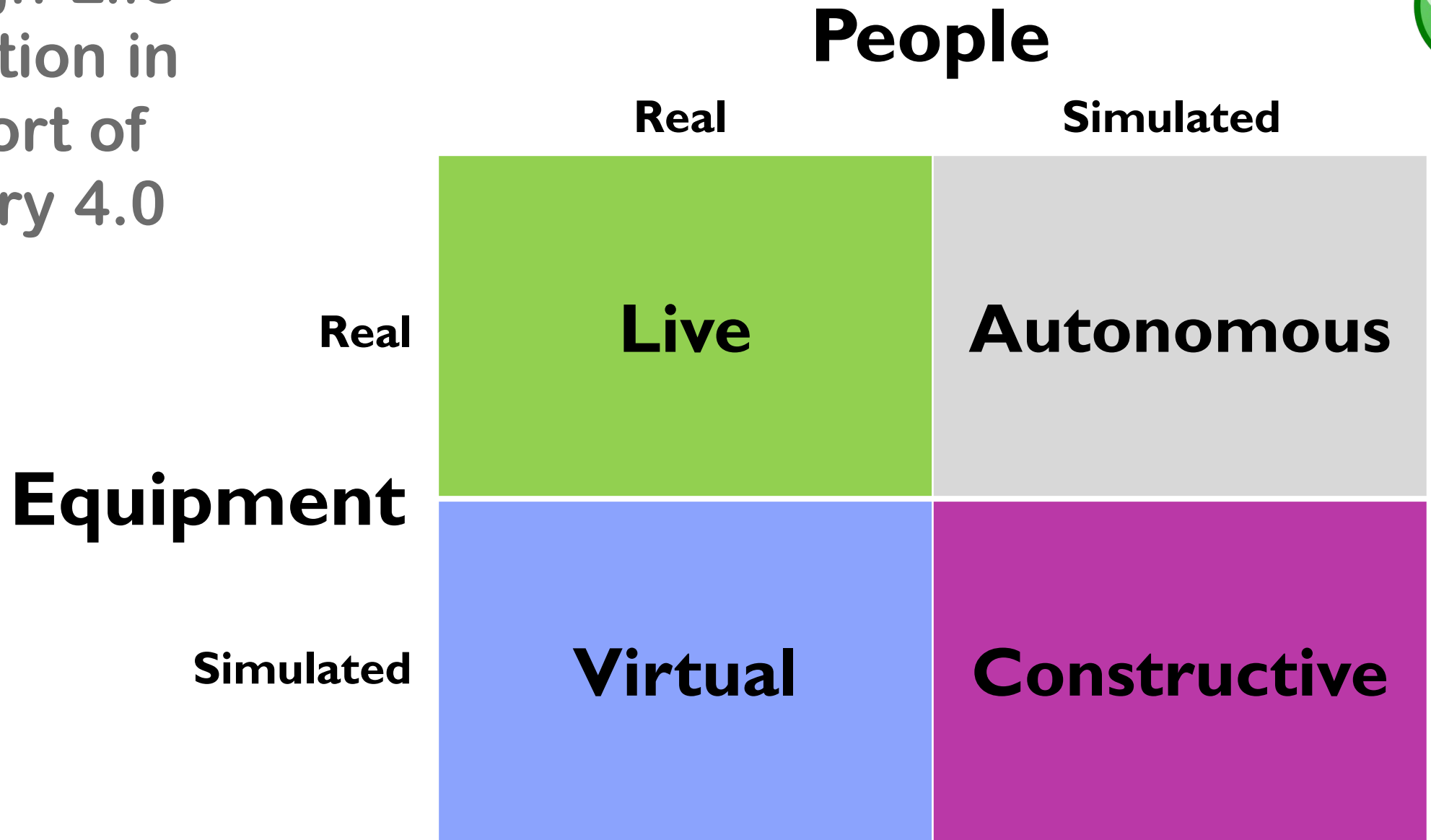
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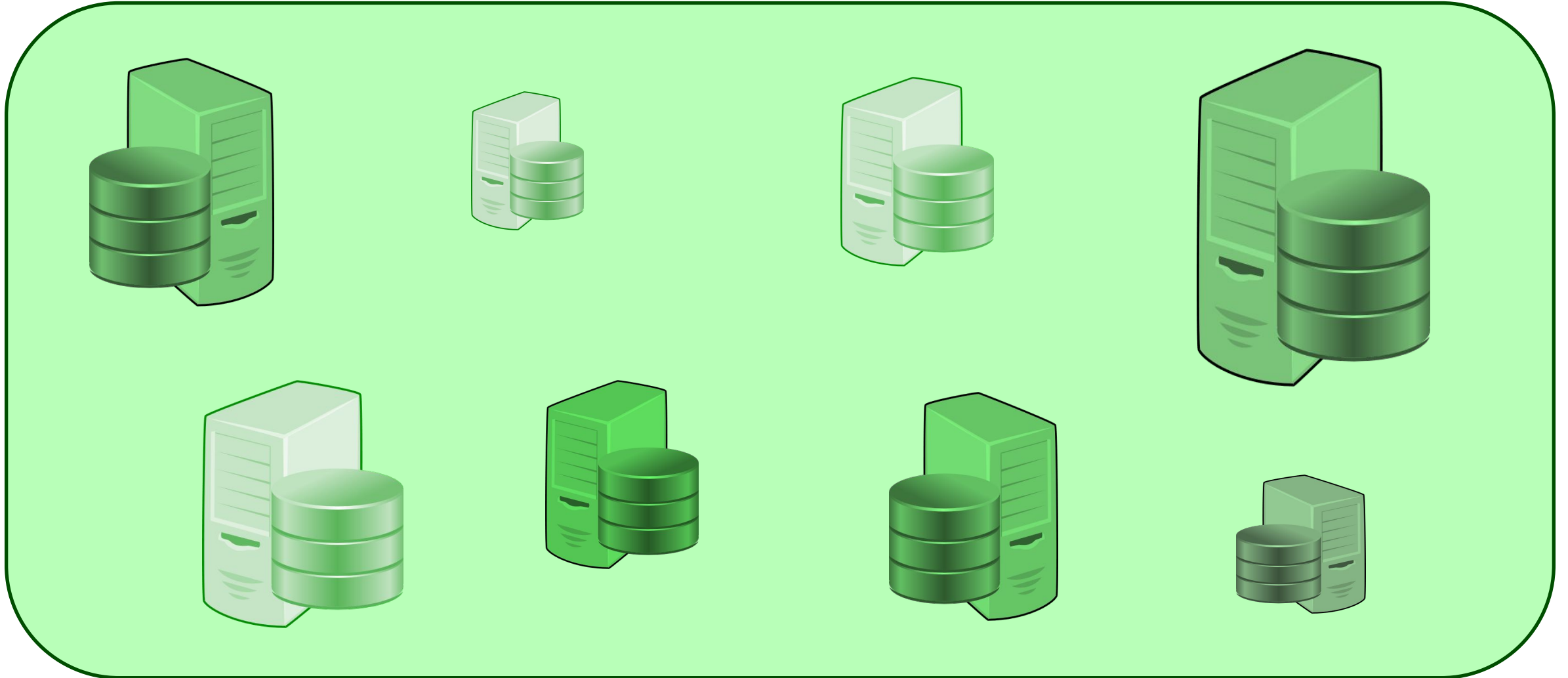
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Through-Life Simulation in Support of Industry 4.0



Data Trends?

Connected - Compatible - Accessible



50% of Companies see lack of Digital Culture and Training as a top challenge to making operations more digital

“The biggest challenge of industrial leaders isn’t technology - it is the people”



2016 Global Industry 4.0 Survey

What we mean by Industry 4.0 / Survey key findings / Blueprint for digital success

Industry 4.0: Building the digital enterprise



2000+
respondents in 26 countries

US\$493 bn
in digital revenue gains p.a.

US\$421 bn
p.a. in cost and efficiency gains

US\$907 bn
in annual digital investments



www.pwc.com/industry4.0

SBA – A Future?



- Technology
- Incentives

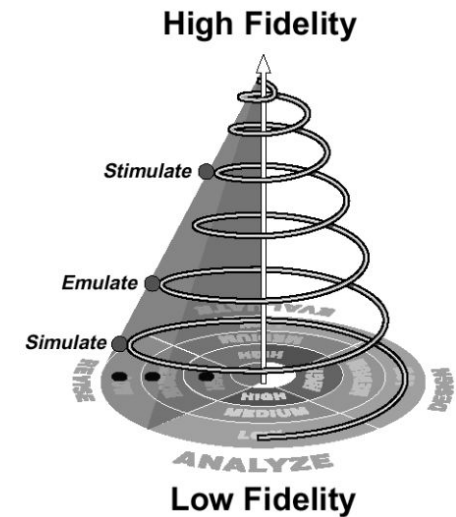
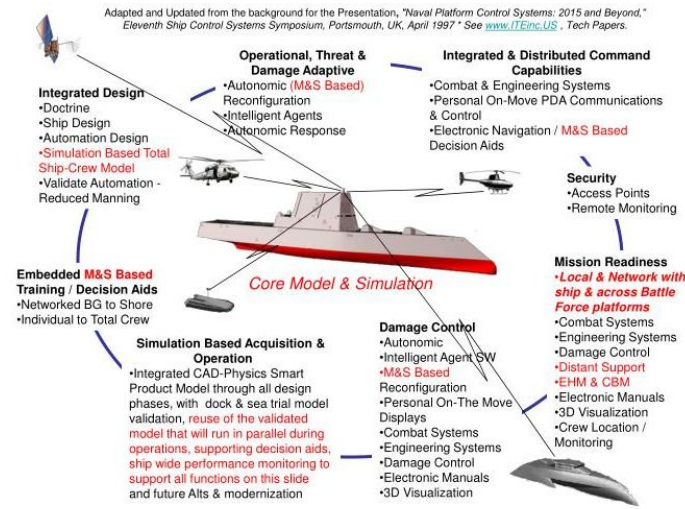
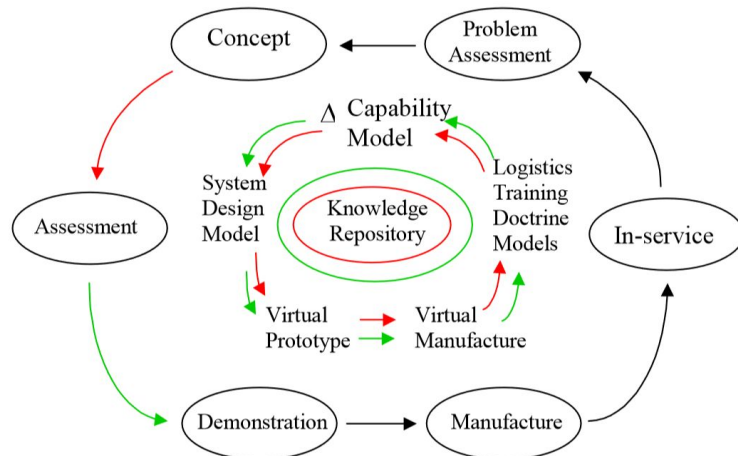
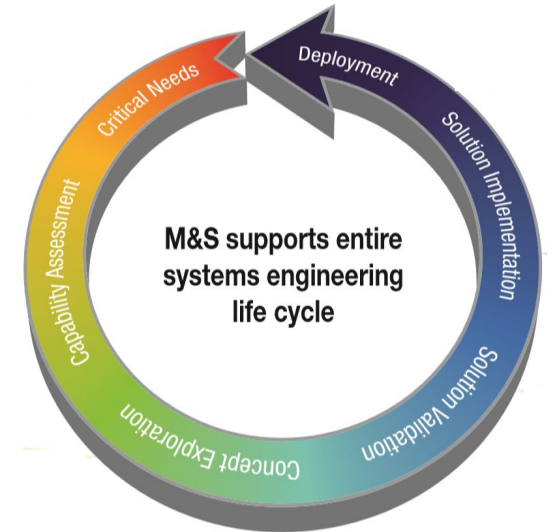
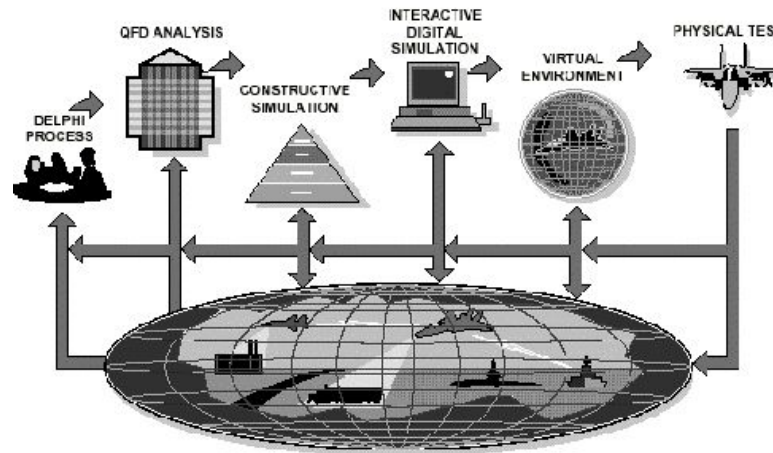




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Questions?



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