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Simulation Based Acquisition - Has its Time Come?

Andy Fawkes



Overview

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



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

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

Military Emphasis



What is/was Simulation Based Acquisition?

An 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

Why?

Why Then?

Faster



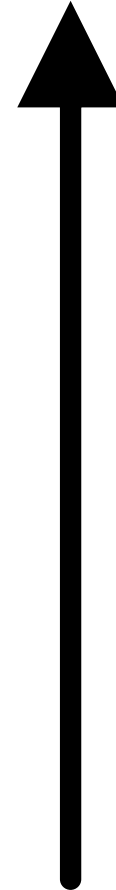
Cheaper



Better

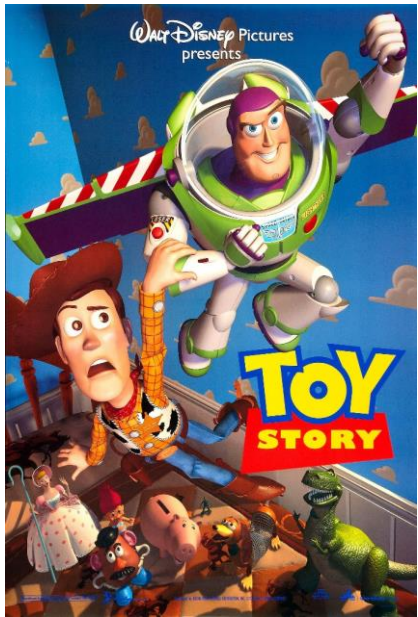


Modelling &
Simulation
Technology

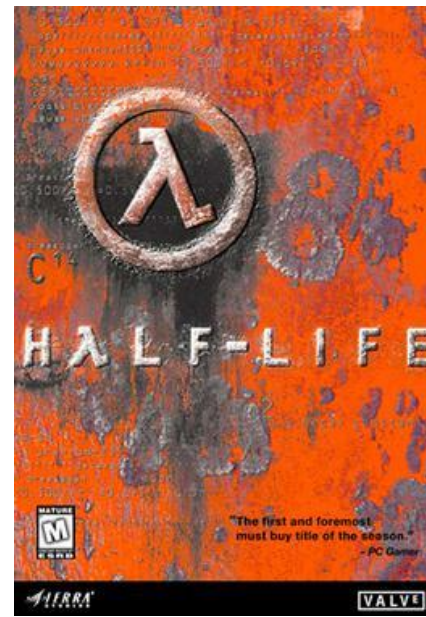


Popular Consciousness

1995 – *Toy Story* Film



1998 – *Half-Life* Video Game



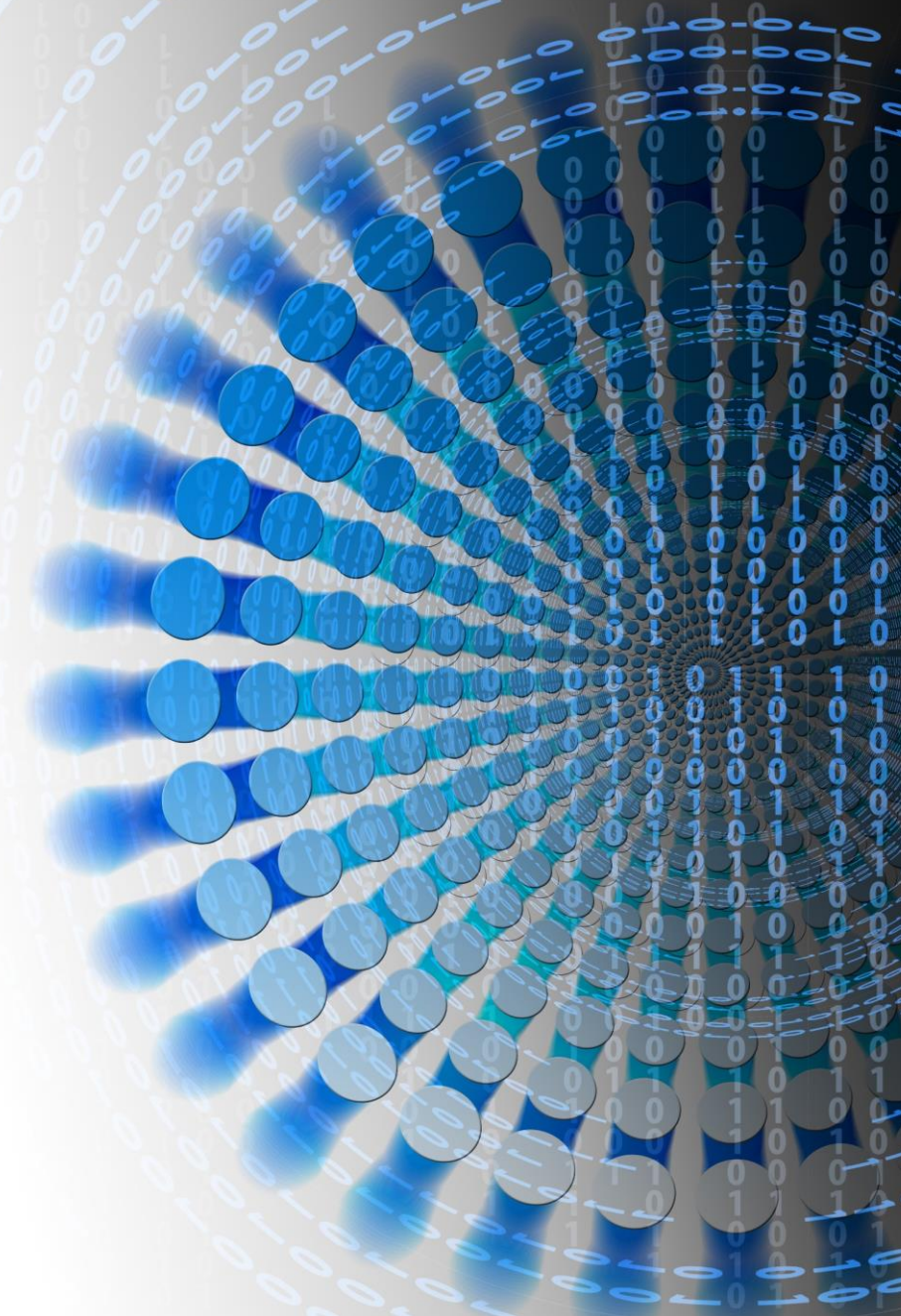
SBA Motives

- **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; and**
- **Enable Integrated Product and Process Development (IPPD) across the entire acquisition life cycle.**

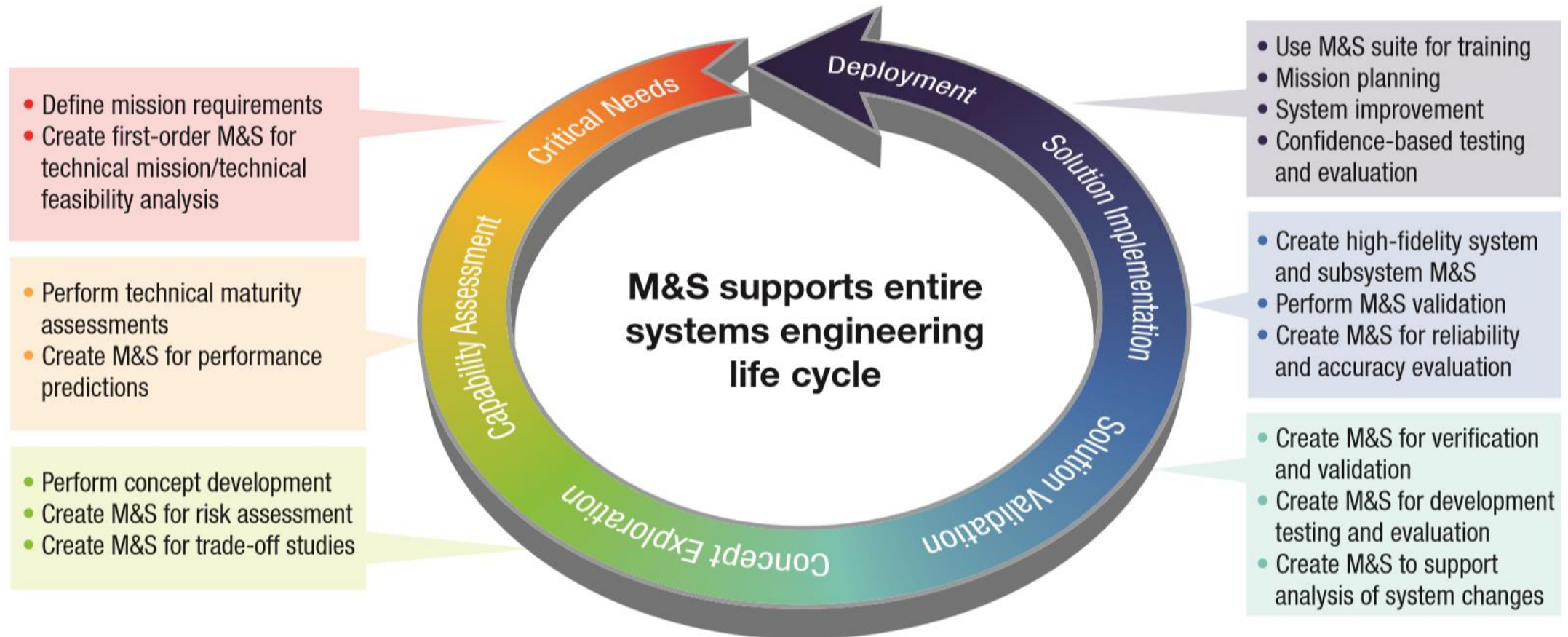
SBA Concepts

Central SBA Technical Concept

- The central SBA technical concept was that of 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

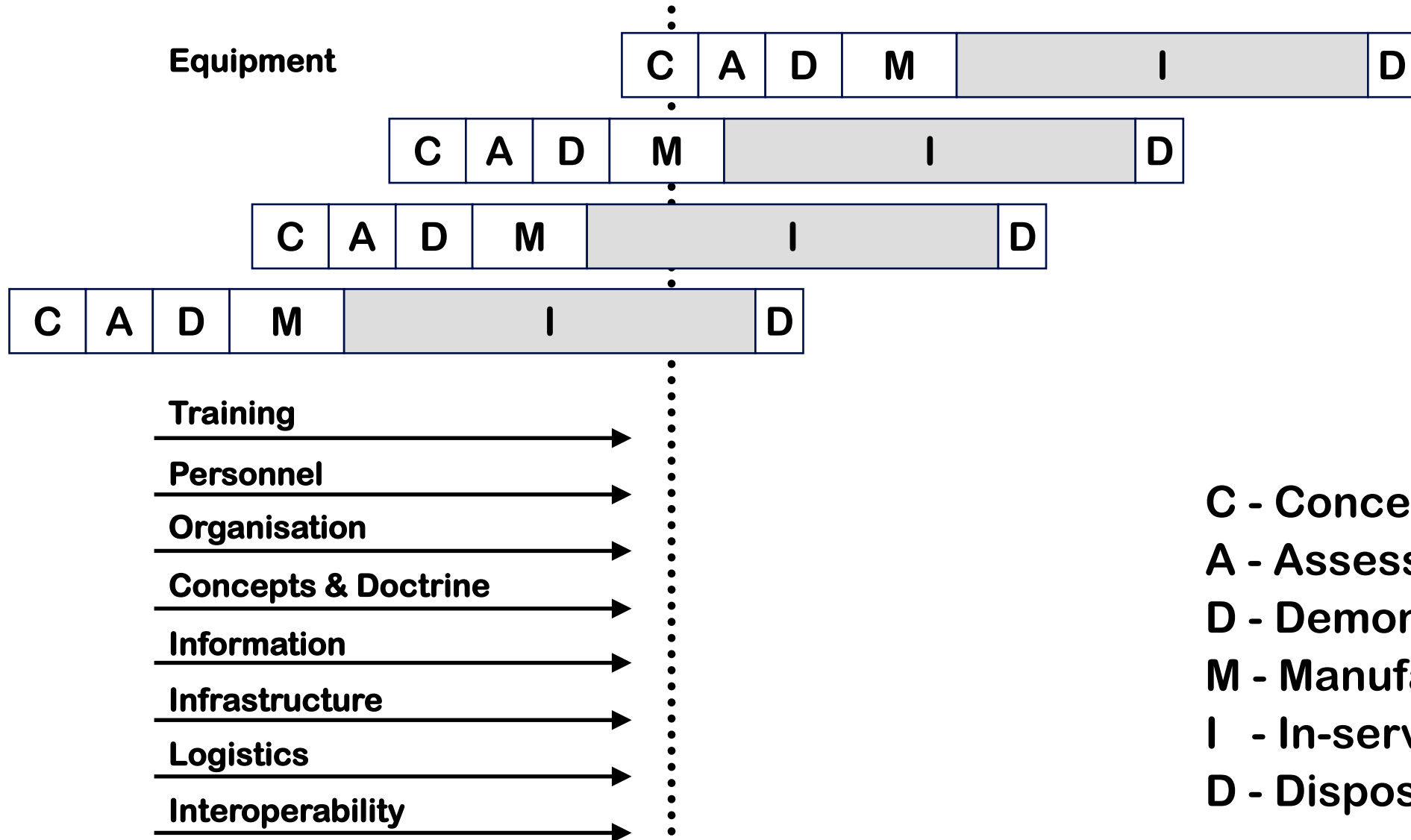


M&S Supporting the Systems Engineering Life Cycle

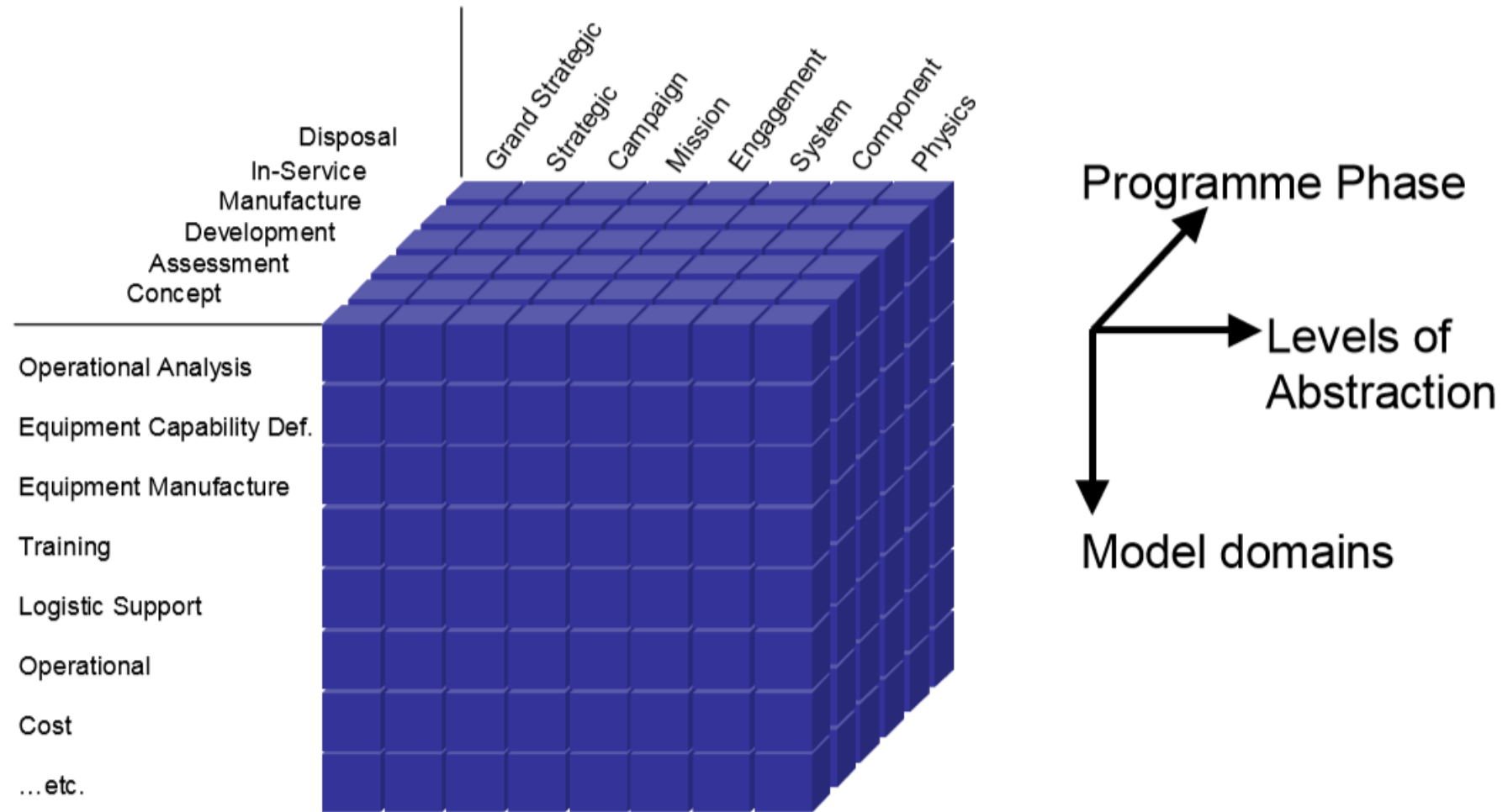


Bringing Military Capability Together (UK)

Lines of Development



“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 - Sharing Models and Data

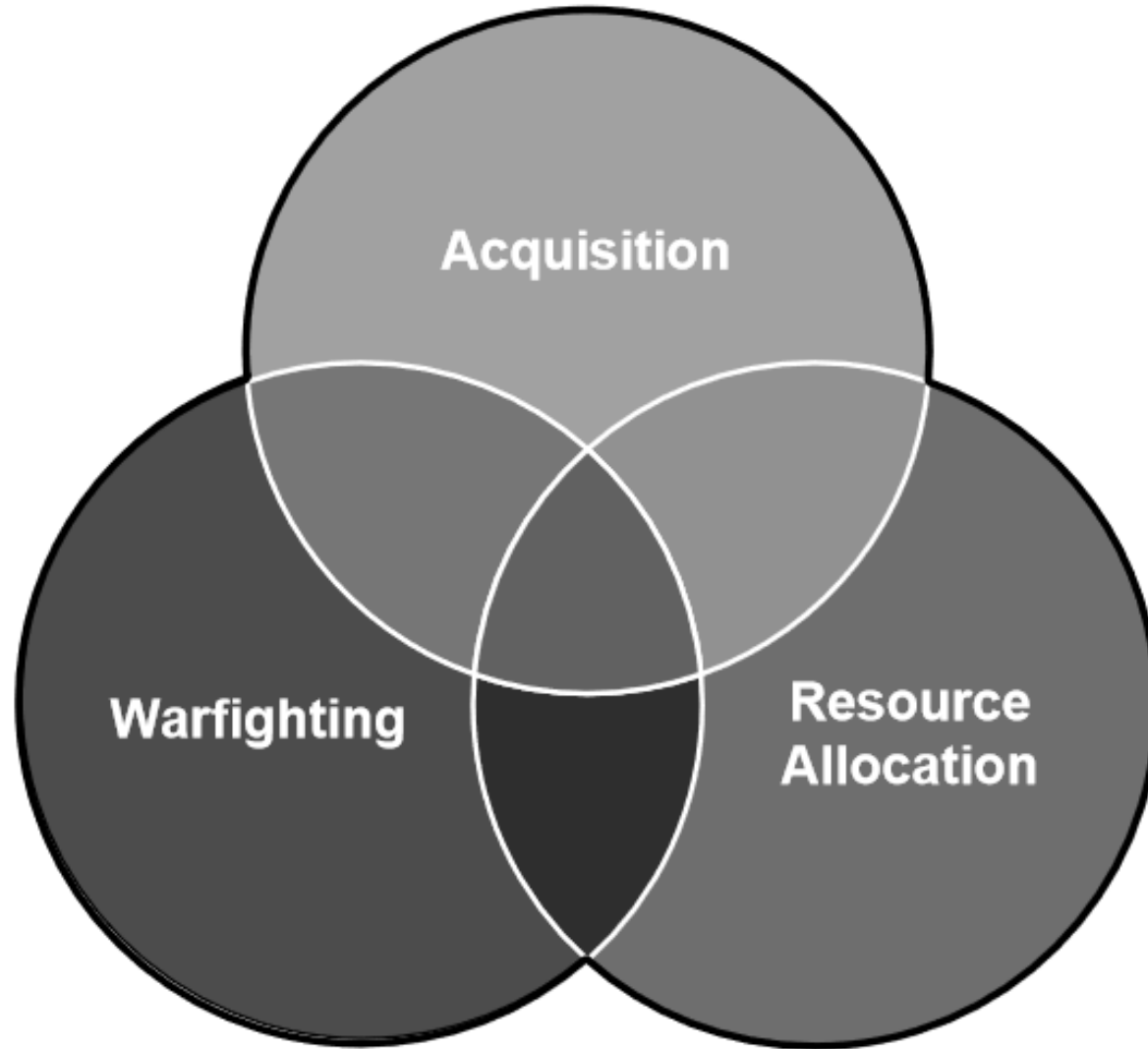
SBA required the sharing of Models and Data among Industry, and between Industry and Government

This sharing of models with SBA would integrate common models among:

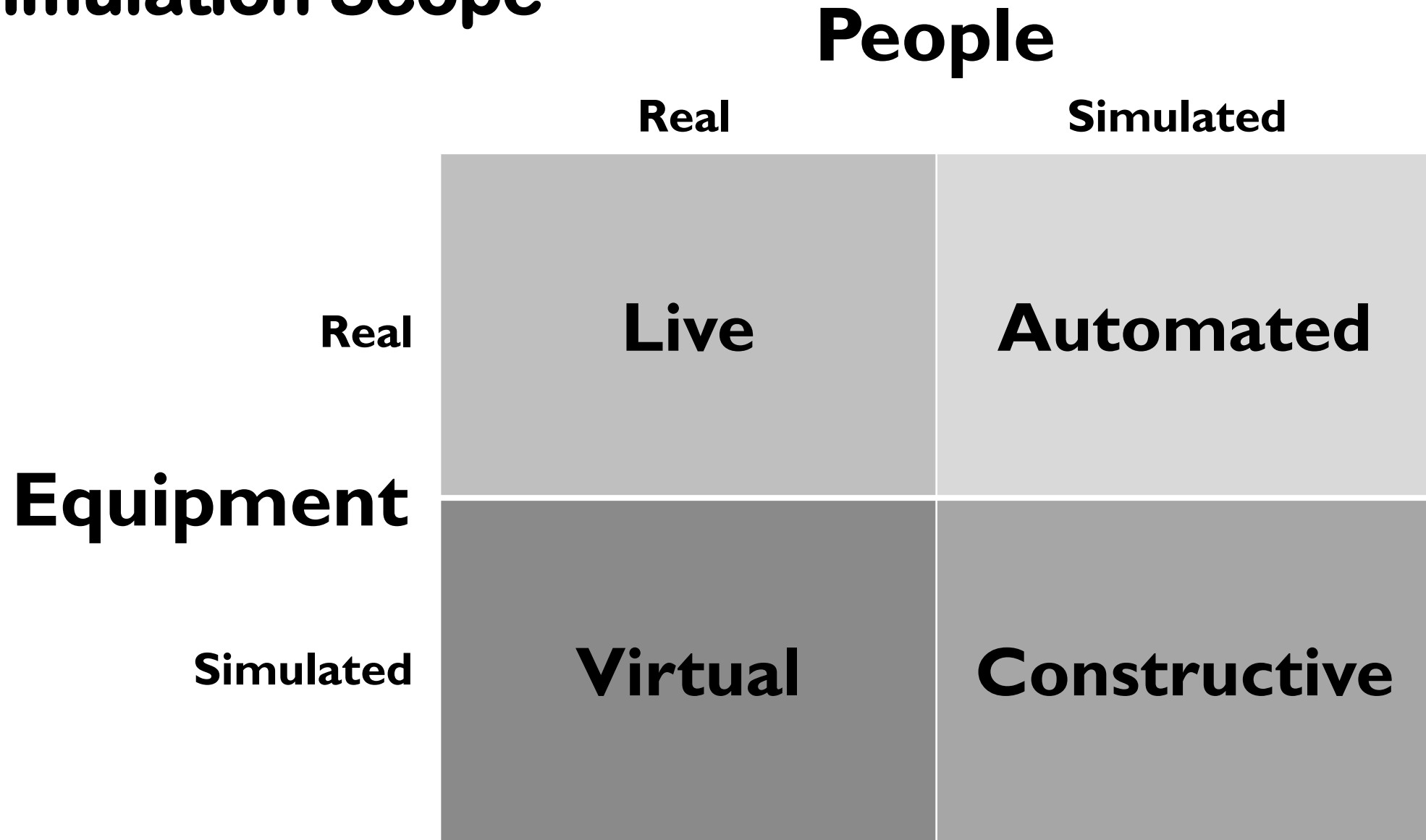
- **Manufacturing Simulation Software**
- **Manufacturing Facility Simulation Software**
- **Weapon System Software**
- **Training System Software**
- **Cost Analysis Software**
- **Mission Support Software:**
 - **Mission Intelligence**
 - **Mission Planning software**
 - **Mission Rehearsal**
 - **Mission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



Linking Communities



SBA Simulation Scope





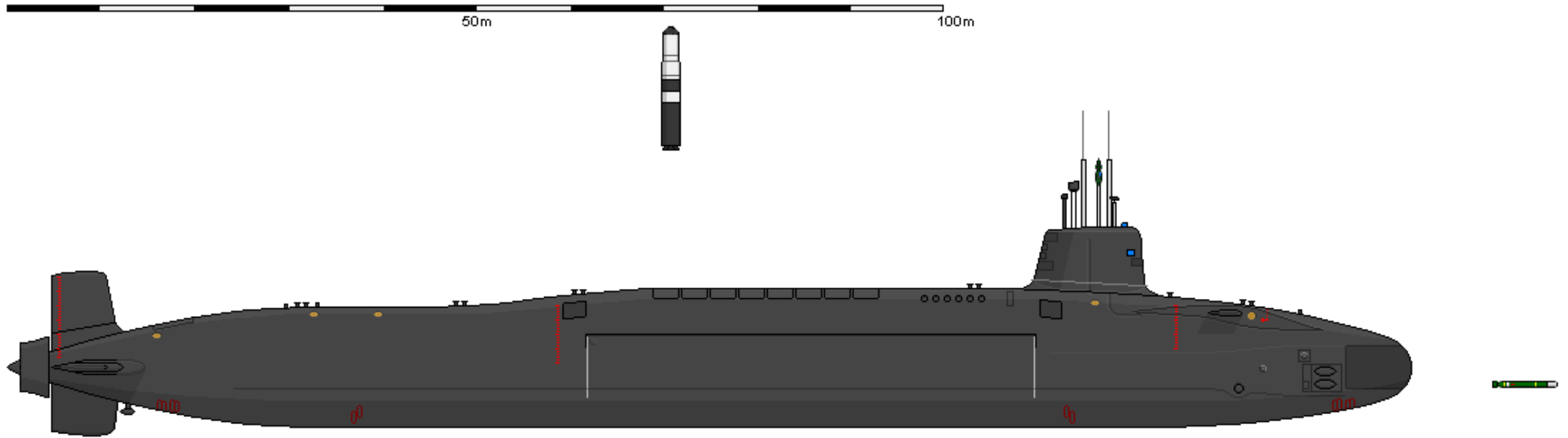
THINKE

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

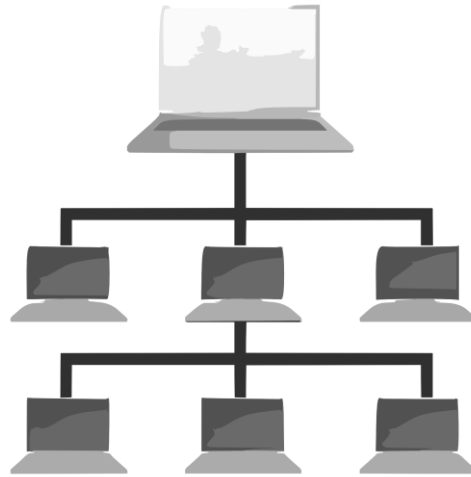
1997 - An SBA Vision

“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)

SBA Challenges Recognised by DoD (1998)

Technical



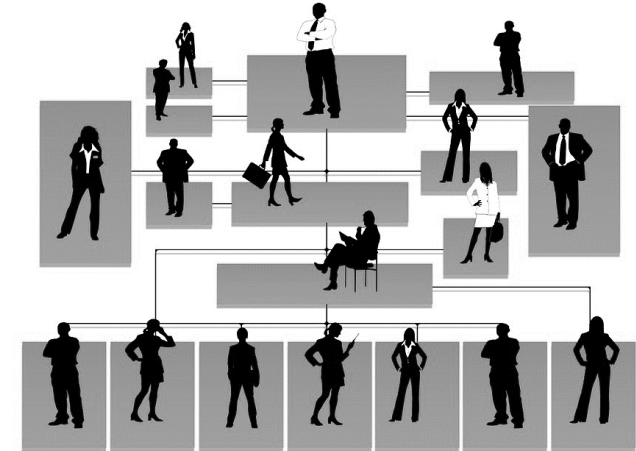
- Interoperability of M&S Tools
- Data Description Availability
- Security/Sensitivity of Data
- Physics-based M&S
- Hardware/Software Limitations
- Variable Resolution

Cultural



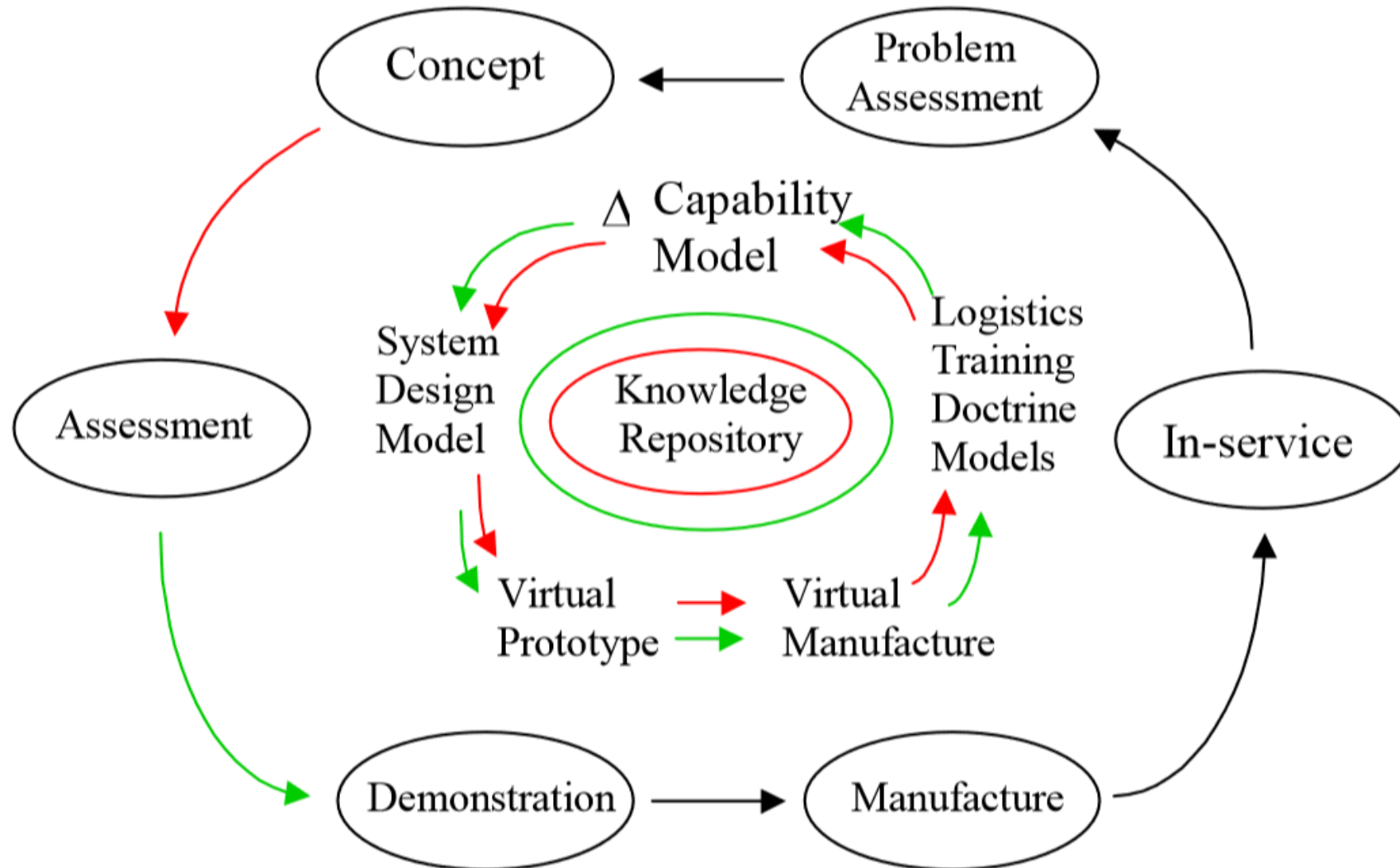
- Acquisition Processes
- Incentives for M&S Use
- M&S Workforce
- Acceptance of M&S

Managerial



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

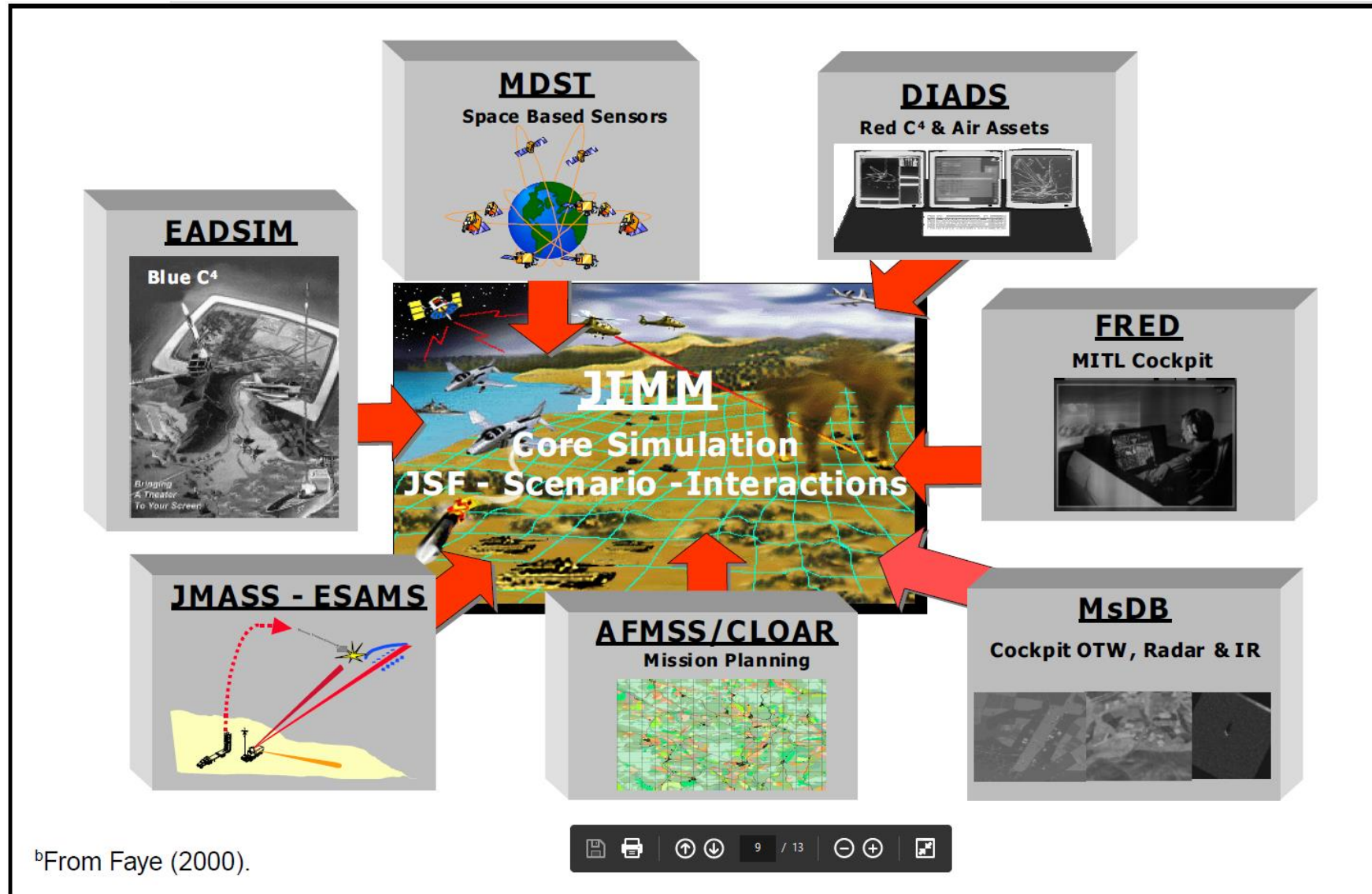
The UK "SeBA Wheel"



UK MoD/Industry SeBA Collaboration

- **National Capability Demonstrators (NCDs)**
 - FlashLAmp (96-98)
 - ADSE (97-98)
 - Project Vitesse (96-99)
 - SeBA (99-02)
- **FOAS (99-00)**
- **NIREUS (98-03)**
- **EUCLID 11.13 (00-03)**
- **NMSG-003 - Feasibility Study on M&S Technology in Support of SBA (03)**

JSF Virtual Strike Warfare Environment (2000)



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

SBA In Trouble?

- In 2003, SBA was eradicated from DoD terminology by removing “SBA” from all DoD 5000-series publications, and 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?

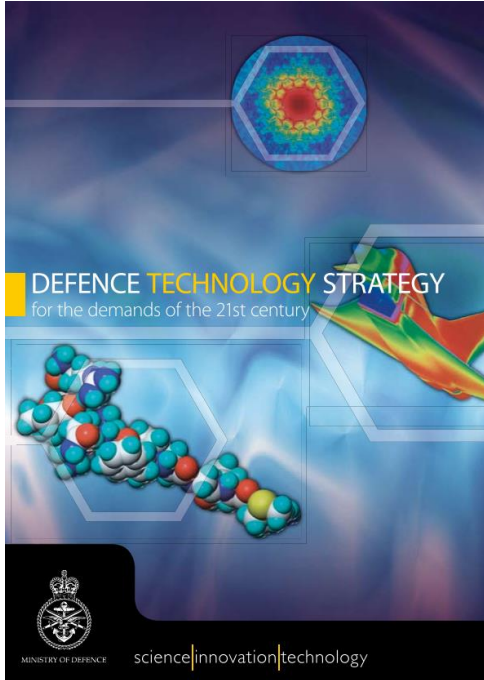
	SBA Challenges		comment
1	Interoperability of M&S Tools	Yellow	Cross-Domain Weaknesses
2	Data Description Availability	Red	Stovepipe Projects
3	Security/Sensitivity of Data	Red	IPR & Security Challenges
4	Physics-based M&S	Green	
5	Hardware/Software Limitations	Green	
6	Variable Resolution	Yellow	“Fair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

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**
- **Organisational & Funding Stovepipes**

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 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”



Credit: Boeing

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

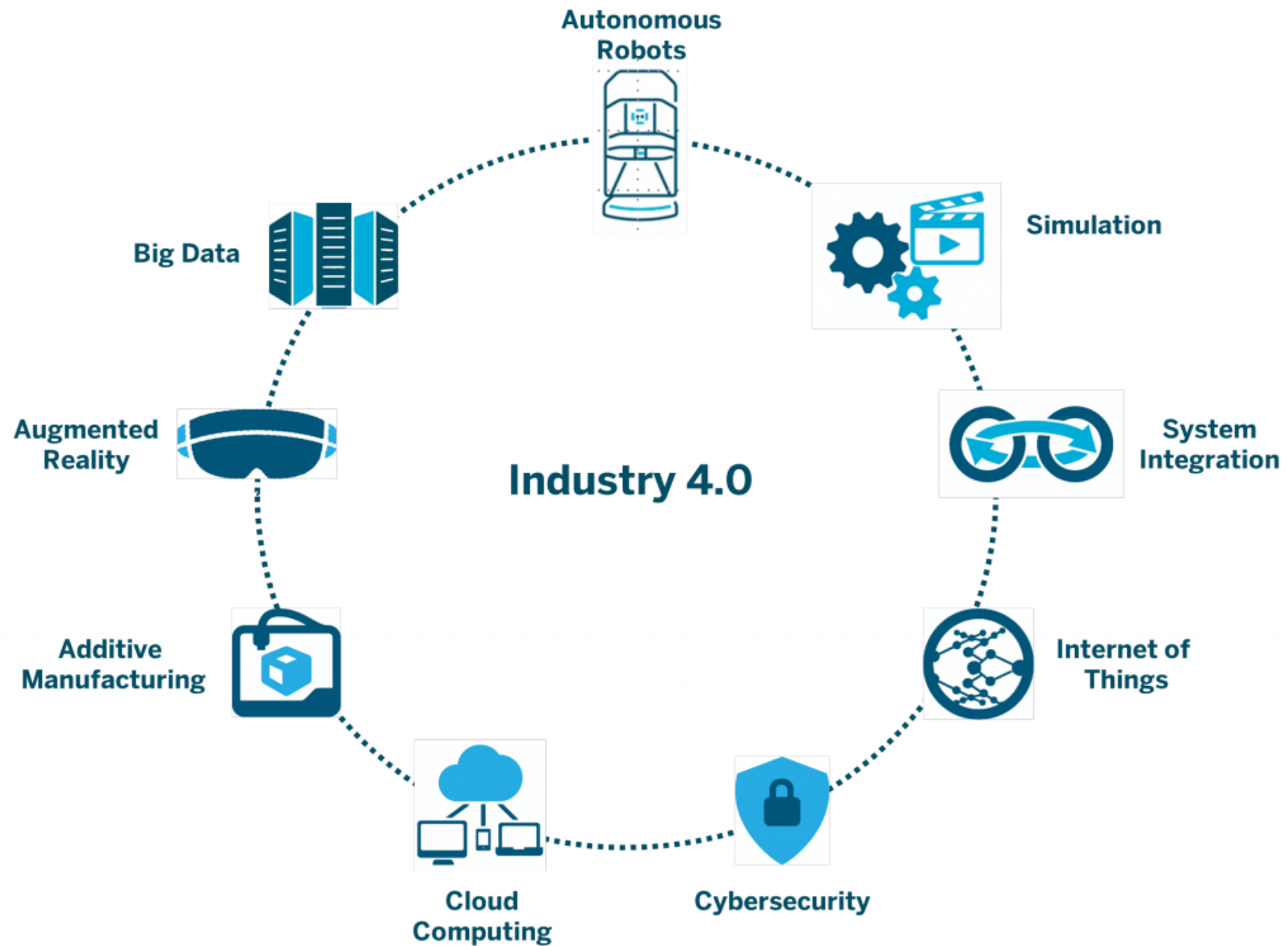
Over the years, the U.S. Air Force has come to rely more and more on industry for its technical understanding of the systems it acquires. To reverse that process and bring costs and risks more under its control, the service is experimenting with creating and carrying digital system models through the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



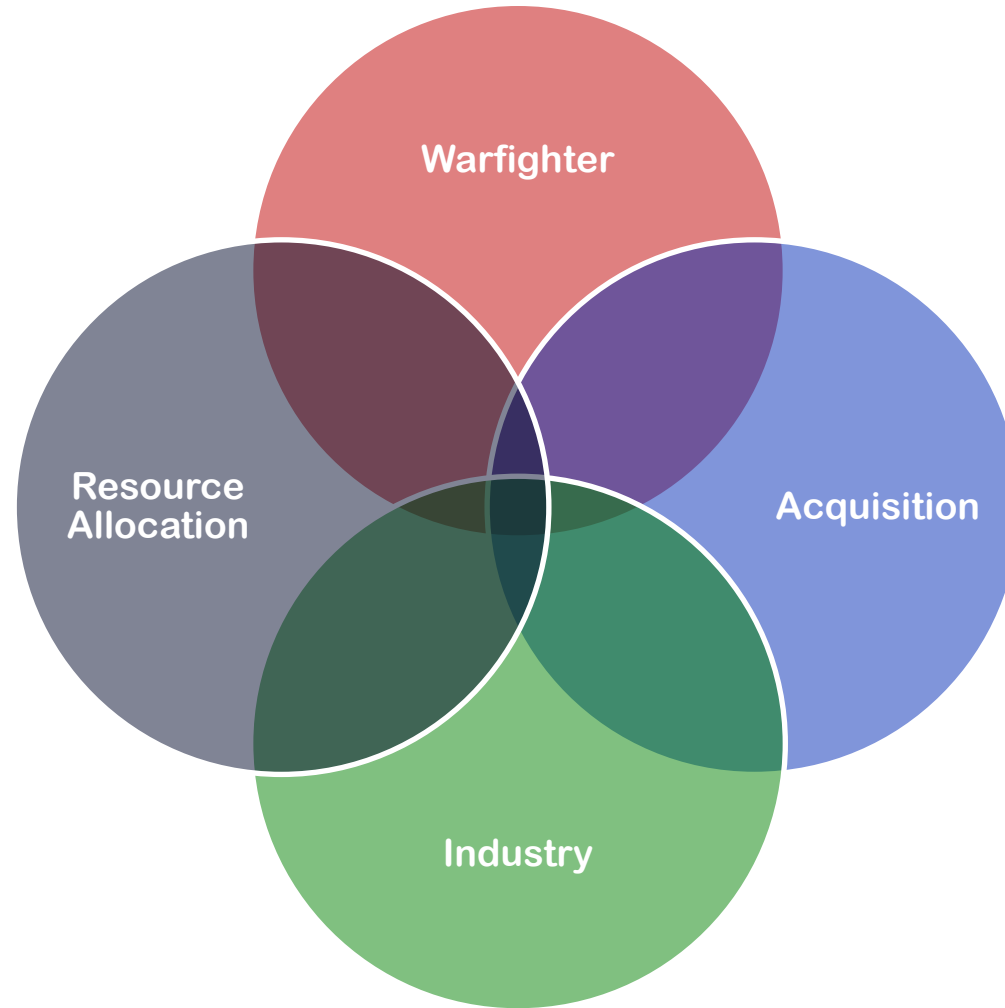
SBA - Has its Time Come?

No

Yes

Maybe

SBA Linking Communities



The Rise of Autonomous Systems

People

Real

Simulated

Real

Live

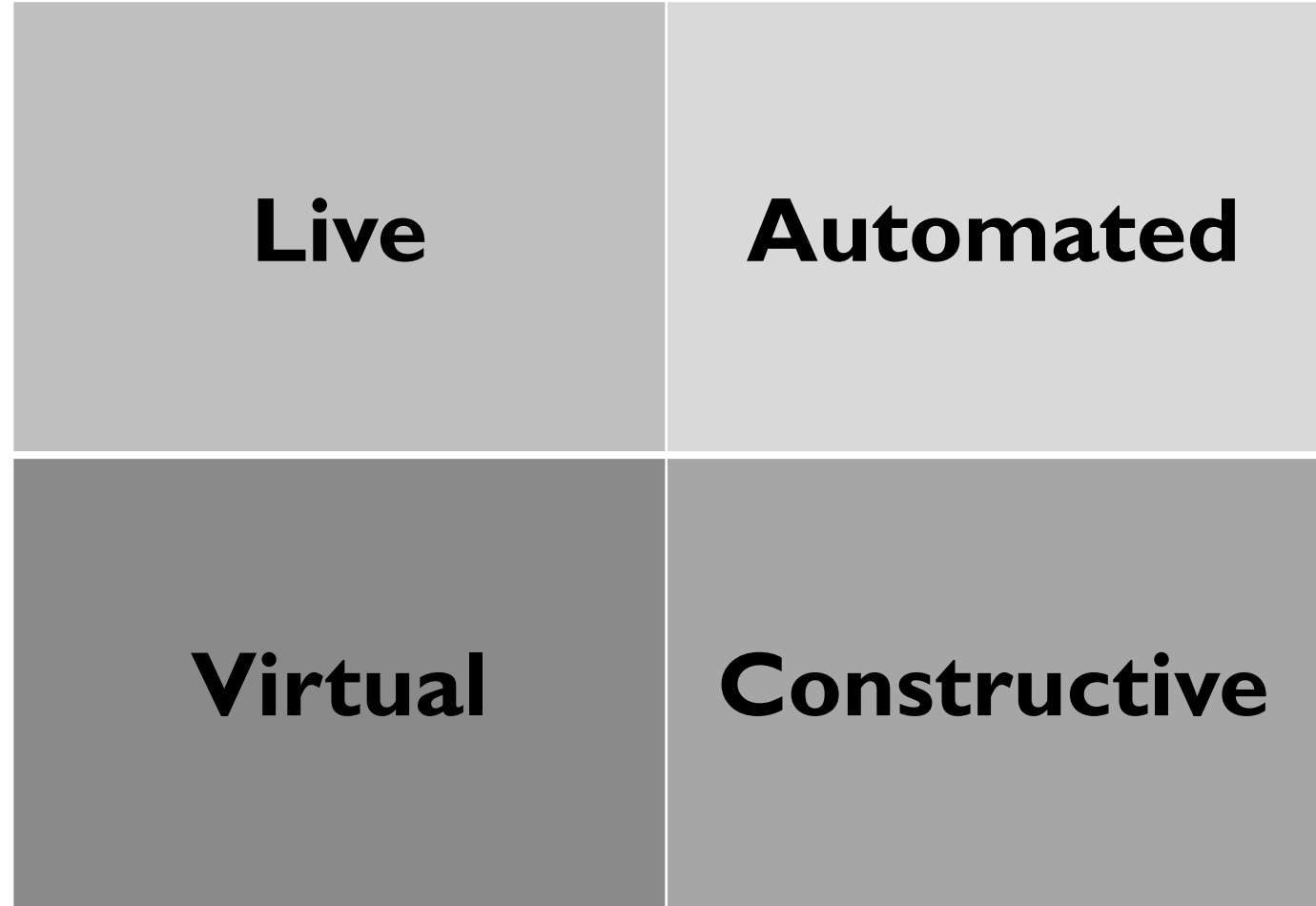
Automated

Equipment

Simulated

Virtual

Constructive



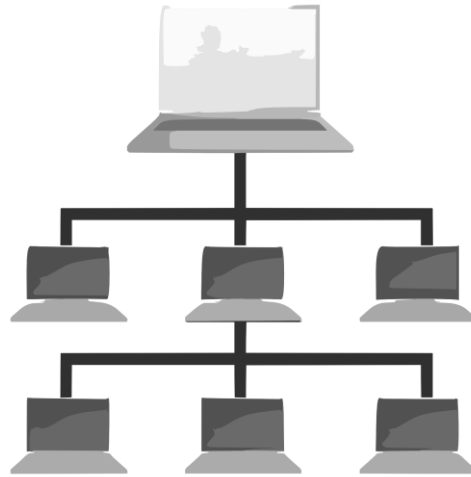
50% of Companies see lack of Digital Culture and Training as a top challenge to making operations more digital



- “The biggest challenge of industrial leaders isn’t technology - it is the people”
- While digital technologies are rapidly becoming a commodity, success largely depends on an organisation’s Digital IQ
- With data analytics becoming a core capability for every industrial company, enhancing skills and organisational structures will be critical”

Industry 4.0 Challenges?

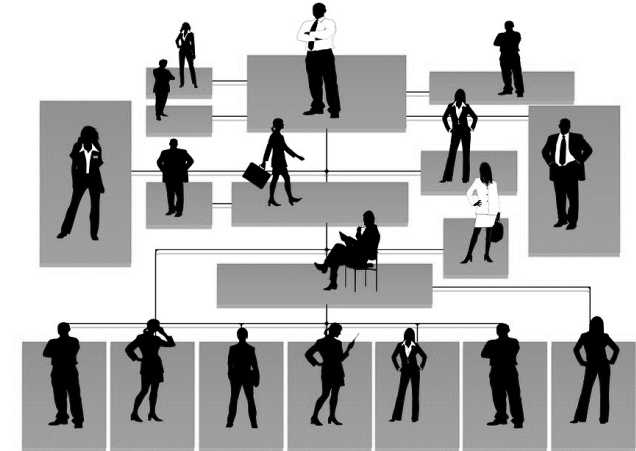
Technical



Cultural



Managerial



- Data Ownership

- Acquisition Processes
- Digital Workforce

- VV&A Requirements
- Funding Process

Questions?

