International Defence Enterprise Architecture Specification (IDEAS)

Analyzing and Presenting Multi-Nation Process Interoperability Data for End-Users

6 February 2008

Briefing Outline

- **IDEAS Overview**
- **Experiment & Exercise Overview**
- **Components of the Experiment**
  - Data
  - Methods
  - Presentation

IDEAS Overview

The IDEAS Group

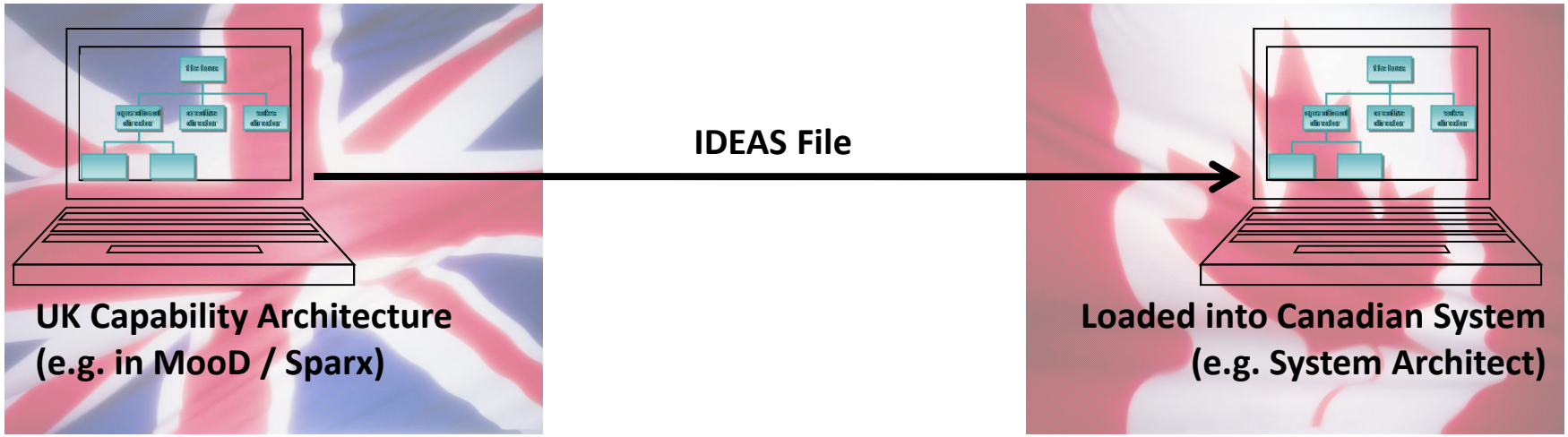
- International Defense Enterprise Architecture Specification for exchange
- Australia, Canada, UK, USA
- Sweden & NATO (observers)
- Established 2005
- UK is leading the technical work, using UK methodology (BORO) and joint MOD/Contractor team

Objective — To deliver a unified specification for the exchange of military architectures between coalition partners.

Approach

- **Use each nation's architecture framework as input**
- **Analyse the common elements between frameworks**
  - Using the BORO Methodology to de-conflict the different national approaches
- **Develop integration model (ontology)**
- **Re-apply national terminology**
  - Provides an interfacing mechanism – each nation can continue to work with their own terminology and data whilst still conforming to IDEAS
- **Implement**
  - Repository (US Experimenting on IDEAS Repository)
  - XML Data Exchange

Usage – Exchange Scenario



UK & Canada in combined ops (e.g. Herrick) and Canadians need to interface to UK systems

Side Benefits

- **UK and US requirements for standard dictionaries to support MODAF and DoDAF architectures**
  - MODEM and DoDAF Conceptual and Logical Data Models
  - Plan is to leverage the IDEAS model to provide the top level of the ontology
- **Interest in ontology is developing all over Govt.**
  - Usage being investigated for data integration in Logs and Casualty tracking – i.e. the benefits and possible uses go well beyond enterprise architecture
  - Possible interest for operational data, e.g., Situation Awareness and Coalition sensor and data fusion to collaborate on derivation of such
- **BORO methodology being used to re-engineer and de-conflict legacy systems**

Components of IDEAS Project

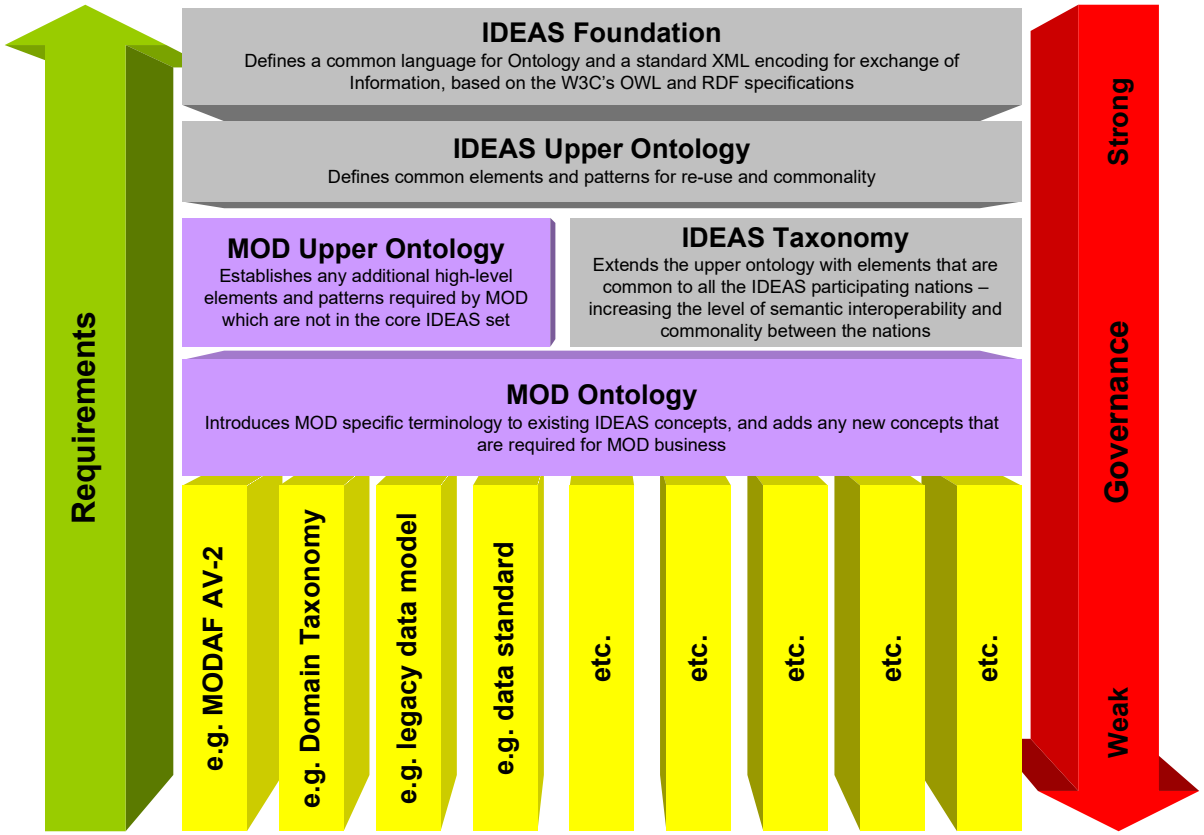
- Data
- Methods
- Presentation

Components of the IDEAS Project: DATA

What Makes IDEAS Different ?

- **The BORO Methodology - http://www.boroprogram.org/**
  - Provides a precise, mathematical approach to comparing information
  - Very easy to understand, and stakeholders readily commit to use the methodology
  - Guaranteed to produce a correct representation, and is fully transparent at every stage – stakeholders are involved so buy-in is kept all the way through
- **Layers**
  - Foundation based on Set Theory
    - Traditional data modelling is generally not founded in mathematic principles
    - IDEAS uses formal set theoretic tools to accurately represent the structure of real-world concepts
  - Next – common patterns based on the foundation
  - Next – domain patterns that specialize the common patterns
- **The Naming Pattern**
  - It does not seek to impose a particular terminology, way of working, or data architecture on the users and stakeholders
  - It brings in the opportunity for international coalition interoperability
  - It fosters a "view from nowhere" approach – soft systems practitioners will be familiar with this idea
  - Once the analysis is complete, the terminology used by the stakeholders is mapped back onto the resulting model
  - Enables stakeholders to continue working with their own terminology
  - Allows seamless integration of legacy systems

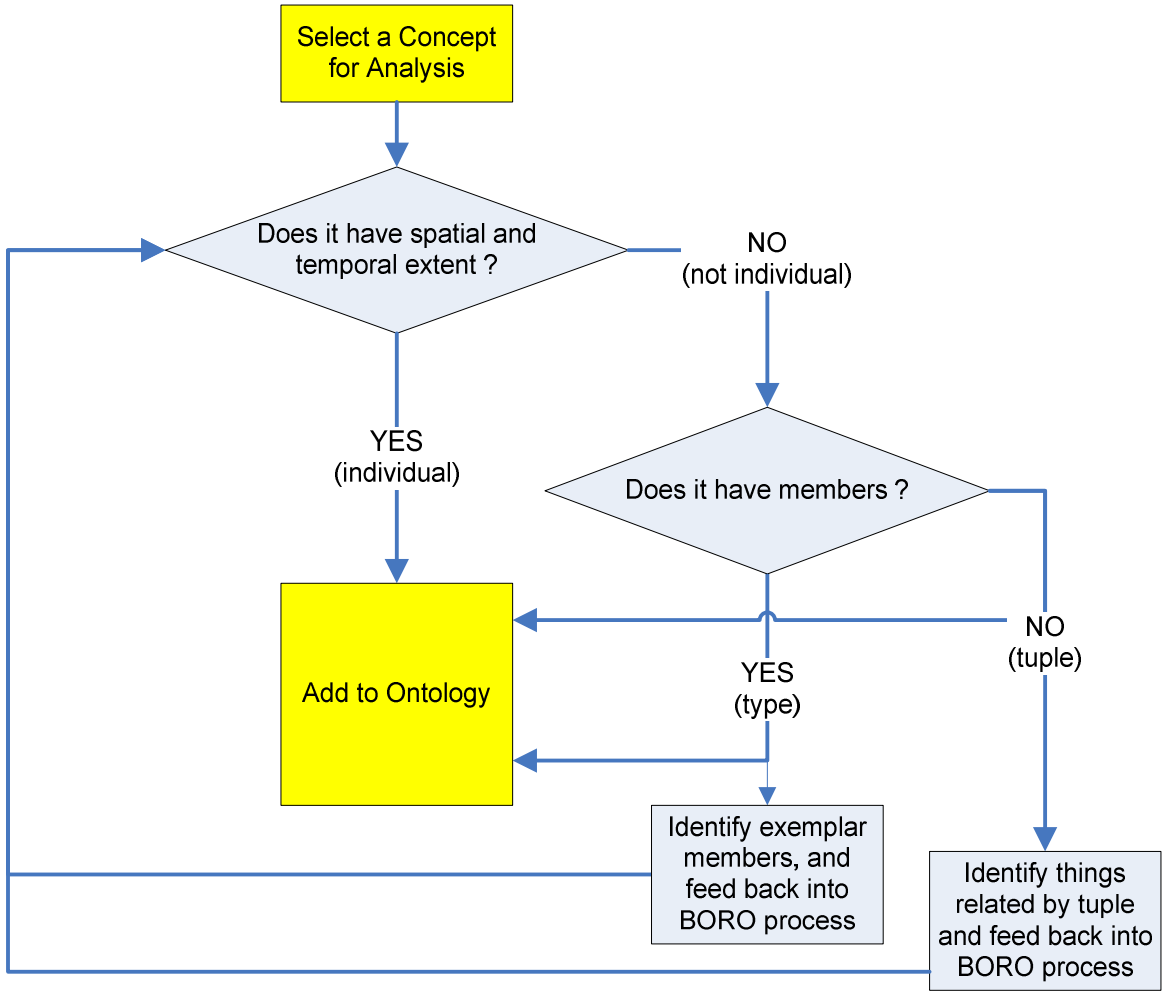
IDEAS Structure



- **Provides a common semantic foundation for multiple uses**
- **The common foundation enables interoperability across domains and applications**
- **All traces back up to IDEAS, so also offers possibility of international interoperability**

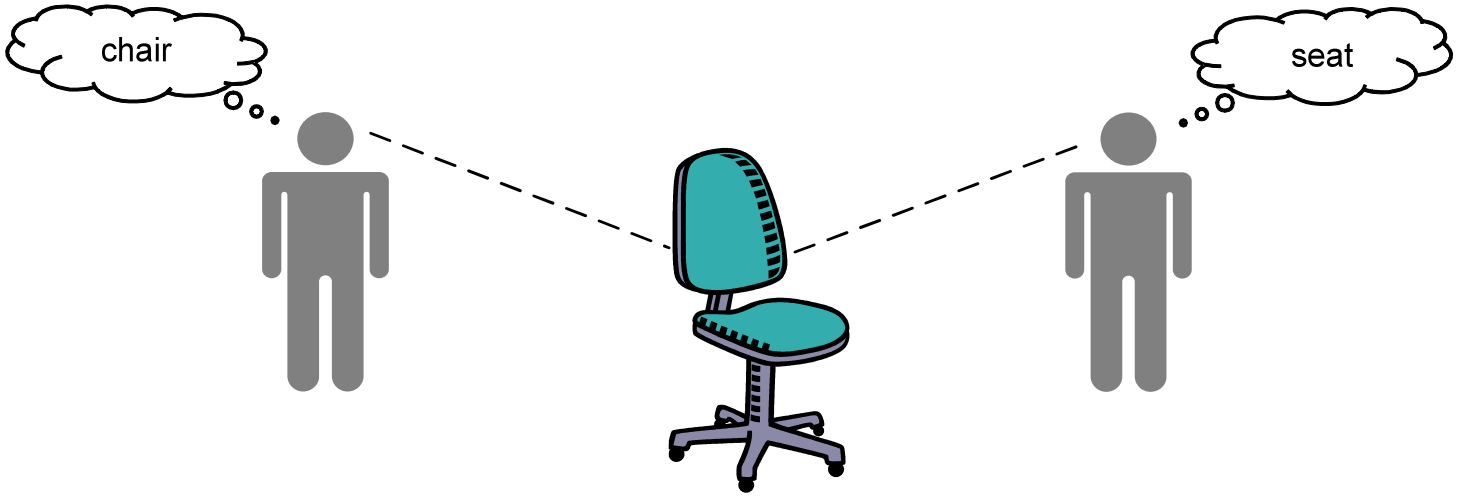
- Data sources act as requirements on the ontology, feeding up the stack into the areas of stronger governance – "standardisation by adoption"

The BORO Process



The Naming Pattern

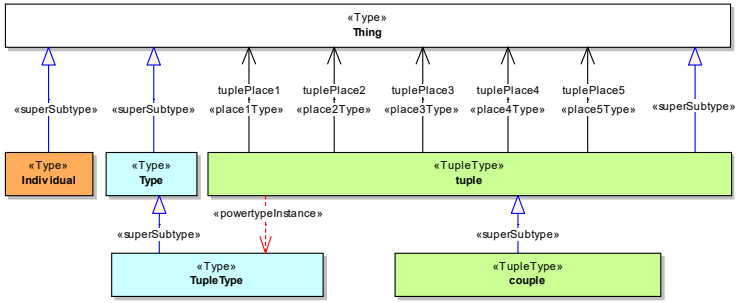
- **The ontology itself is concerned with the nature of things**
  - Relies on the only thing that is irrefutable, the physical extent of something
  - It is useful to ignore names when developing the ontology, as they carry too much baggage and confusion – people tend to cling onto names of things rather than trying to work out if things are the same or not
  - Once the semantic de-confliction is done, the names can be re-assigned, in context of their owners – and this is how interoperability is achieved



Sample Diagrams from IDEAS Model

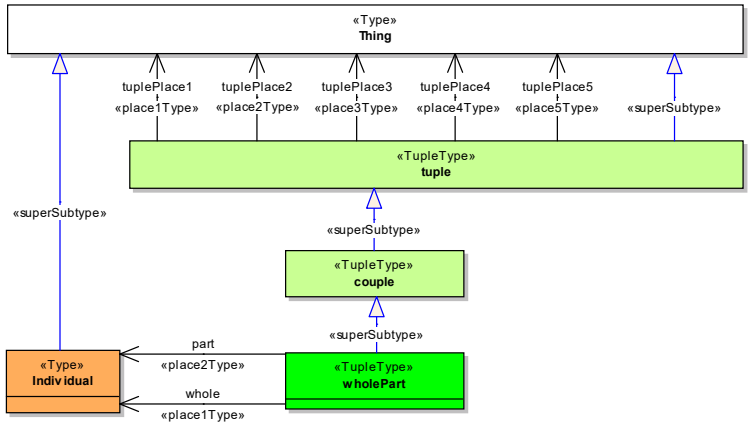
IDEAS Top Level

This diagram shows the fundamental ontic categories defined by the IDEAS Model. The upper level of the IDEAS model is based on BORO and ISO15926.



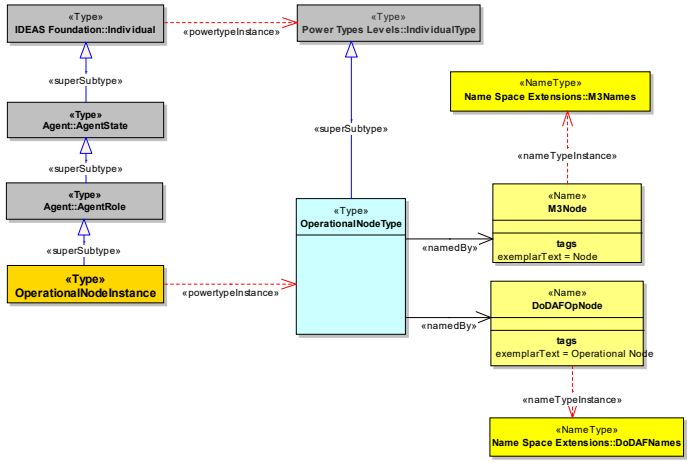
Whole-Part Pattern

The whole-part pattern establishes a relationship between individuals, asserting that one individual is composed of the other.



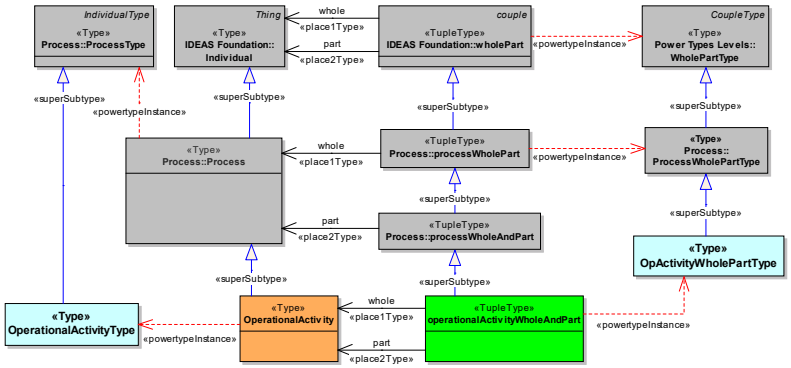
OV-2 Operational Node

AgentRole is a state of an agent when the agent is performing one or more tasks. In military architectures, there are often operational nodes, which represent states of agents that perform operational activities.



OV-5 Activity Whole-Part

This diagram shows the most general process whole-part relationships. ProcessWholePart defines a relationship between a Process (the whole) and an Individual (the part). ProcessWholeAndPart defines a whole-part relationship between Processes.



Foundation Top Level

class IDEAS Top Level

IDEAS Top Level

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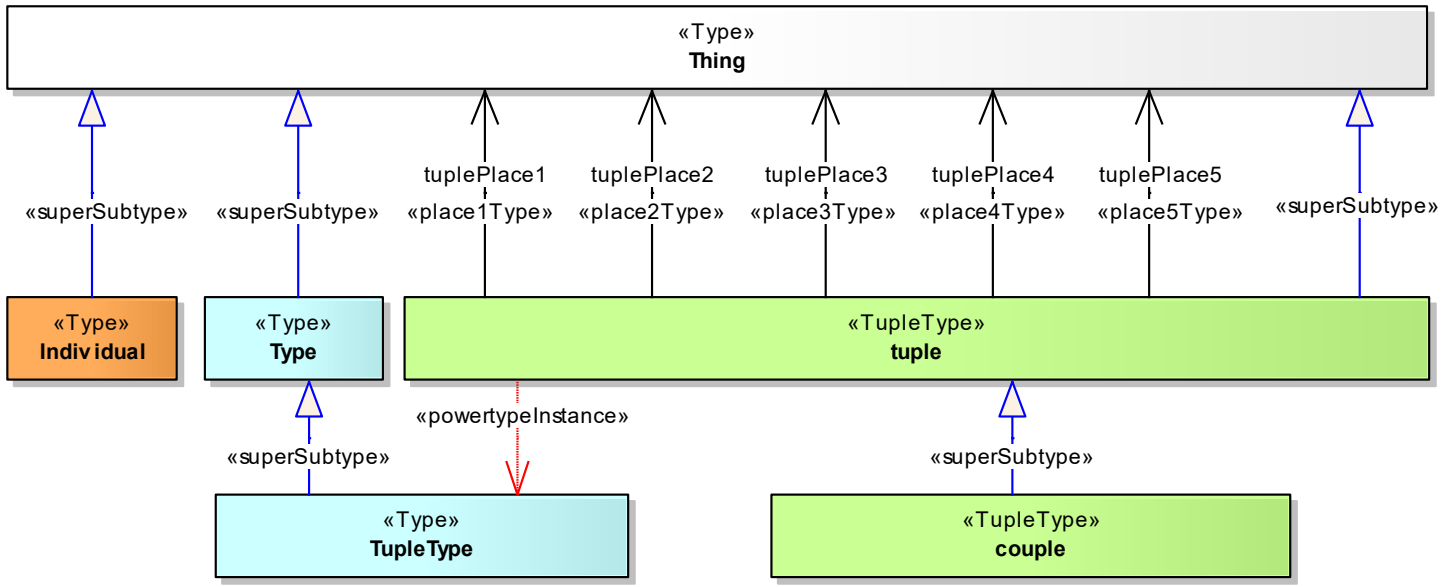
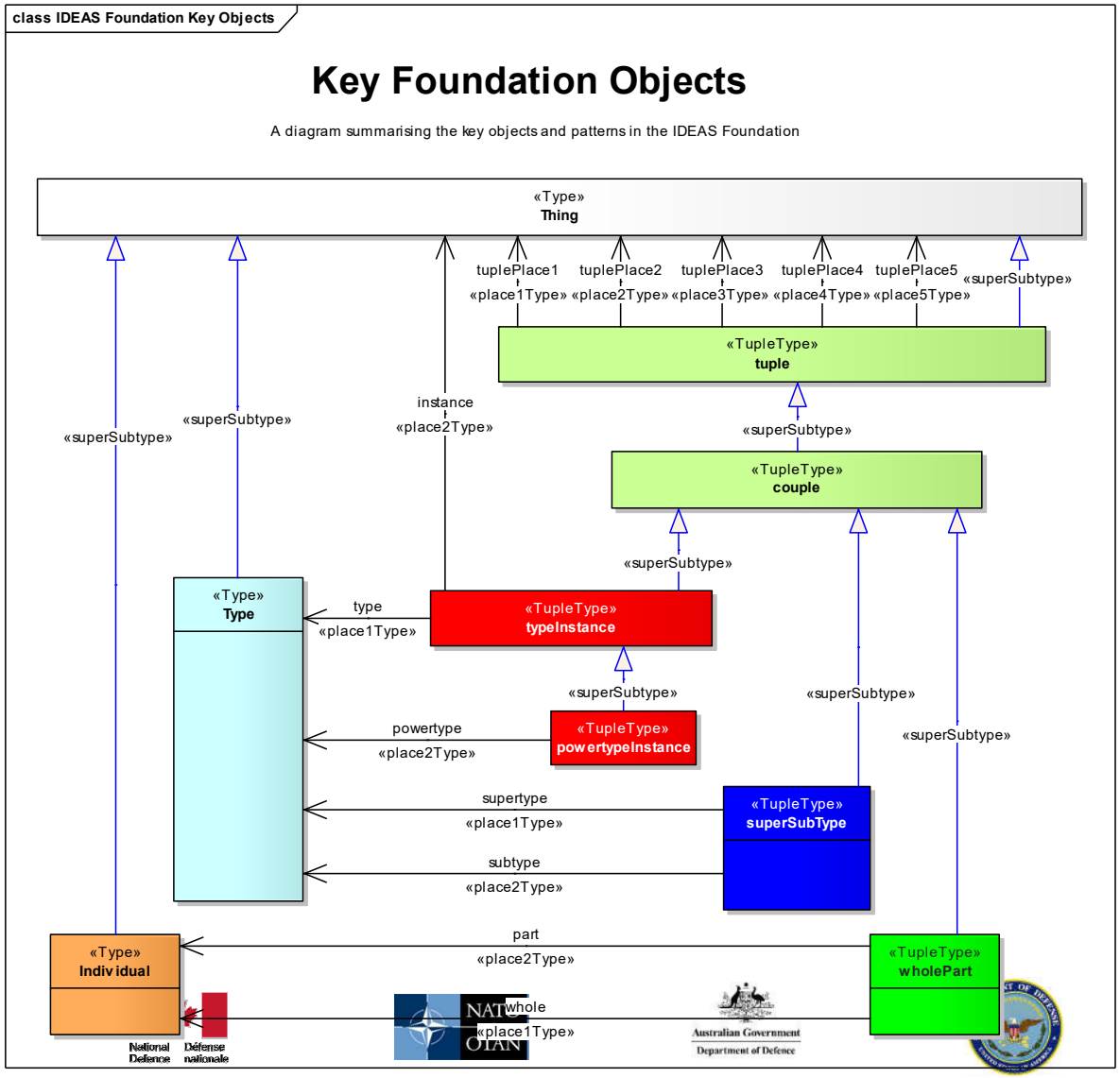


Foundation: Key Objects

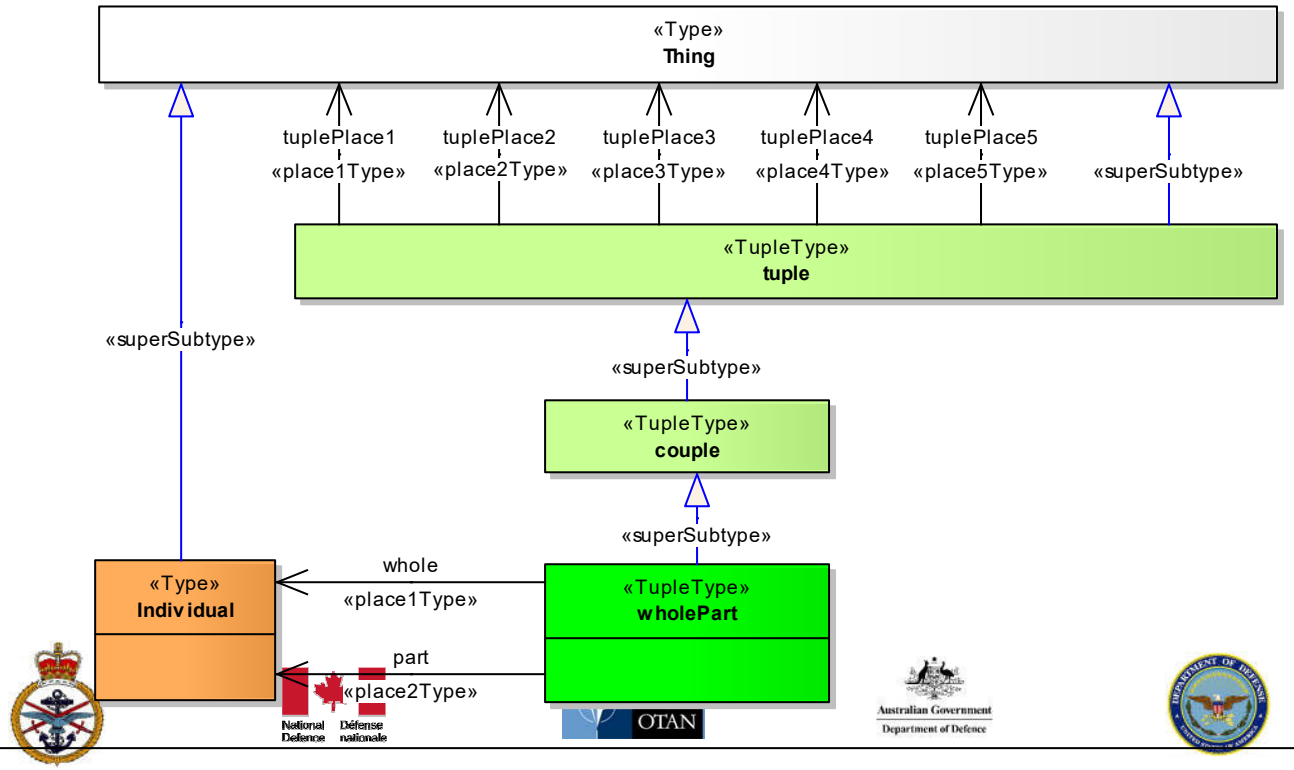


Common Patterns: Whole-Part

class Whole-Part Pattern

Whole-Part Pattern

The whole-part pattern establishes a relationship between individuals, asserting that one individual is composed of the other.



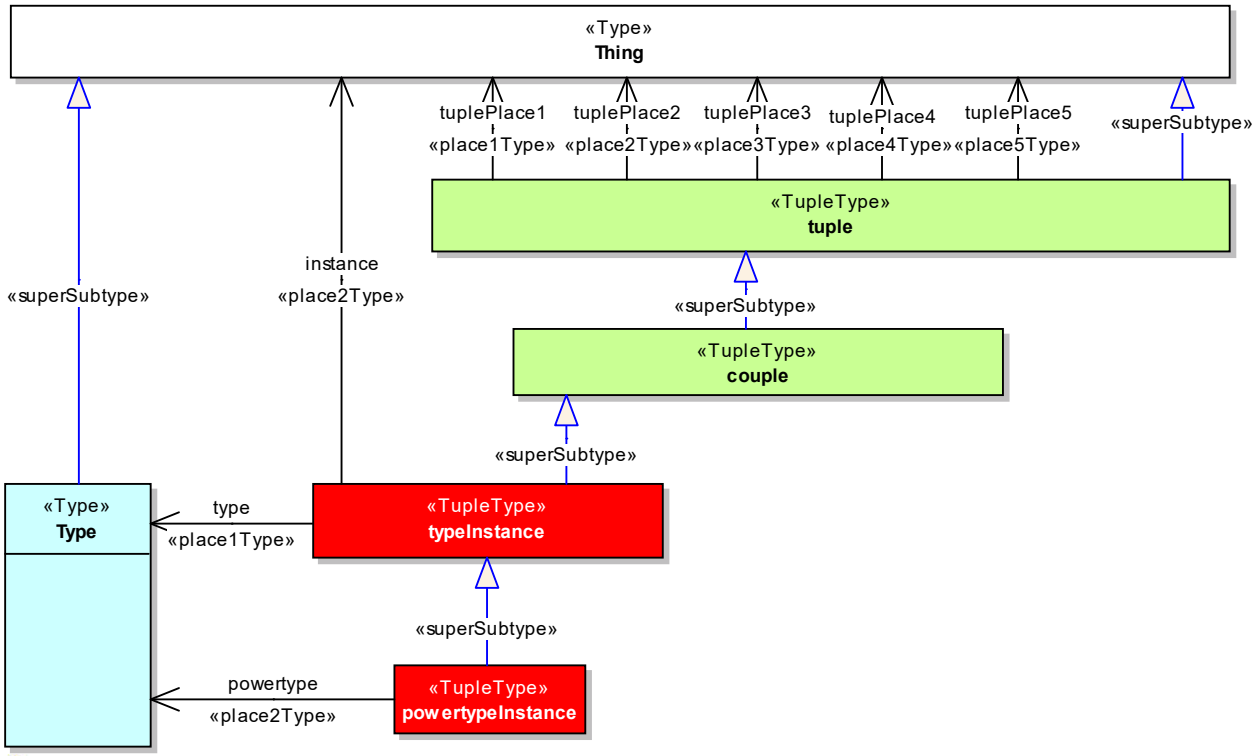
Type Instance Pattern

class Type-Instance Pattern

Type-Instance Pattern

This pattern establishes a relationship between Types and Things where the Thing is an instance of the Type - i.e. class membership

Note that things are instances of types. This means that types may be instances of types - i.e. IDEAS is a higher-order ontology.

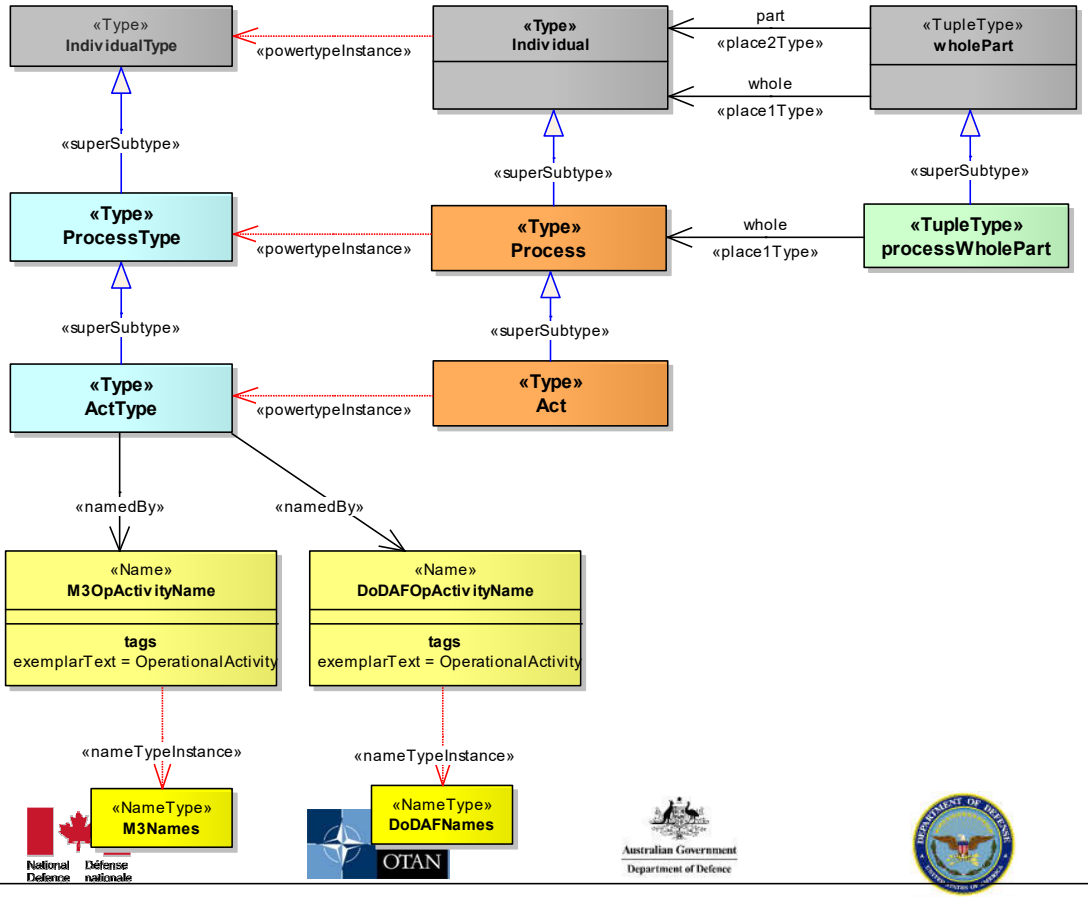


Domain Patterns: Process Type

class Process Type

Process Type

Process Type is a particularly important powertype for IDEAS. Process models are commonly used in government and industry. The processes depicted in a process model are not individuals - i.e. they have no spatial or temporal extent. They are classes of process - hence the importance of this stereotype. The powertype "ActType" is also significant as it represents types of processes conducted by agents, which is typically what is depicted in an activity model or system functional model.

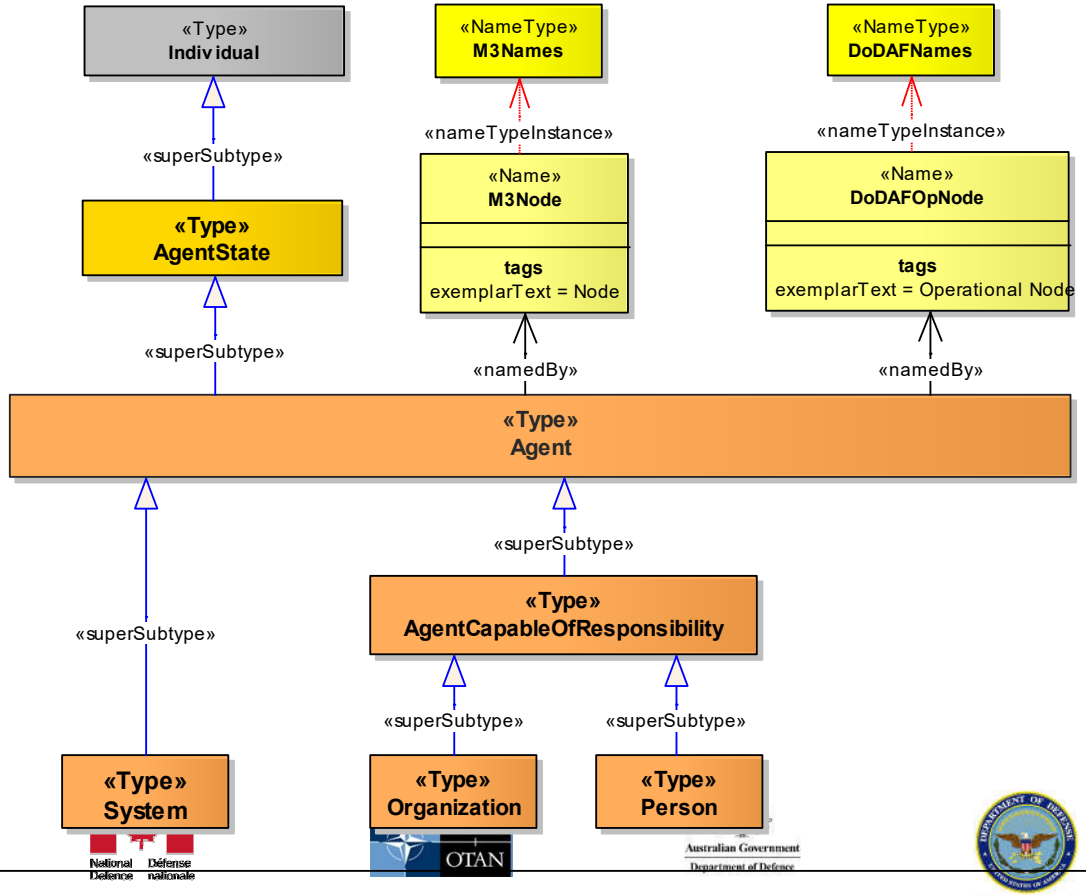


Domain Patterns: Agent Super-SubType

class Agent Super-Sub-Type Hierarchy

Agent Super-Sub-Type Hierarchy

In IDEAS, an Agent is something that actively participates in a process. An AgentCapableOfResponsibility is an Agent that consciously participates in a process.

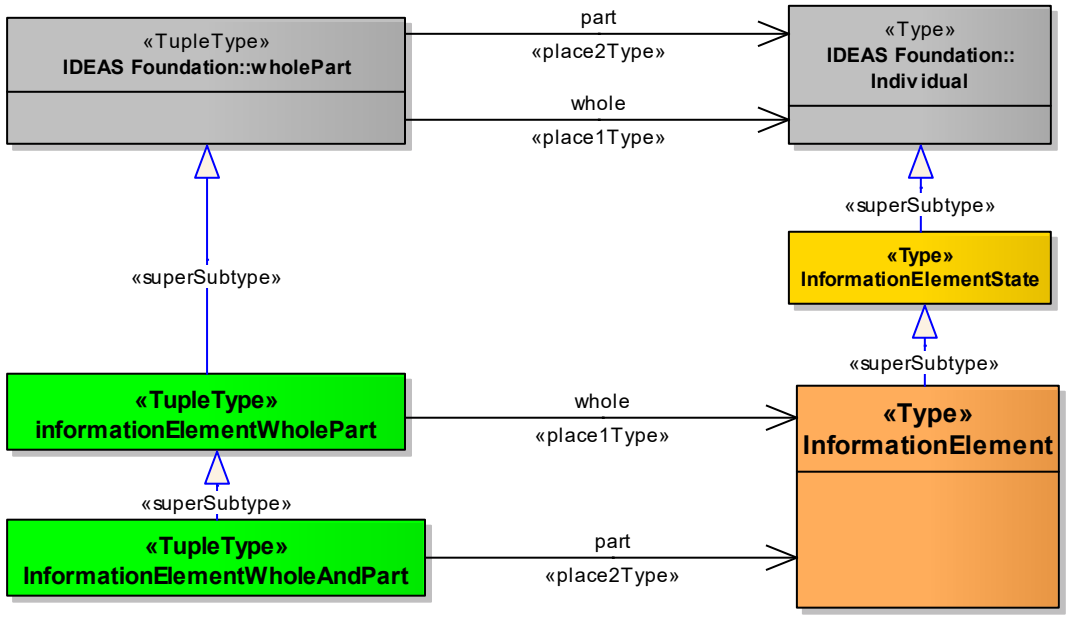


Domain Patterns: Information Element Whole-Part

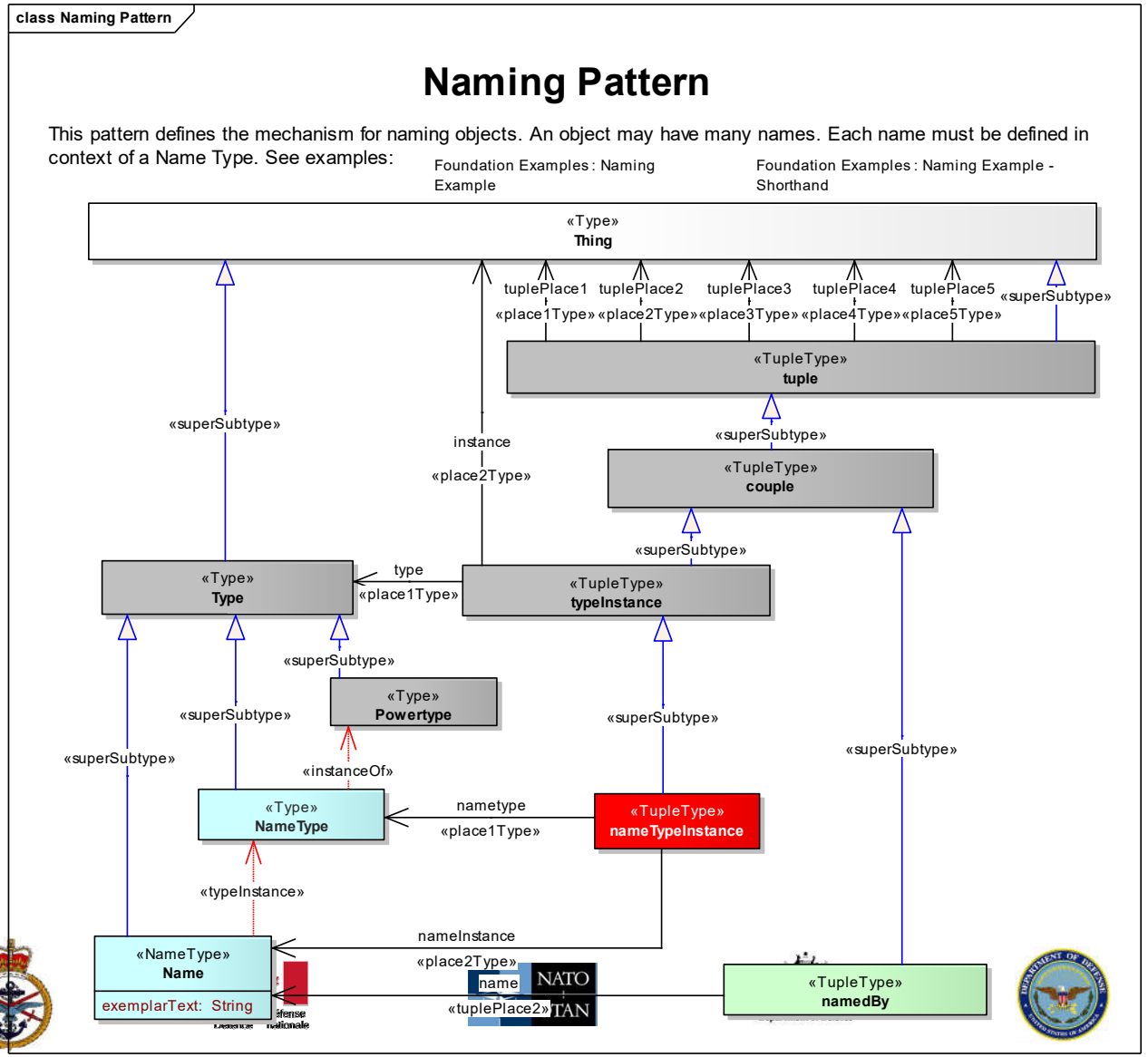
class Information Element Whole-Part

Information Element Whole-Part

...



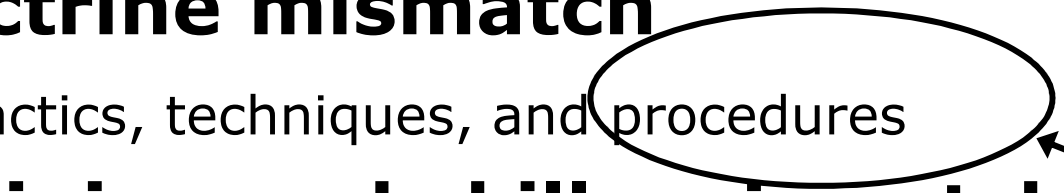
Common Patterns: Naming



Components of the IDEAS Project: METHODS OF ANALYSIS

Examples of Analyses

- **Doctrine mismatch**
  - Tactics, techniques, and procedures
- **Training and skills mismatch**
- **Systems mismatch**
  - Communications
  - Processing
  - Data formats
- **Capabilities gaps and overlaps**



Scope for ’08 experiment

Many Aspects of C4I Interoperability

ELECTRONIC COMMUNICATION Interoperability

- **PHYSICAL**
  - RF Waveform
  - Modulation
  - Compression Technique (JPEG, etc.)
- **DATA TRANSFER**
  - Protocol (Pull, push, etc.)
  - Bulk/Change
  - Publish/Subscribe
  - etc.
- **SECURITY**
  - Crypto (Procedural)
  - Over the Air Rekeying
  - Sanitizers
  - MLS
  - etc.
- **DATA FORMATS**
  - Bit oriented Formats (TADIL A, J, K, etc)
  - Character oriented Formats
    - ➢ USMTF
    - ➢ HTML, XML, XSI, etc.

PROCEDURAL/DOCTRINAL Interoperability

Tactics, Techniques and Procedures (TT&P), Training

- Air control procedures (Navy vs. Air Force)
- Tactical datalink conops, etc.
- Joint/Coalition tactics and training
- Joint/Coalition C2W (mop 6, 30)
- Joint surveillance Conops (IFF, etc)
- etc.

SYSTEM Interoperability

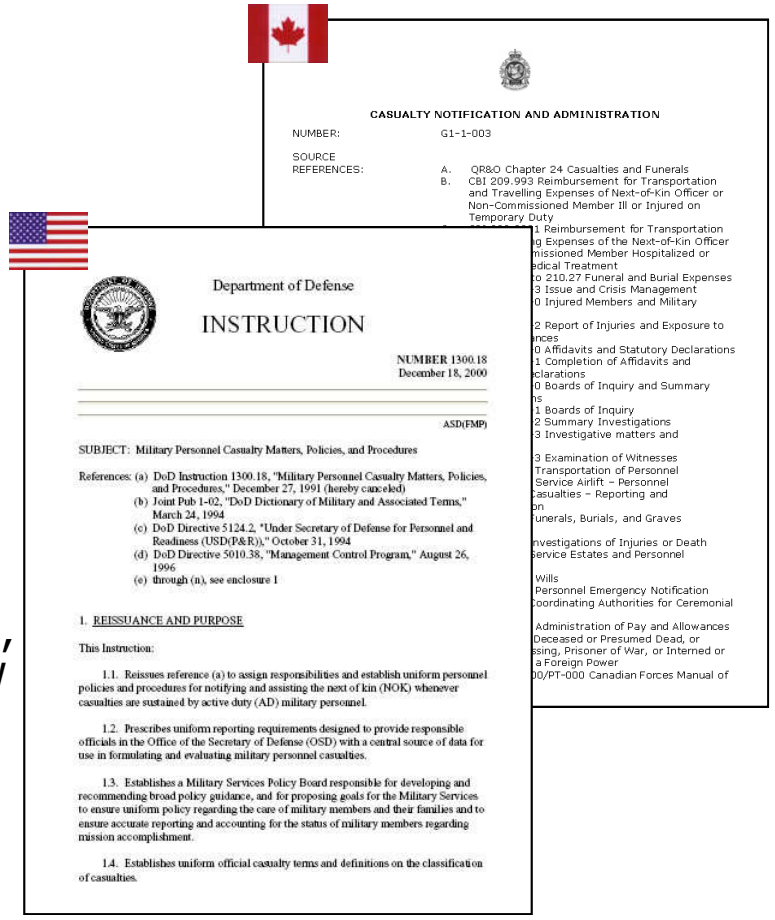
- **PRESENTATION**
  - Symbology
  - GIS types (e.g., PPI vs map/chart)
  - Filtering
  - Formats
- **INFORMATION SEMANTICS**
  - Battlespace Objects (e.g., GCCS and Combat System "track files" vs analysis data like ASAS vs. IEW data)
  - Prior Intelligence (e.g., OOB vs. IPB, Characteristics and Performance)
  - Geophysical (e.g., NGA vs. tactical)
  - Logistics (e.g., field vs. "reachback")
  - etc.
- **ALGORITHMS**
  - Tracking and correlation algorithms
  - Target ID
  - etc.

Components of the '08 Experiment on Procedural Interoperability: Use Cases

- **Doctrine or procedural publications did not address current issues in Casualty Management**
- **Use Cases**
  1. Scud missile attack in Desert Storm
  2. Operation Desert Storm Overall
- **Lessons Learned Categories**
  - Planning
  - Communication
  - Coordination
  - Reporting

Initial Idea – Compare Doctrines

- **Exchange architecture data regarding the processes, agents, information flows, and sequences of activities (OV-5, 6c) involved in Battlefield Human Casualty Management.**
- **Using US & Canadian doctrine documents as "test data"**
- **Want to show "value added" military utility, e.g.,**
  - Inconsistencies in processes, sequence, timing, event triggers, information flow and reporting, …
  - Knowing ahead of time could lead to adjustments or just understanding so there won't be surprises during execution



CASUALTY NOTIFICATION AND ADMINISTRATION

NUMBER: G1-1-003

SOURCE REFERENCES:
A. QR&O Chapter 24 Casualties and Funerals
B. CBI 209.993 Reimbursement for Transportation and Travelling Expenses of Next-of-Kin Officer or Non-Commissioned Member Ill or Injured on Temporary Duty

Department of Defense

INSTRUCTION

NUMBER 1300.18
December 18, 2000

ASD(FMP)

SUBJECT: Military Personnel Casualty Matters, Policies, and Procedures

References: (a) DoD Instruction 1300.18, "Military Personnel Casualty Matters, Policies, and Procedures," December 27, 1991 (hereby canceled)
(b) Joint Pub 1-02, "DoD Dictionary of Military and Associated Terms," March 24, 1994
(c) DoD Directive 5124.2, "Under Secretary of Defense for Personnel and Readiness (USD(P&R))," October 31, 1994
(d) DoD Directive 5010.38, "Management Control Program," August 26, 1996
(e) through (n), see enclosure 1

1. REISSUANCE AND PURPOSE

This Instruction:

1.1. Reissues reference (a) to assign responsibilities and establish uniform personnel policies and procedures for notifying and assisting the next of kin (NOK) whenever casualties are sustained by active duty (AD) military personnel.

1.2. Prescribes uniform reporting requirements designed to provide responsible officials in the Office of the Secretary of Defense (OSD) with a central source of data for use in formulating and evaluating military personnel casualties.

1.3. Establishes a Military Services Policy Board responsible for developing and recommending broad policy guidance, and for proposing goals for the Military Services to ensure uniform policy regarding the care of military members and their families and to ensure accurate reporting and accounting for the status of military members regarding mission accomplishment.

1.4. Establishes uniform official casualty terms and definitions on the classification of casualties.

Use Case Examples

Based on a "Quick-Look" analysis

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1. Scud missile attack (Saudi Arabia)

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- **Background**
  - An Iraqi scud missile strikes a warehouse at U.S. Aujan compound in Saudi Arabia
- **Lessons Learned:**
  - Planning
    - Casualties removed randomly
    - Barracks mistaken for hospital
    - No landing site for Evacuation helicopters
    - Casualties not taken to U.S. facilities
    - Weapons and personal items secured by Saudis, not U.S.
    - No emergency plan in place

1. Scud missile attack (Saudi Arabia), cont.

- **Lessons Learned (cont.):**
  - Communications
    - Saudis only communicated within their own network
    - Soldiers removed without U.S. notification
    - No direct communication existed
    - U.S. Army and Saudi ambulances had no radios
    - Evacuation helicopters had no contact with Medical Group communications center
    - No communications plan in place

1. Scud missile attack (Saudi Arabia), cont.

- **Lessons Learned (cont.):**
  - Coordination
    - U.S. and Saudi hospitals had disparate disaster plans
    - Many casualties initially unaccounted for
    - No coordination between military and civilian assets.
    - No civilian understanding of military concept of echelons of care.
  - Reporting
    - U.S. military not contacted for 22 minutes after attack
    - Families learned of attack via media
    - Delays in notification of status to families
    - Casualties unaccounted for at least 48 hours

Use Case Examples

Based on a "Quick-Look" analysis

2. Desert Storm Overall

2. Desert Storm Overall

- **Background**
  - During Operation Desert Storm, coalition forces faced the possibility of nuclear, chemical or biological (NCR) warfare

- **Lessons Learned:**
  - <u>Planning</u>
    - Disparate coalition partner plans for NCR

2. Desert Storm Overall , cont.

- **Lessons Learned (cont.):**
  - Communications
    - Information not spontaneously shared among Coalition members.

2. Desert Storm Overall , cont.

- **Lessons Learned (cont.):**
  - Coordination
    - Differences in selection of medical countermeasures
    - Differences in drugs and vaccines used
    - Disparate policies on consent for treatment
  - Reporting
    - Different warning and reporting practices in use
    - Not all complied with warning and reporting procedures in place

ideas group
international enterprise architecture exchange

So how could IDEAS and architecture address these types of problems?

Scud Missile Attack

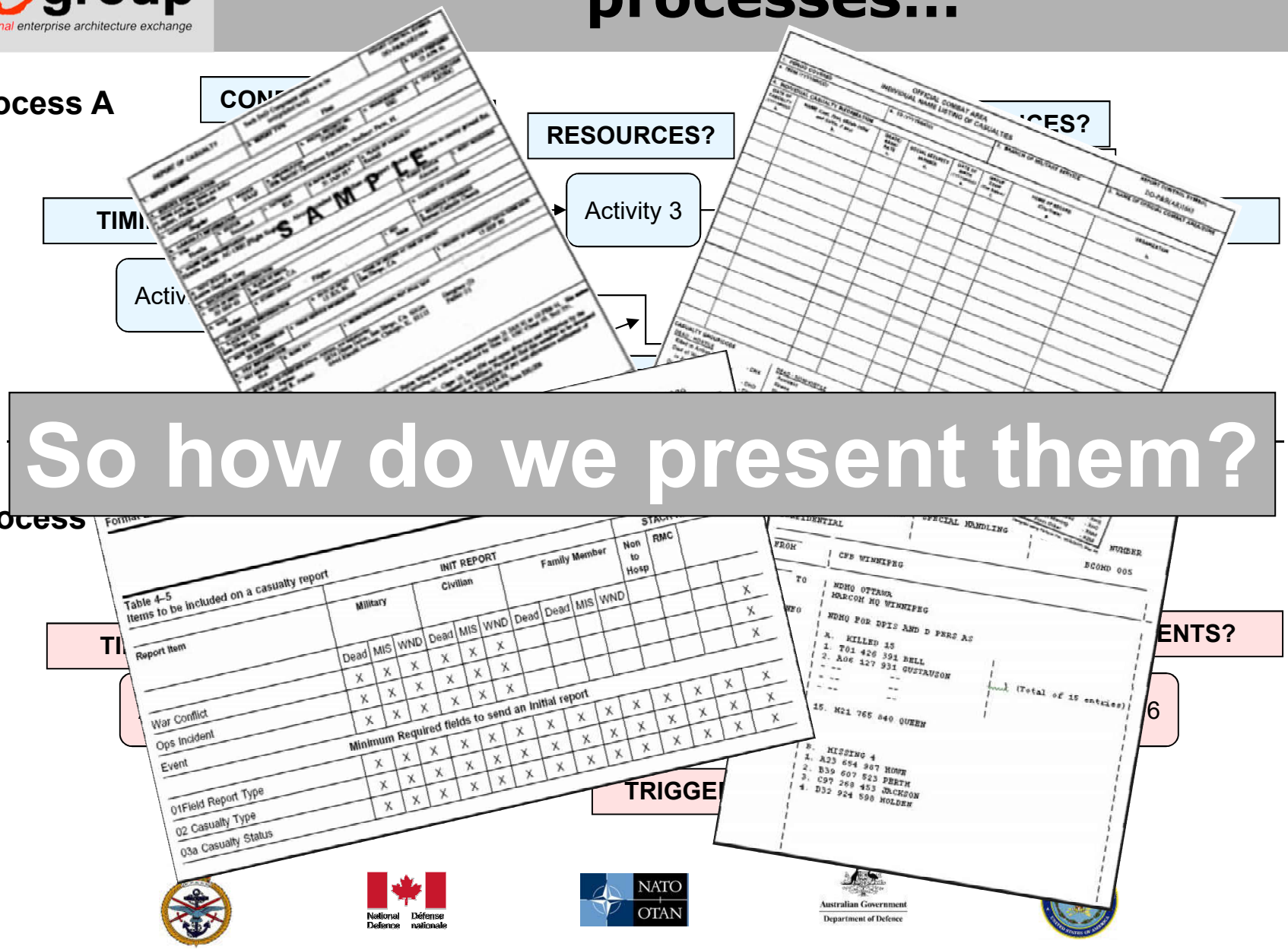
	OV-2	OV-3	OV-4	OV-5	OV-6a	OV-6c	SV-1	SV-2	SV-5	SV-6
Scud missile attack										
Planning										
Casualties removed randomly				X	X	X				
Barracks mistaken for hospital						X				
No landing site for evac helicopters					X					
Casualties not taken to U.S. facilities			X	X	X	X				
Weapons and personal items secured by Saudis, not U.S.			X	X	X	X				
No emergency plan in place			X		X					
Communications										
Saudis only communicated within their own network	X						X	X		
Soldiers removed without U.S. notification	X		X	X	X					X
No direct communication existed	X						X	X		
Army and Saudi ambulances had no radios	X		X				X	X		
Evac helicopters had no contact with Medical Group CC			X				X			
No communications plan in place			X				X			
Coordination										
U.S. and Saudi hospitals had disparate disaster plans			X						X	
Many casualties initially unaccounted for	X	X								
No coordination between military and civilian assets	X								X	
No civilian understanding of military concept of echelons of care			X	X	X				X	
Reporting										
U.S. military not contacted for 22 minutes after attack	X	X		X						
Families learned of attack via media		X								
Delays in notification of status to families		X								X
Casualties unaccounted for at least 48 hours		X								X

Desert Storm Overall

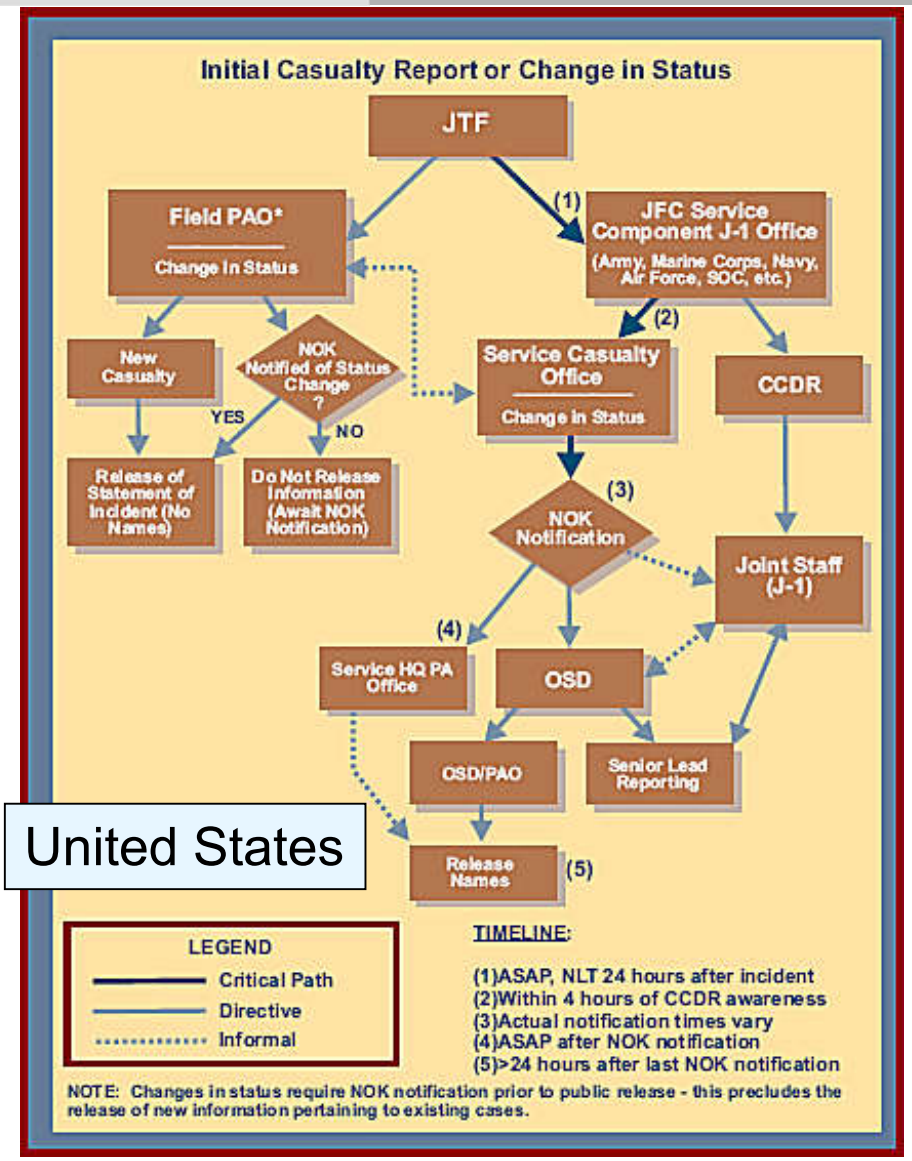
	OV-2	OV-3	OV-4	OV-5	OV-6a	OV-6c	SV-1	SV-2	SV-5	SV-6
Operation Desert Storm										
Planning										
Disparate coalition partner plans for NCR			X	X	X	X	X			
Communications										
Information sharing amoung coalition partners	X			X	X	X	X			
Coordination										
Differences in selection of medical countermeasures					X				X	
Differences in drugs and vaccines used					X				X	
Disparate policies on consent for treatment			X						X	
Reporting										
Different warning and reporting practices in use	X	X	X	X		X				X
Compliance with warning and reporting procedures		X			X	X				X

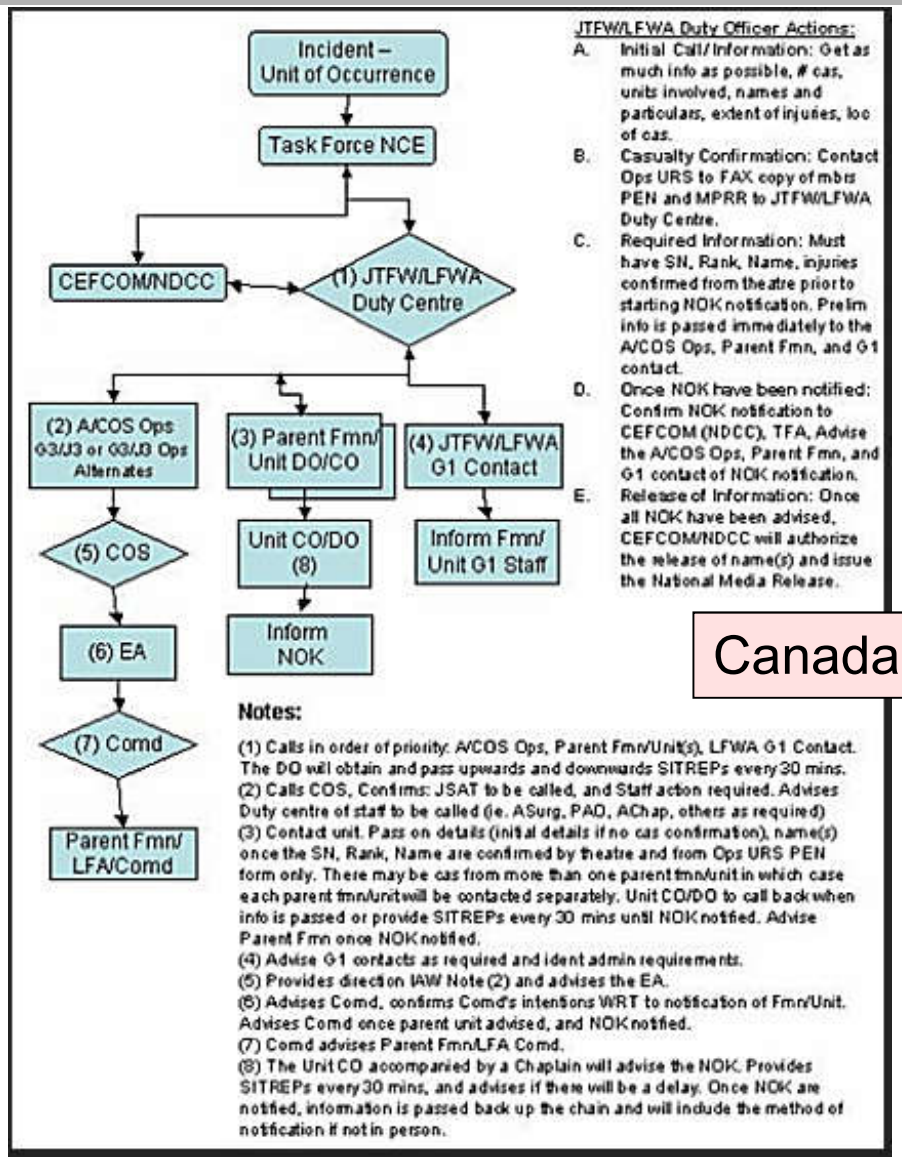
Components of the the IDEAS Project: PRESENTATION

We know differences exist in the processes…

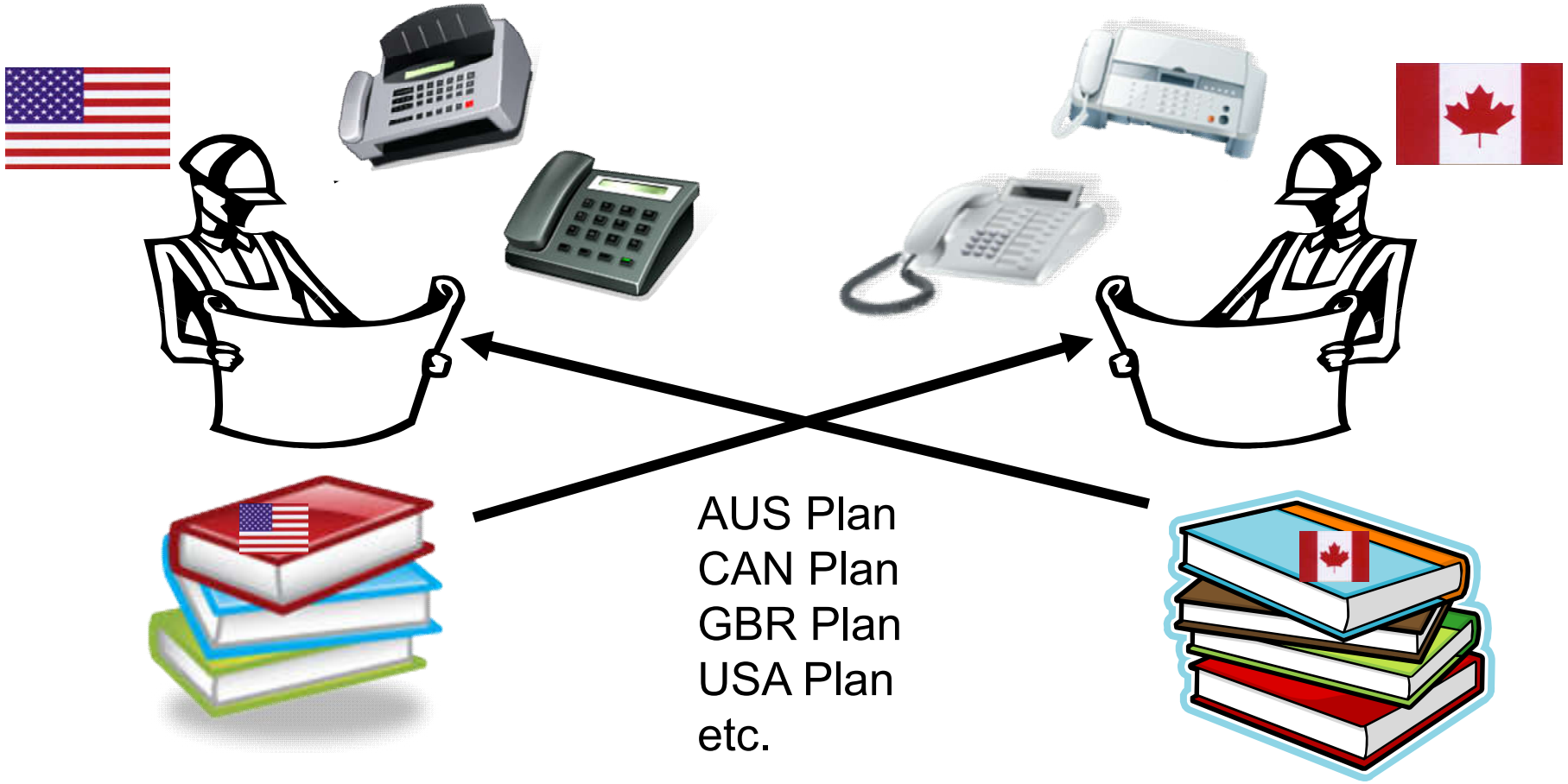


US vs. CA Casualty Management Flowcharts

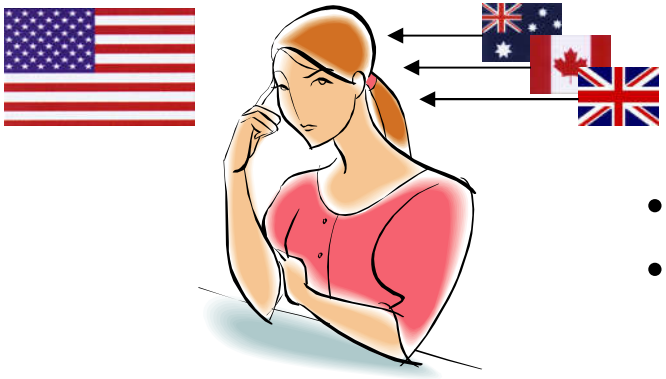


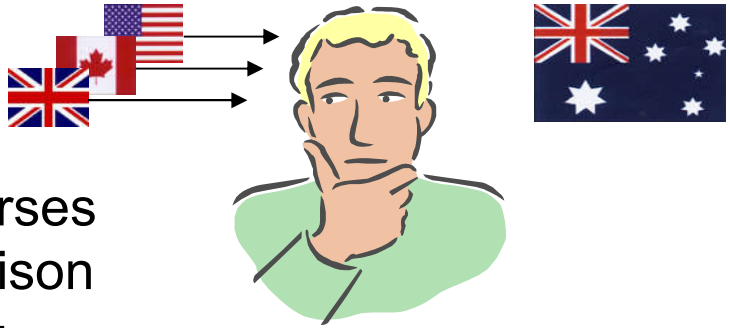


Manual Coalition Ops Planning Processes "As-Is"



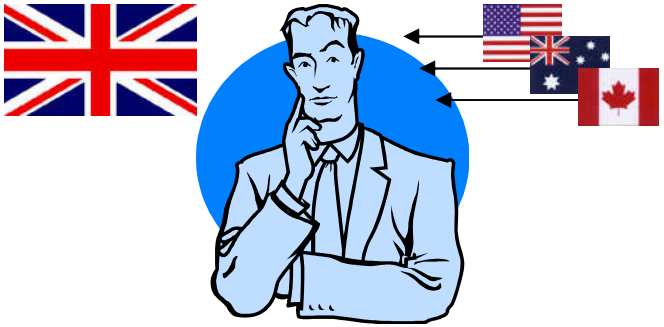
Implication



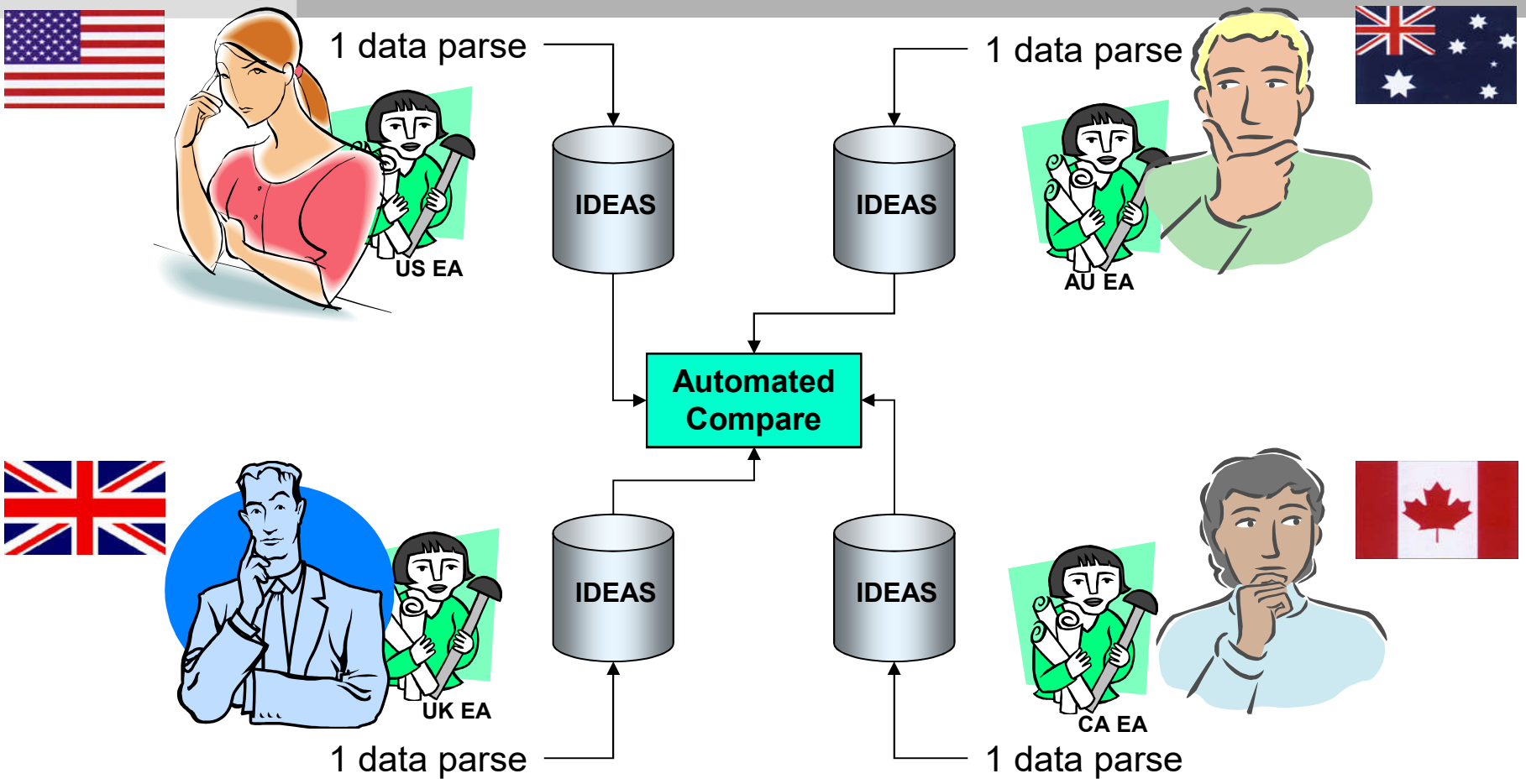


- 3 mental data parses
- 3 mental comparison per *country* =

- **12 mental data parses *<u>IAW national background</u>***
- **12 mental comparisons**



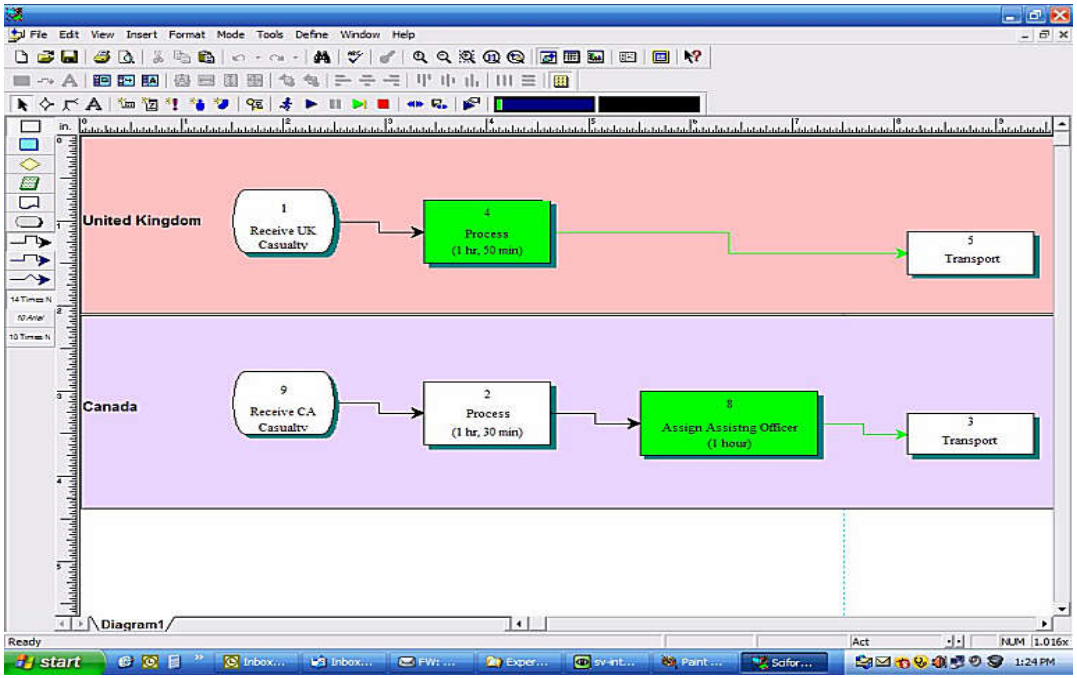
Automation Assistance via IDEAS



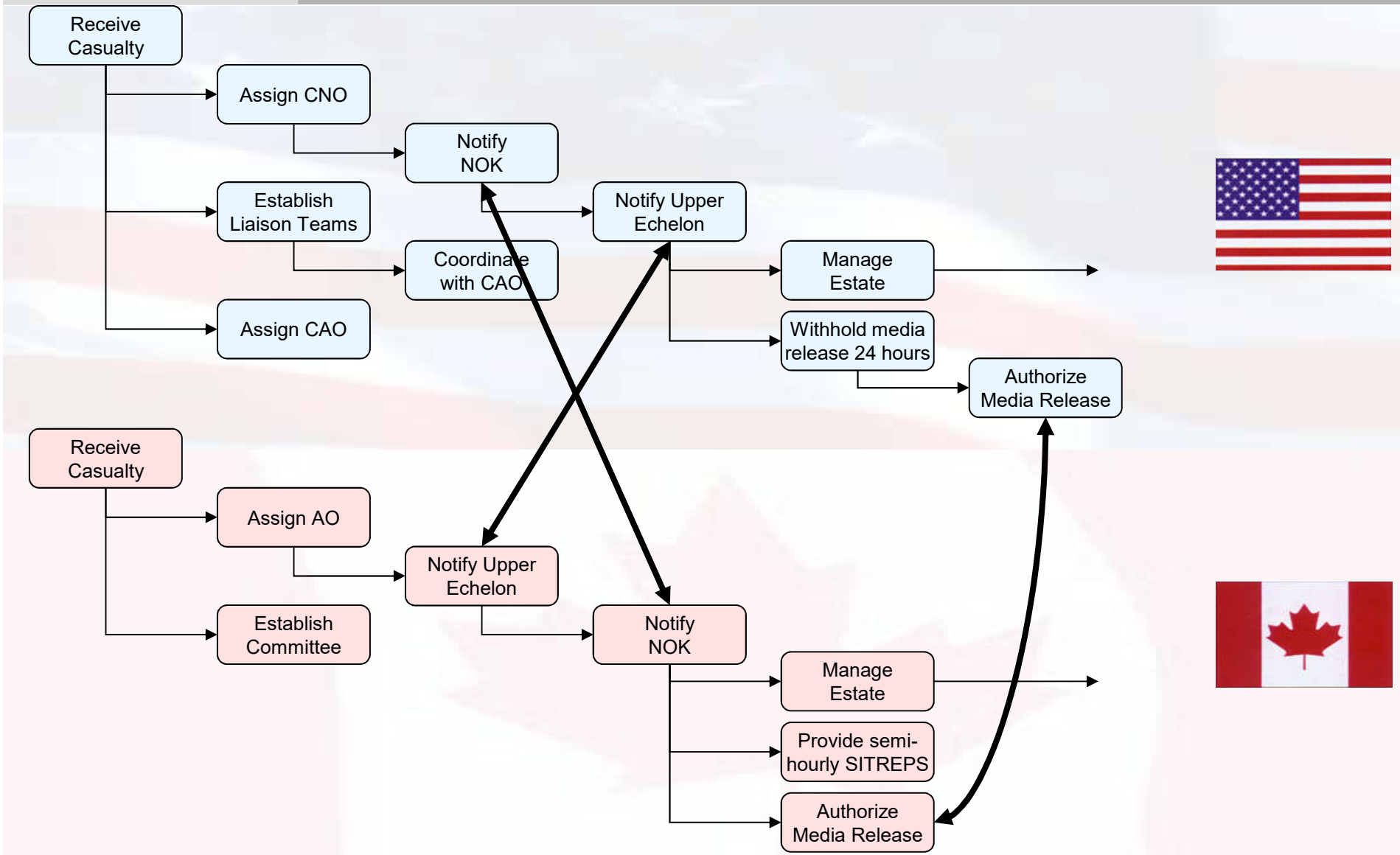
- 4 mental data parses of our native doctrine (instead of 12)
- 0 mental comparisons (instead of 12) against an consistent ontology vice a national background

Process Comparison Presentation

- **Provide rigorous representation of the process data flow and sequencing (OV-5 and OV-6c) precise data representations.**
- **Identify Alternative Visualization and Analysis Techniques**
- **Provide Candidate Visualization Techniques**
  - (Enable Analysis of Doctrine and Process Differences)



Current Status
Initial Process Representation and Comparison



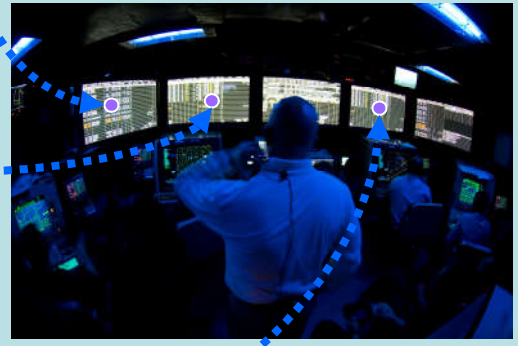
"To-Be" enabling technologies & tools considered in the experiment

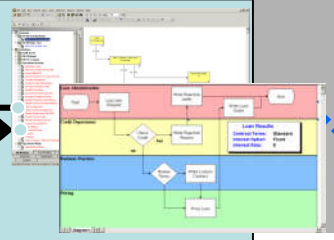
Visualization Environment

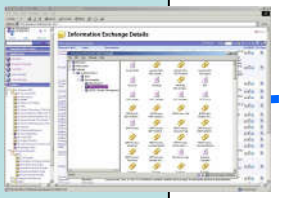
Relational DB Query Environment

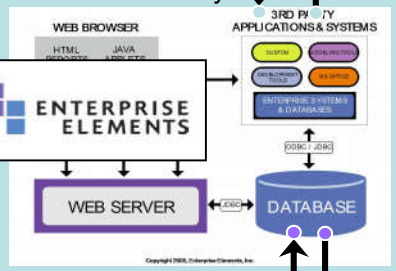
OWL/RDFS DB Data Mining Environment

Decision Environment



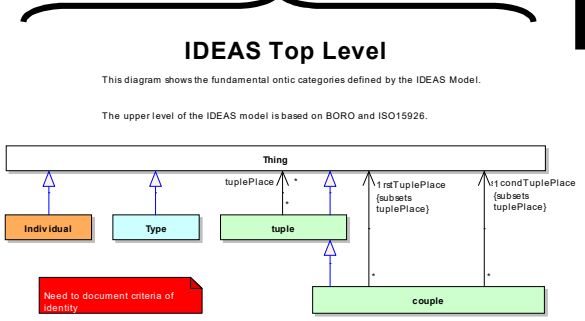






RDFS Database

IDEAS Data Exchange Format (RDFS)



Summary

- **Exchanging architecture data during coalition operations planning process:**
  - Can automate interoperability comparisons to:
    - Reduce resource requirements
    - Speed the process
    - Potentially detect issues that may have been missed
    - De-bias national interpretations of other doctrines
  - Depends on a precise data exchange standard
    - IDEAS grounding in a formal ontology provides such precision
- **A limited experiment in '08 will demonstrate some of these benefits**
- **An exercise in '09 is planned to show these in a broader context**

Backups

Current Interoperability Initiative

- What are we trying to do?
  - Demonstrate the military utility of flexible and interoperable exchange of architecture data.
- What aspects of interoperability is this experiment series focused on?
  - Doctrinal and procedural interoperability.
  - Interoperability between a diverse and ever evolving set of automated architecture design tools.
- What challenges are we addressing ?
  - Providing precise and unambiguous representation and exchange of coalition doctrine and procedures utilizing the precision and discipline that the DoDAF and MODAF architecture standards and products require.
  - Enabling clear and unambiguous visualization of the differences in multi-national doctrine and procedures.
  - Enabling near real-time collaboration and analysis of associated interoperability problems in a multi-national, geographically dispersed environment.

Current Interoperability Initiative (Cont.)

- **What is the current scope (Experiment 08)?**
  - Exchange and collaborative analysis of Process data flow (OV-5) and Event Trace/Sequences (OV-6c) data.
  - Demonstrate candidate visualization tools and techniques.
  - Evaluate the precision of the data exchange.
- **What are the current enabling technologies?**
  - Evolving technologies in Internet exchange techniques and ontology's allowing increased precision in data interoperability (i.e. XML, XSI, WXSD, RDF/OWL, etc.).
  - Precise data models representing the architectural data.
  - Emerging improvements in visualization and business intelligence tools.
- **How does such an exchange help a coalition ops planner?**
  - Brings out unknowns ahead of time, e.g.:
  - Enables the identification of automation opportunities and process improvements

Current Experiment Direction

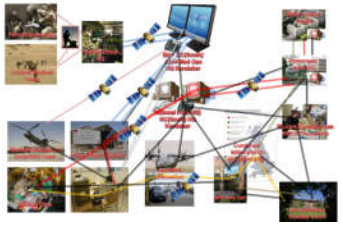
- **Compare and contrast coalition processes**
  - Nations agreed on a Military Casualty Management example scenario.
  - Who are the players? (AU, CA, UK, US)

- **Other examples - JFCOM input needed**
  - Candidate NATO Operational Processes of concern.
  - Known doctrine/process differences (identify country Process differences causing potential interoperability problems)
  - Known doctrine/process successes (identify existing country Process successes resulting in favorable interoperability results)

Military Utility - Current Example: Military Casualty Management

- **Purpose**
  - To demonstrate potential military operational utility of enabling interoperable exchange of Doctrine and Procedural casualty management data utilizing precise DoDAF/MoDAF architecture data.
- **Approach**
  - Contrast "as-is" processes with with potential "to-be" methods
  - Show relevance to procedures, tools, methods, etc., that coalition planners would actually use
- **Objective**
  - To seek out automation opportunities and document how the Coalition Ops Casualty Management Planning scenarios are done today:
    - Identify manual, time consuming processes? (paper, email, faxes, phone calls, meetings, …)
    - Enable discovery of issues in the field (on-the-job interoperability)

Military Utility - Current Example: Military Casualty Management



- **Expected Results**
  - Common data standards allowing for coalition collaboration utilizing XML-based schemas
  - Tool-independent data exchange mechanisms
  - Visual decision aids for coalition planners making use of rigorous layout of procedures, sequences & timing
- **Risks**
  - Disparate doctrine, development procedures & LOEs
  - Methodology way over the heads of most
  - COTS vendors need to embrace development of accommodating tools

EXERCISE '09

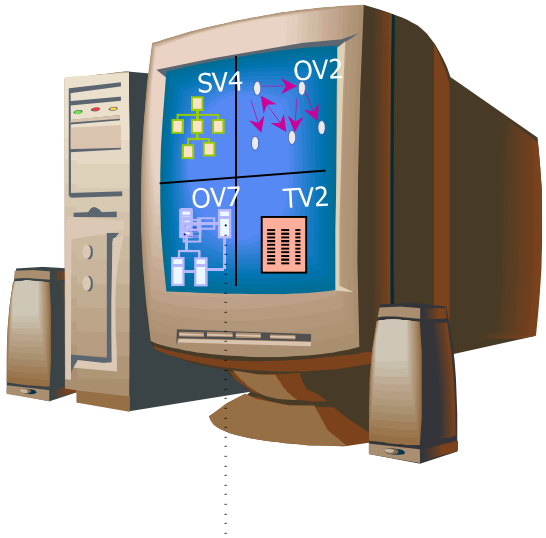
- **Demonstrate Multi-National data exchange and collaborative analysis.**
  - Implement techniques in a diverse tool set
  - Evaluate Precision of data exchange
- **Demonstrate ability to identify manual, time consuming processes? (paper, email, faxes, phone calls, meetings, …)**
- **Demonstrate the ability to discover issues in the field (on-the-job interoperability)**

Current Efforts and Progress to Date

- **Mock-up AU-CA-UK-US Casualty Management process comparison displays (currently underway):**
  - Exchange data via RDFS, allowing for the creation of classes of resources that share common properties
  - Highlight different processes, sequences, information flows, event triggers between coalition partners
  - Develop potential side-by-side comparison analysis
- **Post on IDEAS FTP site for review**
  - US review with Joint Forces Command
- **Thereafter examine tools for potential process comparison functionality**

Potential Tool Interoperability with SysML

Systems Modeling Tool



Model/Data Interchange

AP233/XMI

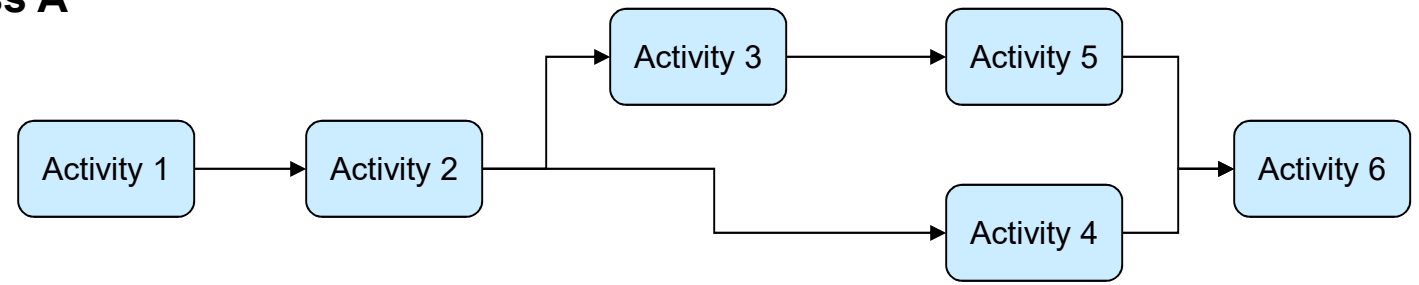
AP233/XMI

Other Engineering Tools

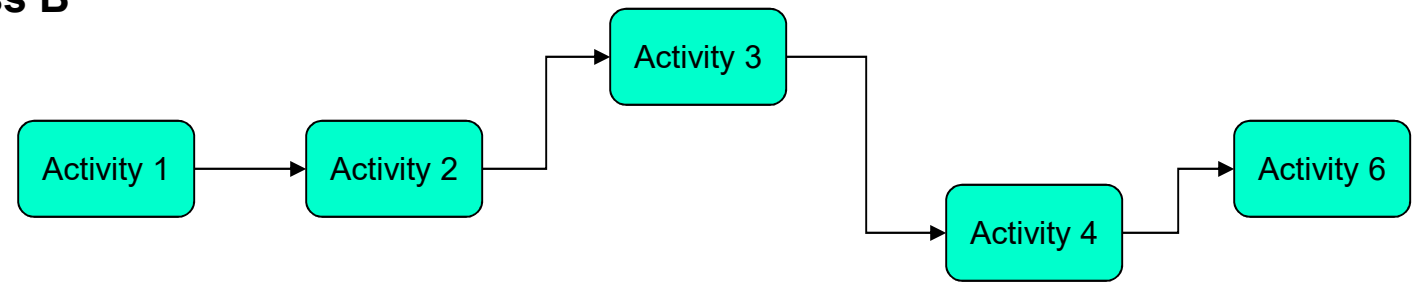
Comparing Processes

In two or more distinct processes …

Process A



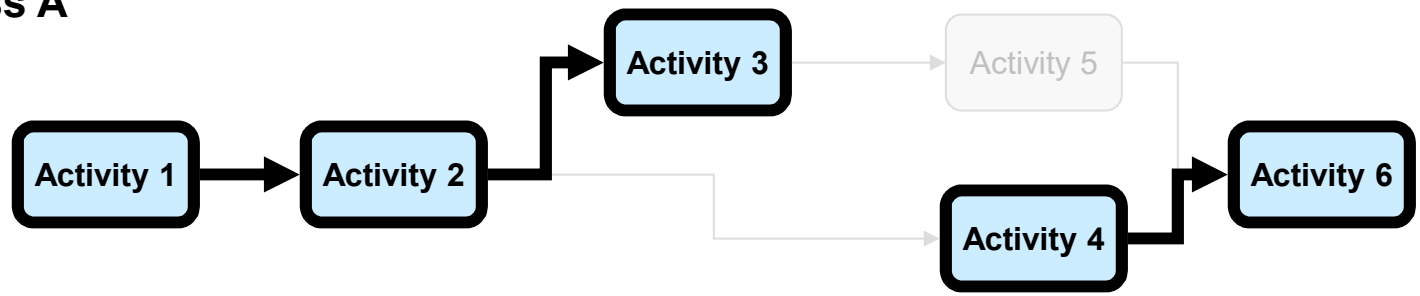
Process B



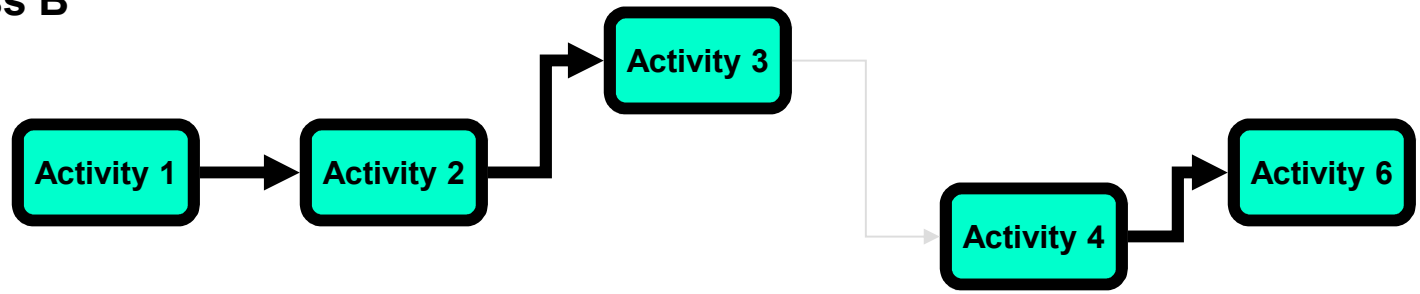
Comparing Processes

Similarities must be easy to identify …

Process A



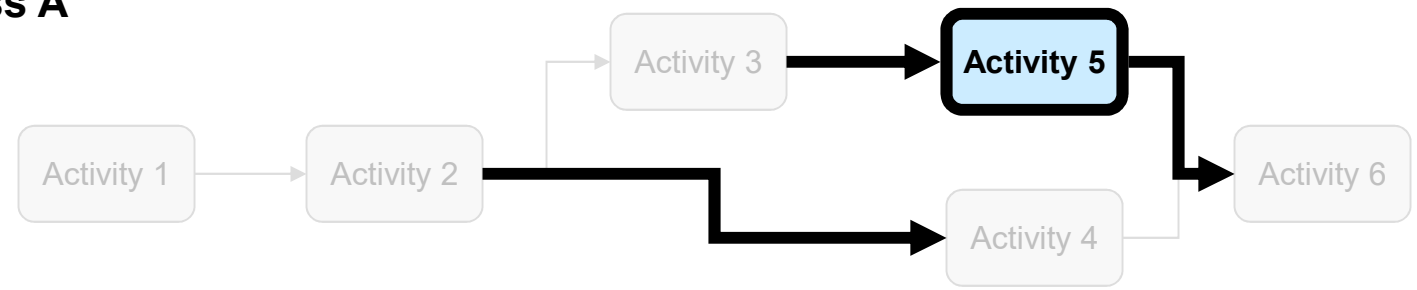
Process B



Comparing Processes

As well as differences in those processes …

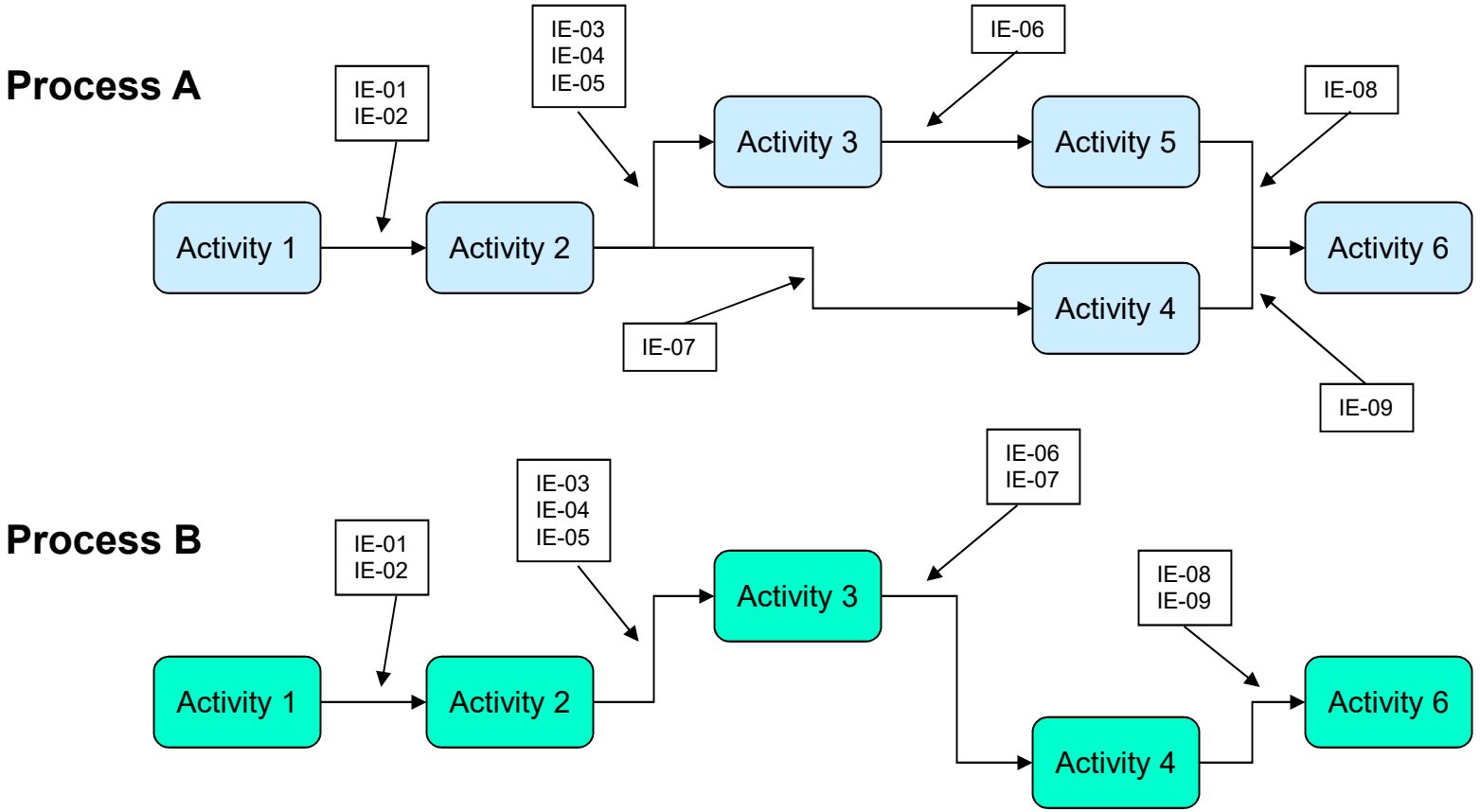
Process A



Process B

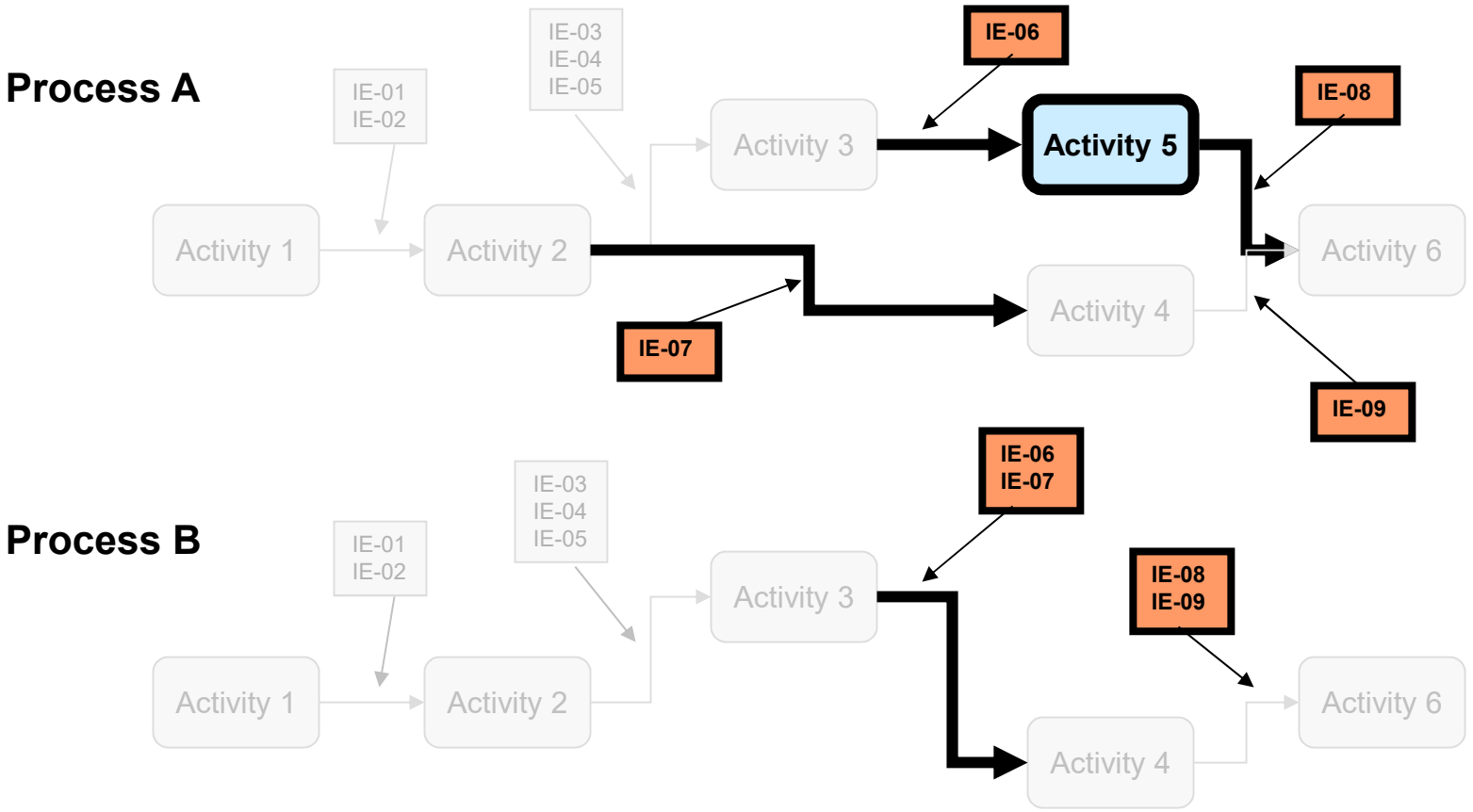
Comparing Processes

What about the information exchanged?

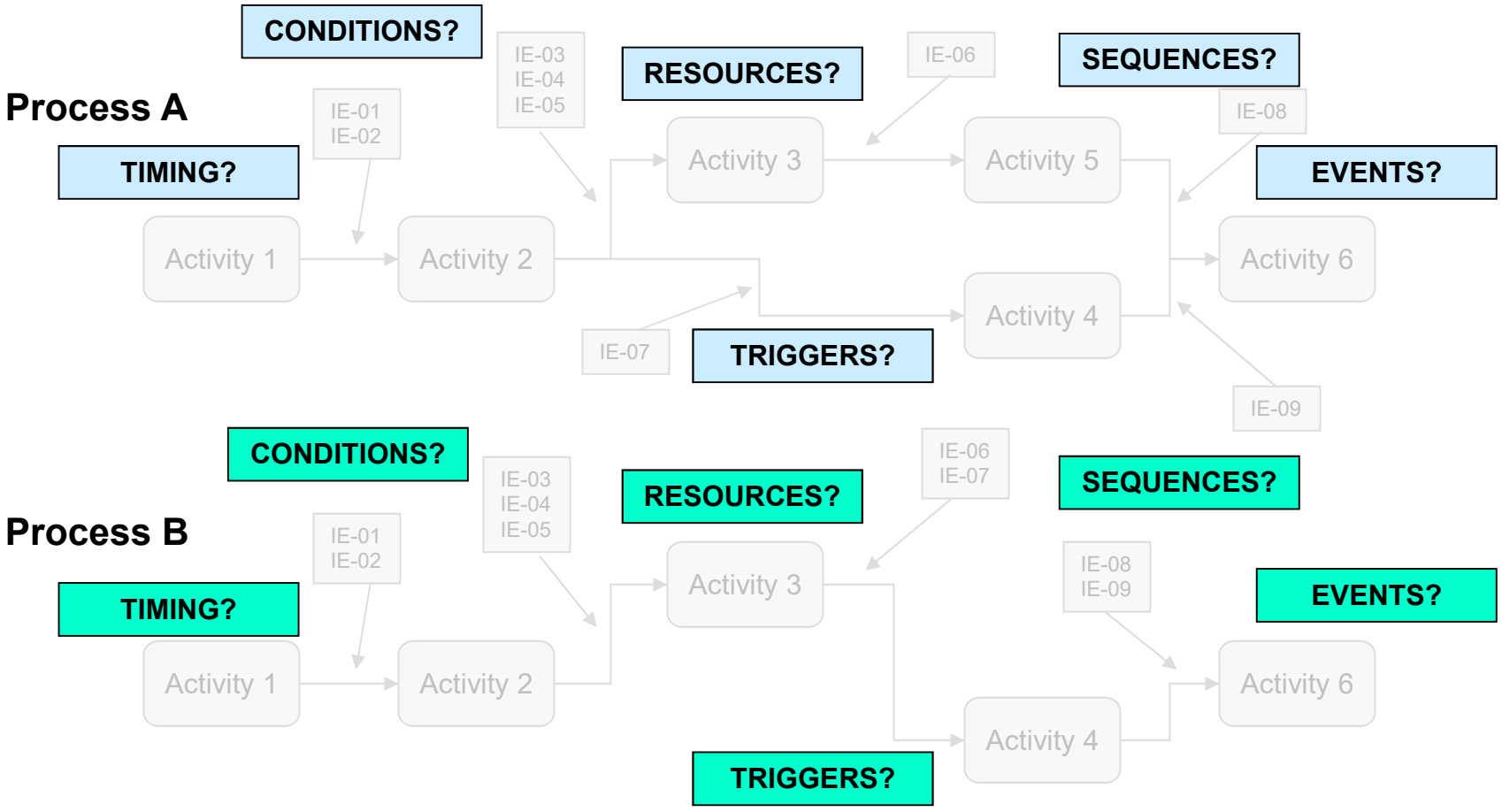


Comparing Processes

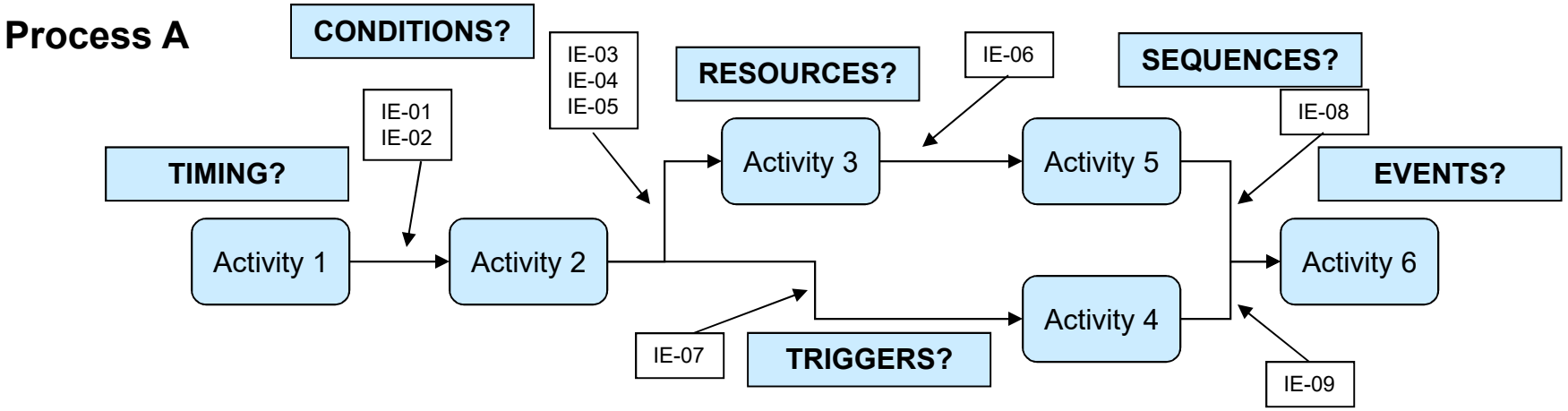
Again, differences exist between the processes and must be identified…

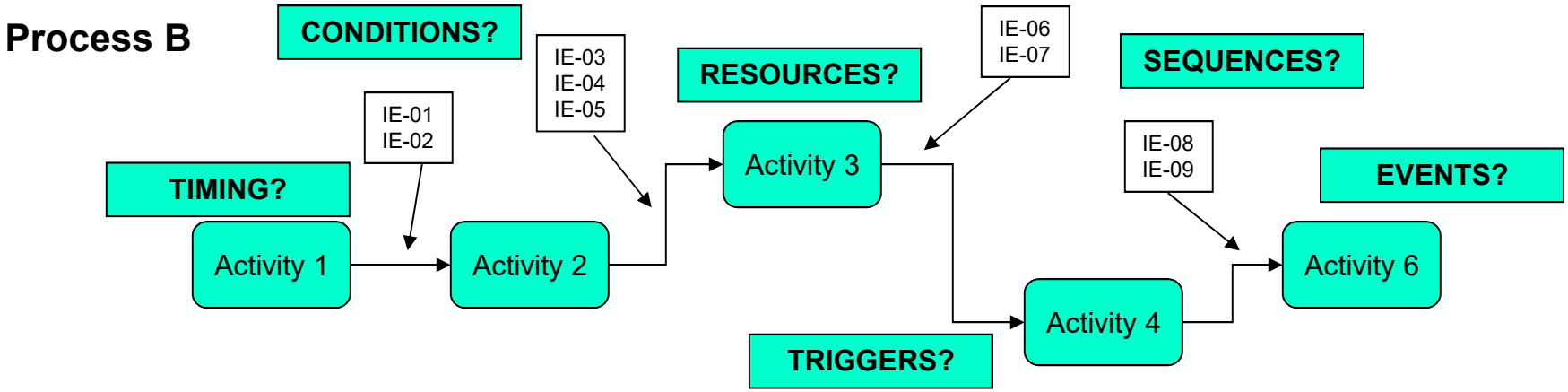


What about other considerations?

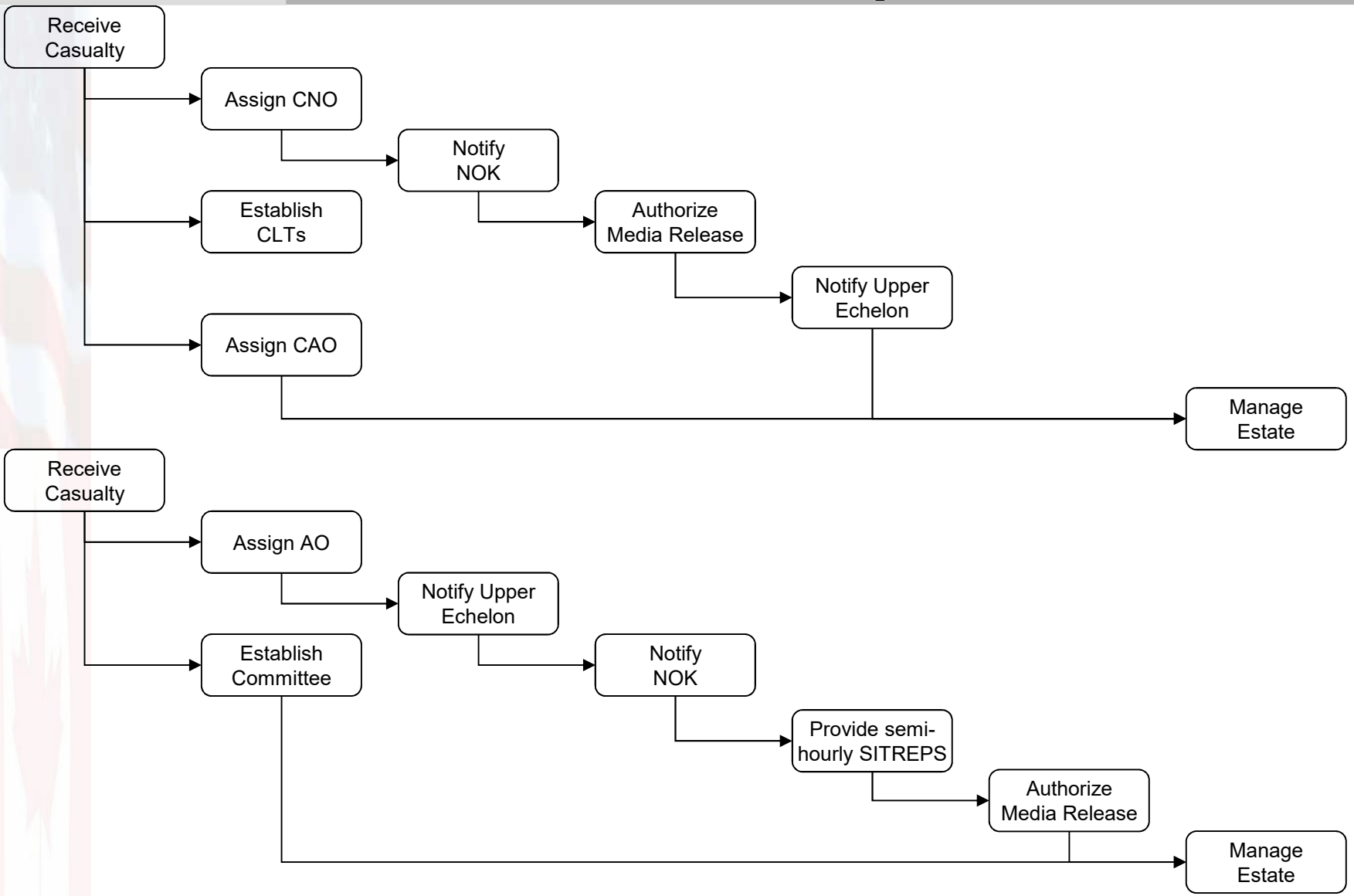


OK, so we found differences, how do we present them?

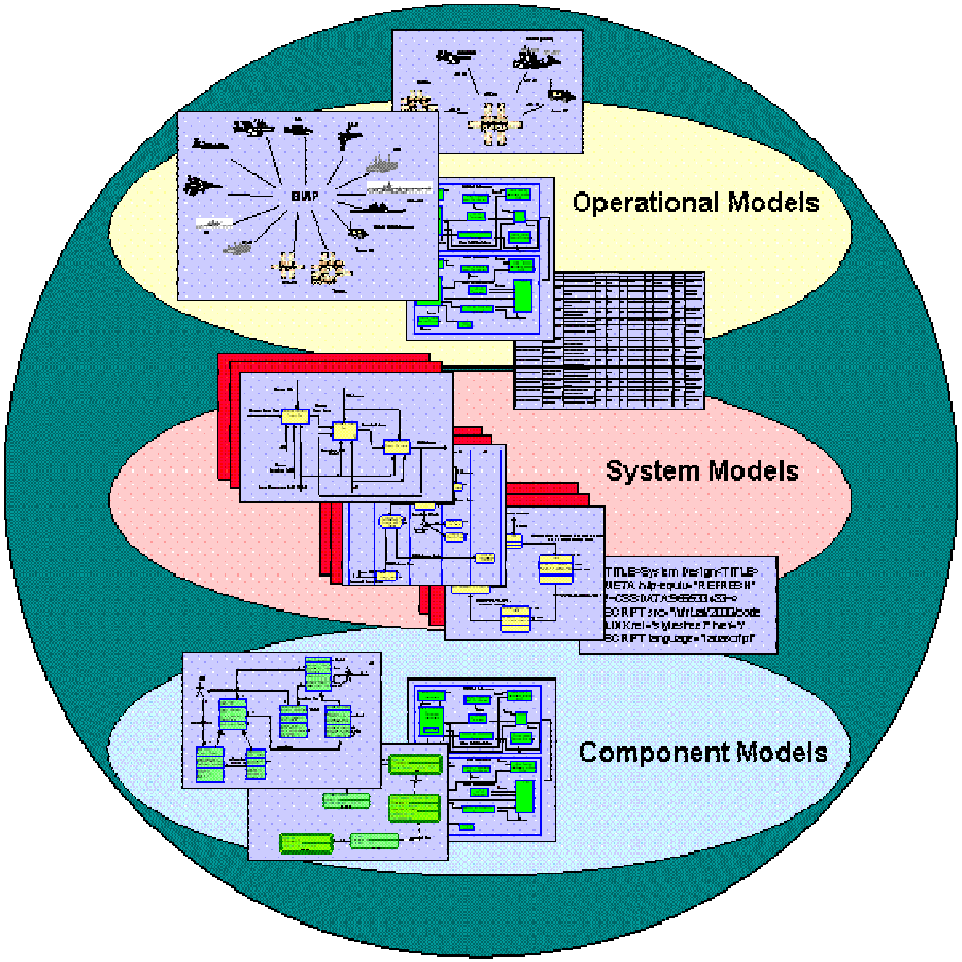




Current Status
Initial Process Representation and Comparison



Goal: Interoperability at Multiple Levels of the Architecture



Requirements and Assumptions

- **Australia, Canada, UK and USA have a history of military coalition**
- **Each nation is pursuing its own version of net-centric warfare**
- **How do we ensure coalition interoperability ?**
- **Need to understand:**
  - Each others' capability and functionality
  - How to interface with coalition systems
- **To do this we need to be able to share architectures**

- **Each nation has its own architecture framework**
  - Requirement to share architectural information between nations to enable interoperability at the operational and system levels
  - Need a standard data format for architectural interoperability
  - Nations using different tools and data formats
- **Semantic integration issues inhibit interoperability**
- **Coalition military operational planners will benefit from IDEAS**

Mission, Goals, and Priorities

- **To facilitate pre-mission planning through exposure of national processes and capabilities expressed through a common ontology.**
- **To establish an ontology for expressing the procedures and capabilities of each nation and put in place a mechanism to interchange architecture information that describe those procedures and capabilities.**
- **To improve force planning capability through:**
  - Reduced timescale for mission planning
  - Enhanced data:
  - Interoperability
  - Reusability
  - Understandability
  - Visibility
  - Shareability

Products

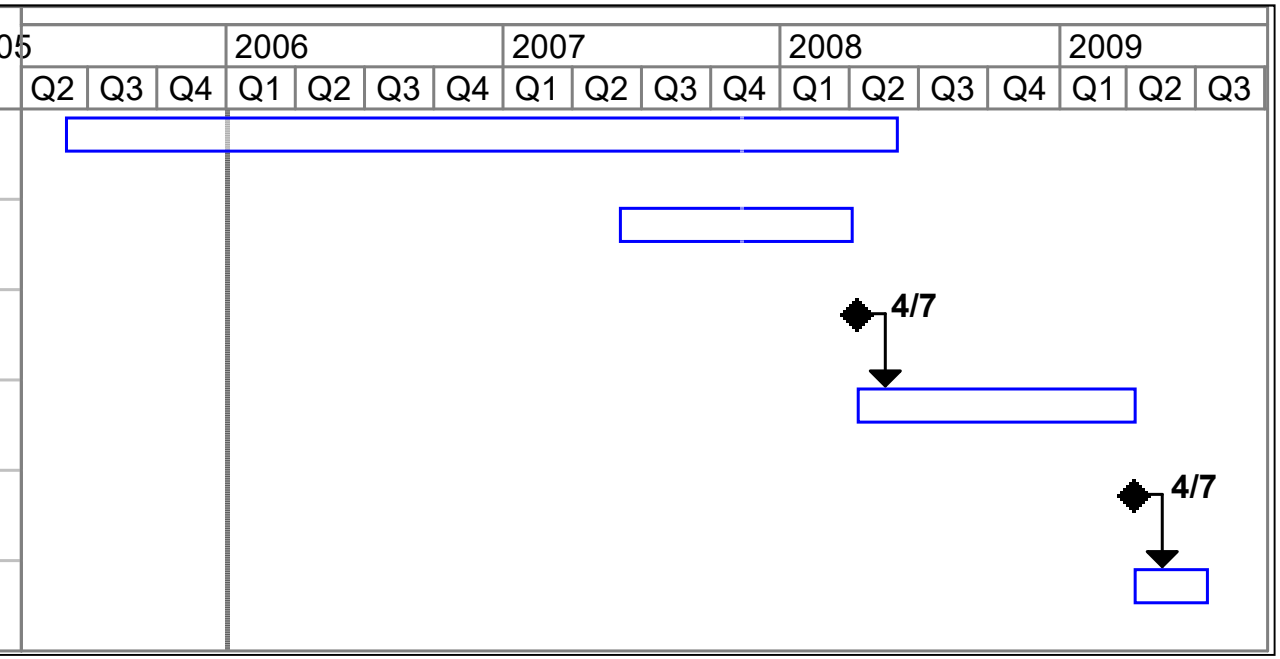
- **IDEAS model; includes all layers of the model and the RDFS / OWL Specifications**
- **IDEAS model documentation; includes business rules**
- **IDEAS experimentation procedures**
- **IDEAS experimentation reports**
- **IDEAS marketing material**
- **IDEAS training material**
- **IDEAS exercise plan, procedures and reports**
- **IDEAS productionisation / industrialisation**
- **Software; various**

Experiment & Exercise Overview

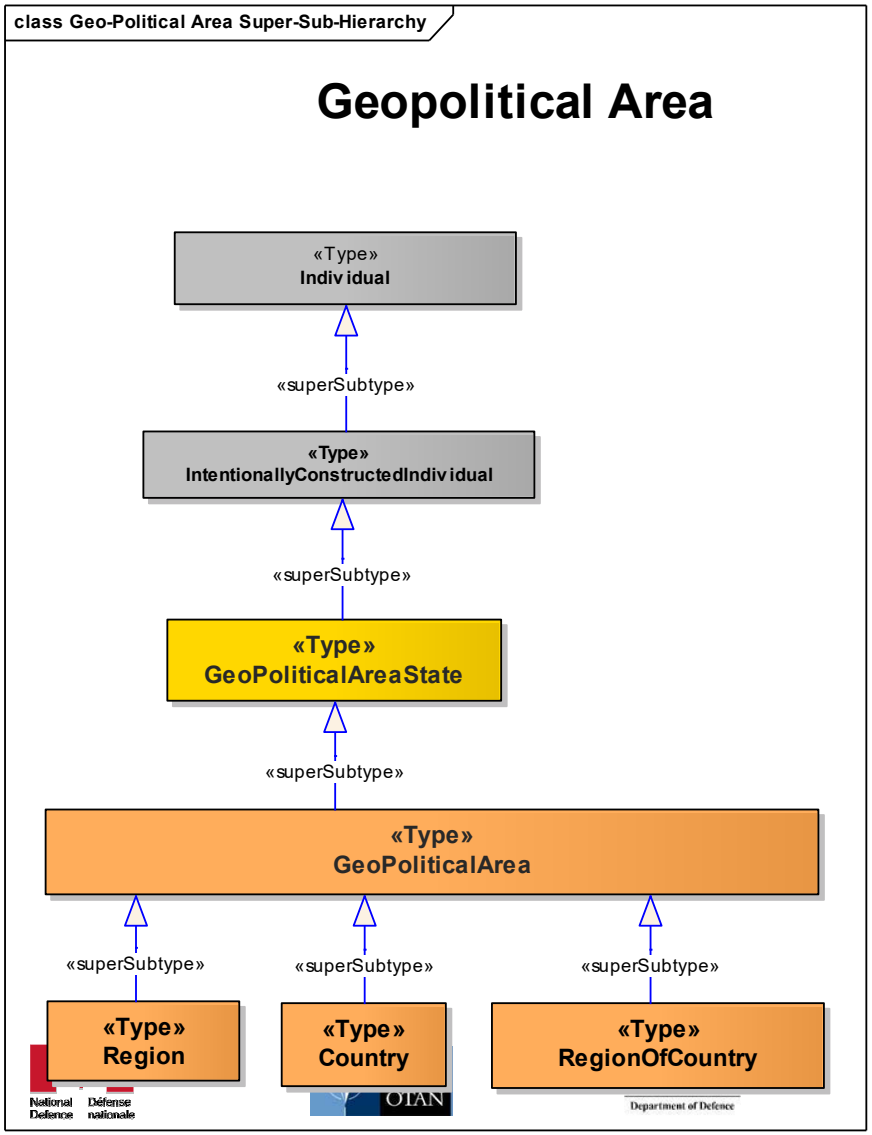
- **Experiment 08**
  - Selected a scenario: Casualty Management
  - Selected a set of architecture data to exchange
- **Exercise (future)**
  - Candidates
    - Avoidance of friendly fire incidents due to procedural mismatches
    - Others TBD?

Experiment & Exercise Overview

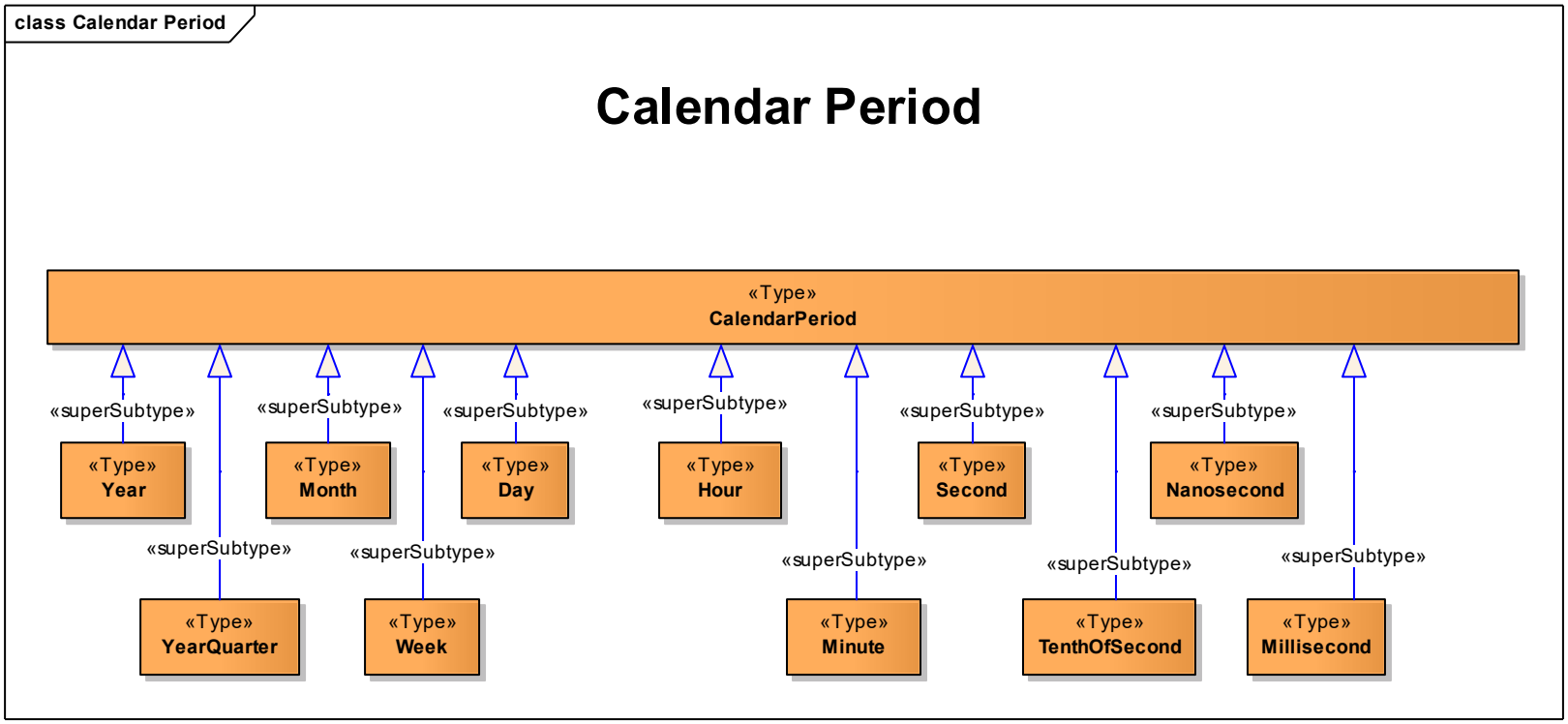
Task Name	2005			2006				2007				2008				2009		
	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
IDEAS Model Development																		
Experiment '08																		
Demonstration planned: April 2008																		
Exercise '09																		
Exercise planned: April 2009																		
IOC successful completion planned: July 2009																		



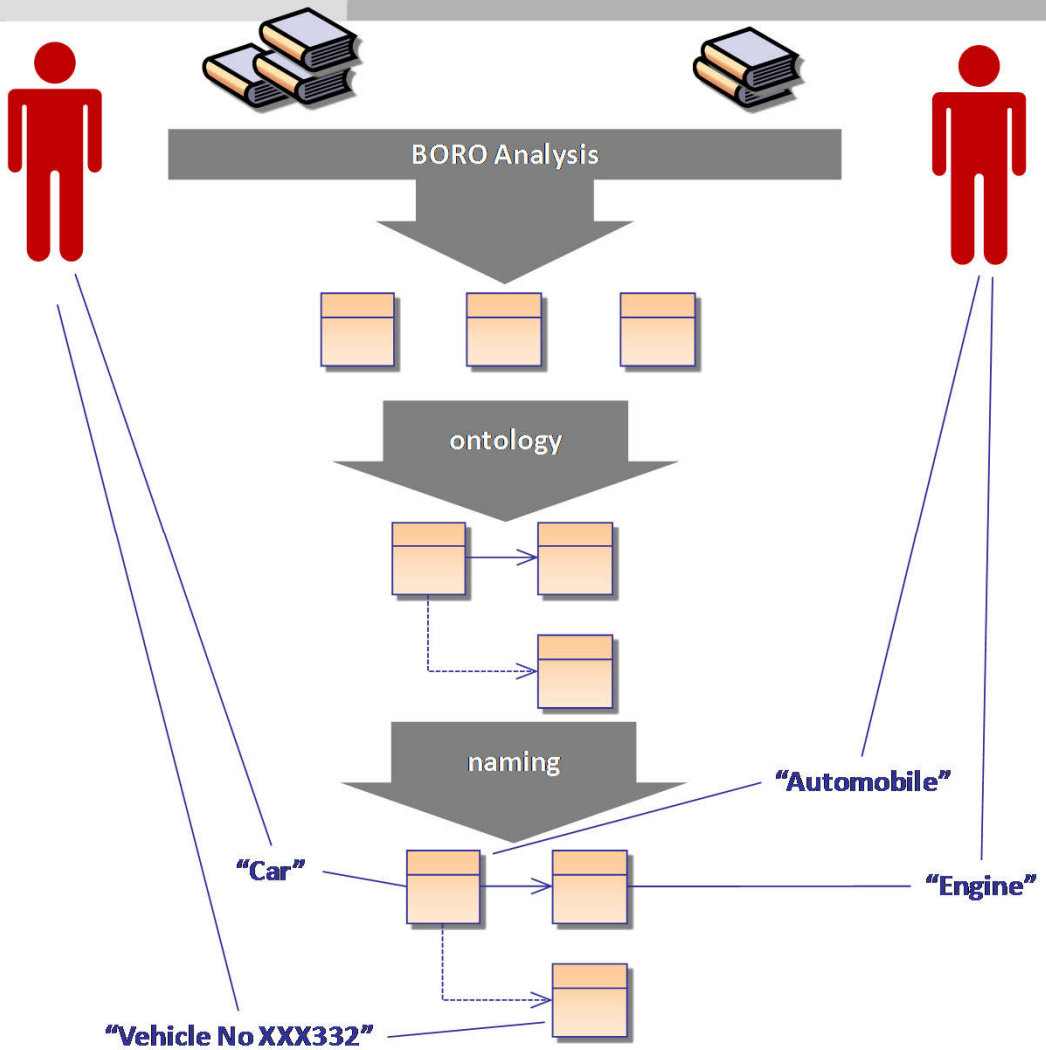
Common Patterns: Geopolitical Area



Common Patterns: Calendar Period



Data Analysis Steps



- The BORO Analysis breaks down the data into its fundamental elements
- These are then re-assembled under the appropriate ontological pattern
- Finally, the names used by the original systems / parties are re-assigned to achieve seamless interoperability