Beyond Technical Interoperability

Introducing a Reference Model for Measures of Merit for Coalition Interoperability

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Interoperability for Network Centric Warfare

- Network Centric Warfare (NCW)
  - NCW is about networking humans, organizations, institutions, services, nations, etc.
  - NCW is **NOT** about technical networks
  - NCW relies on information delivered via the technical networks
- Working Assumption
  - Technical Domain is important
  - Social and Organizational Component may superimpose the Technical Interoperability

Coherent Layered Interoperability View is Needed

Common Operational Models

- Models help to understand the key mechanisms of an operation
- Models act as the basis for IT supporting the process
- Models can be used to improve the current structure and operation
- Models show the structure of innovated solutions
- Models can serve as the basis to evaluate new ideas (in a collaborative manner)
- Models facilitate the identification of potential reuse

Use of Models to get a common Understanding of the Operation (planned, observed, executed, …)

U.S. Technical Reference Model - LISI

Level 4
"Universal"

Shared Systems

Level 3
"Integrated"

Shared Applications, Data

Level 2
"Distributed"

Heterogeneous Product Exchange

Level 1
"Connected"

Homogeneous Product Exchange

Level 0
"Isolated"

No Electronic Connection (Manual)

Coalition Technical Reference Model – NATO C3 TA Reference Model for Interoperability

- NATO's Reference Model for Interoperability is embedded into the **NATO Consultation, Command & Control Technical Architecture (NC3TA)**

(1) Unstructured Data Exchange
- Network Connectivity
- Document Exchange

(2) Structured Data Exchange
- Network Management
- Web Access
- Data Object Exchanges
- Graphics Exchange

(3) Seamless Sharing of Data
- Formal Messages
- Common Data
- System Management
- Security and Real Time

(4) Seamless Sharing of Info
- Common Information Exchange
- Distributed Applications

How to insure Interoperability above this Level?

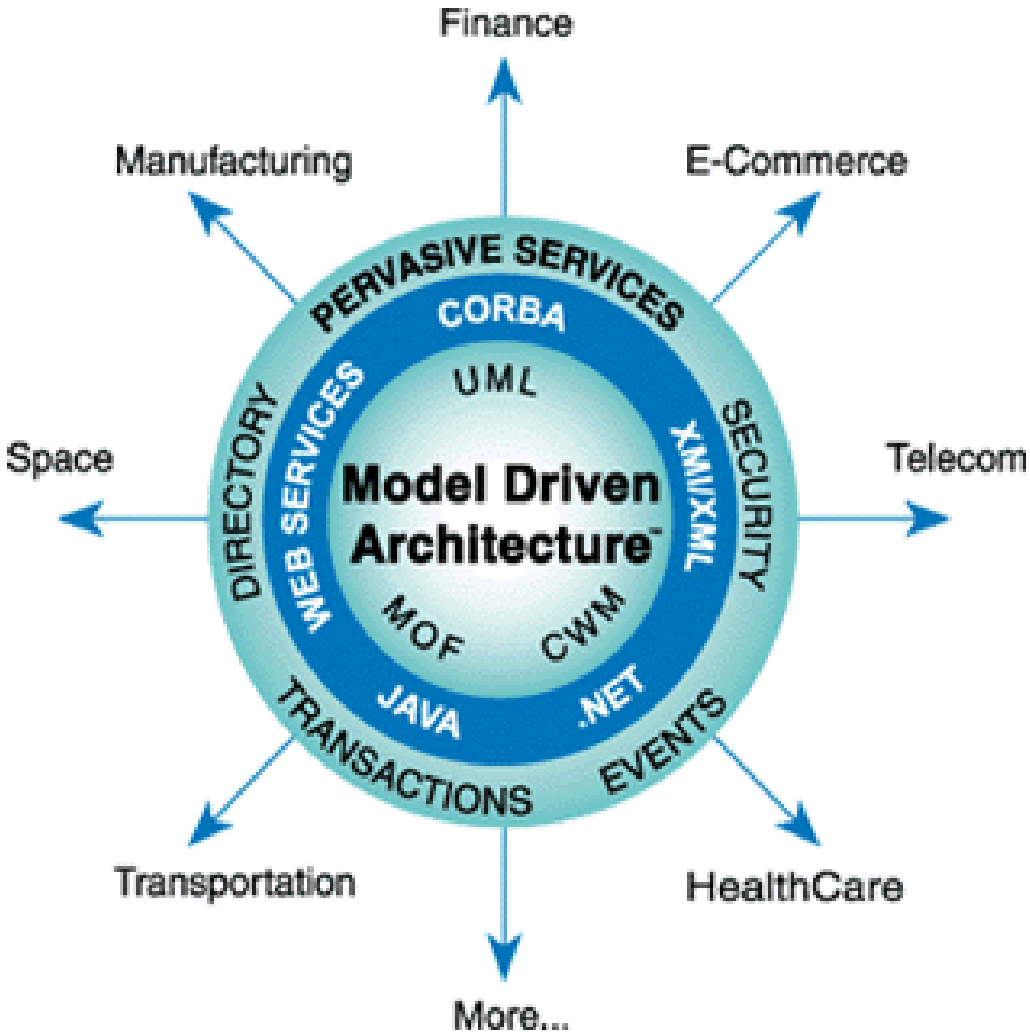
- Technical Levels
  - Physical Connections (incl. Radio, etc.)
  - Common Protocols
  - Data Elements
  - Interfaces
  - Documentation of System Functionality
- Documentation of Functionality is a Key Factor to extend Interoperability beyond the Technical Level
  - What is the Supported Business Model?
  - What is the Workflow?
  - What is the Objective to be reached?

Looking for the Common Language

Proposal: **Unified Modeling Language (UML)**

- Standardized by the Object Management Group (OMG)
- Developed for Requirement driven Software Engineering (Use Cases)
- Used in a variety of domains
  - Management consulting
  - Business analysis
  - Software engineering (since 1997 the de facto standard)
- Supports other Military Frameworks
  - U.S. DoD C4ISR Architecture Framework
  - NATO C3 Systems Architecture Framework

UML and the Model Driven Architecture (MDA)



What is important in the Model? Defining Measures of Merit

- Example I:

The NATO Code of Best Practice for Command and Control Assessment (NCOBP)

- Hierarchy of Measures
  - Dimensional Parameters (DP)
  - Measures of Performance (MoP)
  - Measures of C2 Effectiveness (MoCE)
  - Measures of Force Effectiveness (MoFE)
  - Measures of Policy Effectiveness (MoPE)

Examples for MoP and MoCE in the NCOBP

- Measures of Performance
  - **Availability** (functional capabilities available to the user)
  - **Mobility** (ability to move with operational units)
  - **Bandwidth** (ability to support applications)
  - …
- Measures of C2 Effectiveness
  - **Comprehension** (facilitates the understanding of the situation)
  - **Selectivity** (ability to provide required info in required form)
  - **Timeliness** (information available in appropriate time)
  - **Ease of use** (ease of access to information)
  - **Decision Response Time** (time available to commanders)
  - …

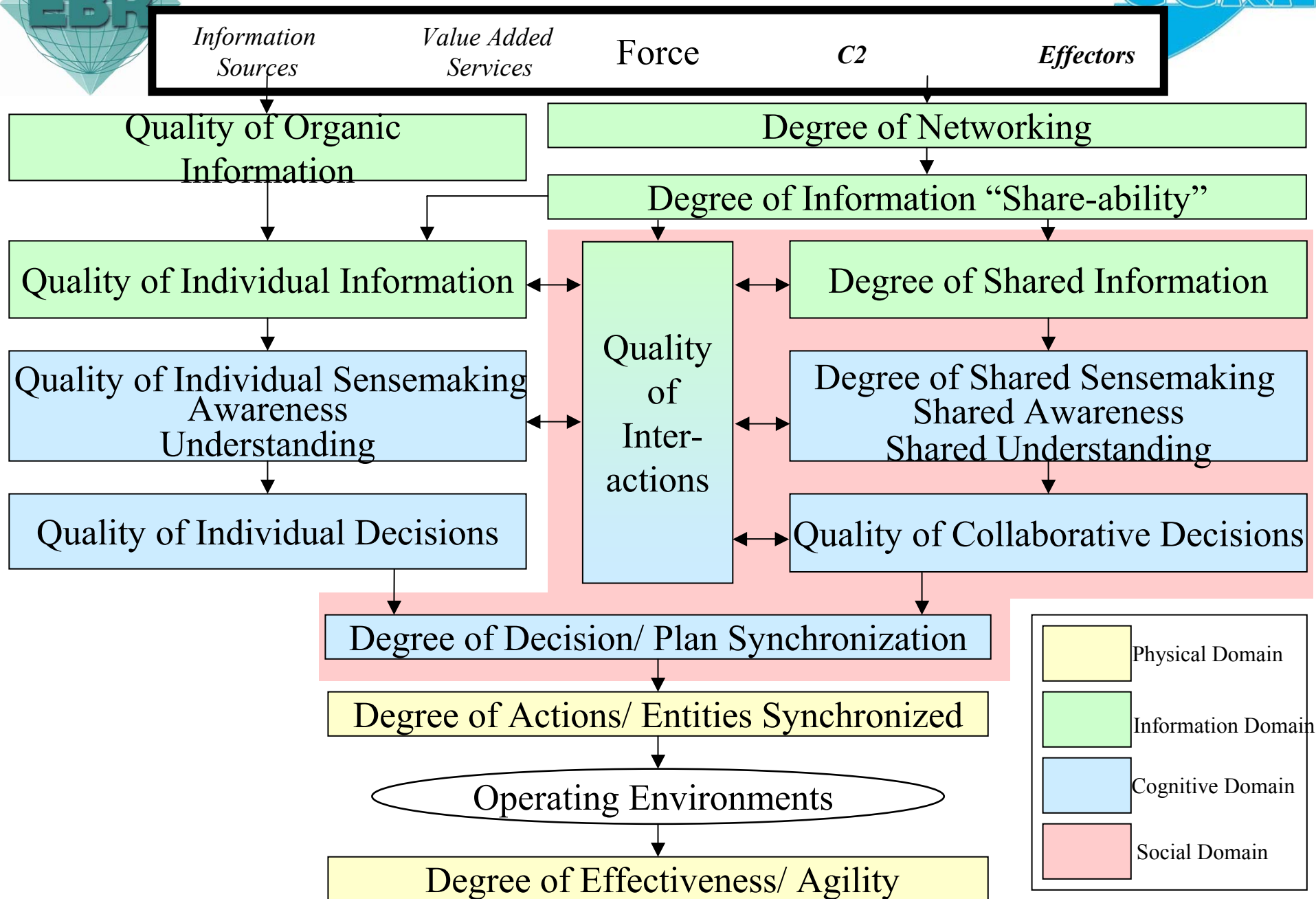
The Network Centric Warfare Value Chain

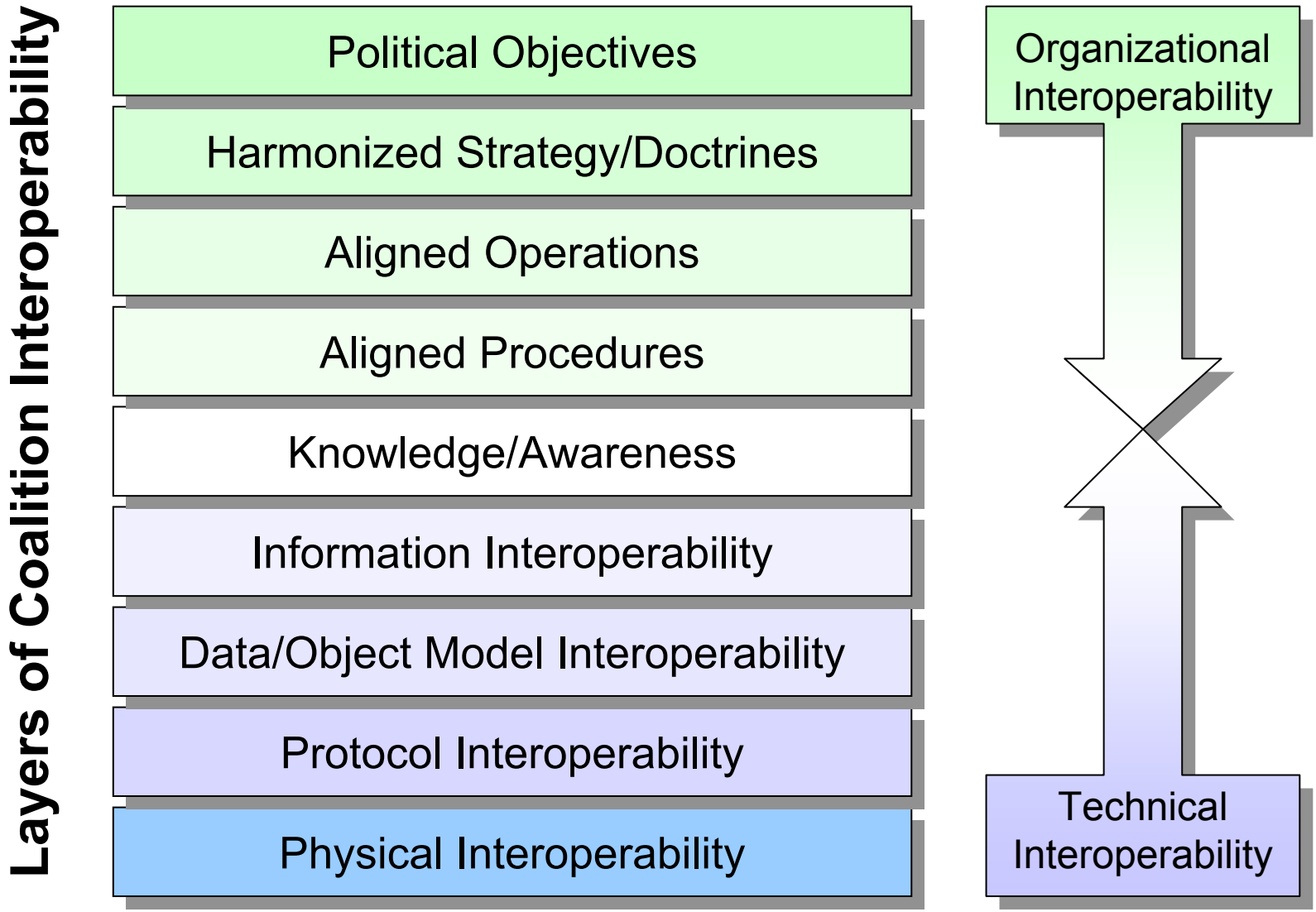
- Data Quality
  - Information within the underlying IT system
- Information Quality
  - Completeness, correctness, currency, consistency, and precision of data
- Knowledge Quality
  - Quality of the agile components of IT, such as procedural knowledge, embedded information, even embedded M&S support for operations
- Awareness Quality
  - Degree of using the information and knowledge for the operation to improve the results

Metrics for Network Centric Warfare

- **Five Level Hierarchy for NCW**
  - Measures of Infrastructure Performance
    - Is the necessary information (such as the Common Operational Picture) available?
  - Measures of Battle Sphere Awareness
    - Is the commander aware of the single activities going on?
  - Measures of Battle Sphere Knowledge
    - Can this activities be connected to an operation going on?
  - Measure of Exploiting Battle Sphere Knowledge
    - Can the commander use this knowledge to support the on planning and decision making processes?
  - Measures of Military Utility
    - Is the own operation supported by the underlying processes?

NCW Metrics Framework





Levels of the Reference Model for MoM (1/5)

Physical Interoperability

- Is the system a stand-alone solution?
- Can a procedure for data/information exchange be established (such as exchange of magnet tapes, disks, etc.)?
- Is the system physically connected to the C4ISR network?

Protocol Interoperability

- What communication protocols are supported on the C4ISR network?
- What kind of media suitable for data/information exchange can be read and analyzed?

Levels of the Reference Model for MoM (2/5)

Data/Object Model Interoperability

- Are standardized data element used for the data/information exchange?
- Are (self-) explaining meta data available with the data that allow the mapping of the exchanged data elements to the data elements used in the participating systems?
- Are Data Management Agencies established that are aware of the data and information presentation of the participating systems?
- Is the meta data used to describe data and information standardized?

That's where we are with the Net-Centric Data Strategy,
U.S. DoD Chief of Information Operations, 9 May 2003

Levels of the Reference Model for MoM (3/5)

Information Interoperability

- Can the procedures and models used to represent dynamical information mapped to each other?
- Are the cause-effect-chains of the models presenting the information comparable? Can they be harmonized?

Knowledge/Awareness

- Is a common operational picture supported?
- Is the agility of the battle sphere supported, e.g., by supporting M&S routines for courses-of-action analyses?
- Are collaboration tools and collaborative environments supported, such as workflow management, tele- and videoconferencing, etc?
- Are various views on the operation supported? Are these views harmonized and coordinated?

That's the best we can reach by Technical Means

Levels of the Reference Model for MoM (4/5)

Aligned Procedures

- Are the Rules-of-Engagements aligned within the tactical levels of the operations?
- Are the tactics available in the form of military field manuals?
- Are the field manuals supported by data or knowledge bases?
- Are models or simulation systems available implementing the tactical procedures?
- Is a communication infrastructure on the tactical level established?

Aligned Operations

- Are the interoperability issues for aligned procedures applicable on the tactical/operational level?
- Are the military leaders and decision makers aware of the processes of the coalition partners, e.g., through exchange programs of the military academies, cultural and political exchange programs, etc?

That's the "Homework" of the Military Decision Makers

Levels of the Reference Model for MoM (5/5)

Harmonized Strategy/Doctrines

- Are the interoperability issues for aligned operations applicable on the strategic level?
- Are the cultural and social backgrounds of the partners aligned?

Political Objectives

- Do the partners share the same political values?
- Are the ethical backgrounds of the partners aligned?
- Are the partners aware of the political objectives of the coalition?

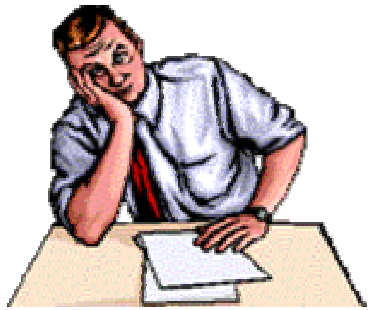
That's the "Homework" of the Policy Decision Makers

Why Using the Reference Model for MoM?

- Military Operations Research Studies become comparable
  - Standardized model documentation facilitates knowledge transfer
- Establishing Technical Interoperability is facilitated
  - Interoperability is no longer the aftermath to system procurement
  - “Build-in Interoperability “ is possible
- Harmonization of Procurement is possible
  - Migrating of legacy systems
  - Alignment of Procurement for Coalition Operations

Summary and Recommendations

- Reference Model for MoM is a Core/Hub
  - Use to map MORS and CCRTS ideas
  - To be filled with “real” MoM, such as those needed by Decision Makers
- Future IT Systems have to support NCW
  - Dynamic and agile capabilities
  - Integrate M&S functionality into the Global Information Grid
  - Replace the **“Common Operational Picture”** with a **“Common Model of the Operation”**



Questions

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