



# MOD Ontology

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# Introduction

- MOD Ontology Team
  - Michael Warner, Bose Lawanson, MOD
  - Ian Bailey, Model Futures
  - Chris Partridge, 42 Objects
  - Fariba Hozhabrafkan, Serco
- Background on MOD Ontology
  - Why we started it
  - What it's founded on
  - IDEAS
- The BORO Method
- The MOD Ontology Demonstrator
  - Semantic integration, naming, de-confliction

# The MOD Ontology

- Originated as a key enabler to MOD's Enterprise Architecture Programme
- Intended to provide a common, reusable enterprise structure across MOD
- Based on the IDEAS Model
- Not intended for inference and reasoning purposes
- Goals are:
  - de-confliction of terminology & data
  - accurate model of enterprise – processes, people, systems, etc.

# About the MOD Ontology

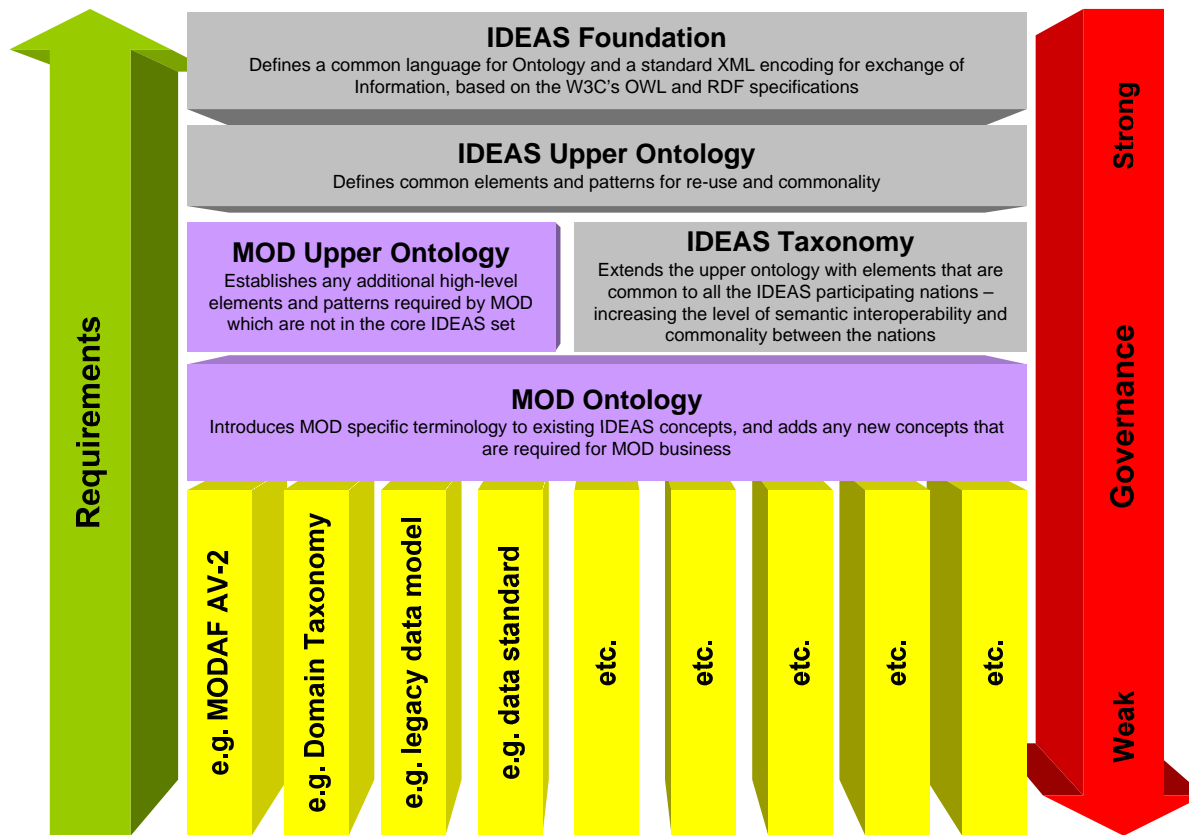
- For the ontologists amongst you, it is;
  - Extensional
  - Fully Four-Dimensional (Sider, Hawley)
  - Higher-Order
- For the non-ontologists;
  - It's very precise about identification
  - It handles time in a consistent manner
  - It embraces and reflects the complexity of the real world
- Developed using the BORO method
  - Precise methodology for developing extensional ontologies
  - Also the basis of the IDEAS model
  - Great for getting to the “true meaning” of legacy data and de-conflicting overlapping data sources

# IDEAS

- The IDEAS Model is a data integration model
  - Co-developed by the Australian, Canadian, UK & US defence departments
  - Sweden & NATO also involved as observers
  - MOD has taken the lead on the modelling, by suggesting the use of the BORO methodology to de-conflict different data types from each country
  - IDEAS is a formal ontology - it is flexible, extensible and based on sound mathematical principles
- MOD Ontology uses IDEAS Foundation
  - Extends the IDEAS concepts with MOD-specific elements
  - ...whilst still retaining international compatibility at the upper levels
- <http://www.ideasgroup.org>



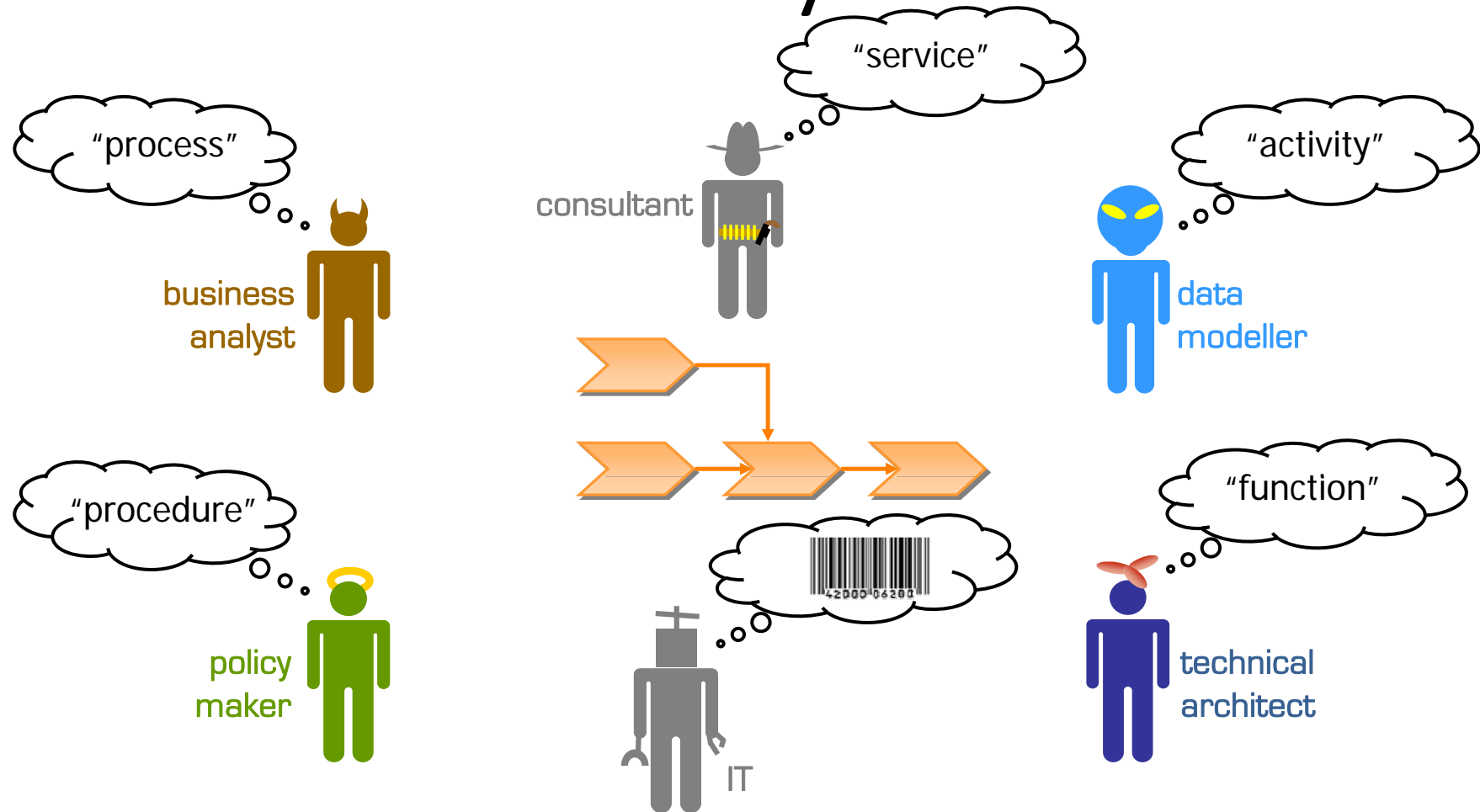
# IDEAS Structure



- 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”

# Traditional Analysis Methods



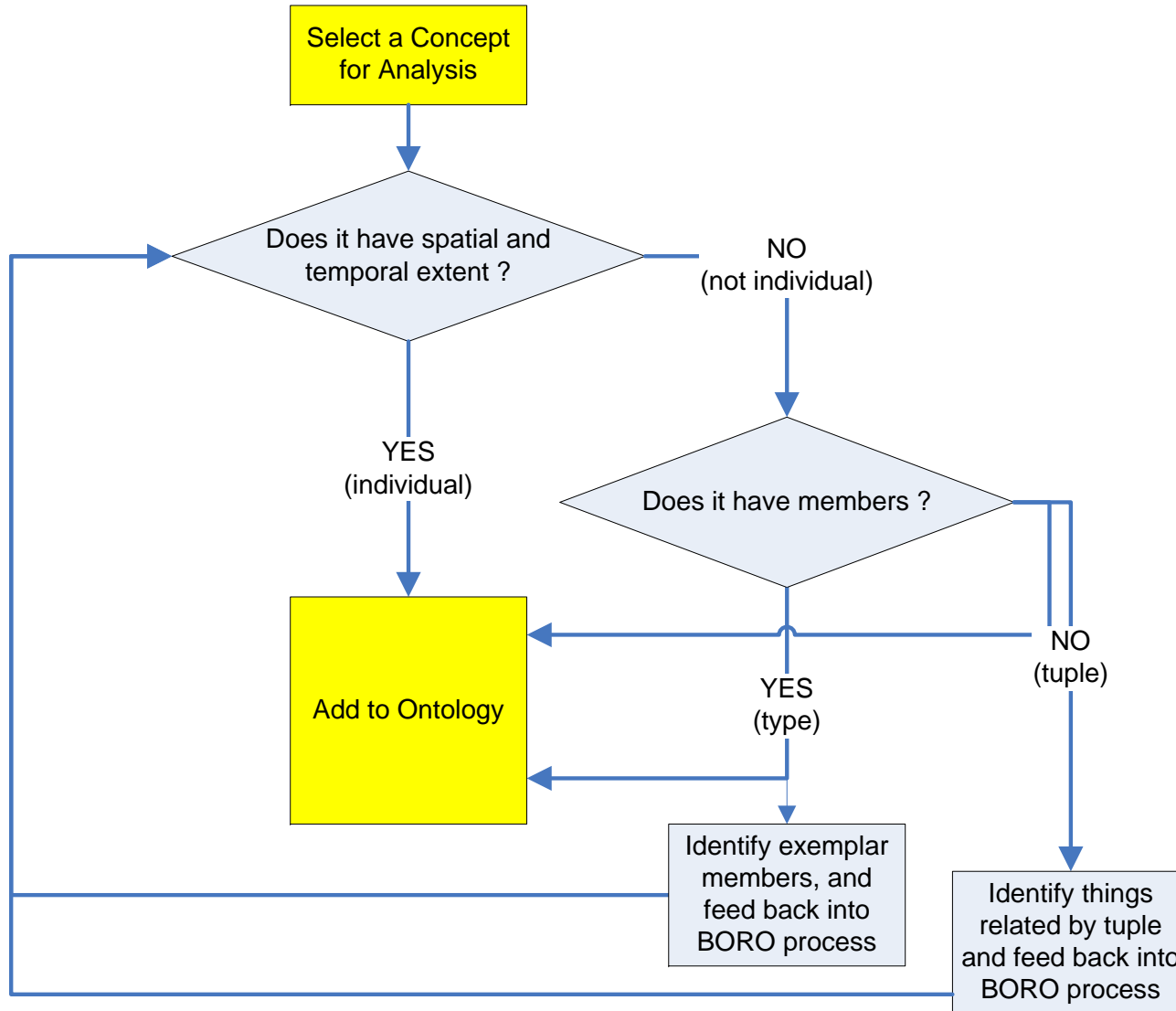
Traditional analysis techniques rely on figuring out what each person or system calls something – in this example, a process – and it never, ever works. But yet we do it over and over again in grand IT projects that always fail. Maybe it's time to think again ?

# The BORO Method

- Very simple method
  - ...hence it's easy to get people to sign up to it
  - Uses physical extent as the criterion for identity
- Names mean nothing
  - No, really
  - Confusion over naming is a big problem
    - In IT systems
    - In conversation
    - In taxonomies
- Basis of BORO is “Can I kick it ?”
  - Identification of individuals by physical extent
  - Identification of classes by their members
  - Identification of relationships by their ends



# BORO Flowchart

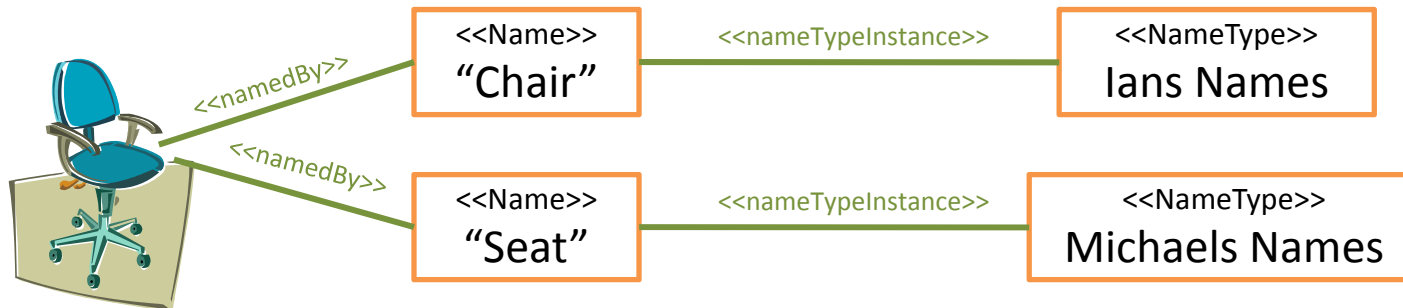


# The Naming Pattern

- Although names are unimportant in BORO, they are quite important to users
  - Different people use different names for the same things
  - Different applications also use different names
  - Foolish to try and impose one naming policy on multiple stakeholders and applications
    - It's costly, it never works in large organisations, and it annoys people who are trying to get on with their jobs
    - Also, different communities use different terminology for good reasons
  - So...we have a naming pattern
    - Once the identity of a thing has been established using BORO (i.e. its extent), we can name it as many times as we like, with context.

# The Naming Pattern

- Things have names, and these are related by the namedBy relationship
- Names are typed – i.e. they belong to a set of names



# The MOD Ontology Demonstrator

- Centred around the naming pattern
- Derived from a pre-existing taxonomy of geopolitical areas
  - Regions, countries, bodies of water
  - Whole-Part structure
  - Multiple names added, with context
  - Border information also added
- Intended to show power of ontologies for integration
  - Data from multiple sources
  - ISO 3166, STANAG1059, FIPS10, CIA World Factbook, etc.

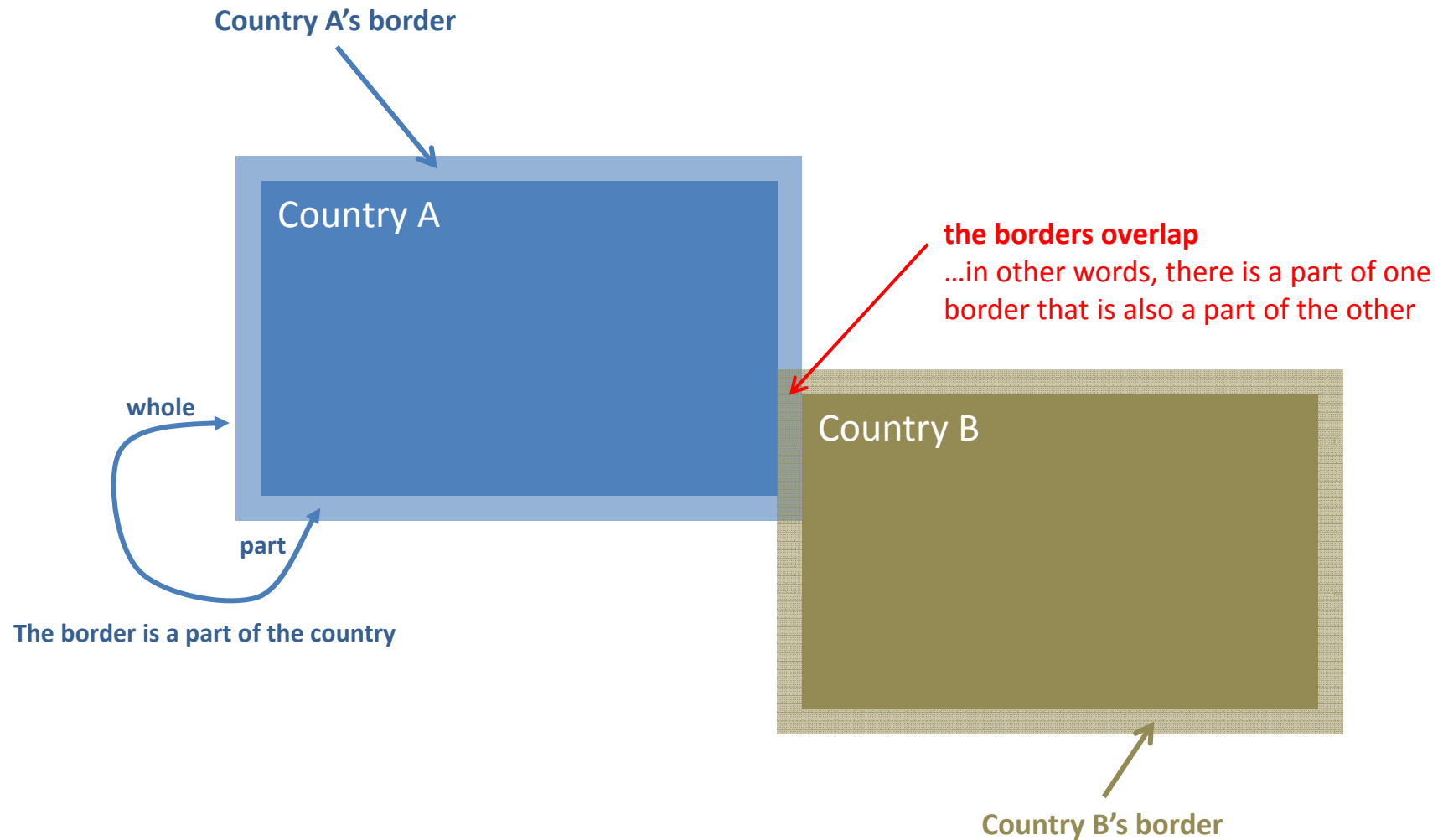
# BORO in Use - Borders

- Borders data came from CIA World Fact Book :

| Country       | b                | Borders  |
|---------------|------------------|--|
| Afghanistan   | total: 5,529 km  | border countries: China 76 km, Iran 936 km, Pakistan 2,430 km, Tajikistan 1,206 km, Turkmenistan 744 km, Uzbekistan 137 km   |
| Akrotiri      | total: 47.4 km   | border countries: Cyprus 47.4 km   |
| Albania       | total: 720 km    | border countries: Greece 282 km, Macedonia 151 km, Montenegro 172 km, Serbia 115 km  |
| Algeria       | total: 6,343 km  | border countries: Libya 982 km, Mali 1,376 km, Mauritania 463 km, Morocco 1,559 km, Niger 956 km, Tunisia 965 km, Western Sahara 42 km   |
| Andorra       | total: 120.3 km  | border countries: France 56.6 km, Spain 63.7 km  |
| Angola        | total: 5,198 km  | border countries: Democratic Republic of the Congo 2,511 km (of which 225 km is the boundary of discontinuous Cabinda Province), Republic of the Congo 201 km, Namibia 1,376 km, Zambia 1,110 km               |
| Argentina     | total: 9,861 km  | border countries: Bolivia 832 km, Brazil 1,261 km, Chile 5,308 km, Paraguay 1,880 km, Uruguay 580 km   |
| Armenia       | total: 1,254 km  | border countries: Azerbaijan-proper 566 km, Azerbaijan-Naxcivan exclave 221 km, Georgia 164 km, Iran 35 km, Turkey 268 km  |
| Austria       | total: 2,562 km  | border countries: Czech Republic 362 km, Germany 784 km, Hungary 366 km, Italy 430 km, Liechtenstein 35 km, Slovakia 91 km, Slovenia 330 km, Switzerland 164 km  |
| Azerbaijan    | total: 2,013 km  | border countries: Armenia (with Azerbaijan-proper) 566 km, Armenia (with Azerbaijan-Naxcivan exclave) 221 km, Georgia 322 km, Iran (with Azerbaijan-proper) 432 km, Iran (with Azerbaijan-Naxcivan exclave) 17 |
| Bangladesh    | total: 4,246 km  | border countries: Burma 193 km, India 4,053 km   |
| Belarus       | total: 2,900 km  | border countries: Latvia 141 km, Lithuania 502 km, Poland 407 km, Russia 959 km, Ukraine 891 km  |
| Belgium       | total: 1,385 km  | border countries: France 620 km, Germany 167 km, Luxembourg 148 km, Netherlands 450 km   |
| Belize        | total: 516 km    | border countries: Guatemala 266 km, Mexico 250 km  |
| Benin         | total: 1,989 km  | border countries: Burkina Faso 306 km, Niger 266 km, Nigeria 773 km, Togo 644 km   |
| Bhutan        | total: 1,075 km  | border countries: China 470 km, India 605 km   |
| Bolivia       | total: 6,940 km  | border countries: Argentina 832 km, Brazil 3,423 km, Chile 860 km, Paraguay 750 km, Peru 1,075 km  |
| Bosnia and He | total: 1,459 km  | border countries: Croatia 932 km, Montenegro 225 km, Serbia 302 km   |
| Botswana      | total: 4,013 km  | border countries: Namibia 1,360 km, South Africa 1,840 km, Zimbabwe 813 km   |
| Brazil        | total: 16,885 km | border countries: Argentina 1,261 km, Bolivia 3,423 km, Colombia 1,644 km, French Guiana 730.4 km, Guyana 1,606 km, Paraguay 1,365 km, Peru 2,995 km, Suriname 593 km, Uruguay 1,068 km, Venezuela 2,200 km    |
| Brunei        | total: 381 km    | border countries: Malaysia 381 km  |
| Bulgaria      | total: 1,808 km  | border countries: Greece 494 km, Macedonia 148 km, Romania 608 km, Serbia 318 km, Turkey 240 km  |
| Burkina Faso  | total: 3,193 km  | border countries: Benin 306 km, Cote d'Ivoire 584 km, Ghana 549 km, Mali 1,000 km, Niger 628 km, Togo 126 km   |
| Burma         | total: 5,876 km  | border countries: Bangladesh 193 km, China 2,185 km, India 1,463 km, Laos 235 km, Thailand 1,800 km  |
| Burundi       | total: 974 km    | border countries: Democratic Republic of the Congo 233 km, Rwanda 290 km, Tanzania 451 km  |
| Cambodia      | total: 2,572 km  | border countries: Laos 541 km, Thailand 803 km, Vietnam 1,228 km   |
| Cameroon      | total: 4,591 km  | border countries: Central African Republic 797 km, Chad 1,094 km, Republic of the Congo 523 km, Equatorial Guinea 189 km, Gabon 298 km, Nigeria 1,690 km   |

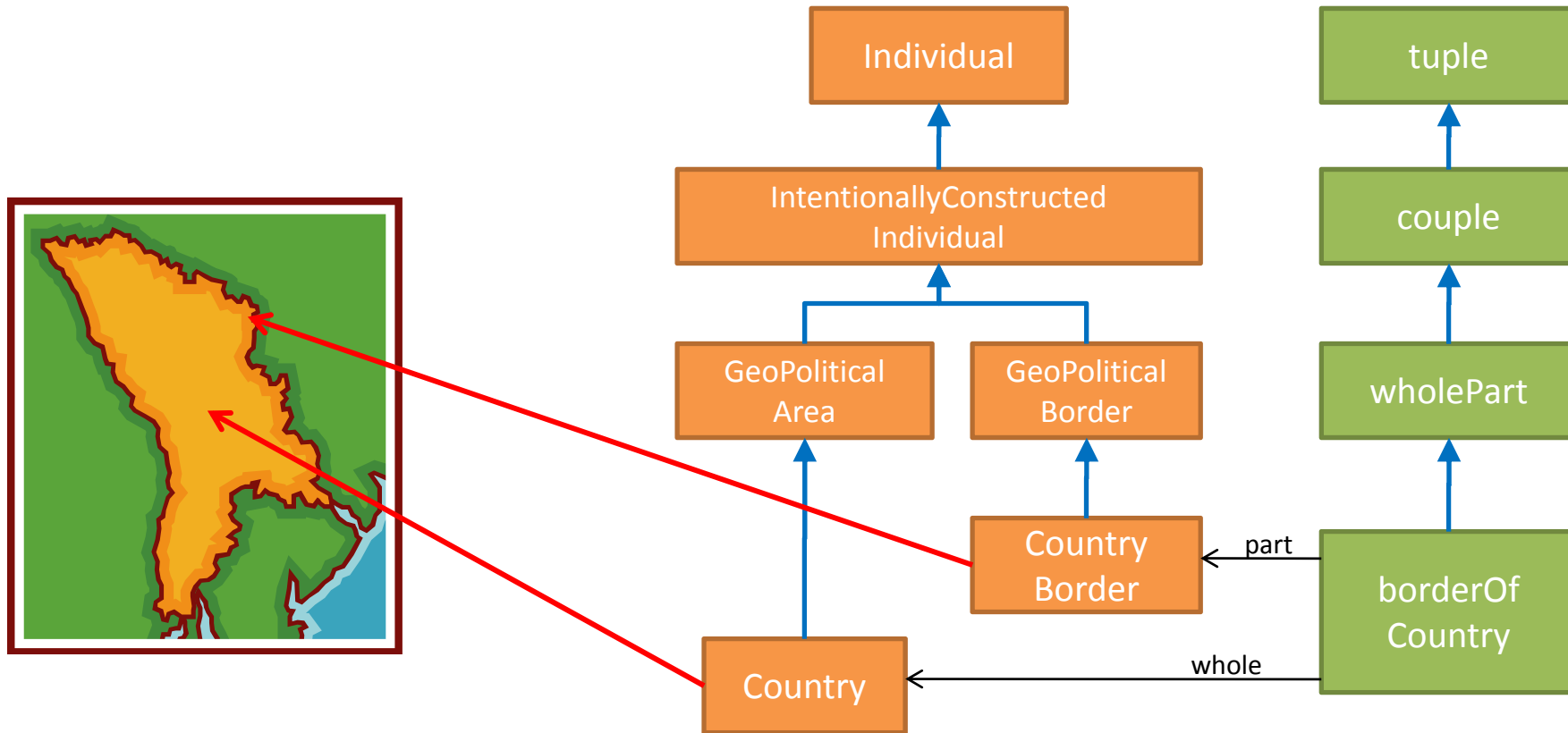
- BORO only deals with the facts presented. In this case:
  1. There are countries
  2. They each have a border
  3. Some parts of their borders coincide

# Analysing Borders



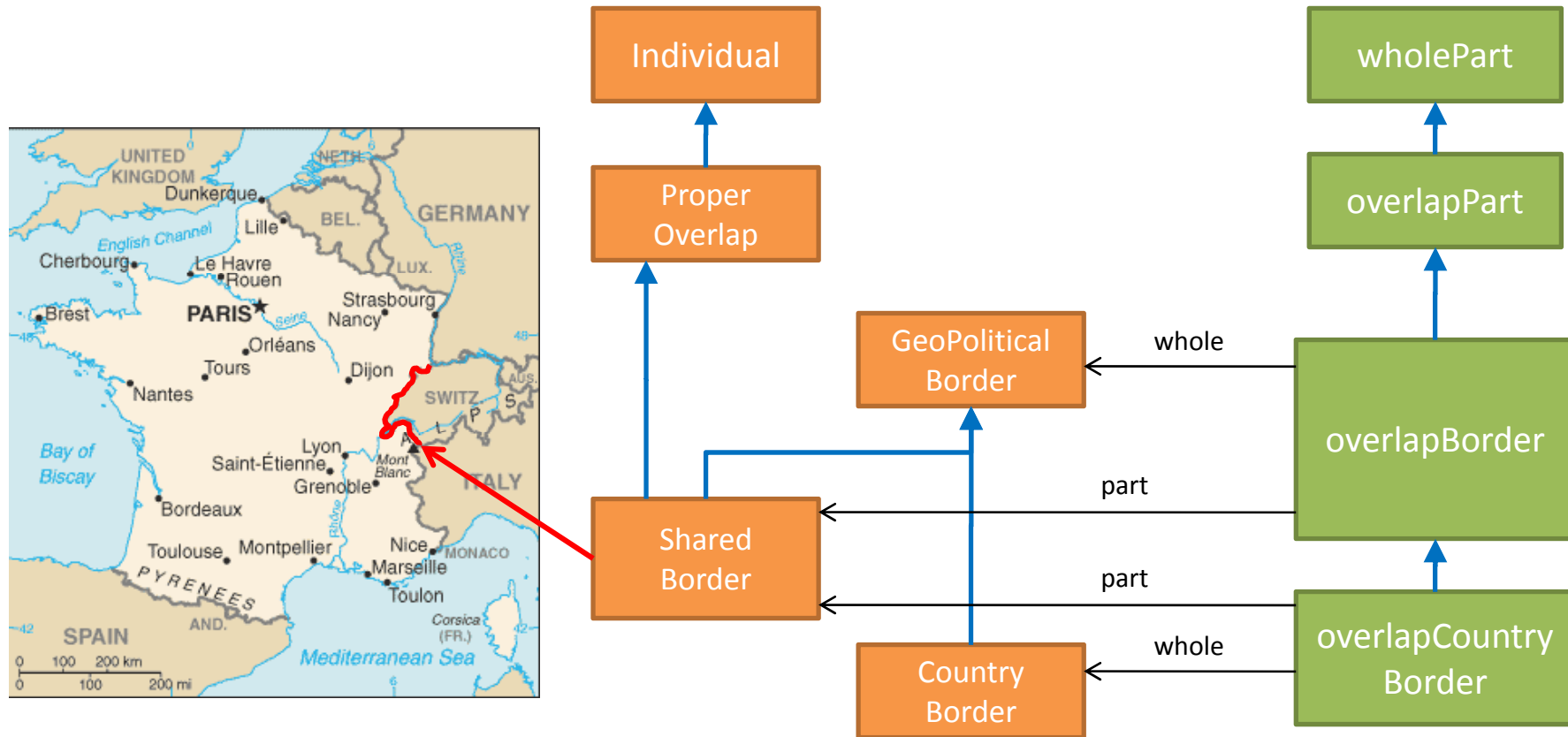
...and that's all the information we have. We could add the complications of neutral territory (e.g. no-mans land), but we don't know that from the data source. BORO is precise and forensic – we are not allowed to invent anything new (rational reconstruction)

# Country has Border



- A *CountryBorder* is the entire border surrounding a given *Country*
- The *CountryBorder* is a proper part of the *Country*, hence we use a specialisation of *wholePart* to relate them - *borderOfCountry*

# One Country Borders Another



- Classic overlap pattern. Each country has a border, those borders overlap.
- The overlapping bit of border is a part of each border
- France has *CountryBorder*, Switzerland has a *CountryBorder*. They overlap, and the overlapping part is the *SharedBorder*



# Applications for Ontology in MOD

- Semantic Integration
  - Current point-to-point solutions expensive to maintain
  - Need accuracy of data conversion
- Intelligence Analysis
  - Ability of a 4D ontology to handle change over time lends it well to evidential analysis
  - BORO method is simple enough to allow subject matter experts to make first-cut at “ontologising” their information
- More Geographic Work
  - Location rationalisation (lat-long, geode, GPS)
- Theatre Airspace (ATOs, ACOs)
  - Pilot project underway

# Applications for Ontology in MOD 2

- Contract Management
  - Combination of 4D Ontology and naming pattern allows for a temporal contact management system
  - Remembers where people use to work, their previous ranks, phone numbers, addresses, etc.
- Enterprise Architecture
  - The discipline of EA covers a broad range of topics and information.
  - EA models are very “webby”
  - Ontology provides an ideal underpinning for EA
  - IDEAS Model used to exchange DoD (DoDAF) architecture data with MOD (MODAF).

# Closing

- BORO is proving useful across MOD
  - Decision makers like defensible information.
  - BORO is defensible – you can prove where semantic overlaps and disconnects exist between systems
  - Theatre Airspace
- IDEAS is a good foundation
  - Foundation works well and is easy to implement in RDBMS technology
  - Patterns tested and shown to work (whole-part, overlap, naming)
  - We could have chosen OWL & RDF, but weaknesses in these are well known
  - Could have chosen ISO15926, but doesn't have a formal foundation