

Domain Ontology for the Analytic Technology Industry Roundtable's Analysis Exchange Model 1.0

1. Introduction

The AE ontology is conceptually split between 3 layers. The upper layer as described in "AE Ontology_V2.docx ", a middle layer, and a domain layer. This document describes the concepts that are in the domain layer. The AE domain layer is a combination of vendor inspired concepts and concepts that are vendor neutral yet necessary to support specific use cases. The AE domain layer contains concepts that are used to model the semantics of the various analytic results. The analytics results that are modelled are limited to those that are generated by analytics that the AE initiative supports. It should be noted that some of the analytic results can be modelled with concepts in the middle layer since the middle layer ideally contains domain independent concepts.

2. Domains

The development of the AE ontology is directly influenced by the use cases that were developed for the AE initiative. As such, the domains are tightly coupled to the uses cases. The use cases for which classes and properties have been added to the AE ontology are listed below.

2.1. Fraud Use Case

This use case is based on the submissions of fraudulent vouchers. In particular, we focus on a travel voucher scenario in which patients may request reimbursement for travel to facilities for medical treatment. In this scenario, the medical institutions need to recognize vouchers that are legitimate and avoid funding those that are not. Fraudulent vouchers may be submitted by travel providers that offer transportation services for patients that are unable to commute independently.

The fraud may exist as excessive fees, incorrect distances traveled, incorrect dates of travel, and non-existent travel events among others.

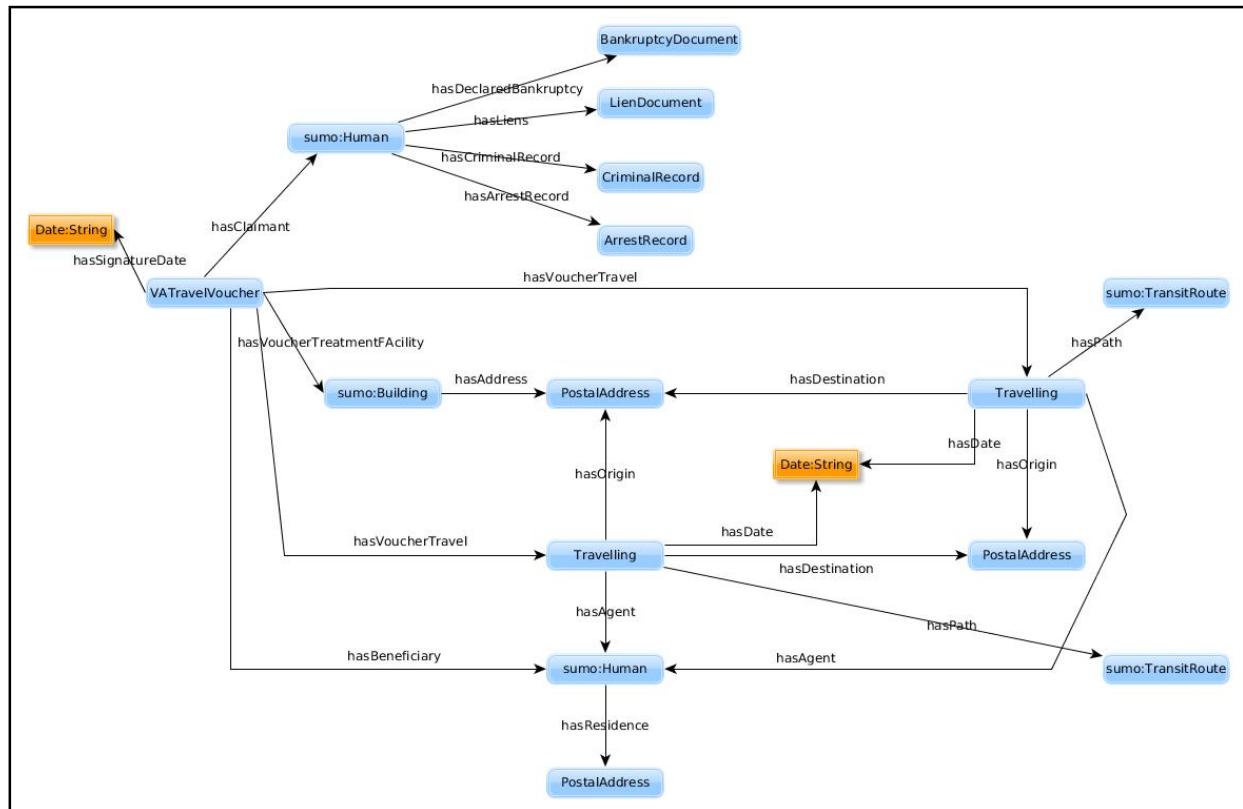


Figure 1: VA Travel Voucher Model

2.1.1. Competency Questions

Q1: How many vouchers did PersonX submit between January 1, 2017 & January 31, 2017 that included travel distances greater than 50 miles?

Q2: Has PersonX submitted requests for toll reimbursement despite the fact that the shorter routes between his home and the destination facility does not contain toll routes?

2.1.2. Classes

VATravelVoucher

- @MITRE “Veteran/Beneficiary Claim For Reimbursement of travel expenses. Derived from VA FORM 10-3542 Nov 2013”

Instances of the `VATravelVoucher` class represent a travel voucher that was submitted for reimbursement. These instances will contain all the information pertaining to a single VA FORM 10-3542 claim form.

`VATravelVoucher` is a subclass of `Voucher`. As such, it inherits all the properties expressed on `Voucher` in the AE Ontology. These include “`hasAdditionalExpenses`” and “`hasVoucherExpense`”.

The expenses expressed via “`hasAdditionalExpenses`” and “`hasVoucherExpense`” can be used along with the distance between the travel end points to identify potential fraudulent claims. The expenses should be consistent with typical expenses incurred during travel between the endpoints recorded in the `Travelling` instances.

`Travelling`

- @MITRE “A travel event from one location to another location”.

Instances of the `Travelling` class have origin and destination assertions identified by “`hasOrigin`” and “`hasDestination`”. The objects of the aforementioned assertions are instances of `PostalAddress`. Instances of the `Travelling` class also have travel dates identified by “`hasDate`”. The “`hasAgent`” property is used to assert the individual that is travelling. In this use case, the individual that is travelling should be the beneficiary of the `VATravelVoucher` instance.

Instances of the `Travelling` class inherit the “`hasPath`” property from the “`sumo:Motion`” class. “`hasPath`” is used to assert instances of “`sumo:TransitRoute`”.

`sumo:TransitRoute`

- @SUMO “TransiteRoute is the class of Regions that are paths for Motion from one place to another.” [1]

Instances of the `sumo:TransitRoute` has travel expense and time assertions identified by “`hasAdditionalExpense`” and “`hasExpectedTravelTime`” properties. Region information is asserted with “`hasStartRegion`” and “`hasEndRegion`” to assert the start and end points of travel routes.

`PostalAddress`

- @Wiktionary “The address (of a person or business) to which mail is delivered, as distinct from the actual street address.”

Instances of the `PostalAddress` class have street, city, and state assertions identified by “`hasStreet`”, “`hasCity`”, “`hasState`” respectively. A `PostalAddress` may also be associated with latitude and longitude coordinates expressed with “`hasLatitude`” and “`hasLongitude`” respectively.

The `PostalAddress` instances are used to determine travel distances and potential travel routes.

`BankruptcyDocument`

- @MITRE “A document describing the details of a bankruptcy file.” Instances of `BankruptcyDocument` are associated with instances of `sumo:Human` via the “`hasDeclaredBankruptcy`” property.

`LienDocument`

- @MITRE “A document describing property that is the target of a legal lien.”

`CriminalRecord`

- @MITRE “A document containing accounts of criminal activity attributed to an individual.” Instances of `CriminalRecord` are associated with instances of `sumo:Human` via the “`hasCriminalRecord`” property.

`ArrestRecord`

- @MITRE “A document containing accounts of arrests of a particular person.” Instances of ArrestRecord are associated with instances of sumo:Human via the “hasArrestRecord” property.

Instances of BankruptcyDocument, LienDocument, CriminalRecord, and ArrestRecord can be used to profile the individuals that submit VATravelVoucher forms. These profiles can be used to gauge the trustworthiness of the individuals submitting the forms.

2.2. Threat Analysis Use Case

This use case is based on gauging the threat posed by terrorist organizations. In particular, we focus on supporting capabilities that reduce the costs of doing complex data exploration and increase the effectiveness in identifying trends and patterns of targeted violent events over time and space. In this scenario, terrorist organizations engage in attacks and government organizations want to identity and assess threats as soon as possible and neutralize specific threat actors.

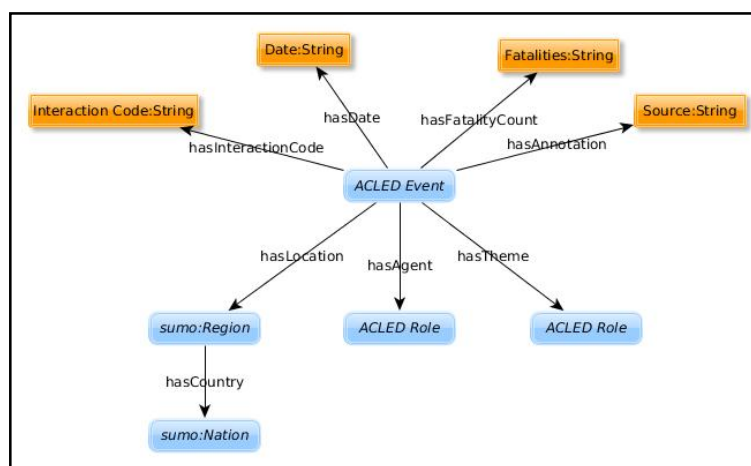


Figure 2: Threat Analysis Model

2.2.1. Competency Questions

Q1: How many people died as a result of the terrorist attack?

Q2: What is the distribution of weapons used in terrorist attacks between June 1, 2017 and August 1, 2017?

2.2.2. Classes

ACLED Event in Figure 2 is a place holder for several types of events that are subclasses of “sumo:Process” in the AE Ontology. These classes all inherit the properties defined on “sumo:Process”. The event model is discussed in “AE Ontology_V2.docx”. An instance of an ACLED Event can have an interaction code identified by “hasInteractionCode” which denote the types of individuals that are mentioned in the ACLED Events, a fatality count identified by “hasFatalityCount” which asserts the number of individuals that died, and a source indicator identified by “hasAnnotation” which asserts the organization that provided the event details.

ACLED Event is one of the following:

NoChangeOfTerritoryBattle

- @ACLED “A battle in which there is no change in the control of a location that is contested.” [2]

OvertakeTerritoryBattle

- @ACLED “A battle in which a group takes control of a territory.” [2]

RegainTerritoryBattle

- @ACLED “A battle in which the government regains control of a location.” [2]

EstablishBase

- @MITRE “The act of establishing control over an area or building.”

StrategicDevelopment

- @MITRE “The act of accomplishing a goal that contributes to the success of a bigger goal.”

Protest

- @Wikipedia “A protest (also called a remonstrance, remonstrations or demonstration) is an expression of bearing witness on behalf of an express cause by words or actions with regard to particular events, policies or situations. Protests can take many different forms, from individual statements to mass demonstrations. Protesters may organize a protest as a way of publicly making their opinions heard in an attempt to influence public opinion or government policy, or they may undertake direct action in an attempt to directly enact desired changes themselves. Where protests are part of a systematic and peaceful campaign to achieve a particular objective, and involve the use of pressure as well as persuasion, they go beyond mere protest and may be better described as cases of civil resistance or nonviolent resistance.

CivilianAttack

- @MITRE “An attack event in which the victims are civilians.”

TerritoryTransfer

- @MITRE “An event in which one group takes over control of a land area from another group.”

RemoteAttack

- @ACLED Remote violence refers to events in which the tool for engaging in conflict did not require the physical presence of the perpetrator. [2]

ACLED Role in Figure 2 is a placeholder for several types of social roles that are subclasses of “sumo:SocialRole” or groups that are subclasses of “sumo:Organization”. An instance of a ACLED Role is a participant in an ACLED Event. The participation is either passive or active. The relationship between the ACLED Role instance and an ACLED Event can be used to gather behavioral statistics to determine an entity’s threat profile. The “hasAgent” property is used to assert the entity that actively engages in an event typically as the initiator. The “hasTheme” property is used to assert the entity that is typically acted upon in an ACLED Event. The

distribution of ACLED Role types that are objects of the “hasTheme” property assertions can be used to gather statistics as part of an entity’s threat profile.

ACLED Role is one of the following:

GovernmentForce

- @MITRE “A group of people that forms a force that is associated with a formal government.”

RebelForce

- @Wikipedia “Rebellion, uprising, or insurrection is a refusal of obedience or order. It refers to the open resistance against the orders of an established authority. The term comes from the Latin verb *rebellō*, “I renew war” (from *re-* (“again”) + *bellō* (“I wage war/I revolt”). The rebel is the individual that partakes in rebellion or rebellious activities, particularly when armed. Thus, the term rebellion also refers to the ensemble of rebels in a state of revolt.”
- @MITRE “A rebel force is a group of people supporting a rebellion.”

PoliticalMilitia / EthnicMilitia

- @Wikipedia “A militia /mɪˈlɪʃə/ is generally an army or some other type of fighting unit that is composed of non-professional fighters, citizens of a nation or subjects of a state or government who can be called upon to enter a combat situation, as opposed to a professional force of regular, full-time military personnel, or historically, members of a warrior nobility class (e.g., knights or samurai). Unable to hold their own against properly trained and equipped professional forces, it is common for militias to engage in guerrilla warfare or defense instead of being used in open attacks and offensive actions.”

Rioter

- @Wikipedia “A riot (/ˈraɪət/) is a form of civil disorder commonly characterized by a group lashing out in a violent public disturbance against authority, property or people. Riots typically involve vandalism and the destruction of property, public or private. The property

targeted varies depending on the riot and the inclinations of those involved. Targets can include shops, cars, restaurants, state-owned institutions, and religious buildings.”

- @MITRE “A rioter is a social role applied to an individual who engages in a riot.”

Protester

- @Wikipedia “A protest (also called a remonstrance, remonstrance or demonstration) is an expression of bearing witness on behalf of an express cause by words or actions with regard to particular events, policies or situations. Protests can take many different forms, from individual statements to mass demonstrations. Protesters may organize a protest as a way of publicly making their opinions heard in an attempt to influence public opinion or government policy, or they may undertake direct action in an attempt to directly enact desired changes themselves. Where protests are part of a systematic and peaceful campaign to achieve a particular objective, and involve the use of pressure as well as persuasion, they go beyond mere protest and may be better described as cases of civil resistance or nonviolent resistance.”
- @MITRE “A protester is a social role applied to an individual who engages in a protest.”

sumo:Civilian

- @SUMO “Someone who is not a member of an active MilitaryOrganization.” [1]

ExternalForce

- @MITRE “A group of individuals that form a “force” that is not formerly associated with a political, ethnic, nor government organization.”

3. References

[1] "Suggested Upper Merged Ontology," [Online]. Available: <http://www.adampease.org/OP/>.

- [2] R. Clionadh, A. Linke, H. Hegre and J. Karlsen, "Introducing ACLED-Armed Conflict Location and Event Data," *Journal of Peace Research*, vol. 47, no. 5, pp. 651-660, 2010.
- [3] M. Taylor, "Upper Ontology for the Analysis Exchange Model 1.0," Analytic Technology Industry Roundtable, 2017.