Usage of Semantic Modelling for the Improvement of a Shared Situation Awareness

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The most widely cited definition of situation awareness is the generic model proposed by (Endsley, 1995):

"Situation Awareness is the perception of elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future"

Shared situation awareness defined by Endsley (Endsley and Robertson, 1996):

"the degree to which each team member has the same SA or understanding of a situation"

Shared situation awareness supporting tools – objectives

- To achieve common goal
- To achieve separate, agents' goals

What do we share?

- Context
- Space
- Responsabilities
- Trust
- Time

Problems - challenges

- Information gaps
- Lack of fluent communication
- No common operational picture in use
- Need for semantic interoperability
- Semantic gap
- Pragmatic gap

Problems concerning the interpretation of data from homogenous to dispersed non-homogeneous groups (Harrald and Jefferson, 2007)

- Disparate semantic meaning of the data collected
- Inadequate ability to ensure or even know data quality (particularly the timeliness and completeness components)
- Even when given the same data, nonhomogeneous decision nodes will perceive the information differently
- Even when given the same data, and similar perceptions, different nodes will imply different meaning and requirements for future action

From John Harrald, Theresa Jefferson, „Shared Situational Awareness in Emergency Management Mitigation and Response" Proceedings of the 40th Hawaii International Conference on System Sciences - 2007

Semantics

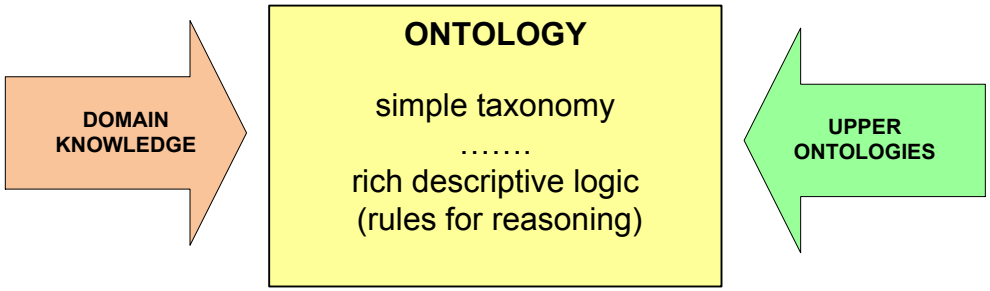
- Meaning of data, information
- Use of data, information
- Relations between data, information
- Similarities between objects, data, information
- Understanding the context
- Building a structure

Semantic models

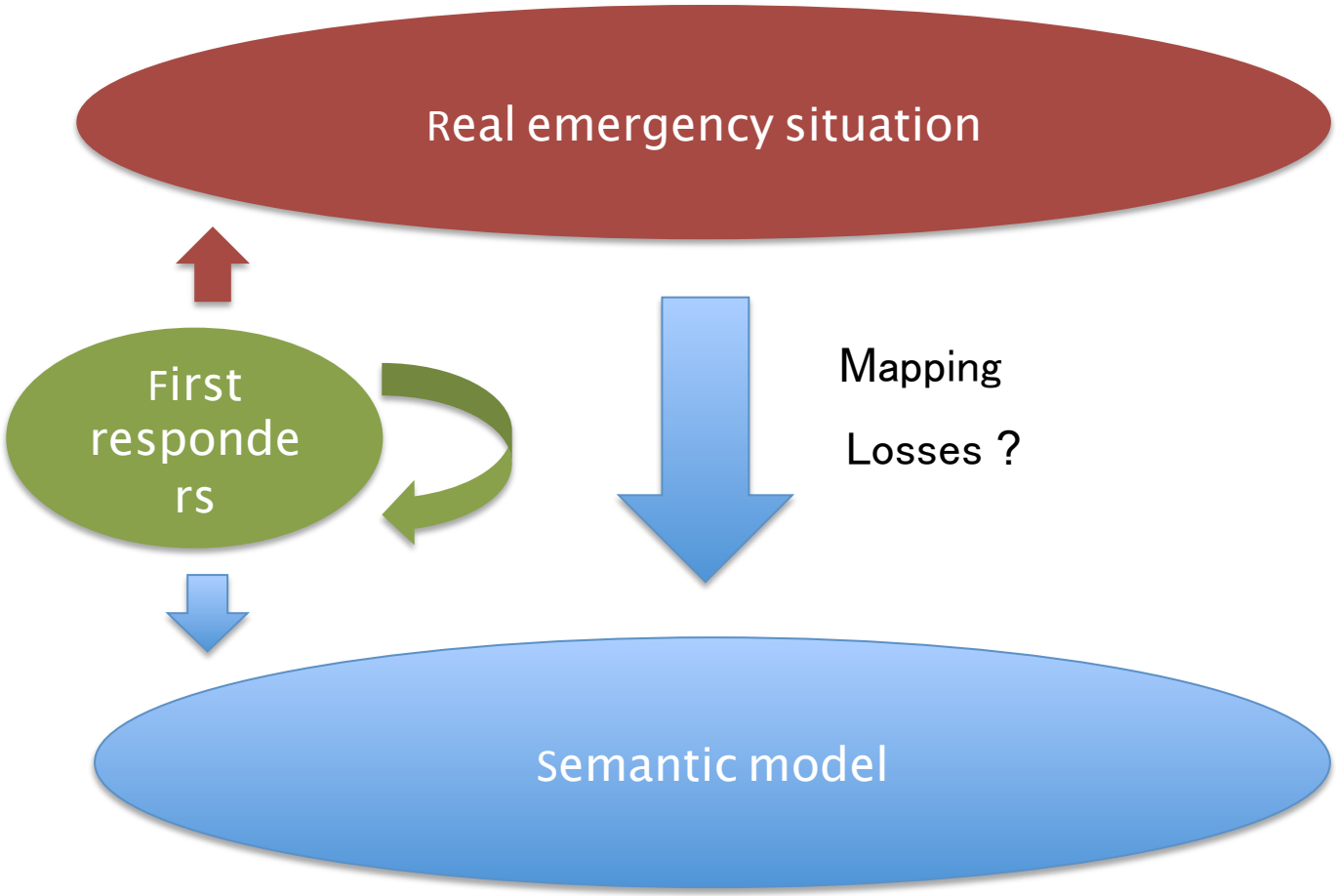
- Taxonomy
- Semantic networks
- Ontology
- Artificial intelligence – models
- Semantic web
- Mind maps

Semantic modelling approaches

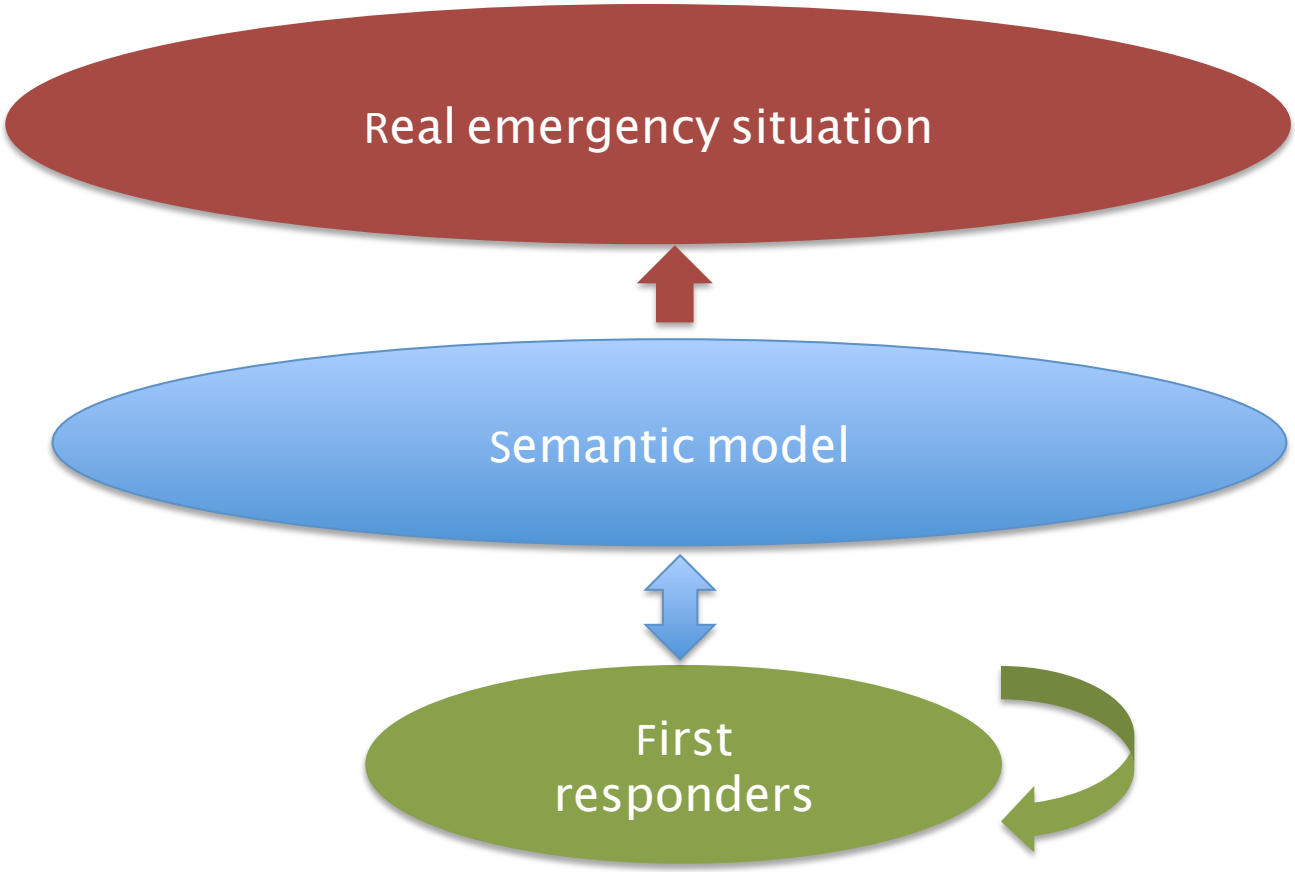
- Recognition of basic system objects
- Definition of domains
- Recognition of relationship between objects



Semantic models' roles (1)



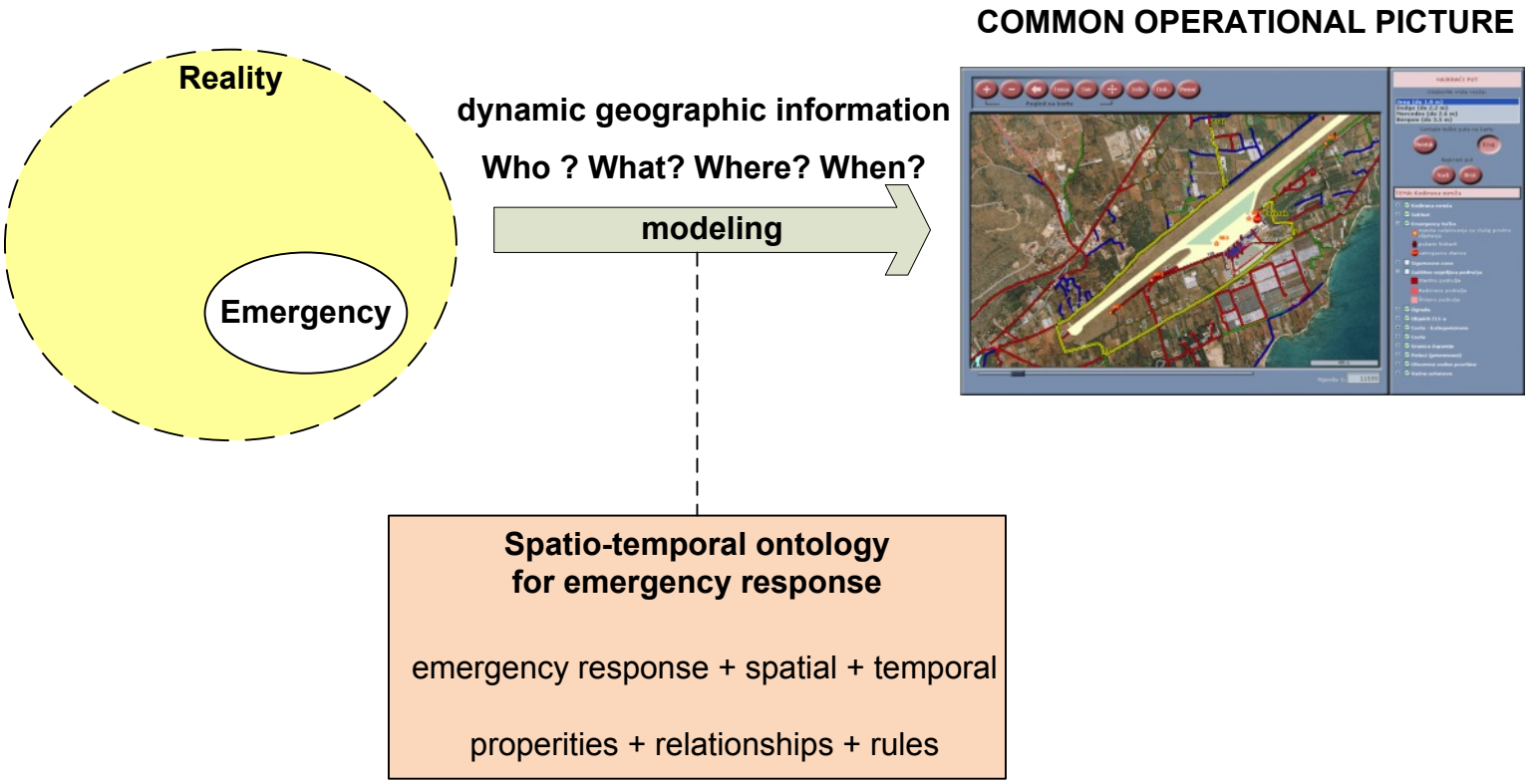
Semantic models' roles (2)



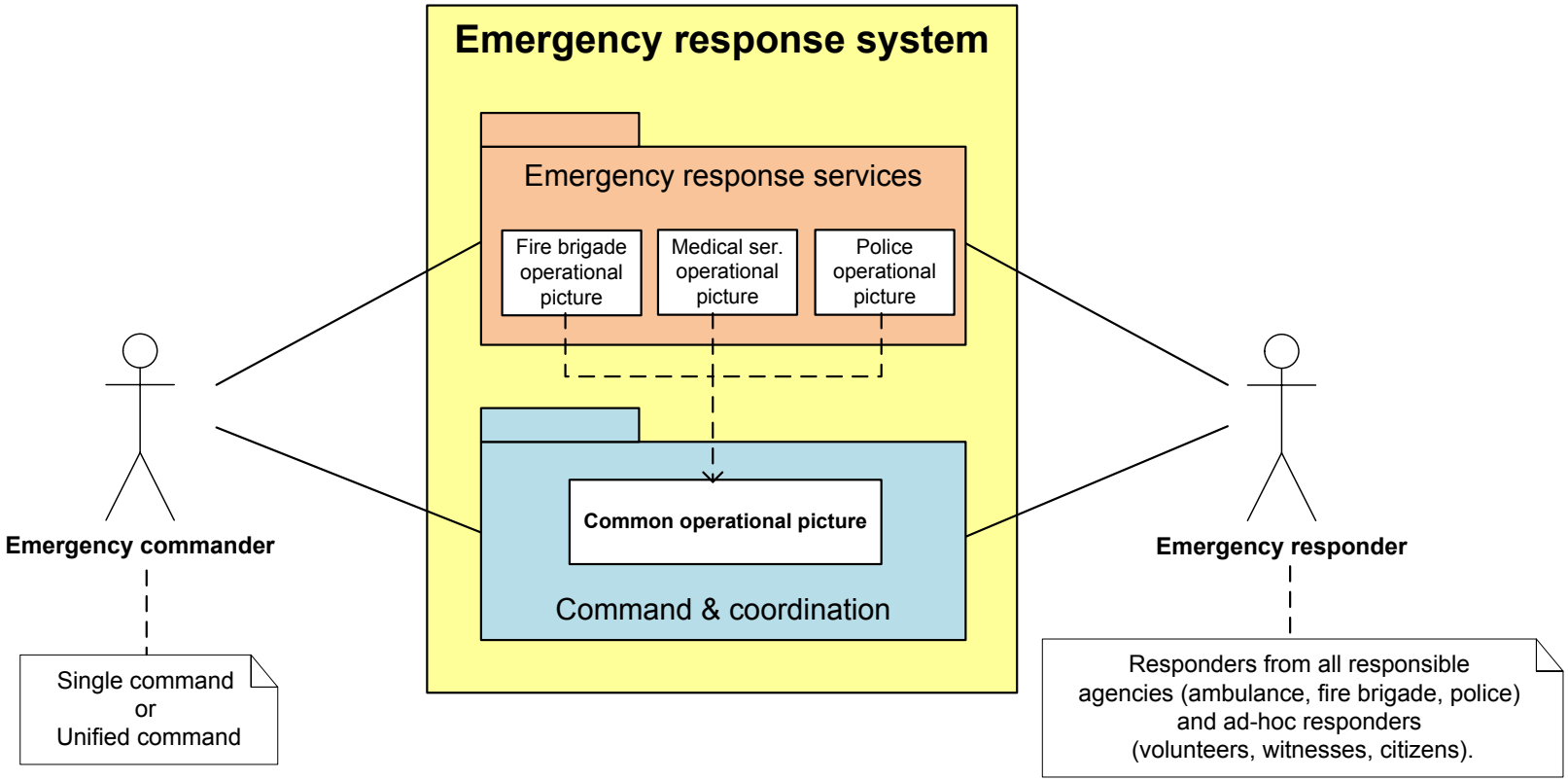
Semantic modelling – expectations

- To eliminate terminological inconsistency
- To eliminate reasoning inconsistency
- To enhance mutual comprehesion of the situation
- To clarify common operating picture

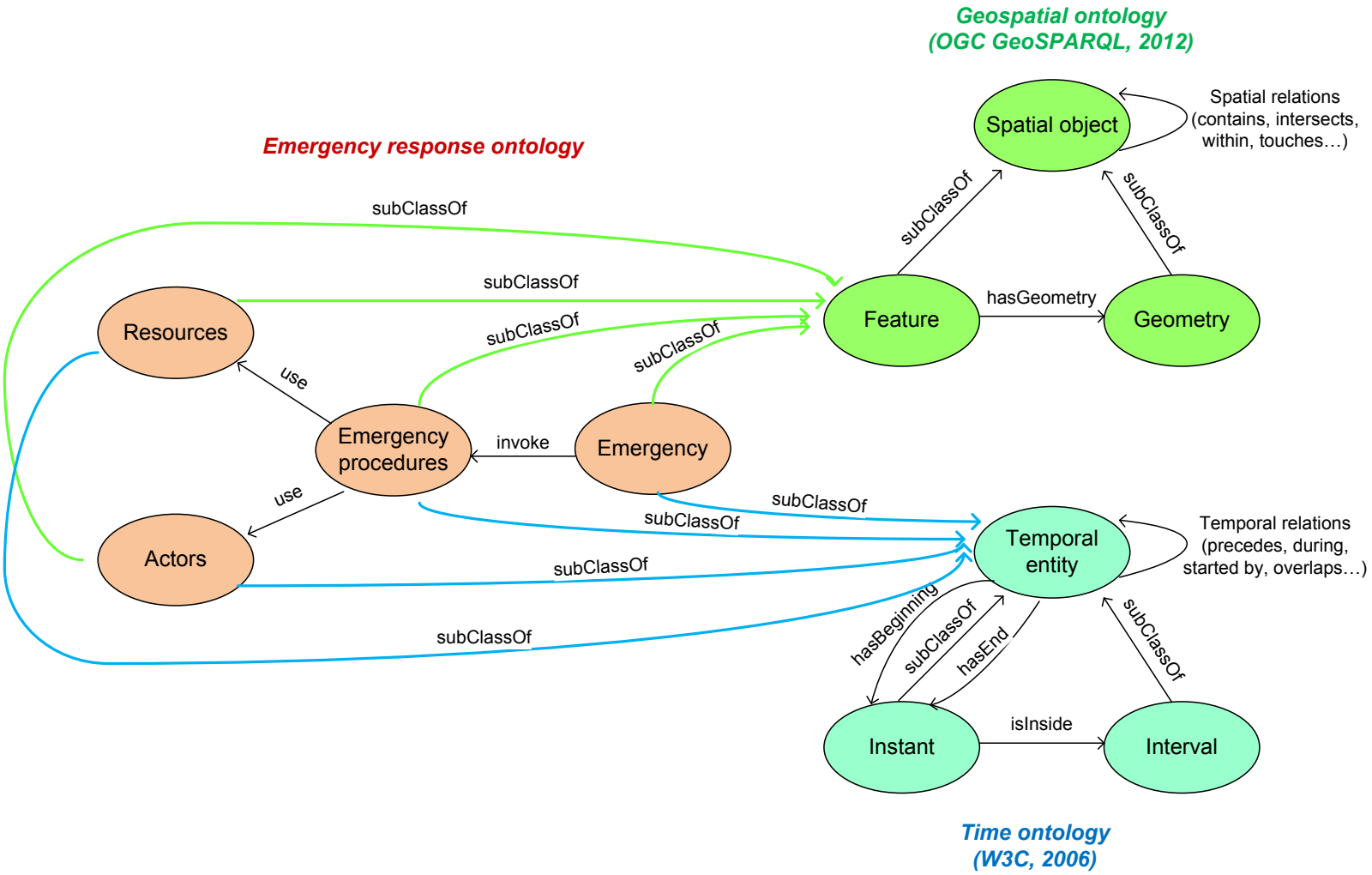
Semantic modelling for common operating picture



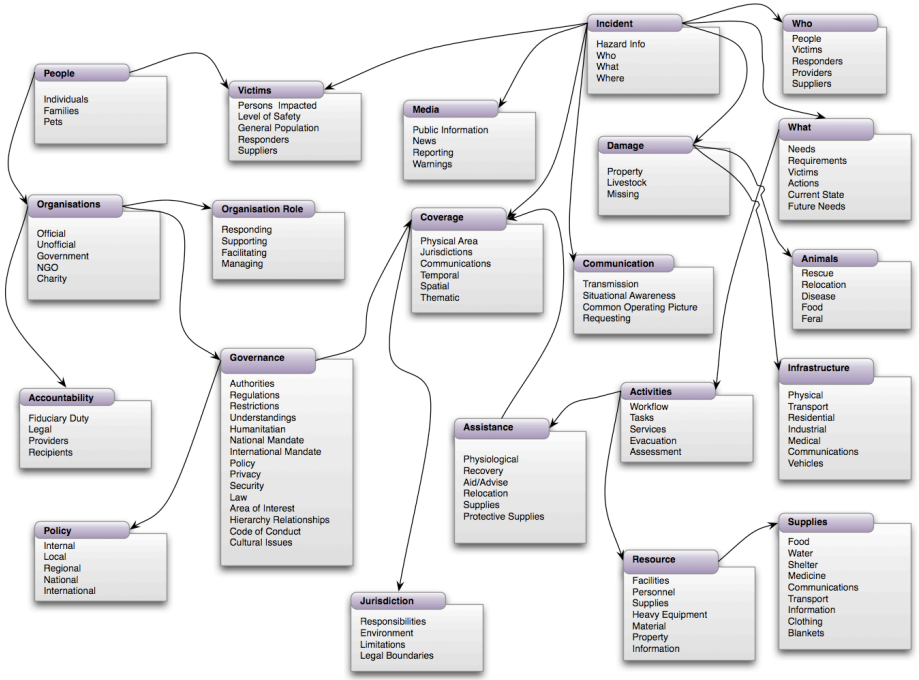
Emergency Management Modelling, (M. Baučić, 2013)



Emergency Management Ontology, (M. Baučić, 2013)

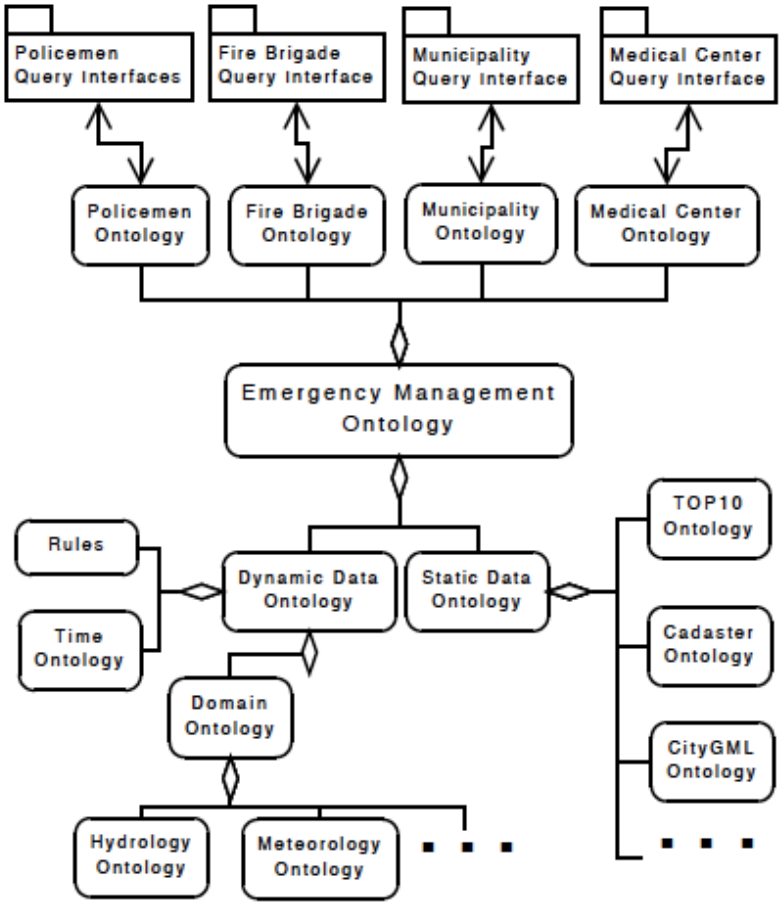


The Conceptual Mind Map - a result of the brainstorming shows the various information entities that participants deal with in their particular emergency management contexts
(source: http://www.w3.org/2005/Incubator/eiif/XGR-Framework-20090806/).



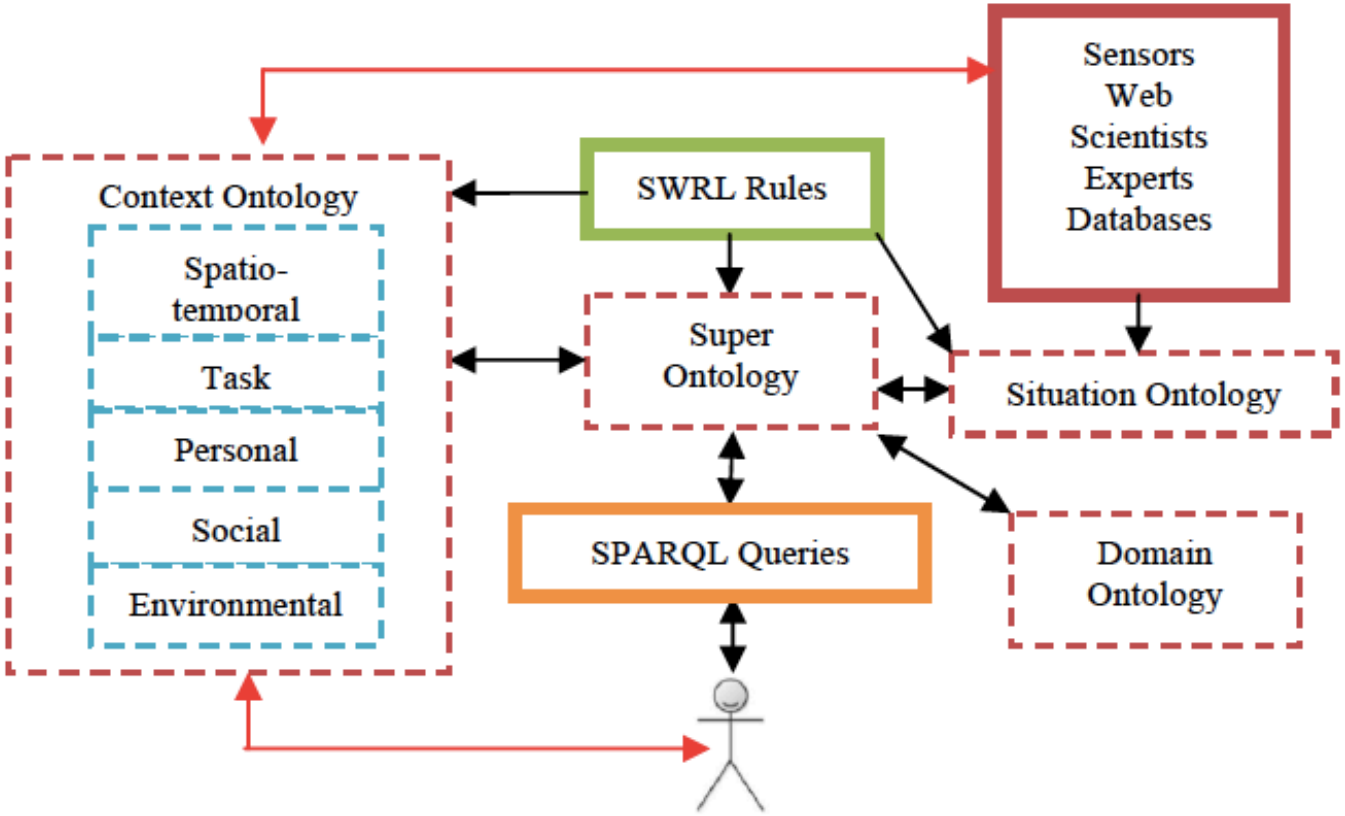
From: Emergency Information Interoperability Frameworks
W3C Incubator Group Report, 6 August 2009

Emergency Management Ontology, (Z. Fan and S. Zlatanova, 2010)



From Z. Fan, S. Zlatanova,
Exploring Ontology Potential in Emergency Management,
Proceedings of the Gi4DM Conference - Geomatics for Disaster Management, Torino, 2010

Emergency Management System architecture

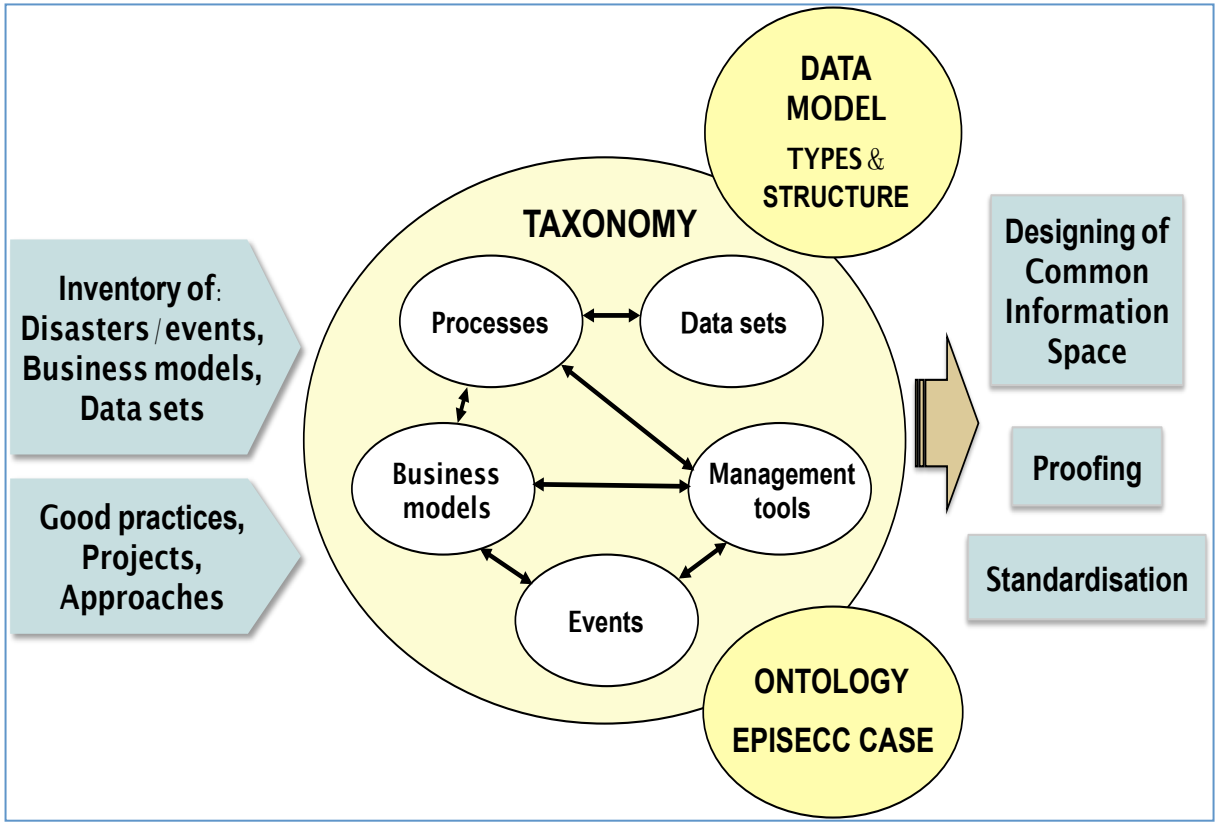


From Yasir Javed, Tony Norris, David Johnston, Ontology-Based Inference to Enhance Team Situation Awareness in Emergency Management, *Proceedings of the 8th International ISCRAM Conference, Lisbon, Portugal, May 2011*

The objectives of taxonomy structure, accompanied with data model and ontology for EPISECC use case, is to facilitate:

- communication - by building a common structure of crisis management systems understood by all involved parties in critical events/disasters (despite of different culture, practice, expertise etc.);
- interoperability - by building common context in terms of data, processes, management tools and business models used in different events used by all services in the security field, enabling them to work together;
- development of the Common Information Space - by structuring data and processes;
- standardisation - by building formal, easy to search models and structures of security services' business models, enabling efficient and consistent transfer of the developed models into standards.

Taxonomy building process from EPISECC proposal



Semantic modelling vs. information gaps

- Uniform definitions on the data used in emergency management
- Definition of common concept upon different domains
- Clearly defined data flows
- Dynamic data models

Semantic modelling vs. lack of fluent communication

- Definition of common concept upon different domains bridges the gap between actors
- Context-related information
- Semantic model serves as an interface between actors
- Actors can communicate from their own domains

Semantic modelling vs. common operational picture

- Semantic model serves as common operational picture
- Semantic model gathers information from different actors, interprets them and deliver

Semantic modelling vs. semantic interoperability

- Semantic models provide full semantic interoperability through their structure
- Semantic models provide a knowledge base that supports reasoning, interpretation and inference

Semantic modelling helps to

- Extract context related information
- Evaluate common operating picture
- High-level view of domains

Future

- Is the ontology the only modelling technique tha can effectivley cope with EM complexity, being implementable at the sam time?
- Do we see a novelty at the horizon?