DISASTER

Data Interoperability Solution At Stakeholders Emergency Reaction

285069

EMS Core Ontology - V2

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Abstract

This technical report contains the reference manual of the ontology EMERGEL (Emergency Elements), developed for the DISASTER project. It is a companion document to EMERGEL OWL file, for which publication we give details in the following sections. It provides details about the publication of the ontology and the methodology carried out for the design. Also, it explains the vocabulary and provides documentation about the classes and the properties of both the core and the transversal modules. In addition, a description of the extensible design is also included.

This report is an ongoing document that could be improved or modified when D3.32 (Transversal and vertical modules complementary to the EMS Core Ontology, V1 & V2), corresponding to month 24 will be delivered.

Executive summary

This document describes the EMERGEL ontology developed for the DISASTER project. It is a companion document to EMERGEL OWL file published at the moment at http://purl.org/emergel and hosted by CTIC in http://vocab.ctic.es. It provides details about the publication of the ontology and the methodology carried out for the design. Also, it explains the design decisions, ontological assumptions of the vocabulary and provides documentation about the classes and the properties of both the core and the transversal modules. In addition, a description of the extensible design is also included. This report is an ongoing document that could be improved or modified when D3.32 (Transversal and vertical modules complementary to the EMS Core Ontology, V1 & V2), corresponding to month 24 will be delivered.

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Abbreviations

ADMS Asset Description Metadata Schema

CAP Common Alerting Protocol

DCAT Data Catalog Vocabulary

EDXL Emergency Data Exchange Language

EMERGEL Emergency Elements

GeoSPARQL Geographic SPARQL Protocol and RDF Query Language

GML Geography Markup Language

HTTP Hypertext Transfer Protocol

IETF Internet Engineering Task Force

IRI Internationalised Resource Identifier

ISA Interoperability Solutions for Public Administrations

KML Keyhole Markup Language

OGC Open Geospatial Consortium

OWL Web Ontology Language

PURL Persistent Uniform Resource Locators

RADion Repository Asset Distribution

RDF Resource Description Framework

SLD Styled Layer Descriptor

URI Uniform Resource Identifier

W3C World Wide Web Consortium

WFS Web Feature Service

WMS Web Map Service

XML eXtensible Markup Language

Chapter 1

Introduction

This technical report contains the reference manual of the ontology EMERGEL, developed for the DISASTER project. It is a companion document to EMERGEL OWL file, for which publication we give details in the following sections. It provides details about the publication of the ontology and the methodology carried out for the design. Also, it explains the vocabulary and provides documentation about the classes and the properties of both the core, the transversal and the vertical modules. In addition, a description of the extensible design is also included.

This report is an ongoing document that could be improved or modified when D3.32 (Transversal and vertical modules complementary to the EMS Core Ontology, V1 & V2), corresponding to month 24 will be delivered.

EMERGEL interprets a disaster as a kind of event. Events are liable to cause other events, and a simple landing operation of a plane can lead to a disaster like a airplane crash in an airport. Additionally, this accident may have direct and collateral consequences (like a fire, chained explosions, a chemical accident in a neighbour industrial facility, a full airport block, etc.) so it is important to semantically capture the causality chain between the diverse events. In addition, the proper spatio-temporal contextualisation of a disaster is crucial to ensure successful information exchange among stakeholders. EMERGEL provides means to temporally describe a crisis situation in RDF. This is a critical problem as information changes over time, and in particular, with respect to space.

1.1 EMERGEL publication

The publication of any ontology usually includes the reservation of an ontology namespace, i.e., the URI that identifies the ontology. It is also necessary to host the ontology files in a public repository and associate the URI with this hosting location. The official name of the ontology has been decided by the consortium to be EMERGEL (Emergency Elements). As for the first stage of the ontology, a namespace has been registered at PURL: http://purl.org/emergel. The ontology is hosted by CTIC in http://vocab.ctic.es and will be published according to W3C best practices.

A further option has been considered to publish the ontology. Initial contacts have been arranged

with the W3C consortium, in particular with the Government Linked Data Working Group[1], to draw attention from the community. In this Working Group, there is also presence from the EU JoinUp[2] initiative, a platform caring about the standardisation of open vocabularies and models, and open source software within the European Union. The first reaction has been positive, although it may take some time to formalise the relationship and agree about the publication procedure of EMERGEL. The last task is to provide human-readable documentation of the ontology to facilitate its consultation and consumption by security experts. Best practices recommend ontologies to include valuable metadata information that helps identify the elements of the ontology that can be useful for potential users. In the last years, a number of ontology documentation tools leverage that metadata to offer visualisations of this information in the form of HTML pages or other multimedia formats to the final user. We use CTICs Parrot[3] online available tool to automatically generate the end-user documentation of the EMERGEL ontology.

1.2 Methodology

The methodology followed to model the EMERGEL ontology has involved an initial definition of semantic-coverage requirements, already done in D2.40[4]. This task is complemented with the identification of existing ontologies and non-ontological domain resources that partially cover an aspect of the ontology. As a design decision, the ontology is modularised, i.e., application of ontology engineering guidelines to divide and structure the knowledge domain in meaningful segments. This step will finally produce the DISASTER ontology, composed of a core (abstract, upper-level ontology including transversal modules: space-time representation) and vertical (associated with specific domains). The W3C OWL 2 ontology language has been selected to describe the DISASTER data model.

1.2.1 Competency questions

One of the ways to determine the scope of an ontology is to chalk out a list of questions that our ontology should be able to answer. Competency questions are targets for what your ontology should be able to cover, given sufficient facts (i.e. data) in our knowledgebase. These questions serve as a test and help us to find out if the ontology contains enough information. The answers assist the ontology experts to work out the requirements for the level of detail needed or the representation of a particular area. The competency questions are just rough drawings and do not need to be exhaustive.

To capture the requisites for the core ontology a number of competency questions was conceived during the first steps of the project. They were discussed by the consortium and included in Deliverable D2.40. The current initial version of the core module of the ontology is grounded in those questions, that cover a number of wide subjects as time, space, resources, agents, etc.

[1] www.w3.org/2011/gld/
[2] http://joinup.ec.europa.eu/page/about_us
[3] http://ontorule-project.eu/parrot/parrot
[4] http://disaster-fp7.eu/sites/default/files/D2.40.pdf

Chapter 2

EMERGEL upper-level design

EMERGEL uses some upper-level classes belonging to the DOLCE+DnS Ultralite (DUL) ontology. DUL is a simplification and an improvement of some parts of DOLCE Lite-Plus library[1] and of the Descriptions and Situations ontology[2]) that provides a set of upper level concepts that can be the basis for easier interoperability among many middle and lower level ontologies.

In this aspect, to model what is involved in an emergency situation, EMERGEL uses `dul:Event` and also `dul:PhysicalObject`, two classes belonging to DUL.

To model agents and roles, as it will be more specifically presented later, EMERGEL uses FOAF[3] and WAI[4]. FOAF is a vocabulary to describe people, the links between them and the things they create and doTo model people and groups EMERGEL reuses the FOAF classes `foaf:Person` and `foaf:Group`. WAI is a vocabulary aiming to extend the FOAF specification through introducing the concepts of roles and profiles. From WAI, EMERGEL takes `foaf:Role`, `foaf:Profile` and `foaf:Context`.

2.1 Disasters as events

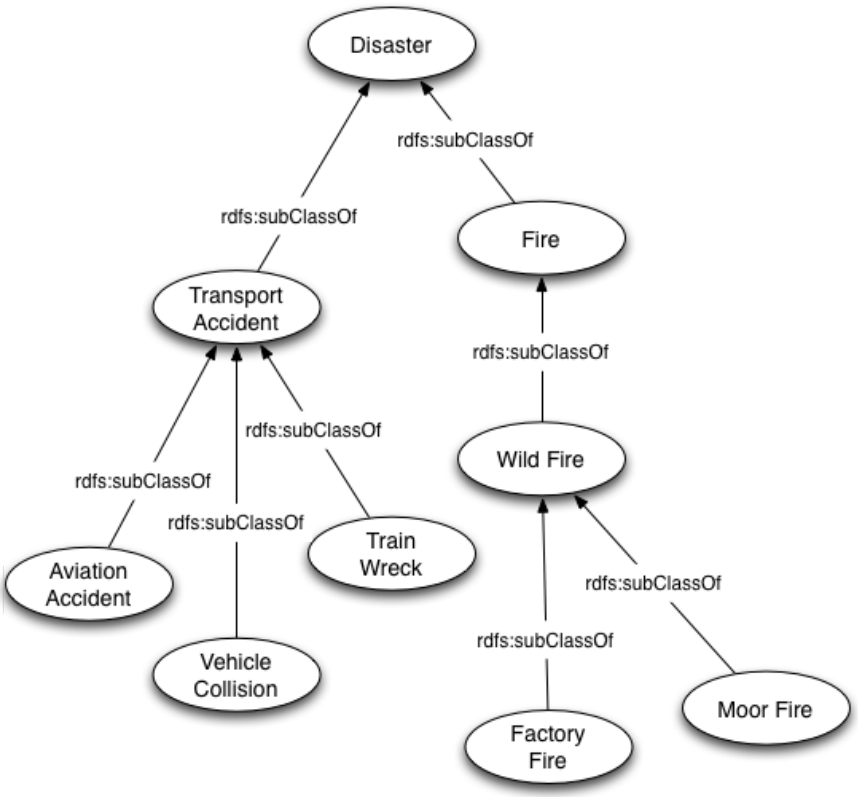
A disaster is defined as a natural, man-made or technological hazard resulting in an **event** of substantial extent causing significant physical damage or destruction, loss of life, drastic change to the environment or simply damage to property. It can affect and destroy the economic, social and cultural life of people. That kind of events stem from other events such as earthquakes, floods, catastrophic accidents, fires, or explosions. From a security point of view, disasters can be seen as the consequence of inappropriately managed risks, that are the product of a combination of both hazards and vulnerability.

EMERGEL thus interprets a disaster as a kind of event. Therefore, two upper-level classes are hierarchically introduced: `emergel:Disaster` as subclass of `dul:Event`. Furthermore, the ontology builds upon existing disaster classifications widely used in security domains, such as in-

[1] http://dolce.semanticweb.org
[2] http://www.ontologydesignpatterns.org/wiki/Ontology:DnS
[3] http://www.foaf-project.org/
[4] http://vocab.ctic.es/wai/wai.html

surance, freight transport and critical infrastructures (ports, airports, etc.), namely: NatCatSERVICE[5], more focused on natural disasters, and EM-DAT[6], more general. These classifications have been adapted and merged to fit the modelling requirements identified in the aforementioned competency questions (cf. D2.40).

Figure 2.1: Examples of emergency situations



`emergel:Disaster` has a number of subclasses dealing with wide specific emergency situations: `emergel:AviationAccident`, `emergel:ChemicalAccident`, `emergel:ComplexDisaster`, `emergel:MiscellaneousAccident`, `emergel:Fire`, etc. These are grouped thematically as shown in Figure 2.1. Note that we only present some of the classes in an illustrative way, the taxonomy is more complex and also can be completed, improvable or modified.

Events are liable to cause other events. A simple landing operation of a plane can lead to a disaster like a airplane crash in an airport. Additionally, this accident may have direct and collateral consequences as a fire, chained explosions, a chemical accident in a neighbour industrial facility, a full airport block, etc. To semantically capture the causality chain between the diverse events in a given disaster, the property `emergel:causes` (and a set of companion subproperties) has been added to the ontology.

[5] http://www.munichre.com/en/reinsurance/business/non-life/georisks/natcatservice/default.aspx

[6] http://www.emdat.be/database

2.1.1 Incidents classification

The incident taxonomy provided in EMERGEL was implemented with the asistance of domain expert partners of the DISASTER consortium and it is inspired by the ones used in some European Emergency Management Systems. It is focused on the most common incidents in emergency management but other kinds of incidents might be still included in the future in order to improve and/or extend the model of EMERGEL.

Figure 2.2 shows the hierarchy of the concepts included in the list presented below:

Road accident: an accident with cars, motorcycles or trucks in the public road traffic.

Car accident: an accident in public road traffic with one or more cars involved.

Motorcycle accident: an accident in public road traffic with one or more motorcycles involved.

Truck accident: an accident in public road traffic with one or more trucks involved. Dangerous goods: an accident in public road traffic with one or more trucks involved and dangerous goods loading.

Aviation accident: an accident involving any kind of aircraft.

Helicopter crash: an accident with one or more helicopters involved.

Small aircraft crash: an accident with one or more small aircrafts involved (like sporting airplanes).

Tall aircraft crash: an accident with one or more tall aircrafts involved (like Jumbo-Jets).

Passenger aircraft: an accident with an aircraft carrying passengers on board.

Cargo aircraft: an accident with an aircraft carrying cargo on board.

Dangerous goods: an accident with an aircraft carrying cargo including dangerous goods.

Seafaring accident: an accident with one or more ships involved, happening on rivers, lakes or oceans.

Boat accident: an accident with a boat involved.

Ship accident: an accident with a ship involved.

River traffic: accident concerning seafaring on rivers.

Ocean traffic: accident concerning seafaring on oceans.

Passenger liner: an accident with a passenger carrying ship involved.

Cargo liner: an accident with a cargo carrying ship involved.

Dangerous goods: an accident with a cargo carrying ship including dangerous goods.

Train accidents: accidents concerning railway vehicles.

Passenger train: an accident with a train carrying passengers involved.

Cargo train: an accident with a train carrying cargo involved.

Dangerous goods: an accident with a train carrying cargo including dangerous goods.

Building fire: conflagration concerning man-made buildings.

Room fire: conflagration concerning one room of a building.

Fully developed fire: conflagration concerning a complete building.

Without danger to life: conflagration concerning man-made buildings that does not threaten human life.

Within danger to life: conflagration concerning man-made buildings that threatens human life.

Industrial fire: conflagration concerning an industrial facility.

Dangerous goods: conflagration concerning an industrial facility where dangerous goods are handled.

Without danger to life: conflagration concerning industrial buildings that does not threaten human life.

Within danger to life: conflagration concerning industrial buildings that threatens human life.

Fire in buildings of special use: conflagration concerning buildings, which arent used as apartment buildings or industrial buildings.

Kindergarten: conflagration concerning a building where children are accustomed.

School: conflagration concerning a building where people are educated.

Department store: conflagration concerning a building within sale side.

Event hall: conflagration concerning a building where cultural events such as concerts take place.

Stadium: conflagration concerning a large building mainly used for sports events such as soccer matches.

Office building: conflagration concerning a building where people usually work.

Hospital: conflagration concerning buildings where people are medically treated.

Nature fire: conflagration not concerning buildings but landscape and nature.

Forest fire: conflagration concerning forests and woodland.

Moor fire: conflagration concerning large areas of moor.

Surface fire: conflagration concerning large areas such as grassland, heath, farmland.

Natural disasters: Threats and damages concerning the environment.

Oil slick: oil slick on water and land surface.

Flood: inundation of landside and cities.

Earthquake: earthmoving able to cause great damage to buildings and people.

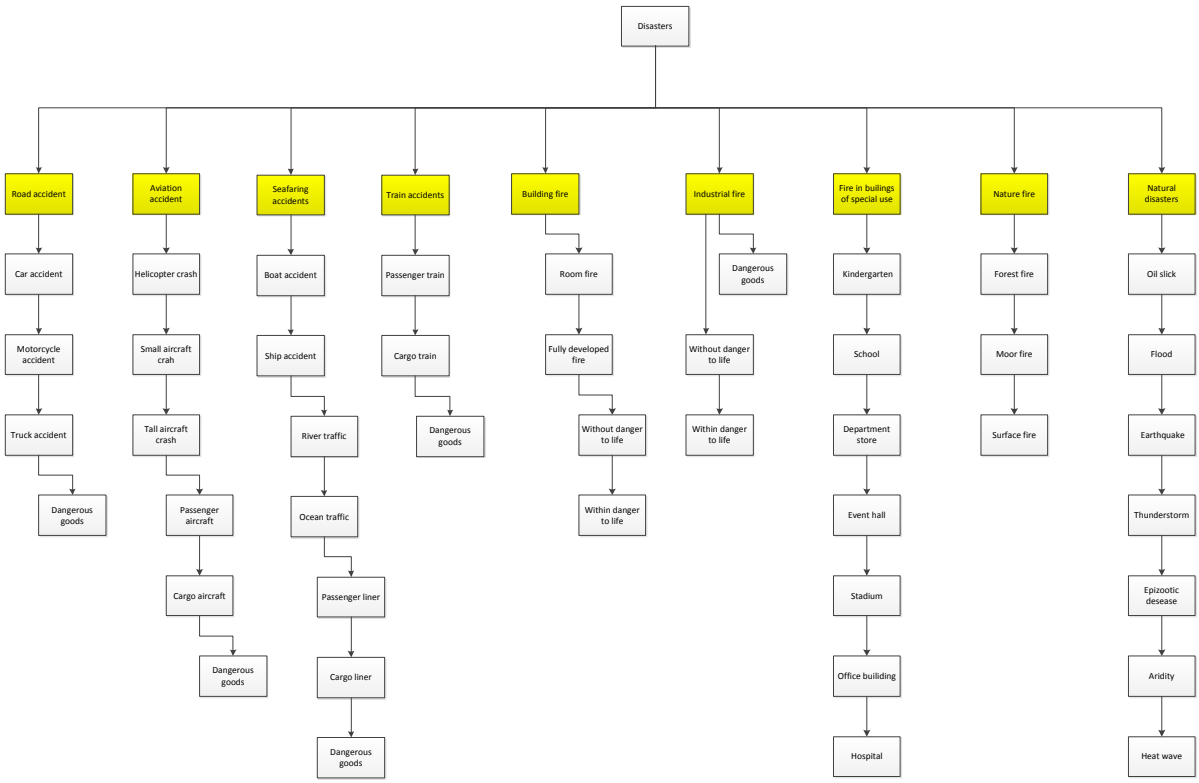
Thunderstorm: Threats to people and environment caused by inclement weather.

Epizootic disease: threats to people and/or animals caused by quickly outspreading diseases.

Aridity: threats to people and animals caused by long dry periods.

Heat wave: threats to people and animals caused by long heating periods.

Figure 2.2: Incident taxonomy



2.2 Agents, roles and profiles

Many agents (with different descriptive granularity and resolution) are involved in a crisis situation: from a rescue army brigade to the technical specifications of a fire truck. Agents are understood in a broad and generic way in order to cover beyond organisations, groups of people and individual profiles. Therefore equipment, affected buildings, casualties, etc. also fall into this agentive dimension of the ontology.

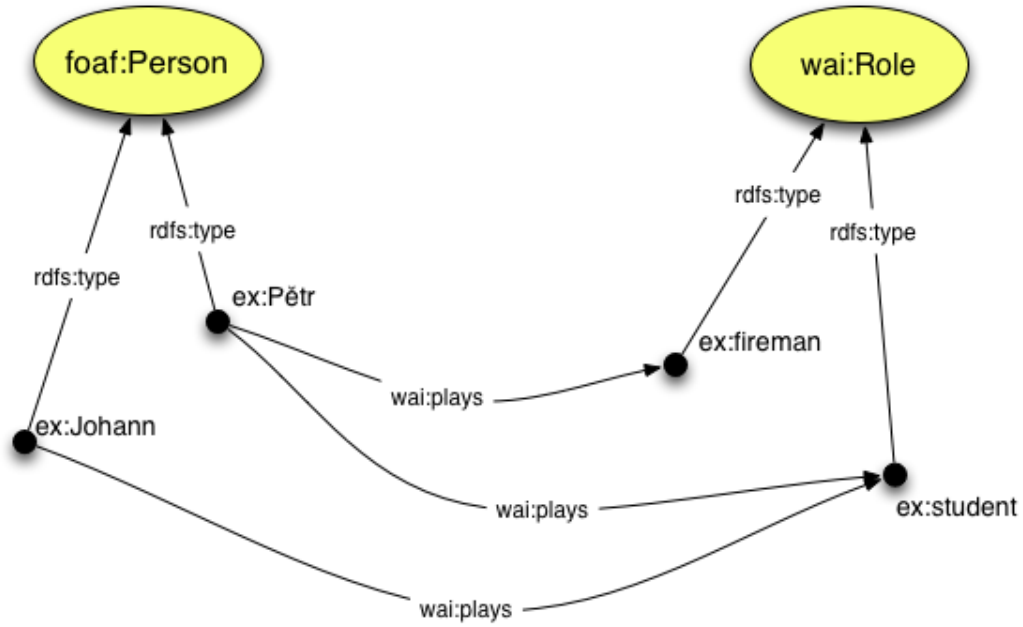
The different agents involved in an emergency situation are modelled in EMERGEL reusing the WAI[7] ontology, a vocabulary to describe roles and profiles. Using WAI we can smoothly be attach to a given person different roles and profiles: a person can be for instance a fireman or a victim depending of the context or the moment within the emergency situation.

WAI provides a class `wai:Role` and the corresponding property `wai:plays` to link up individuals and roles. This strategy was also applied by the DOLCE ontology, but with a general knowledge

[7] http://vocab.ctic.es/wai/wai.html

representation purpose. WAI instead is a specifically dedicated vocabulary to represent people and a given person can play more than one role, as shown in Figure 2.3, where a German Sorb called Pětr is both an engineer student and a voluntary firefighter.

Figure 2.3: People can play more than one role

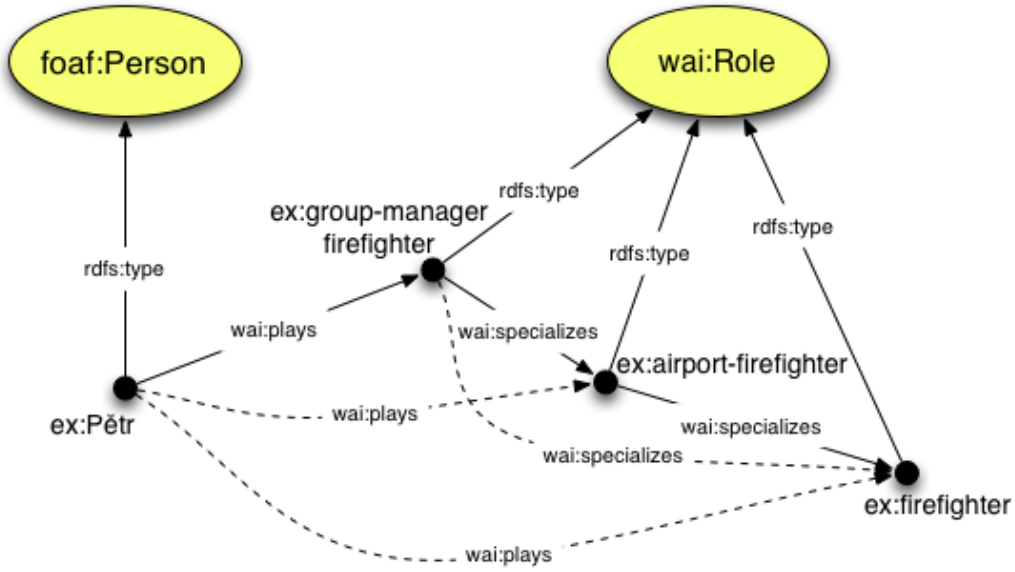


Roles can also be arranged in a hierarchy of entities in a similar way as ontology classes are organised via a subsumption relation. For instance, a fireman can be specialised into a fireman corporal, which is also specialised into a fireman corporal of Germany's fire brigade. However, roles are considered first-order individuals and therefore it is not possible to use OWL subclassification axioms. WAI introduces a primitive property `wai:specializes` able to capture these hierarchies of roles, so allowing more generic roles to be successively refined into more specific ones.

Profiles are entities capturing the dynamic and temporal aspects of roles. For instance, the full meaning of the sentence "Pětr the fireman was a fire victim 3 hours ago" cannot be represented by a simple relation between Pětr and the role "fireman" by means of the property `wai:specializes`. A temporal location of "Pětr-as-victim" is needed. Profiles are introduced to cover this knowledge representation gap. Roles are not inherent to people, as they are not essential properties. Profiles (`wai:Profile` in the ontology) are a mechanism allowing to refer to people when they are actually playing a particular role, i.e. "person-as-role".

Profiles using WAI do not necessarily need to refer to a role. When contexts and groups are used to fix the interpretation coordinates of the profile, roles may be implicit. In this case, a profile is considered a "person-at-context" or a "person-in-group", rather than "person-as-role". Nevertheless, none of the three are exclusive, but complementary. Figure 2.5 shows a WAI example where the firefighter "Johann" is the operational leader of a group of firefighters in the given geographical context of a wildfire in the Schiphol airport.

Figure 2.4: Hierarchies and inheritance of roles

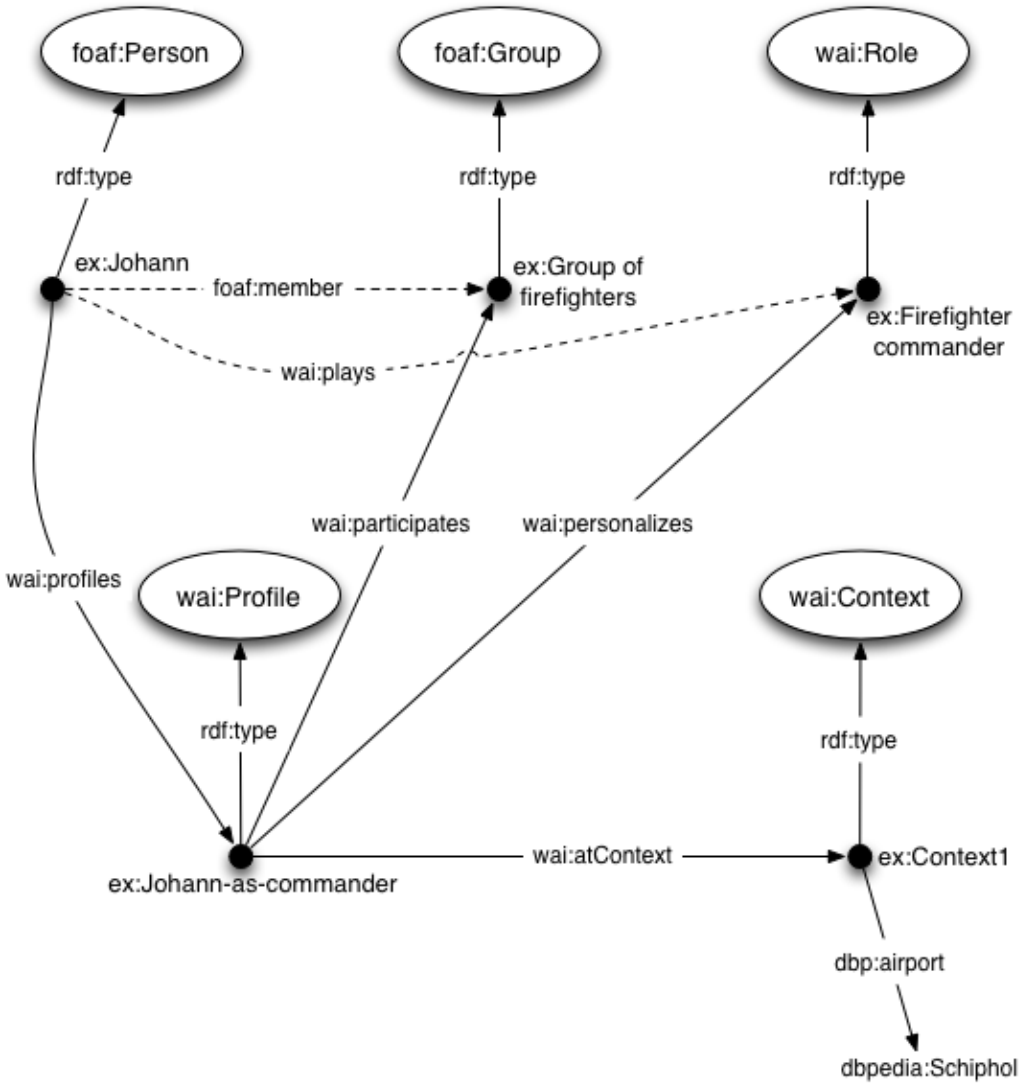


2.3 Describing emergency situations

Apart from the events themselves and the agents participating, to properly describe emergency situations it is also mandatory to have an extensive account of physical objects involved. Under the umbrella of DUL's superclass `wai:PhysicalObject`, EMERGEL includes buildings, facilities, and infrastructures affected, but also trucks, planes, equipment, tools, resources, etc. If the core of EMERGEL offers an upper-level model for this, to take account of the more specific domain subclasses EMERGEL supplies vertical modules, which are described in chapter 4.

In addition, time and space are the other crucial, transversal elements when describing that kind of situations. This is analysed in chapter 3.

Figure 2.5: A person playing a role in a group at a given context



Chapter 3

EMERGEL transversal modules

The two transversal modules considered in EMERGEL are space and time. Other possible transversal modules, such as magnitudes, are not considered yet, but it may be included in the second version D3.32, a deliverable focusing on transversal modules.

3.1 Space: from geographical features to spatial geometries

Regarding spatial representation of an emergency situation, EMERGEL introduces a pristine ontological distinction between the involved conceptual layers: (1) features, (2) geometries, and (3) feature-types classifications related with cartographic visual representation (i.e., maps). This distinction eases the reconciliation between the geographical-feature description of emergency-entities and a pure geometrical representation of the space.

3.1.1 Core geographical model

A common modelling choice in geospatial science is a distinction between a Feature and a Geometry:

- A feature is an entity in the real world with some spatial extent, such as airports, monuments, hospitals, hotels, etc. A feature can have a spatial location that does not need to be precisely defined. Imagine, for instance, a lake, where a unique geographical point cannot determine its location.

- A geometry, on the other hand, is a geometric shape, such as a point, polygon or line. Geometries are used to capture a features spatial location. For instance, the Guggenheim Bilbao Museum is a geospatial feature (it is an entity with a specific location in the world), therefore it has an associated geometry that is a point with coordinates 43.268964, -2.934219 (in the WGS84 datum). The reader should note that geometries could be measured at varying resolutions, from a single point in the centre of a feature to a complex and precise measurement of a shape border.

In DISASTER, we assume that geographical information is captured by the NeoGeo Vocabulary, which provides the distinction between features and geometries by means of `spatial:Feature` and `geom:Geometry` classes. The property `geom:geometry` is used to reconcile both facets of the same geographical entity. URIs (implicitly) denoting a `geom:Geometry` might have any format based on HTTP content negotiation. NeoGeo recommends using MIME Media Type negotiation to provide access to different supported serialisations. In other words, when an HTTP request with the "Content-Type: application/vnd.google-earth.kml+xml" header field is sent, a KML representation of the feature should be received. In addition, the geographical entity is not forced to be typed as a `spatial:Feature`.

Finally, the visual aspect of maps is conformed by style guidelines. This is not a random decision, on the contrary, the styling of a map is aligned with final user visualisation requirements, i.e., the same geographic information often is presented with different styling according to the intended audience. Thus, styles usually conform to cartography style manuals or follow symbology standards to assure proper understanding. In this line, we can refer to maps as human-readable artifacts to visualise geospatial information. According to this, styles are the mechanisms to build these visualisations, selecting the properties of features that must be encoded in the map. There are different maps depending on the kind of the visualised information: geocharts, i.e., statistical data associated with spatial information presented as maps; political maps, i.e., maps that emphasise the division of territory according to governmental directives; or physical maps, i.e., maps that represent the properties of the terrain such as mountains, rivers or lakes.

The style assigns a number of visual properties to each feature. The nature of style is dual, as it assigns graphical representations to concepts. EMERGEL captures this double identity of styles by linking features to SKOS concepts, and then SKOS concepts with graphical representations. We associate a `neogeo:Feature` to a `skos:Concept` using the `dct:subject` property. Finally, concepts can be linked using the property `emergel:prefStyle` to specific `emergel:Style` instances, which are in charge of containing, or linked to, their graphical representation.

3.1.2 Classification and description of geographical objects

Every physical entity can be geographically located, so to be interpreted as spatial features. This means that current domain ontologies and vocabularies might be reused to describe features. Even if this is possible, it is not advisable from the point of view of a uniform treatment of the features. Domain ontologies and vocabularies diverge with respect to ontological assumptions and world interpretation. Moreover, besides semantic web approaches, there exist a lot of data models in the geospatial community that must be reused at some extent. Without a common structure to describe features, automatically translation is difficult and the different outputs do not guarantee compatibility. This poses a hindrance to geospatial data fusion and integration.

We propose SKOS[1] vocabulary as the underlying model to represent geospatial schemas, that are used to describe features. One of the positive effects is that we do not enter in conflict with the current description of the feature according to particular and domain ontologies.

[1] http://www.w3.org/2004/02/skos/

3.1.3 Classifications and map symbols

Most of the geospatial classifications provide map symbols. These icons are used in data visualisation to understand the cartography of the map, i.e., what is the kind of feature present at a given location. Basically, each map icon represents a given type (or class) of feature. Map symbols are used from the origins of cartography and there exist a huge diversity of collections due to cultural and historical reasons. In Map symbols collections, some of them are identified and briefly presented.

Regarding SKOS and map symbols collections, the subjacent concepts and hierarchy are easily captured by this vocabulary. In case of the icons themselves, there used to be in previous versions of the SKOS specification properties to relate a given concept to some symbols expressing its same meaning by means of iconographic resources. These properties were skos:prefSymbol and `skos:altSymbol`. As they are no longer part of the vocabulary, we propose to extend SKOS with our own properties able to replicate the aim of the former.

3.2 Time: a 4D approach

3.2.1 Introduction

A critical problem for representing a disaster (i.e., a crisis management situation) in RDF is dealing with information that changes over time, and in particular, with respect to space. For instance, the damaged surface in a forest fire is not the same at the beginning of the conflagration than two days after. During this time interval, many squared kilometers may have been affected. How to reflect these changes in a proper and understandable representation is the aim of this introduction.

We can summarise the problem as how do we logically account for the fact that ”same” entity appears to be ”different” at different times [Welty[2]]. In an endurantist perspective, such as the DOLCE approach, a distinction is made between endurants and perdurants. The former relate to entities that are three-dimensional, and persist through time, i.e., are always present. Physical objects, like people, buildings and animals, are typical samples of endurants. On the other hand, perdurants have temporal parts that exist during the times the entity exists.

Our approach is based on a 4D (four dimensionalism) view of the reality, sometimes called a perdurantist perspective. The basic idea is that everything in the reality, on an a universal and microscopic scale, is an event: from the birth of a newborn baby to a chair in a room. The prescription that so-called endurants are somehow different is product of our interpretation and perspective on time and space. Therefore, all entities have temporal parts and can be thought as four dimensional ”spacetime worms”. The temporal parts are the slices of the worm. There are two OWL-based initiatives in the state of the art that follow this four dimensionalism approach: the 4D Fluents ontology and the temporal extension to the OWL language tOWL.

[2] http://www.comp.leeds.ac.uk/brandon/FOIS-06/CRC/Part-5/20_fois06.pdf

3.2.2 Proposed formalisation

Our formalisation relies on these previous works, but putting the focus on the representation (and exchange) of data describing a crisis management situation.

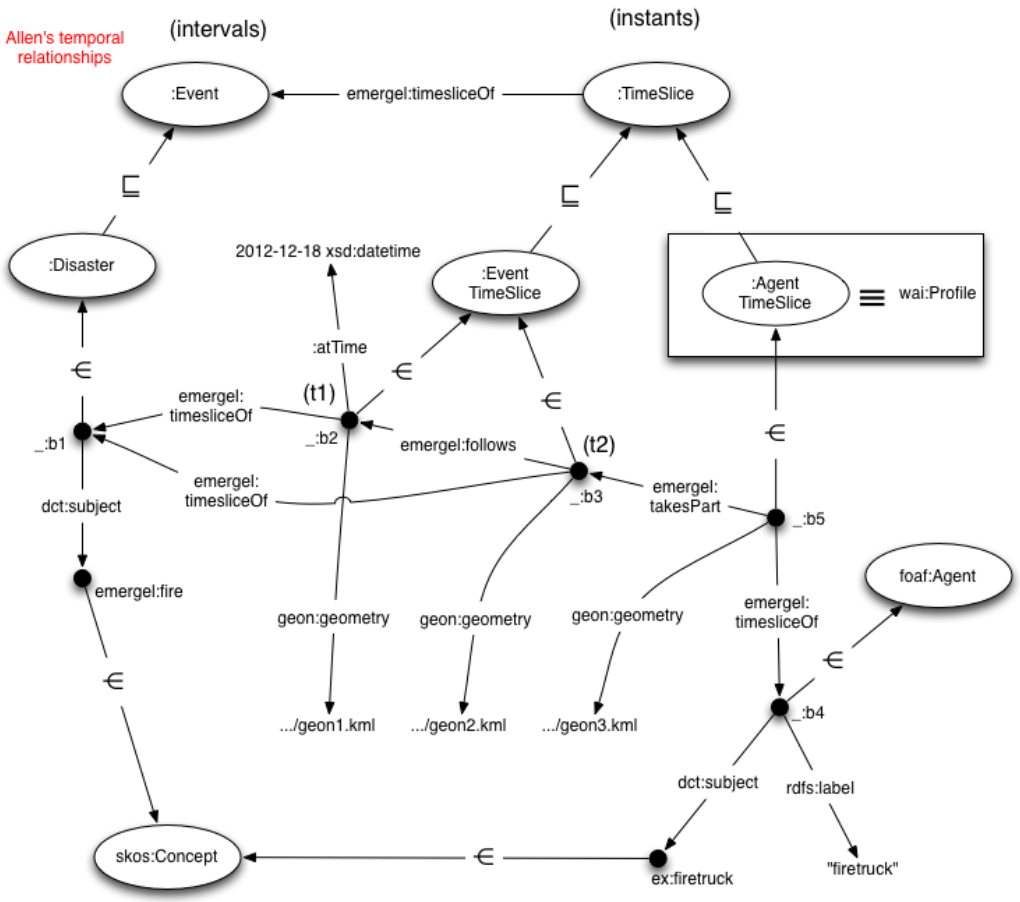
- The first step is to provide our ontology with a clear interpretation of time. To this end, a temporal infrastructure should be supplied. There are two alternatives: representing time in the form of instants and/or intervals. From our point of view, an instant-based model is preferable as they provide snapshots of a situation at a given moment. In other words, we have mindful vision of an event without considering evolution in time. This is important in order to guarantee interoperability between information systems and to come up with easily-translatable visualisations.

- However, interval-based interpretation of time does not disappear, but it is implicit in the 4D approach of the ontology, as every entity is a composition of successive temporal parts. We restrictively introduce the class `dul:Event` in the ontology, as a generic and broader concept meaning ”something that happens” and ”the occurrence of a process or a phenomenon”. Events are inherently time intervals, and so they can relate each other by means of the Allen’s temporal algebra. For instance, ”the fire started before the explosion in the factory”. Notice that even if a 4D approach is considered, Allen’s relationships only apply to what is usually understood as events in natural language.

  The ontology introduces timeslices and fluents to provide the diachronic perspective of time. Timeslices represent the temporal parts of a specific entity at given snapshots in time (i.e., instants). Fluents are properties that hold at a specific moment in time, or at a specific interval in time. In other words, uents and timeslices represent a vocabulary to capture temporal parts of individuals that change some property in time. You can understand a timeslice of ”an event x in time y” as an entity, which a temporal part of x that occurs in y. This entity can be name eventx@timey, which syntax does not have any semantic implication.

  One of the drawbacks of this approach is the proliferation of objects in the ontology due to the creation of two timeslices each time something is changing, which, in turn, must be associated to the static individuals they represent and linked to each other by a fluent.

Figure 3.1: First draft of time representation in EMERGEL



Chapter 4

EMERGEL vertical modules

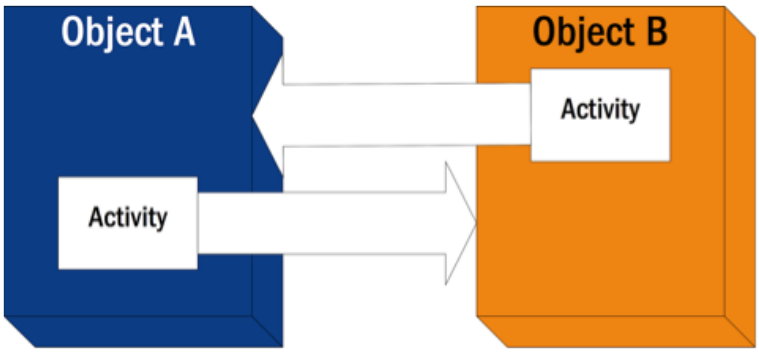
In order to create a comprehensive ontology for the emergency management domain it is first of all important to structure the existing concepts and their representations in the real world in a way that can be used in ontological terms. These vertical modules can be seen as the very context in which every emergency situation takes place. The following sections describe this structuring process of this vertical modules as well as the resulting concepts and their underlying connections.

4.1 General modelling approach

The first step in understanding the vertical modules modelling approach is to understand the fact that every emergency operation consists of two main components:

- Objects that are having an effect on other objects and
- Activities that represent the effect of a respective object on other objects.

Figure 4.1: Connection between objects and activities



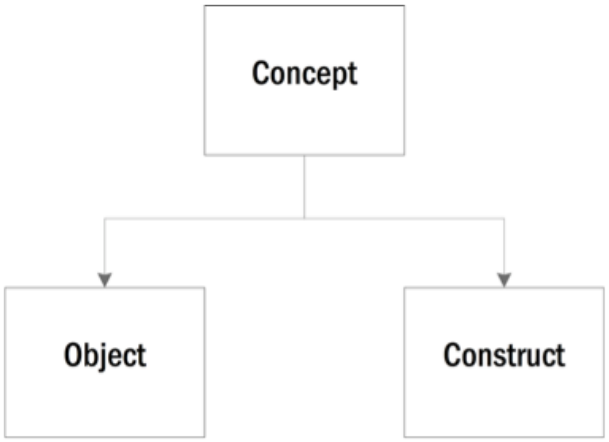
This separation of objects and activities is the first modelling principle for modelling the vertical modules. Figure 4.1 shows this simple but important concept in a graphical way. It can be seen that an object is only capable of acting towards another object by using an activity, which of course

is a property of the specific object. As can be seen it is not possible that an object directly interacts with another object other that by using its activities. In addition, there is no direct interaction between activities. Of course there might be an activity that can be characterized as some kind of response, but this activity still needs a responding object to be able to execute the response. The second modelling principle therefore states that there is no direct interaction between objects or between activities. Although there are some existent ontologies dealing with hazards and their structuring it is interesting to mention that the proposed general method and structure is able to describe both, hazards as well as emergency management concepts in the same way. The concept described above is easy to understand for units of the ambulance or fire service, however a hazard that is exposing a thread to another object also dies this by being an object itself (e.g. fire) and executing an activity (e.g. burning in direction A). Since there are already existing resources to represent hazards the following sections will focus on objects form the emergency management domain.

4.1.1 Objects and Constructs

In order to understand objects of the emergency management domain it is first of all necessary to remember the definition of an object as defined in this deliverable: A representation of a concept in the real word. This means that an object is a thing that really exists in the real world, that can be touched an used in some very manual way. On the other hand there are well known concepts in the emergency management domain that are different from touchable objects. One example is the concept of a unit. This concept is abstract and does not describe something with a representation in the real world. Of course there are objects (e.g. vehicles) representing the unit, but this shows the very essence of a construct: It is a description of something more complex than a plain object. A construct always needs to be connected in some way to an object otherwise it will not exist. This, however, does not mean that the underlying objects always need to be defined. Considering, for example, the construct Municipality, it would be inconvenient to list all houses etc. that build the municipality. In this case it is easier to just use the construct. Regardless of the use the municipality stays a construct according to the definition above. Figure 4.2 shows the relationship between concepts, objects and constructs.

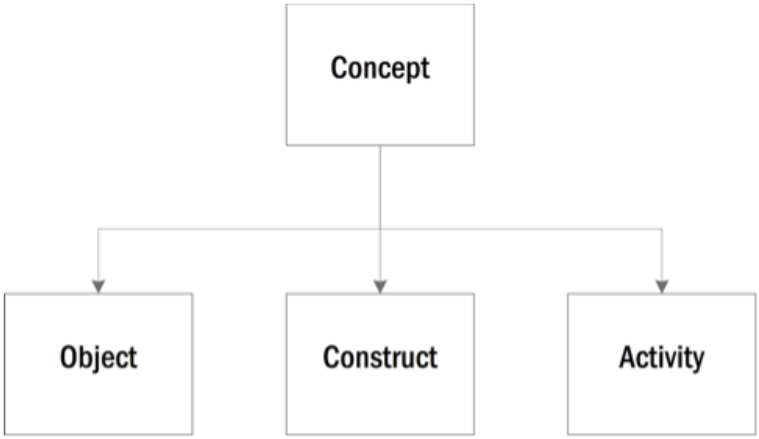
Figure 4.2: Objects and constructs



4.1.2 Scenarios and Activities

The DISASTER development approach is a scenario driven one. So it was reasonable to start developing the vertical modules by applying scenarios such as the border-fire scenario described in other deliverables to them. The first approach on the vertical modules therefore was assuming a similar structure as described for the objects for possible scenarios. This would also imply an underlying hierarchy in the scenario structure. During development it became clear that the idea of a scenario as part of the ontology would not work out. The reason for this is that a scenario is a complex description of a given situation that also in most cases includes a specific way of looking at the situation.

Figure 4.3: Objects, constructs and activities



4.2 Vertical Concepts

The following sections describe the vertical concepts of the EMERGEL ontology.

4.2.1 Objects

As mentioned above objects represent concepts with a representation in the real world.

Main Object Classes

Name	Person
Assembly	Object
Superclass	A generic person as a single individuum.

Name	Vehicle
Assembly	Object
Superclass	A generic vehicle as a single technical entity.

Name	Equipment
Assembly	Object
Superclass	A generic part of equipment.

Name	Infrastructure
Assembly	Object
Superclass	A generic part of infrastructure.

Name	SpatialPoint
Assembly	Object
Superclass	A point on the surface of the earth.

Name	Communication
Assembly	Object
Superclass	A generic mean of communication.

Person Objects

Name	Leader
Superclass	Object → Person
Description	A generic leadership-person with the mission to lead a group of persons in an operation.

Name	Special function
Superclass	Object → Person
Description	A generic person with a special function in the respective operation.

Name	SquadronLeader
Superclass	Object → Person → Leader
Description	A person leading a squadron.

Name	SquadLeader
Superclass	Object → Person → Leader
Description	A person leading a squad.

Name	GroupLeader
Superclass	Object → Person → Leader
Description	A person leading a group.

Name	CompanyLeader
Superclass	Object → Person → Leader
Description	A person leading a company.

Name	BrigadeLeader
Superclass	Object → Person → Leader
Description	A person leading a brigade.

4.2.2 Vehicle Objects

Name	LandVehicle
Superclass	Object → Vehicle
Description	A vehicle to move on land.

Name	WaterVehicle
Superclass	Object → Vehicle
Description	A vehicle to move on or in water.

Name	AirVehicle
Superclass	Object → Vehicle
Description	A vehicle to move in the air.

Name	VehicleEquipment
Superclass	Object → Vehicle
Description	Equipment and Objects to enhance vehicles. These objects in general can operate without a vehicle but may not be moved without one.

Name	LandMotorVehicle
Superclass	Object → Vehicle → LandVehicle
Description	A vehicle to move on land, propelled by an engine.

Name	OffroadMotorVehicle
Superclass	Object → Vehicle → LandVehicle
Description	A vehicle to move on land, propelled by and engine and suitable to go offroad.

Name	LoadHandlingSystemVehicle
Superclass	Object → Vehicle → LandVehicle
Description	A vehicle equipped with a load handling device.

Name	RailVehicle
Superclass	Object → Vehicle → LandVehicle
Description	A vehicle to move on rails.

Name	TrackVehicle
Superclass	Object → Vehicle → LandVehicle
Description	A vehicle driving on tracks.

Name	MotorBike
Superclass	Object → Vehicle → LandVehicle
Description	An engine propelled bike.

Name	Bike
Superclass	Object → Vehicle → LandVehicle
Description	A two wheels vehicle without engine.

Name	Excavator
Superclass	Object → Vehicle → LandVehicle
Description	Engine propelled heavy construction equipment.

Name	Aircraft
Superclass	Object → Vehicle → AirVehicle
Description	An air vehicle using aerodynamic force by wings.

Name	Helicopter
Superclass	Object → Vehicle → AirVehicle
Description	An air vehicle using aerodynamic force by rotors.

Name	Container
Superclass	Object → Vehicle → AirVehicle
Description	A storage device without wheels that can be transported on either a truck or a trailer.

Name	Trailer
Superclass	Object → Vehicle → VehicleEquipment
Description	A transportation device with wheels that can be linked to a vehicle to be pulled.

Name	RemovingEquipment
Superclass	Object → Vehicle → VehicleEquipment
Description	Equipment used to remove objects.

Name	LiftingEquipment
Superclass	Object → Vehicle → VehicleEquipment
Description	Equipment used to lift objects

4.2.3 Equipment Objects

Name	Siren
Superclass	Object → Equipment
Description	An acoustic warning device emitting predefined sounds.

Name	Speaker
Superclass	Object → Equipment
Description	An acoustic device used to increase the volume of an emitted sound.

Name	BlastingMeans
Superclass	Object → Equipment
Description	Equipment used for blasting.

Name	DrinkingWater
Superclass	Object → Equipment
Description	Water that is purified and suitable for drinking.

Name	DomesticWater
Superclass	Object → Equipment
Description	Water that was used and/or is not suitable for drinking.

Name	Supply
Superclass	Object → Equipment
Description	Supply of consumer goods and operating materials.

Name	Catering
Superclass	Object → Equipment
Description	Supply of food and drinks.

Name	Accommodation
Superclass	Object → Equipment
Description	Places and means for temporal housing of people.

Name	Tent
Superclass	Object → Equipment
Description	A temporal housing or shelter consisting of fabric and poles that can be carried by a person .

4.2.4 Infrastructure Objects

Name	Building
Superclass	Object → Infrastructure
Description	A structure used for continuous occupancy.

Name	Street
Superclass	Object → Infrastructure
Description	A (usually paved) thoroughfare used to connect different locations.

Name	Bridge
Superclass	Object → Infrastructure → Street
Description	A structure used to span physical obstacles in order to expand a street over them.

4.2.5 Spatial Point Objects

Name	Assembly
Superclass	Object → SpatialPoint
Description	A point in space for gathering objects.

Name	Meeting
Superclass	Object → SpatialPoint
Description	A point in space used for gathering in order to execute a joint operation.

Name	Post
Superclass	Object → SpatialPoint
Description	A point in space representing a specific task.

Name	CommandPostMeeting
Superclass	Object → SpatialPoint → Post
Description	A point in space representing a point in the operational hierarchy.

Communication Objects

Name	Wire
Superclass	Object → Communication
Description	A flexible strand of metal of fibre used to connect electronic and electric devices.

Name	Radio
Superclass	Object → Communication
Description	Wireless transmissions of signals through free space.

Name	ImageTransmission
Superclass	Object → Communication
Description	The transmission of (moved) images of video.

Name	DataTransmission
Superclass	Object → Communication
Description	The transmission of any kind of data.

Name	Fax
Superclass	Object → Communication
Description	Device to submit and receive written text .

Name	Telephone
Superclass	Object → Communication
Description	Device to submit and receive spoken language.

Name	Telex
Superclass	Object → Communication
Description	A device to be used in a telex network.

Name	StaticPictureTransmission
Superclass	Object → Communication
Description	The transmission of static pictures.

Name	RelayRadioTransmission
Superclass	Object → Communication
Description	The transmission of radio signals via a relay or a network of relays.

Name	DirectionalRadioTransmission
Superclass	Object → Communication
Description	The transmission of radio signals via direct connection.

Name	CableConstruction
Superclass	Object → Communication
Description	Connection of objects via cables.

Name	DigitalRadio
Superclass	Object → Communication
Description	Generic digital radio device.

Name	HandRadioTerminal
Superclass	Object → Communication → DigitalRadio
Description	Digital radio device to be carried around by a person.

Name	MobileRadioTerminal
Superclass	Object → Communication → DigitalRadio
Description	Digital radio device to be build into a vehicle.

Name	FixedRadioTerminal
Superclass	Object → Communication → DigitalRadio
Description	Digital radio device to be build into a building.

Name	DirectModeOperation
Superclass	Object → Communication → DigitalRadio
Description	Direct communication between digital radio terminals without the use of a trunking network.

Name	TrunkedModeOperation
Superclass	Object → Communication → DigitalRadio
Description	Communication between digital radio terminals by using a trunking network.

4.2.6 Constructs

Constructs represent a collection of objects. They are used to describe more complex concepts.

Main constructs classes

Name	Basic
Superclass	Construct
Description	This class represents a basic constructs.

Name	Organisation
Superclass	Construct
Description	This class represents the organisation of a specific object.

Name	Formation
Superclass	Construct
Description	This class represents a formation of objects.

Name	Tendency
Superclass	Construct
Description	This class represents the tendency of an objects property or a situation.

Name	ObjectActivity
Superclass	Construct
Description	This class represents the activity of an object or an objects property.

Name	Outage
Superclass	Construct
Description	This class represents the level of outage of an object.

Name	Complex
Superclass	Construct
Description	This class represents complex information based constructs.

Name	Basic
Superclass	Construct
Description	This class represents a basic constructs.

Basic Constructs

Name	Area
Superclass	Construction → Basic
Description	A representation of an area.

Name	Mean
Superclass	Construction → Basic
Description	A representation of a mean or a way of solving a situation.

Name	Event
Superclass	Construction → Basic
Description	An event before or during an operation.

Name	Incident
Superclass	Construction → Basic → Event
Description	A malicious event.

Name	Threat
Superclass	Construction → Basic
Description	A representation of a hazardous situation or development.

Name	Stationary
Superclass	Construction → Basic
Description	A construct defining an object as immovable and/or not intended to be moved.

Name	Mobile
Superclass	Construction → Basic
Description	A construct defining an object as movable and intended to be moved.

Organisation Constructs

Name	FireFighting
Superclass	Construction → Organisation
Description	A construct defining an object as belonging to a fire-fighting organisation or the fire-fighting part of an operation.

Name	Rescue
Superclass	Construction → Organisation
Description	A construct defining an object as belonging to a rescue organisation or the rescue part of an operation.

Name	AmbulanceService
Superclass	Construction → Organisation
Description	A construct defining an object as belonging to an emergency medical organisation or the emergency medical part of an operation.

Name	Command
Superclass	Construction → Organisation
Description	A construct defining an object as belonging to the command part of an operation.

Name	Police
Superclass	Construction → Organisation
Description	A construct defining an object as belonging to a police organisation or the police part of an operation.

Name	Military
Superclass	Construction → Organisation
Description	A construct defining an object as belonging to a military organisation or the military part of an operation.

Name	Other
Superclass	Construction → Organisation
Description	A construct defining an object as belonging to a not defined organisation or a not defined part of an operation.

Formation Constructs

Name	Unit
Superclass	Construction → Formation
Description	A construct used to describe a collection of objects depending on their number.

Name	Brigade
Superclass	Construction → Formation
Description	A construct used to describe a collection of units.

Name	GovernmentalEchelons
Superclass	Construction → Formation
Description	A construct used to describe governmental structures.

Name	Squadron
Superclass	Construction → Formation → Unit
Description	A unit of up to three objects.

Name	Squad
Superclass	Construction → Formation → Unit
Description	A unit of up to five objects

Name	Group
Superclass	Construction → Formation → Unit
Description	A unit of up to nine objects.

Name	Company
Superclass	Construction → Formation → Unit
Description	A unit of more than nine objects.

Name	CommandSupportTeam
Superclass	Construction → Formation → Unit
Description	A unit specially indented to support the operation command.

Name	Municipality
Superclass	Construction → Formation → GovermentalEchelons
Description	A city or town belonging to a rural district or a county.

Name	County
Superclass	Construction → Formation → GovermentalEchelons
Description	A governmental area belonging to a district.

Name	District
Superclass	Construction → Formation → GovermentalEchelons
Description	Main subdivision of a (federal or free) state or country.

Name	FederalState
Superclass	Construction → Formation → GovermentalEchelons
Description	A federal state of a federal governed country.

Name	Country
Superclass	Construction → Formation → GovermentalEchelons
Description	A country of the world.

Name	EU
Superclass	Construction → Formation → GovermentalEchelons
Description	The European Union.

Tendency Constructs

Name	TendencyRising
Superclass	Construction → Formation → Tendency
Description	A rising tendency.

Name	TendencyUnchanged
Superclass	Construction → Formation → Tendency
Description	An unchanged or static tendency.

Name	TendencyFalling
Superclass	Construction → Formation → Tendency
Description	A falling tendency.

Object Activity Constructs

Name	LowActivity
Superclass	Construction → Formation → ObjectActivity
Description	A low activity of an object or an objects property.

Name	ModerateActivity
Superclass	Construction → Formation → ObjectActivity
Description	A moderate activity of an object or an objects property.

Name	IncreasedActivity
Superclass	Construction → Formation → ObjectActivity
Description	An increased activity of an object or an objects property.

Name	StrongIncreasedActivity
Superclass	Construction → Formation → ObjectActivity
Description	A strong increased activity of an object or an objects property.

Outage Constructs

Name	25PercentOutage
Superclass	Construction → Formation → Outage
Description	An outage of an object of about 25%.

Name	50PercentOutage
Superclass	Construction → Formation → Outage
Description	An outage of an object of about 50%.

Name	75PercentOutage
Superclass	Construction → Formation → Outage
Description	An outage of an object of about 75%.

Name	FullOutage
Superclass	Construction → Formation → Outage
Description	A complete outage of an object.

Complex Constructs

Name	Note
Superclass	Construction → Formation → Complex
Description	A note regarding an object, a construct or an activity.

Name	Assumption
Superclass	Construction → Formation → Complex → Note
Description	A note regarding an object, a construct or an activity that is an assumption.

Name	AcuteSituation
Superclass	Construction → Formation → Complex → Note
Description	A note regarding an object, a construct or an activity that contains an acute situation rather than an assuption.

4.2.7 Activities

Activities represent the ability of objects and constructs to do something. They are the interface of an object or construct to the world.

Main Activity Classes

Name	Task
Superclass	Activity
Description	A task carried out by a unit following an order.

Name	Movement
Superclass	Activity
Description	The movement of an object.

Task Activities

Name	Extinguishing
Superclass	Activity → Task
Description	The fighting of fires.

Name	Rescue
Superclass	Activity → Task
Description	The rescue of people and objects.

Name	RescueFromHightsAndDepths
Superclass	Activity → Task → Rescue
Description	Special rescue of people and objects from heights or depths.

Name	WaterTransport
Superclass	Activity → Task
Description	Transport of water including pumping.

Name	PumpingOut
Superclass	Activity → Task → WaterTransport
Description	Pumping out water out of buildings or vehicles.

Name	TechnicalAssistance
Superclass	Activity → Task
Description	Assistance with technical issues.

Name	Lifting
Superclass	Activity → Task
Description	Lifting of loads.

Name	Recovering
Superclass	Activity → Task
Description	Recovery of objects.

Name	Removing
Superclass	Activity → Task
Description	Removing of obstacles and objects. Clearing.

Name	ExplosiveOrdanceClearin
Superclass	Activity → Task → Removing
Description	Removing explosives.

Name	Blasting
Superclass	Activity → Task
Description	Blasting of Objects.

Name	Transport
Superclass	Activity → Task
Description	Transport of Objects.

Name	Lighting
Superclass	Activity → Task
Description	Lighting of areas.

Name	SearchWithRescueDogs
Superclass	Activity → Task
Description	Searching Objects and / or Persons with rescue dogs.

Name	FloodProtection
Superclass	Activity → Task
Description	Protecting areas against floods. Especially dikes.

Name	HazardMaterialResponse
Superclass	Activity → Task
Description	Dealing with hazardous materials.

Name	DetectingAndMeasuring
Superclass	Activity → Task
Description	Detection and measurement of substances.

Name	Decontamination
Superclass	Activity → Task
Description	Decontamination of objects and persons.

Name	RemovingEnvironmentalThreats
Superclass	Activity → Task
Description	Dealing with environmental threats, especially on water.

Name	MedicalService
Superclass	Activity → Task
Description	Application of (emergency) medical services to a person.

Name	Care
Superclass	Activity → Task
Description	Provision of care and assistance for persons.

Name	Accommodation
Superclass	Activity → Task
Description	Provision and organizing of accommodation for persons.

Name	Logistics
Superclass	Activity → Task
Description	Ensuring supply and provision of logistic services.

Name	Catering
Superclass	Activity → Task
Description	Provision of food and drinks.

Name	PowerSupply
Superclass	Activity → Task
Description	Provision of electric power.

Name	Maintenance
Superclass	Activity → Task
Description	Provision of maintenance and repair services.

Name	VeterinaryService
Superclass	Activity → Task
Description	Application of veterinary services to animals.

Name	Slaughthering
Superclass	Activity → Task
Description	Slathering of animals.

Name	Slaughthering
Superclass	Activity → Task
Description	Slaughthering of animals.

Name	Command
Superclass	Activity → Task
Description	Actions related to operation command.

Name	Communication
Superclass	Activity → Task
Description	Provision of communication means and networks.

Name	Reconnaissance
Superclass	Activity → Task
Description	Provision of information about the area and the situation.

Name	Warning
Superclass	Activity → Task
Description	Warning of citizens and operational personnel.

Movement Activities

Name	Direction
Superclass	Activity → Movement
Description	Direction of movement. Moving in a specific direction.

Name	AdvancingDirection
Superclass	Activity → Movement → Direction
Description	Movement of threats (e.g. fire) or (parts) of operation.

Name	BeginMovement
Superclass	Activity → Movement
Description	Beginning of a movement.

Name	EndMovement
Superclass	Activity → Movement
Description	End of a movement.

Name	TwoWayMovement
Superclass	Activity → Movement
Description	Moving in two ways.

4.3 Vertical modules development methodology concerning standard classifications

Emergency-domains (i.e., vertical modules) are being formalised collaboratively between the ontology engineers (with strong experience in OWL-based modelling) and the domain experts of the project: ANT, AIM and DBI. There are a number of non-ontological resources at national and European levels that are of EMERGEL interest. For instance, regarding crisis data representation in a given cartography, there exist different symbologies used in the European landscape. These differences pose a hindrance to interoperability in both international cross-border cooperation and national coordination of stakeholders. EMERGEL aims to incorporate these in-use schemes (taxonomies, data catalogues, cartographic symbologies, and so forth) into a common representation format, i.e., RDF, to enable the specification of semantic equivalences to drive data translation processes between IT crisis management systems.

Some options are available to specify these mappings between knowledge resources, ranging from heuristic-based semiautomatic generation to manual definition by experts. The former is more of a research topic that might not guarantee accurate results. The latter is backed by the knowledge of an expert. Moreover, these manual alignments can be validated by the experts community. Given the strong domain knowledge in the DISASTER consortium, it is reasonable to design a manual methodology to successfully involve consortium security experts in the ontology development loop.

This methodology is a 3-step workow, defined as following: Figure 4.4 shows a particular example of a translation between a Dutch map symbology and a German map symbology:

1. *Taxonomy creation and mapping specification*. The domain expert encodes original non-ontological resources and specifies correspondences between them in the form of a table that is specially formatted for further automatic processing.

2. *Automatic generation of SKOS taxonomies and RDF mappings (EMERGEL vertical modules)*. The taxonomies and classifications are automatically encoded in SKOS/OWL. The previous correspondences are automatically extracted from the table and converted to mappings defined in a technical format, i.e., SKOS vocabulary to taxonomies alignment.

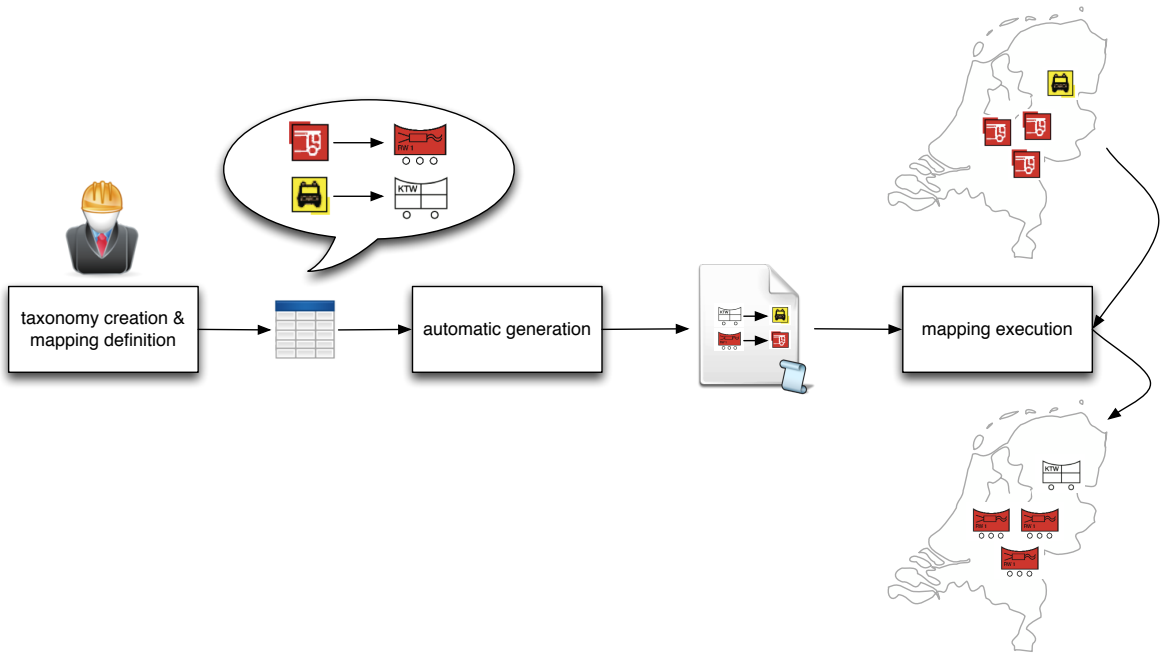
3. *Execution of mappings*. The mappings are available online as part of the EMERGEL ontology. They are used on demand by the mediation component (specified in D4.20) to perform a given data translation process.

These three steps are described in more detail in the following sections.

4.3.1 Taxonomy creation and equivalences specification

Despite the existing tools able to perform automatic generation of mappings, DISASTER approach is to exploit the domain knowledge of the consortium and formalise it as mappings, i.e., correspondences between two different in-use classifications or symbologies in the emergency field. The choice of tabular structures for representation of this knowledge has been made to lighten the burden of domain experts on this task, so they can focus on the work skipping their involvement in highly-technical IT knowledge management tools.

Figure 4.4: Processes involved in symbology translation applied to situational information maps for emergency responders



The initial structure of such spreadsheets has already been created so domain experts can start with the process. These spreadsheets are available as shared Google docs, so enhancing the collaboration between partners. Table 4.1 defines the content of each column.

4.3.2 Automatic generation of EMERGEL vertical modules

This process bridges the gap between the tabular format used to manually represent the classifications and the correspondences between them by the emergency-domain experts and the RDF-based final format. The choice of a tabular format is backed up by the broad support of translation tools available nowadays. As an example, the list gathered by `csv2rdf4lod-automation` team has more than 50 tools identified (and this is not the only compilation available). Most of the tools that cover this conversion rely on some type of transformation language used to specify the format of the output file applied to each column of the table. This requirement suggests a small export from our side to define what is the output format of choice for the mappings and formalise it on the tabular transformation tool language. As an example, the following diagram exemplifies a final EMERGEL representation of a Fire Station using both the German and Dutch icon sets. Notice that apart from the iconographic divergence, the meaning is the same and symbols are interchangeable in a given spatial representation. EMERGEL recycles SKOS machinery to declare semantic equivalences (i.e., mappings). In this case, mapping is expressed by means of the `skos:exactMatch` property.

4.3.3 EMERGEL mapping execution

The mappings between classifications are part of the EMERGEL specification, so publicly available. They provide added value to the project as are part of the solution to resolve the heterogeneity and diversity of available schemes used within the emergency domain. These mappings will be used on-demand by the mediation component to perform data transformation processes, such as mediation between different national map symbologies. How the mappings are actually executed is covered in further detail in D4.20.

4.3.4 Symbol classifications supported

Currently, the efforts transforming classifications (and mappings between them) into RDF format include 2 main types. On the one hand, a number of symbol classifications used in emergency situations by different countries. On the other, classifications of dangerous goods, chemical substances, etc. such as GHS/ADR, or codes from air transport agencies or aviation organisations. At the moment of this writing the whole collections of the British, Danish and German symbols are ready to be transformed into RDF format, including all the graphical files. Mappings between them are currently under study by all the participant partners. We briefly describe the symbol classifications that are already included in EMERGEL in the next subsections.

Table 4.1: Fields in the mapping definition table

Column	Contents
Concept name	The name of the concept. For instance, the ones: Ambulance, Truck, etc.
Concept ID	A code used to identify the concept in a given classification.
Description	A natural language text
Symbol URI	We are going to need a file with all the symbols compressed (all of them preferably in vector graphics). Each symbol should have a file name (with what in the future we expect to create URIs, but we are still thinking about that).
Label (German)	Alternative labels in German language for that concept. Understanding here labels as synonyms (i.e., a synset). Labels are separated with commas to easy their machine readability.
Label (Dutch)	Alternative labels in Dutch
Label (English)	Alternative labels in English
Label (Danish)	Alternative labels in Danish
Label (N language)...	Alternative labels in other language
Mappings (classification1)	A field to establish semantic equivalences between different symbologies
Mappings (classification 2)	Equivalences with another classification
Mappings (classification N)	Equivalences with another classification
Parent	This field enables capturing hierarchical relationships between concepts, for instance ambulance is a narrower concept than vehicles

UK Civil Protection Common Map Symbology

The UK symbol set[1] is the result of the efforts of the Civil Contingencies Secretariat in the Cabinet Office, working in partnership with Ministry of Defence and Ordnance Survey, to create a set of common map symbols[2]. They are linked to the common terminology of the Civil Protection Lexicon and they promote interoperability between emergency responders.

The symbol set is still considered and published as a statement of good practice, and its adoption is planned to promote interoperability and enable shared situational awareness. It is freely available for download in both SVG and BMP formats from the Ordnance Survey page and the symbol set is fully documented in the symbology description[3].

EMERGEL includes the entire symbol set featuring labels, categories and graphical files of the symbols in SVG format. A limited subset of symbols between this symbol set and the other national ones is already available in EMERGEL and for the second version of this deliverable it is expected that it include the entire mappings with other symbol sets.

Danish symbol set

The Danish authorities are currently developing a standard symbol set which will be adopted for the whole first responders in emergency situations within Denmark. The DISASTER consortium, thanks to the participation of DBI as partner, has been granted access to a first draft of this symbol set and the EMERGEL ontology has included it among the vertical modules featuring both labels and graphical files.

As of this writing EMERGEL includes a limited number of mappings with the rest of national symbol sets, which is expected to be fully covered in the second version of this deliverable.

German symbol set

The German Federal Office of Civil Protection and Disaster Assistance released a guidance document called Empfehlungen fr Taktische Zeichen im Bevlkerungsschutz. It is a report in PDF edited by the BBK (Bundesamt fr Bevlkerungsschutz und Katastrophenhilfe)[4] that contains suggestions for the use of tactical symbols to represent situational information.

The symbols are based on tactical symbols used by the military forces. They consist of a basic symbol representing the basic kind of unit (vehicle, formation, building), a colour, representing the organisation of the unit and a special indication drawn into the unit symbol representing the special qualification of the unit (extinguishing, CBRN etc.). The symbol set is extended by symbols indicating danger zones, collapsed buildings and fires. These symbols can indicate the size of the fire or damage by repeated use of the same symbol.

[1] https://www.gov.uk/government/publications/emergency-responder-interoperability-common-map-symbols

[2] http://www.ordnancesurvey.co.uk/oswebsite/support/knowledgebase/symbols-for-emergencies.html

[3] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/168057/Civil_Protection_Common_Map_Symbology_V1-0_March_2012.pdf

[4] www.bbk.bund.de

EMERGEL has so far included the whole list of labels for this classification and it is expected that the full mappings between them and the rest of national symbol sets can be covered for the second version of this deliverable, as currently only a limited number of mappings has been produced.

4.3.5 Other non-symbolic classifications or controlled vocabularies

On the other hand, EMERGEL consider as well other kind of classifications, thesauri and vocabularies in general. For this first deliverable D3.31 (D3.32 will be its second part) EMERGEL features a number of them, which are presented in the following subsections.

UN numbers, GHS/ADR, ADN, etc.

EMERGEL is expected to cover different classifications focusing on hazardous and dangerous goods and substances, namely:

- **UN numbers** (sometimes simply UN IDs)[5] are four-digit numbers that identify hazardous substances, and articles (such as explosives, flammable liquids, toxic substances, etc.) in the framework of international transport. UN numbers range from UN0001 to about UN3500 and are assigned by the United Nations Committee of Experts on the Transport of Dangerous Goods.

- **GHS**: The United Nations internationally agreed-upon system Globally Harmonized System of Classification and Labelling of Chemicals[6], designed to replace the various classification and labelling standards used in different countries by using more consistent criteria. It is designed to replace the various classifications and labelling standards used in different countries by using consistent criteria for classification and labelling on a global level.

- **ADR** (from the French abbreviation Accord européen relatif au transport international des marchandises Dangereuses par Route) refers to the European Agreement concerning the International Carriage of Dangerous Goods by Road and it governs transnational transport of hazardous materials.

- **IMDG** (International Maritime Dangerous Goods) is a uniform international code for the transport of dangerous goods by sea covering such matters as packing, container traffic and stowage, with particular reference to the segregation of incompatible substances.

- **RID/COTIF**: International carriage of dangerous goods by rail within Europe; Convention Concerning International Carriage by Rail. They regulate transnational transport of hazardous materials by train.

- **ADN**: The International Carriage of Dangerous Goods by Inland Waterway contain provisions concerning dangerous substances and articles, their carriage in packages and in bulk on board inland navigation vessels or tank vessels.

[5] http://www.unece.org/trans/danger/danger.html
[6] http://www.unece.org/trans/danger/publi/ghs/ghs_welcome_e.html

Basically, all the above classifications are based upon the UN numbers but all of them add some specific features which are interesting for first responders in emergency situations.

EMERGEL currently includes the full list of transport pictograms for the division and classes of GHS and ADR, as well as full information about the substances represented by them. Additionally, other related pictograms referring to radioactive hazards are also included, even if they do not officially belong to GHS or ADR. Mappings with the corresponding IATA handling codes are also available, as explained in the next section. The rest of classifications mentioned can be mapped through the UN numbers.

IATA codes

The International Air Transport Association (IATA) is an international industry trade group of airlines headquartered in Montreal, Quebec, Canada, where the International Civil Aviation Organisation (ICAO) is also headquartered. The executive offices are at the Geneva Airport in Switzerland. IATA's mission is to represent, lead, and serve the airline industry. IATA represents some 240 airlines comprising 84% of scheduled international air traffic. Currently, IATA is present in over 150 countries covered through 101 offices around the globe.

The IATA codes[7] are an integral part of the travel industry, and also important for the identification of an airline, its destinations and its traffic documents. They are also key to the simple running of several electronic applications which have been built based upon these coding systems for passenger and cargo traffic purposes. Currently, EMERGEL includes the following subsets of the IATA codes:

- IATA handling codes for goods: The codes used by IATA for handling the different goods transported in planes defined by the International Air Transport Association (IATA).
- IATA DGR (Dangerous Goods Regulations): It is IATAs guide to shipping Dangerous Goods by air. It enables shippers, forwarders, and carriers to have the tools and resources to ship dangerous goods safely.
- IATA airport codes: Also known an IATA location identifier, IATA station code or simply a location identifier, it is a three-letter code designating many airports around the world.
- IATA country codes: the codes used by IATA to identify countries (based upon the ISO country codes).
- IATA aircraft codes: the codes used by IATA to identify aircrafts.
- IATA airlines and/or companies codes: the codes used by IATA to identify airlines and similar air companies.

All these codes (except the IATA DGR) have been already added to EMERGEL and, as of this writing, a number of mappings with the ICAO equivalent codes have been already obtained. Also, crucial mappings between the IATA codes and the transport pictograms of the GHS/ADR subsets for dangerous substances are already available in EMERGEL. The rest of them will be the aim of this deliverable second version.

[7] http://www.iata.org/services/Pages/codes.aspx

ICAO codes

The International Civil Aviation Organisation (ICAO)[8] is a specialised agency of the United Nations. It codifies the principles and techniques of international air navigation and fosters the planning and development of international air transport to ensure safe and orderly growth. Its headquarters are located in Montreal, Quebec, Canada.

The ICAO Council adopts standards and recommended practices concerning air navigation, its infrastructure, flight inspection, prevention of unlawful interference, and facilitation of border-crossing procedures for international civil aviation. In addition, the ICAO defines the protocols for air accident investigation followed by transport safety authorities in countries signatory to the Convention on International Civil Aviation, commonly known as the Chicago Convention.

The Air Navigation Commission (ANC) is the technical body within ICAO. The Commission is composed of 19 Commissioners, appointed by the Council. Commissioners serve as independent experts, who although nominated by their states, do not serve as state or political representatives. The development of Aviation Standards and Recommended Practices is done under the direction of the ANC through the formal process of ICAO Panels. Once approved by the Commission, standards are sent to the Council, the political body of ICAO, for consultation and coordination with the Member States before final adoption.

At the moment of this writing, EMERGEL includes the following subsets of the ICAO codes:

- ICAO airport codes: A four-character alphanumeric code designating each airport around the world according to the International Civil Aviation Organization (ICAO). ICAO codes are used by air traffic control and airline operations such as flight planning. They differ from IATA codes, which are generally used for airline timetables, reservations, and baggage tags. For instance, the IATA code for London's Heathrow Airport is LHR and its ICAO code is EGLL.
- ICAO aircraft codes: the codes used by ICAO to identify aircrafts.
- ICAO nationality codes: the codes used by IATA to identify countries/nationalities.
- ICAO call signs: Common reference name for airlines to be used by operators. For instance, Murman is the call sign for the Murmansk Aviation Enterprise, LLC.
- ICAO airlines and/or companies codes: the codes used by ICAO to identify airlines and similar air companies.

All these ICAO codes subsets have been already added to EMERGEL and, at the moment of this writing, a number of mappings with their IATA equivalent codes have been already obtained. The rest of them will be the aim of this deliverable second version.

[8] http://www.icao.int/

Chapter 5

EMERGEL alignment with upper-level vocabularies

EMERGEL has been designed to aligned with some upper-level government-ground vocabularies designed by the W3C consortium and the European JoinUP platform[1]. These vocabularies play two roles with respect to EMERGEL. On the one hand, they allow EMERGEL to incorporate into a general description framework of standardise vocabularies at the European (even international) level. On the other hand, their top-level structure enables domain-specific classifications and vocabularies (vertical modules) to be connected and integrated in the single semantic space of EMERGEL.

5.1 EMERGEL connected to semantic assets

Despite of their importance, standards are not easily discoverable on the web via search engines because metadata about them is rarely available. Navigating on the websites of the different publishers of standards is usually not productive either. That is why EMERGEL with the help of some upper-level government-ground standard vocabularies tries to make sense of the complex multi-publisher environment around standards and in particular the ones which are semantic assets such as ontologies, data models, data dictionaries, code lists, XML and RDF schemas.

A semantic asset is a specific sort of standard which imbroils highly reusable metadata and/or reference data. Typically companies and organisations use semantic assets to share information and knowledge (within themselves and with others). Semantic assets are usually very valuable and reusable elements for the development of Information Systems, in particular, as part of machine-to-machine interfaces. As enablers to interoperable information exchange, semantic assets are usually created, published and maintained by standardisation bodies. Nonetheless, ICT projects and groups of experts also create such assets. There are therefore many publishers of semantic assets with different degrees of formalism.

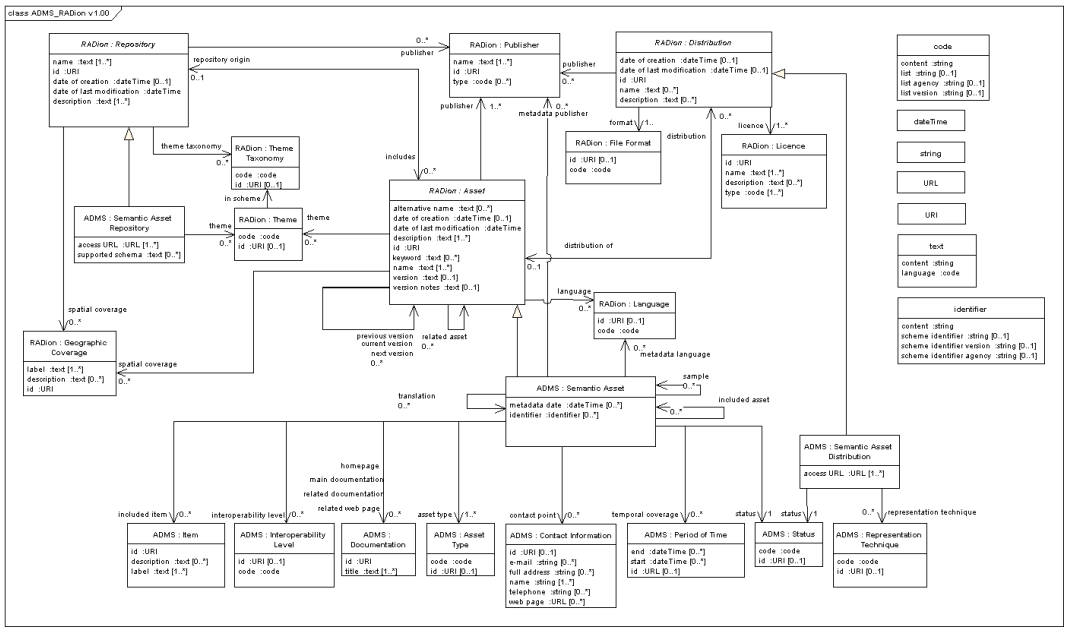
[1] https://joinup.ec.europa.eu/

5.1.1 ADMS and adjacent pillars

ADMS[2] is an OWL standardised metadata vocabulary created by the EU's Interoperability Solutions for European Public Administrations (ISA) Programme[3] of the European Commission to describe semantic assets, their repositories and this way help publishers of standards document what their standards are about (their name, their status, theme, version, etc) and where they can be found on the Web. ADMS descriptions can then be published on different websites while the standard itself remains on the website of its publisher (i.e. syndication of content).

ADMS embraces the multi-publisher environment and, at the same time, it provides the means for the creation of aggregated catalogues of standards and single points of access to them based on ADMS descriptions. The Commission is supposed to offer a single point of access to standards described using ADMS via its collaborative platform, Joinup. The Federation[4] service increase the visibility of standards described with ADMS on the web. This also tries to stimulate their reuse by Pan-European initiatives. In addition to ADMS, another couple of vocabularies mut be taken

Figure 5.1: UML Model of ADMS

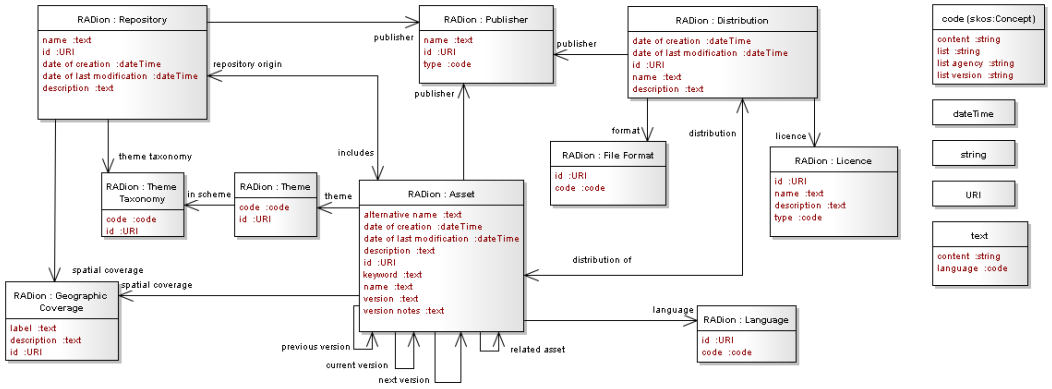


into account with respect to the fitting of EMERGEL vertical modules. As shown in Figure 5.1, ADMS builds upon RADion (Repository Asset Distribution)[5], a high-level vocabulary intended to facilitate the federation and co-operation of semantic assets repositories. It aims to act as a common layer among repositories that want to exchange data. Because the key class names in this model are Repository, Asset and Distribution, the model got the name RADion. This is shown in Figure 5.2. RADion was also developed under the European Commission's ISA Programme.

Finally, the third leg of this upper-level government-ground vocabularies is DCAT (Data Catalog

[2] http://joinup.ec.europa.eu/asset/adms/home
[3] http://ec.europa.eu/isa/
[4] https://joinup.ec.europa.eu/elibrary/document/adms-enabled-federation-semantic-asset-repositories-bro
[5] http://www.w3.org/ns/radion

Figure 5.2: RADion UML Class Diagram



Vocabulary)[6], an RDF Schema vocabulary for metadata about structured data resources, such as datasets or catalogs. By using DCAT to describe datasets in data catalogs, publishers increase discoverability and enable applications easily to consume metadata from multiple catalogs. It further enables decentralised publishing of catalogs and facilitates federated dataset search across sites. Figure 5.3 illustrates how DCAT easily connects with some of the SKOS classes used by EMERGEL, and the class `skos:ConceptScheme` is the suitable anchor to link EMERGEL with `adms:ConceptScheme` and `radion:Asset` providing that way a vertical modularity.

5.1.2 Future work

Further steps in this line will be worked out to fully incorporate EMERGEL to the framework of these vocabularies. As mentioned in section 1.1, initial contacts have been made with the Government Linked Data Working Group[7] to negotiate the publication of EMERGEL within W3C's hosting. This demands a fully compliance with the JoinUp platform principles, and some other pertinent vocabulary anchors from EMERGEL to these vocabularies must be defined.

It is worth noticing that EMERGEL embracing of these initiatives permits it to be a consortium-open product, leaving the door open and welcoming future third-party extensions and contributions.

[6] http://www.w3.org/TR/vocab-dcat/
[7] www.w3.org/2011/gld/

Figure 5.3: Example providing a quick overview of how dcat might be used to represent a government catalog and its datasets