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OF TRENTO - Italy



DIPARTIMENTO DI INGEGNERIA E SCIENZA DELL'INFORMAZIONE

– KNOWDIVE GROUP –

# KDI 2021 - Trentino Transportation

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## Revision History:

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0.3	16.10.2021	Xuanli Li	Added todo support for document development
0.4	17.10.2021	Carlo Corradini and Xuanli Li	Project purpose and formalization
0.5	19.10.2021	Carlo Corradini	Data resources collection
0.6	20.10.2021	Xuanli Li	Knowledge Graph description and Knowledge level
0.7	22.10.2021	Xuanli Li	Data Level and Evaluation
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0.26	05.12.2021	Xuanli Li	Resources description
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0.29	15.12.2021	Carlo Corradini and Xuanli Li	Open issues
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0.32	19.12.2021	Carlo Corradini and Xuanli Li	Conclusions

# 1 Introduction

This Chapter illustrates the main idea about this Trentino Transportation Project through five aspects.

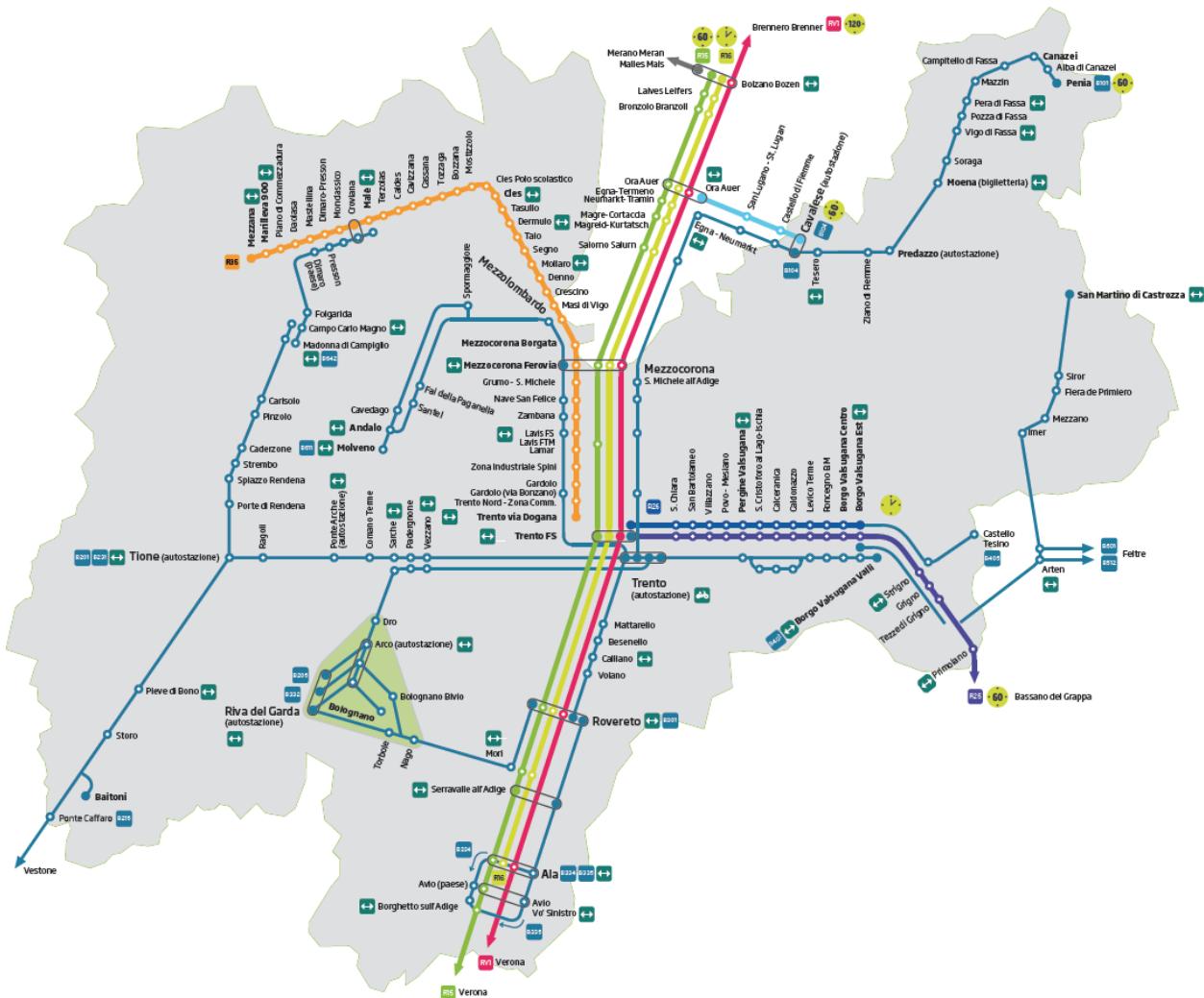


Figure 1.1: Trentino's transport network

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## 1.1 General Material

All the resources shown are available at the following URL:

[https://drive.google.com/drive/folders/12p27IFsmy9Us4AD2lw\\_0fEv1k7BaIMk?usp=sharing](https://drive.google.com/drive/folders/12p27IFsmy9Us4AD2lw_0fEv1k7BaIMk?usp=sharing)



## 1.2 Knowledge Graph Description

This project aims to integrate more data and information about Trentino transportation and present them via the standard data and information format used for the General Transit Feed Specification(GTFS).

GTFS includes static or realtime transit, which defines a common format for public transportation schedules and associated geographic information. GTFS "feeds" let public transit agencies publish their transit data and developers write applications that consume that data in an interoperable way.

However, except for the information of train and bus, there is little information about car and bike sharing as well bike stations. The innovation of our project will improve the provision of diverse transportation service information for users so that they will have more choices and spend less time or money to finish their trips.

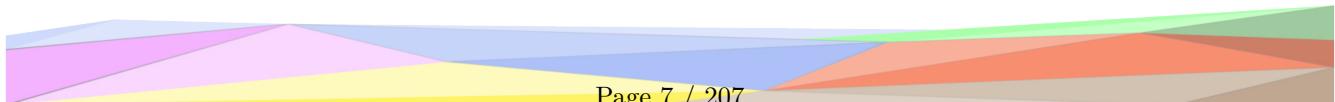
## 1.3 Knowledge Level

Firstly, we considered that GTFS and schemas offered by Schema.org can be considered as the significant reference teleologies concerning the transportation domain of interest since they provide the related Etypes, corresponding properties, and the relationship among the Etypes. Especially GTFS has become one of the most important standard format to describe the data in the transportation field.

Based on the specific aim, we described some competency questions and formalize them, which helped us figure out the Etypes and their properties. Furthermore, the ER was constructed associated with the Etypes and corresponding object as well as data properties. Ultimately, the ontology and the Entity Graph were built in compliance with the ER model.

## 1.4 Data Level

We focus on collecting, processing, and aligning specific Entity and their values on the data level. To be more specific, we collected the datasets as much as possible with respect to transportation. Then there was a screening process executed during the informal modeling phase since the useful Etype(s) were further confirmed. At last, the datasets were decomposed and recombined in line with the new schema.



#### 1.4.1 Datasets Generic Overview

The 7 initial datasets we used in total and the brief descriptions are delineated below:

- **Trentino Trasporti**

<https://www.trentinotrasporti.it/open-data>

Trentino Trasporti offers users the data of bus, train, and cable car in the format of GTFS. This dataset has a different text file and each file represents an aspect of data, like routes, stops, agency etc.

- **Trasporti pubblici del Trentino**

<https://dati.trentino.it/dataset/trasporti-pubblici-del-trentino-formato-gtfs>

Trentino Trasporti extended dataset containing fares information. The Trentino Trasporti dataset available on the official site does not contain information about ticket prices and payment methods. Therefore, this dataset is an extension that contains both the information contained in the official dataset and information about prices. Note that the official dataset is updated regularly weather this every six months only. In GTFS the information about fares are respectively fare\_attributes.txt and fare\_rules.txt.

- **Parcheggio protetto per biciclette**

<https://dati.trentino.it/dataset/parcheggio-protetto-per-biciclette-open-data>

This dataset is provided by the Municipality of Trento, which is the data about three protected car parks for bicycles. The attributes comprise the names, location, slots, and so on.

- **Stazioni Bikesharing**

<https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino>

This dataset shows the situation of the bike sharing stations near different city's municipalities. The main attributes including the station location, the available bike, and empty slots etc.

- **Centro in bici**

<https://dati.trentino.it/dataset/c-centro-in-bici-open-data>

The dataset offers the data about bicycle rental service for public use for travel within the city center. It still displays different properties, that is, the location, number of total bikes, contact, and so on.

- **Car sharing**

<https://dati.trentino.it/dataset/car-sharing-open-data>

This dataset demonstrates the data of the Car sharing vehicles within Trentino. It shows the location of sharing car station, the id, the car availability of the stations, etc.

- **Taxi**

<https://dati.trentino.it/dataset/taxi-open-data>

The dataset manifests the data about the taxi within the municipal area. It reveals the some attributes such as location, price, telephone, and so on so forth.

### 1.4.2 Datasets Metadata

The metadata documentations and graphs of the datasets can be found in the chapter regarding the Informal Modeling phase.

## 1.5 Evaluation

Evaluation aims to provide a big picture about the modeling status in order to be exploited as a driver for the modeling. In order to monitor the process, evaluations are supposed to be executed in every phase.

There are four principal metrics, that are, Coverage (Cov), Extensiveness (Ext), Sparsity (Spr), and Cue Validity (Cue). The concrete definitions and equations are displayed below.

- The Coverage is computed as the ration between the intersection of  $\alpha$  and  $\beta$  and the whole  $\alpha$  sets, which can be represented in Formula 1.1.

$$Cov = \frac{\alpha \cap \beta}{\alpha} \quad (1.1)$$

- The Extensiveness is computed as the proportional amount of knowledge provided by  $\beta$  with respect to the whole knowledge set, which is described as Formula 1.2

$$Ext = \frac{\beta - (\alpha \cap \beta)}{(\alpha + \beta) - (\alpha \cap \beta)} \quad (1.2)$$

- The Sparsity is computed as the sum among the percentage of  $\alpha$  not defined in  $\beta$  and vice-versa, which is shown in Formula 1.3.

$$Spr = \frac{(\alpha + \beta) - 2(\alpha \cap \beta)}{(\alpha + \beta) - (\alpha \cap \beta)} \quad (1.3)$$

- The Cue validity is to evaluate the performance of Cue that is a set of metrics to measure the quality of the Etype/ETG, which is shown in Formula 1.4 and 1.5.

1. Cue for Etype

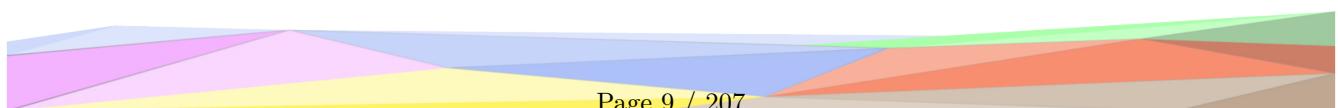
$$Cue_e(e) = \sum_{i=1}^{|prop(e)|} Cue_p(p_i, e) \in [0, |prop(e)|] \quad (1.4)$$

2. Cue for ETG:

$$Cue_k(K) = \sum_{i=1}^{|E_K|} Cue_e(e_i) \in [0, |prop(K)|] \quad (1.5)$$

## 1.6 Content Structure

The current document aims to provide a detailed report of the DI project developed following the iTelos methodology. The report is structured, on top, to describe:



- Chapter 2: The project's purpose and the resources involved (both schema and data resources) in the integration process.
- Chapter 3, 4, 5, 6: The integration process along the iTelos phases.
- chapter 7 & 8: The open issues and how the result of the integration process (KGs) can be exploited.

## 1.7 Representation Diversity

We have *Semantic Heterogeneity* (e.g., in language, KBs, DBs) when there are differences in how the same real-world phenomenon is represented.

Semantic heterogeneity arises whenever we have KBs and DBs developed by independent parties (in space and time).

We take *Representation Diversity* to mean semantic heterogeneity, as organized in the four components of the concept, language, knowledge, and data[2].

### 1.7.1 Levels

Representation diversity occurs in:

1. The different concepts used to denote the same entity.
2. The different terms and meanings used in language.
3. The different entity types and the properties used.
4. The different entities and the property values used.



We categorize representation diversity in 4 levels:

#### 1.7.1.1 L1 | Conceptual Diversity

The notion of concepts is well known in *Philosophy of Mind* and in *Computational Linguistics*.

Concepts must be taken to be *unique linguistic identifiers*

Concepts are organized in multiple hierarchies, in terms of "*hypernym-hyponym*" links. E.g: *Car* or *Vehicle*?

#### 1.7.1.2 L2 | Language Diversity

Languages, taken in a very broad sense to include: *Natural languages, Namespaces, and Formal languages*.

Linguistic phenomena like *polysemy* and *synonymy* allow for diverse representation of entities.

*Many-to-many* mapping between words and concepts, both within the same language and across languages. E.g: *Nameplate* in *English* and *Targa* in *Italian*.



### 1.7.1.3 L4 | Knowledge Diversity

Knowledge is modeled as a set of *entity types*, also called *Etypes*: "Classes of entities with associated properties".

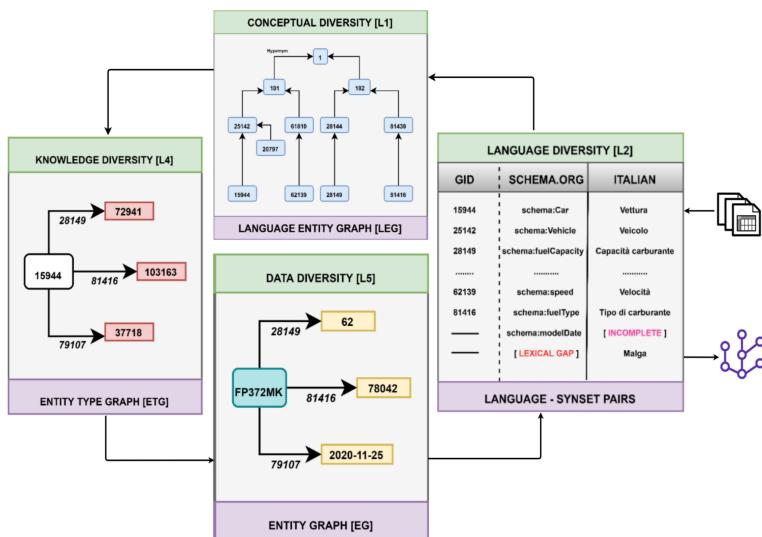
Knowledge diversity arises from the *many-to-many* mapping between *Etypes* and the *properties* employed to describe them and can appear in two different forms. E.g: *Same Etype Car associated with different groups of properties*.

### 1.7.1.4 L5 | Data Diversity

The Data is modeled as entities, each associated with property values, where properties are inherited from the Etype of the entity.

Exists because the fact that the *mapping between entities* and the *property values* used to describe them is *many-to-many*. E.g: *Same entity car "FP372MK" but with different velocities*.

## 1.7.2 Architecture



The language representation layer (L2) appears first and last in the architecture. L2 enforces the input and the output dependence of the representation of data and the user language. In fact, language is the key enabler of the bidirectional interaction between users and the platform. In the first phase, the L2 input language is translated into the system-internal L1 conceptual language and the input language is only resumed during the last step, when the results of the Data Integration steps are represented back to the user.

In this process, L2 is key in keeping completely distinct the multilingual user-defined data representation and the linguistic system-level data representation.

The management of conceptual diversity (L1) involves the organization of the L1 linguistic concepts, as identified in the first step, into a Language Entity Graph (LEG) which codifies the semantic relations across concepts (and, therefore, among, the corresponding L2 input words). In order to achieve this goal we exploit, as a-priori knowledge, a multilingual lexico-semantic resource, called Universal Knowledge Core (UKC).

The alignment of meanings across languages and namespaces absorbs a major source of heterogeneity present in the (Semantic) Web.

---

The net result of this phase is an LEG with the following properties:

- Concepts identified during the first phase are all and only the nodes in this graph
- Nodes are annotated with the input L2 terms, across languages
- Nodes are organized into a hierarchy which preserves the ordering, across the links of the UKC (in the case of nouns, the synonym/ hyponym/ hypernym relations)

Managing knowledge diversity (L4), involves the construction of a (linguistic) Entity Type Graph (ETG) encoded using only concepts occurring in the LEG constructed during the previous two phases.

In this phase, the first step is to distinguish concepts into Etype(s) and properties (both object properties and datatype properties) while the second step is to organize them into a subsumption hierarchy.

In the fourth representation layer (L5), we tackle data diversity via an Entity Graph (EG), namely, a data-level knowledge graph, by populating the ETG with the entities extracted from the input datasets.

The EG is constituted of a backbone of L1 linguistic id(s), each annotated with the input L2 terms where, for each L2 term, the system remembers the dataset it comes from.

This mechanism is implemented via a provenance mechanism which applies to all the input dataset elements, both at the schema and at the data level.

One major advantage of our approach is that the combinatorial explosion deriving from the interaction of the four different types of diversity is avoided and the complexity of the data integration problem reduces to the sum of the complexity of each layer.

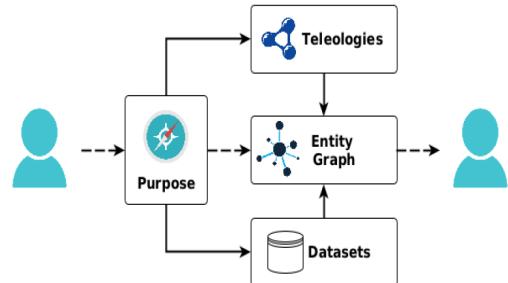
# 2 Purpose and project's resources

This section report and describe:

- The project's purpose, by reporting the purpose itself and the definition of the project's domain, personas, and scenarios.
- Knowledge resources: The reference teleologies initially collected to satisfy the purpose along the integration process.
- Data resources: The datasets initially collected to satisfy the purpose along the integration process.
- Metadata: The metadata defined for the knowledge and data resources mentioned in the previous items.

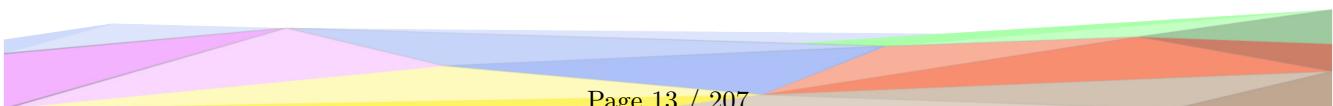
## 2.1 Purpose

With the development of big data technology and cloud storage technology, we are in an era of rapid increase in information, with countless data or knowledge. How to manage these data and achieve more efficient sharing and utilization is a field that many researchers are exploring, that is, to fulfill the integration of knowledge and data in specific, rather than leaving information be unorganized. This report focuses on integrating all the public transportation as well as sharing vehicles information within Trentino so that the more complete transport information system could help people make a better decision and save time or money as much as possible. Specifically, we pay attention to the application of vehicles that GTFS has not covered, such as sharing bikes, sharing cars, and so on so forth, which is added to the system and then residents have more choices to determine paths.



## 2.2 Personas

As a matter of fact that everyone has more or less connection with transportation. The principle characters involved in this field are these:



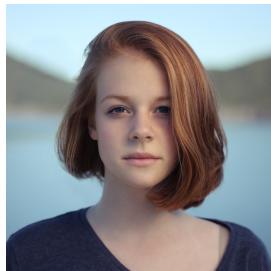
Public transport companies: They run the bus, train, or airline companies and they plan the routes including the paths and timeline as well as transport-system prices which affect people daily live.

Public transport drivers: They join in the traffic as the essential characters to drive the public vehicles and they are the bridges between the passengers and the transport companies.

Personal owners: They normally use their own vehicles to travel to participate in traffic and their paths timetable are flexible. However the number of private cars on the streets at some time tends to be large.

Public transport passengers: The public transport passengers are the most common stakeholders in traffic, they could take the public vehicles to some destination at a good price and the way to travel is environmentally friendly.

After screening, we made up 10 characters to be as the typical people who live within Trentino participating in transportation everyday. They have different attributes such as gender, age, occupation etc, the detailed information is as below:

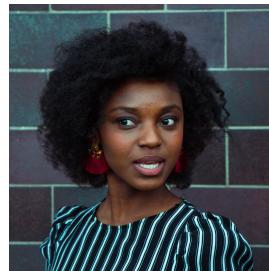


### Alice Jones

I'm a high school student and an active green activist. I've a public transport subscription included in my school taxes. In my family we share everything, starting from my older sister's clothes. I love cycling and running but currently I'm trying archery. I prefer watching a movie rather than reading a book. I'm looking forward to have my driving license and being independent. My secret dream is to become a biologist and help the animals.

ID:	1
Name:	Alice
Surname:	Jones
Age:	14
Gender	♀
Occupation:	Student
Driving License:	✗
Car:	✗
Subscription:	✓
Stable Income:	✗
Particularity:	leaf

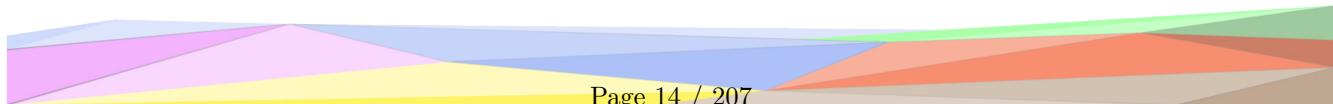
Home: Corso degli Alpini, 14, 38121 Trento TN  
Work: Via Brigata Acqui, 15, 38122 Trento TN



### Linda Thompson

Recently, of age and ready to crush the world. Currently I'm a waitress only to gain some money for my real passion: traveling. I'm never been a model student and I always thought the school as a waste of time so left it as early as I could. I've neither a car nor the driving license but I'm planning to obtain it, unfortunately the overall procedure is a little bit expensive. I love reading and watching, not practicing, sports.

Home: Via delle Masere, 35, 38123 Ravina TN  
Work: Via Cembra, 27, 38015 Lavis TN





## Tom Wilson

I'm a high school professor with a specialization in chemistry. I've a car but I've never enjoyed driving. Therefore, I prefer to go to work with my new bicycle that I won the three months ago. If the weather is bad, the public transport is my preferred solution even though I've to pay the ticket. My hobby is airplane model making and a regular visitor of historical fairs. I love chocolate but I'm allergic of it.

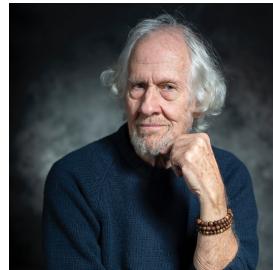
ID:	3
Name:	Tom
Surname:	Wilson
Age:	54
Gender	♂
Occupation:	Professor
Driving License:	✓
Car:	✓
Subscription:	✗
Stable Income:	✓
Particularity:	⌚⌚⌚𝔖ປ



## Xuanli Li

I'm an Erasmus student from China. My main specialization is data science but I also like the economy. I obtained the driving license as soon as I had the opportunity but here in Italy I don't have a car. I've obtained the public transport subscription through the university for a super reasonable price. I've never tried in my life the cable car but certainly here in Trento I will. I love going to the cinema and watch films in their original language.

ID:	5
Name:	Xuanli
Surname:	Li
Age:	25
Gender	♀
Occupation:	Student
Driving License:	✓
Car:	✗
Subscription:	✓
Stable Income:	✗
Particularity:	⌚⌚⌚𝔖ປ



## Tony Evans

I'm a retired civil engineer. I've some problem with my eyes and my vision gets worse and worse every year. Nevertheless, I've constantly renovated my driving license and sometimes I still drive my '80s Ford Mustang. Thanks to a recent legislating all people that are 70 years old or more can request the public transportation subscription for free. I love painting and listening to some good old rock music.

ID:	4
Name:	Tony
Surname:	Evans
Age:	78
Gender	♂
Occupation:	Retired
Driving License:	✓
Car:	✓
Subscription:	✓
Stable Income:	✓
Particularity:	⌚⌚⌚𝔖ປ

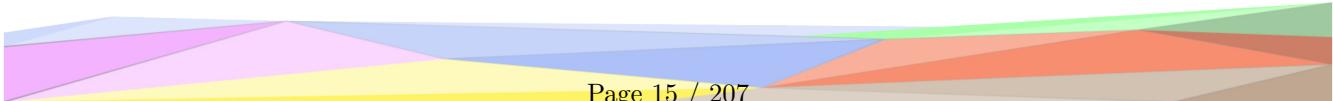


## Carlo Corradini

I'm a Computer Science student and I always take the public transports, both urban and extra-urban ones, with my subscription due to the fact that I live outside Trento. I've obtained my driving license in the recent years and I'm driving the old family car that consumes relatively little. Sports lover, in particular athletics and box. Love going out with friends and in the quiet moments reading books about programming and sci-fi.

ID:	6
Name:	Carlo
Surname:	Corradini
Age:	22
Gender	♂
Occupation:	Student
Driving License:	✓
Car:	✓
Subscription:	✓
Stable Income:	✗
Particularity:	👤

Home: Via Nazionale, 101, 38070 Padernone TN  
Work: Via Sommarive, 5, 38123 Povo TN





### Paolo Smith

Due to the recent Covid-19 pandemic I've lost my job as a bouncer. Currently unemployed and in search of a stable income. I've never obtained the driving license, therefore no cars or motorbikes in my life. The only way I travel in Trento is by using my public transport subscription. I love going to the mountain with my wife and my children. I've always tried to be in time but most of the time I'm late. I'm curious about electric scooter and sooner or later I'll try one.

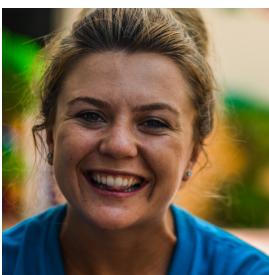
ID:	7
Name:	Paolo
Surname:	Smith
Age:	45
Gender	♂
Occupation:	Unemployed
Driving License:	✗
Car:	✗
Subscription:	✓
Stable Income:	✗
Particularity:	
Home:	Via Soprasasso, 1, 38121 Trento TN
Work:	



### Richard Miller

I'm Richard and I'm a plumber. In my work we have to go physically to our customer's house and therefore the driving license is a must. I drive a Golf, but I'm looking forward to change it with something more powerful, something that can satiate my passion for engines. I live near the city center; it's a fascinating place but not very practical, and a little bit too noisy at night. I hate public transports and electric vehicles but my worst

ID:	8
Name:	Richard
Surname:	Miller
Age:	38
Gender	♂
Occupation:	Plumber
Driving License:	✓
Car:	✓
Subscription:	✗
Stable Income:	✓
Particularity:	
Home:	Vicolo Parolari, 2, 38068 Rovereto TN
Work:	Via delle Orfane, 8, 38122 Trento TN



### Luisa Harris

I'm a happy mother of two children and one dog, working as a saleswoman. I don't have a car and I've stopped renovating my driving license since driving makes me anxious. The public transport subscription is the only way I can go to work and move freely in Trentino. Due to my chronic headache I always have to bring some medicines with me. I'm a yoga lover and curious about all things related to meditation.

ID:	9
Name:	Luisa
Surname:	Harris
Age:	42
Gender	♀
Occupation:	Saleswoman
Driving License:	✗
Car:	✗
Subscription:	✓
Stable Income:	✓
Particularity:	⌚
Home:	Via la Clarina, 3, 38123 Trento TN
Work:	Via di Cultura, 9, 38123 Cadine TN



I'm Betty and I've a shoe shop in the city center. Due to an accident in my youth, I can't walk and the wheelchair is always with me. I don't have a car, because the customization for my needs is too expensive, but the public transports are good enough. I love being served and relaxing in the spa during my vacation. My husband is always with me and we are thinking of buying a double bike that can be used for traveling together.

ID:	10
Name:	Betty
Surname:	Bolding
Age:	63
Gender	♀
Occupation:	Shop Owner
Driving License:	✗
Car:	✗
Subscription:	✓
Stable Income:	✓
Particularity:	♿
Home:	Via Giulio Catoni, 106, 38123 Mattarello TN
Work:	Piazza Garibaldi, 38057 Pergine Valsugana TN

## 2.3 Scenarios

In life, people usually meet a lot of situations about transportation like catching a bus under a rainstorm, when this occurs, to find out a most useful path is especially significant. In order to fit



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in better with life, we pick out eight common scenarios as following:



ID: 1  
Name: Raining

## Raining

It's a heavy raining day, the sky is pretty dark, lightning flashes, and thunder rumbles.

Some standing water on the slippery road, which make people easily to get wet when they walk on the street.

Some shops are closed earlier.

The vehicles move on slowly on the street because the rain obscured the drivers' vision.



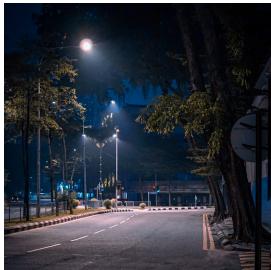
ID: 2  
Name: Strike

## Strike

More than 1000 people involved in the transport sector start to strike because they protest against Covid-19 vaccine and Green Pass. Under the latest policy, they are limited to work and/or left unpaid. The public transport is almost at a standstill in this small city. Commuters are forced to take other approaches to go to companies or schools.

Numerous inconveniences are expected throughout the city for the rest of the day and those that follow.

During the protest there is a high possibility of a clash with the police called to maintain the overall order.



ID: 3  
Name: Night

## Night

It's already 1:00 am, all shops are closed and the streets are quiet. The atmosphere is too quiet, that is almost scary.

There are few people and vehicles on the streets.

Most of the people are tipplers, vagrants who look unfriendly.

In some narrow streets there is a poorly lit.

Moreover, some stray dogs wander around.



ID: 4  
Name: Rush Hour

## Rush Hour

In the morning, a lot of commuters are on the way to their companies or school.

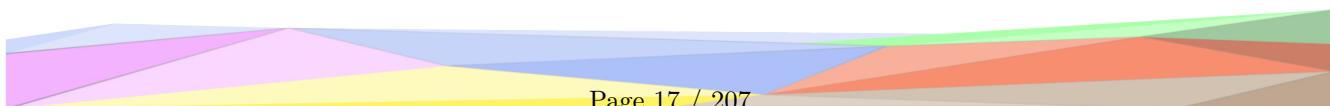
Buses and trains come every 10 minutes.

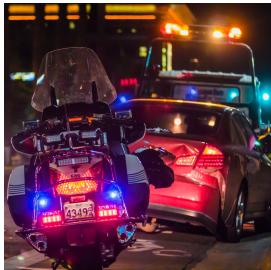
Many people are waiting for the bus or trains and it's hard to get on them through the crowd.

Numerous private cars are moving on the road quickly.

Sometimes, traffic jam happened and the possibility of collisions get

higher and higher.





ID: 5  
Name: Accident

## Accident

There was a serious collision between two cars and 3 persons got terribly injured.

Police officers have arrived at the place and they blocked the road. Some people come here watching the scene and taking pictures due to their curiosity.

Buses and cars have to change their path or wait until the block is free again.



ID: 6  
Name: Hot Summer Day

## Hot Summer Day

The air temperature has arrived at 38 degrees, the surface temperature even is 42 degrees.

Everything on the ground seems to be burnt.

By design, the windows of all urban and extra-urban buses can't be fully open and the air conditioner is underpowered. Due to this inside them it looks like to be in a greenhouse where the air does not circulate.

Most of the passengers feel uncomfortable and sweat.



ID: 7  
Name: Special Event

## Special Event

Near Mattarello there is a huge music festival presented by Vasco Rossi.

The number of people is around 100,000.

All available public transport (even old ones) are used to try to serve the large number of people. During the hours preceding the concert and in the following hours, all means of transport are full and the number of people waiting at the stops seems to never end.



ID: 8  
Name: Normal Day

## Normal Day

A normal day where the public transports operates regularly without any particular issues.

People are walking and commuting on the streets. Cars are queued up at traffic lights and the freeways are running smoothly.

The weather is sunny and the temperature is mild.

Nothing particularly interesting or dangerous is happening in the city.

## 2.4 Resources

This project attempts to answer the competency questions based on the integration of the knowledge and data. And linguistic processing is an indispensable part of the modeling phase. Hence, linguistic, knowledge and data resources are the foundation for this research.

### 2.4.1 Types

#### 2.4.1.1 Linguistic Resources

A linguistic resource is a dataset which provides data about languages (e.g., meanings, relations between words, ...)[4].



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There are two types of mono/multi-lingual resources:

1. Online Dictionaries
2. Wordnet like resources. Wordnets much more useful in data integration as they connect meanings of words in a LKG.

#### 2.4.1.2 Knowledge Resources

A Knowledge resource is a dataset which consists of a KB encoding information about schemas (Etype(s) and properties).

KBs of high quality are usually called ontologies. We call them teleologies (meaning by this, ontologies with metadata which empower their practical use in knowledge and data integration)[4].

#### 2.4.1.3 Data Resources

A data resource is a dataset which consists of data in some format (tabular, unstructured, entities, and property values). Open Data: data freely available[4].

### 2.4.2 Organizations

As mentioned above, the research needs the support of linguistic, knowledge, and data resources. After comparison, we confirmed the 5 final resource providers who supply reliable and helpful information for us. And the specific introduction of them is as follows:

#### 2.4.2.1 Universal Knowledge Core



Active: 2018 – Today  
Resource Type: Linguistic

The UKC is a huge, high-quality, human-curated multilingual lexical database, with millions of words from over 1,000 languages, interconnected by supra-lingual concepts that are shared across languages, yet are culture-specific. The UKC is the principal tool for collecting diversity-aware knowledge on the lexical level. Core principles:

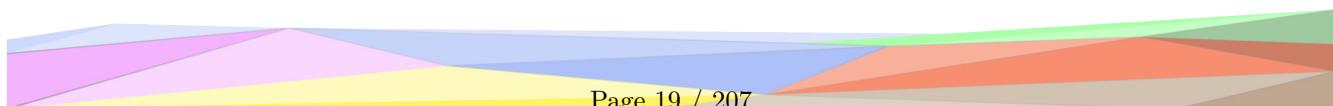
- High Quality
- Diversity-aware by design
- Common-sense lexicon

Website: <http://ukc.datascientia.eu>

Last access: October 30, 2021

Validity:

License: Unknown



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#### 2.4.2.2 Schema.org



Active: 2011 - Today  
Resource Type: Knowledge

Schema.org is a collaborative, community activity with a mission to create, maintain, and promote schema(s) for structured data on the Internet. Schema.org is a reference website that publishes documentations and guidelines to using structured data mark-up on web-pages.

In addition to people from the founding companies there is substantial participation by the larger Web community.

Website: <https://schema.org>  
Last access: October 30, 2021  
Validity: ✓  
License: CC Attribution-ShareAlike v3.0

#### 2.4.2.3 Google Developers



Active: 2005 - Today  
Resource Type: Knowledge

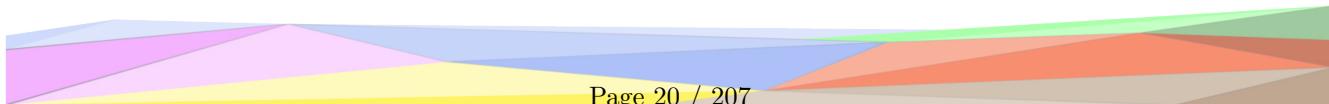
Google Developers (previously Google Code) is Google's site for software development tools and platforms, application programming interfaces (APIs), and technical resources. The site contains documentation on using Google developer tools and APIs including discussion groups and blogs for developers using Google's developer products.

There are APIs offered for almost all of Google's popular consumer products, like Google Maps, YouTube, Google Apps, and others.

The site also features a variety of developer products and tools built specifically for developers.

The site contains reference information for community-based developer products that Google is involved with like Android from the Open Handset Alliance and OpenSocial from the OpenSocial Foundation.

Website: <https://developers.google.com>  
Last access: October 30, 2021  
Validity: ✓  
License: CC Attribution v3.0



#### 2.4.2.4 Trentino Trasporti



Active: 2002 – Today  
Resource Type: Data

Trentino Trasporti is the public transport company of the Autonomous Province of Trento, which also operates as the infrastructure manager of the Trento-Malé-Mezzana railway.

The company is the concessionaire for the urban service in the cities of Trento and Rovereto, for the suburban service in all the Trentino valleys and for the management of the infrastructure of the Trento-Malé-Mezzana railway line.

Website: <https://www.trentinotrasporti.it>  
Last access: October 30, 2021  
Validity: ✓  
License: CC Generic Attribution v2.5

#### 2.4.2.5 Open Data in Trentino



Active: 2012 – Today  
Resource Type: Data

Completing a federated process of opening up the public information asset by attending to the organizational change in order to stimulate growth, efficiency, and participation; making of Trentino a high-data-culture-territory in a harmonized way from an institutional, legislative, organizational, and technological standpoint, by aligning to the EU and national directives for the development of the Digital Agenda in view of the Digital Single Market.

Website: <https://dati.trentino.it>  
Last access: October 30, 2021  
Validity: ✓  
License: CC Attribution v4.0

### 2.4.3 Collection

This section briefly explains the collection and application of the resources used in this study.

#### 2.4.3.1 Linguistic Resources

There is an obvious representation diversity in the real world. In terms of language, the expressions of the same phenomenon in different languages are diverse. Besides, there are multiple ways to represent the same entity even in the same language. The multiple ways to represent the same entity is because the mappings between the word and the intended meanings within a language are many-to-many and the existing of linguistic phenomena such as polysemy, homographs, synonymy, hyponym proves it clearly.

The UKC provides us the WordNets and dictionaries of high quality to help us annotate the

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Etype(s) and their properties well from the previous classified CQs elements in formal modeling phase.

#### 2.4.3.2 Knowledge Resources

Before constructing a more capable knowledge graph, the basic references are helpful for us to think about the structure and direction need to be underlined. In this report, we try to integrate more information in the format of GTFS, which is developed by google and they combine the transport agencies to update the static and real-time traffic vehicles, position, path so that passengers can check it at any time. GTFS gives substantial useful contents and well-organized frame for reference. Besides, making schema is the key part of our task, the website Schema.org is a collaborative community, which offers the platform for teammates to collaborate and helpful ontology reference examples to be exploited.

#### 2.4.3.3 Data Resources

The construction of Knowledge graph is based on the accessibility of the related data. Especially, the purpose formalization process is driven by data. Collection of datasets is crucial to the whole system. In terms of transportation, the key points that people pay attention to are the 4 aspects, time cost, price, location, and vehicles.

we gather the existing datasets of Trentino transport, transit-extra-urban, and urban data related to diverse aspects, including train, bus, cable car as well as their paths, stops, fares, etc.

Opendata Trentino is a comprehensive platform providing various aspects of data in detail. From this platform we collected the data of bike-sharing station, bike rental service, bike parking area, and car sharing, which are distinct from the public transport modes.

## 2.5 Metadata

Metadata is the data about data. Concretely, it is mainly the information describing the properties of the data, which is used to support functions such as indicating the storage location, historical data, resource search, and file recording. Metadata can be regarded as an electronic catalog. In order to achieve the purpose of cataloging, it is necessary to describe and collect the content or characteristics of the data, and then achieve the purpose of assisting data retrieval.

In our project, we build metadata to describe, organize, and retrieve the data resources. And we put the emphasis on the two important dimensions, quality and reusability.

Metadata Standard describes the collection of all rules when specific objects of a certain type of resource. Different types of resources may have different metadata standards, which generally include a collection of data items required to completely describe a specific object, semantic definitions of each data item, description rules, and grammatical regulations for computer applications. In this project, we use DCAT2, W3C recommended metadata standard expressed as an RDF vocabu, to construct our metadata. The more details of our datasets metadata can be found in the next chapter.

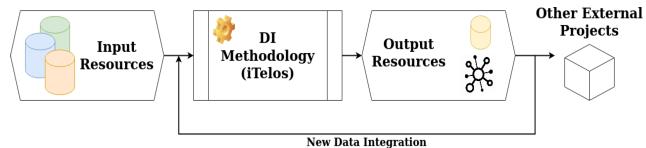
# 3 Inception

This section report and describe:

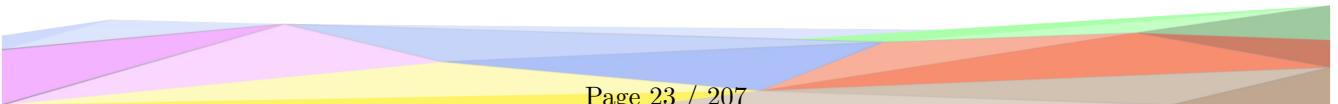
- The project's purpose, by reporting the purpose itself and the definition of the project's domain, personas, and scenarios.
- Knowledge resources: The reference teleologies initially collected to satisfy the purpose along the integration process.
- Data resources: The datasets initially collected to satisfy the purpose along the integration process.
- Metadata: The metadata defined for the knowledge and data resources mentioned in the previous items.

## 3.1 Reusability

In the era of knowledge and data explosion, it's still hard to deny that to use the existing datasets to develop a new application or project straightforwardly isn't an easy thing, which means in terms of datasets, people need to spend more time or money on exploring and discovering new ones. However, the proposal and application of knowledge graph to some extent could solve the issue. Knowledge graphs are constructed by people according to their applying purpose to integrate the related knowledge and data under some specific domain. The clear representation of entities, properties, and relationship in the knowledge graph made up of datasets from various sources and the resources inside are tend to be highly shareable.



Reusability is as one of the main principles in the Data Integration (DI) process defined by iTelos. The data integration project documentation plays an important role in order to enhance the reusability of the resources handled during the methodology, as well as for the resources produced by the data integration process. A clear description of the resources and the process that have to manage them, provides a clear understanding of the information handled in the DI project, allowing external readers to exploit the same resources in different projects[3].



Reusing accessible datasets rather than producing the new data has obvious merits with respect to saving time, resources, and computation. In this project, we devote to achieving the reliability of transportation knowledge and data via different aspects. First, we choose the open and public knowledge or data resources and then try to integrate the different formats of them based on some standard. In addition, classifying the transportation resources is also indispensable, which helps others to identify and adapt related resources more easily. Moreover, deploying metadata to describe the information is also a useful method to reaching the aim. Furthermore, in the end of each process step, we apply the elaborated evaluation approaches to ensure the resources are shareable and reusable.

## 3.2 Purpose Formalization

The project final result (KG) will provide residents or tourists some helpful and efficient ways to reach the different points of interest within Trentino. According to this purpose and reusability, we specify the domain of interest, create 10 different persons and 8 scenarios with diverse properties, and then based on these, 31 competency questions are put forward. The whole project research revolves around these questions and focuses on finding the best solutions.

### 3.2.1 Domain of Interest

This project aims to comprehensively consider the transportation situations under the specific Trentino region, not only involving the public transportation services but also the personal tracks. Collecting the latest temporal and spacial information and integrating the data and knowledge from diverse sources. public transportation services, vehicles, bus stations, train stations, railways, highways, simple streets, public transportation service timelines, and trip schedules are the main important elements will be mainly paid attention, besides, the mixed using of some vehicles and the parking path will be exploring.

### 3.2.2 Competency Questions

Competency questions are the set of functional user requirements for the whole project, and the final results will be evaluated by these questions. Hence, the CQs are directions for us to develop the project and help us figure out the importance of elements. There are 28 QCs are posed as follows:

ID	Persona Scenario	Raw Competency Question	Kernel Competency Question	Analysed Competency Question		
				Common Kernel Concepts	Core Kernel Concepts	Contextual Kernel Concepts

1	1	1	I've finished school, at I.T.T Buonarroti, at 1PM and I want to go to the public library for preparing an exam for tomorrow. Since I've forgotten the subscription card and it's raining outside, which is the best way to arrive to the destination without being too wet?	Person, Establishment, Building, School, Time, Library, Location, Day, Subscription Card, Weather, Rainy, Place, Stop, Time Table, Public Transport, Commuter, Date, Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Vehicle, Cable Car	Person, Establishment, Building, Location, Day, Subscription Card, Weather, Rainy, Place, Stop, Time Table, Public Transport, Commuter, Date, Weather, Vehicle, Current Position	Car, Train, Electric Scooter, Bicycle, Taxi, Cable Car, Stop, Time Table	Bus, School, Raining, Subscription Card, Current Position	Library, School, Raining,
2	1	2	Today is Friday morning and I don't want to go to school because I want to participate to a peaceful protest, called Fridays for Future, about the future of our planet. My friend Martina gifted me a coupon that can be used to rent an electric scooter. I've never used one in my entire life but due to the possibility of the busses to arrive late and/or being blocked I think it's a better choice. Given my location, where is the nearest electric scooter or depot?	Person, Establishment, Building, School, Day, Protest, Event, Date, Electric Scooter, Public Transport, Private Transport, Location, Place, Vehicle, Tool, Application, Coupon, Bus, Delay, Time, Distance, Event, Electric Scooter Depot, Unexpected, Experience, Current Position, Stop	Person, Establishment, Building, Event, Public Transport, Private Transport, Place, Vehicle, Tool, Application, Coupon, Bus, Delay, Time, Distance, Event, Electric Scooter Depot, Unexpected, Experience, Current Position, Stop	Electric Scooter, Electric Scooter Depot, Bus, Stop	Protest, Application, Coupon, Delay, Distance, Current Position	Application, Coupon, Delay, Distance, Current Position
3	1	3	My friend Janine and I went to the cinema to watch a spin off of the famous Toy Story movie: Lightyear, a film about Buzz the space-man and his adventures. Fortunately we managed to buy the last two tickets available but the screening of the film started at 9pm and ended at 11:15 pm. We are two young girls and go around the city at these hour is not the safest thing to do. Therefore, our parents gave us some money and the phone number for Taxi Trento. What is the nearest taxi station so we can go home safely?	Person, Establishment, Building, Cinema, Location, Place, Time, Time Table, City, Safe, Sensation, Feeling, Day, Public Transport, Private Transport, Taxi, Money, Phone Number, Taxi Station, Home, Application, Tool, Distance, Friend, Current Position	Person, Location, Establishment, Building, Time, Day, Place, Public Transport, Private Transport, Transport, Date, Sensation, Feeling, Home, Tool, Friend	Taxi, Station, Taxi Table	Safe, Cinema, Money, Application, City, Phone Number, Distance, Current Position	Cinema, Money, Application, City, Phone Number, Distance, Current Position

4	1	8	I don't know how to ride a bike but my best friend will teach me this afternoon. Where can I find the sharing bikes and the closest park to learn it ?	Person, Friend, Bike, Bike Depot, Experience, Day, Time, Date, Park, Area, Location, Place, Distance, Current Position, Subscription Card	Person, Friend, Experience, Day, Time, Date, Area, Location, Place	Bike, Depot, Park	Bike	Distance, Current Position, Subscription Card
5	2	3	Today it's my grandmother's birthday and our family came to her home around Verona's avenue. We had a lot of fun with our relatives on this birthday party as it's not easy for us to get together and we don't want to leave. Now it's quite late, but it's not bad because tomorrow it's Sunday. What are all the possible transports available at this hour so we can get home properly and safely?	Person, Group, Family, Home, Establishment, Building, House, Location, Street, Avenue, Transport, Emotion, Fun, Relatives, Birthday, Party, Event, Late, Day, Sunday, Time, Table, Time, Night, Date, Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Cable Car, Safety, Emotion, Comfortable, Stop	Person, Group, Family, Home, Establishment, Building, House, Location, Street, Avenue, Transport, Emotion, Fun, Relatives, Birthday, Party, Event, Late, Day, Sunday, Time, Table, Time, Night, Date, Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Cable Car, Safety, Emotion, Comfortable	Time Table, Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Cable Car, Stop	Table, Night, Sun-day	Location, Night, Sun-day
6	2	8	As a waitress of a bar, I need to go to my workplace early (7:30 am) to serve our customers. I don't know how to drive and I don't have a car, how can I get there as soon as possible?	Waitress, Person, Job, Occupation, Income, Money, Bar, Building, Establishment, Workplace, Morning, Time, Day, Date, Customer, Client, Drive, Car, Driving License, Trip, Path, Route, Fast, In Time, Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Cable Car, Stop, Time Table, Transportation, Vehicle	Waitress, Person, Job, Occupation, Income, Money, Bar, Building, Establishment, Workplace, Morning, Time, Day, Date, Customer, Client, Drive, Trip, Path, Route, Fast, Transportation, Vehicle	Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Cable Car, Stop	Morning, Driving License, Time Table	Driving License, In Time

7	3	1	According to my schedule, I have to give a class to my students in the city center at 11:00 am. It rains heavily and I don't have good eyesight when the rains fall on my car windows. Which transport I can take to go the classroom safely and not being late?	Person, Schedule, Class, School, Building, Establishment, Student, Morning, Time, Date, Day, Weather, Raining, Water, Body, Eye, Eyesight, Car, Window, Driving License, Transportation, Vehicle, Health, Bus, Train, Electric Scooter, Cicycle, Taxy, Cable Car, Stop, Time Table, Schedule, Late, Safe, Location	Person, Class, School, Building, Establishment, Student, Time, Date, Day, Weather, Raining, Water, Body, Eye, Eyesight, Car, Window, Driving License, Transportation, Vehicle, Health, Schedule, Late, Safe	Car, Train, Electric Scooter, Bicycle, Taxy, Cable Car, Stop, Time Table	Bus, Location, Rain, Driving License
8	3	7	Tomorrow I will have an important academic conference in Rome. I will definitely not be late for that. I need to start going there today by airplane. The closest airport is in Verona and I just have 90 minutes to go there after my regular class. I've already made the check-in online with my smartphone. How to go to the airport in the most reliable way?	Day, Date, Time, Person, Academy, Conference, Event, Meeting, City, Capital, Country, Late, Vehicle, Airplane, Airport, Location, Class, Check-in, Online, Internet, Smartphone, Reliability, Car, Bus, Train, Electric Scooter, Bicycle, Taxy, Cable Car, Stop, Time Table, University, Establishment, Building, Location, Stop	Day, Date, Time, Person, Academy, Conference, Event, Meeting, City, Capital, Country, Late, Vehicle, Airplane, Class, Check-in, Online, Internet, Smartphone, Reliability	Car, Train, Electric Scooter, Bicycle, Taxi, Cable Car, Stop, Time Table	Airport, Location
9	3	8	Only for curiosity, what are all the available means of transport in Trento?	Person, Curiosity, Vehicle, Transport, Trento, Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Cable Car	Person, Curiosity, Vehicle, Transport	Car, Train, Electric Scooter, Bicycle, Taxi, Cable Car	Trento
10	4	3	It's late and my grandson is outside with his expensive bicycle. He doesn't want it to be stolen. Where is the nearest safe bicycle depot?	Late, Grandson, Person, Depot, Bicycle Depot, Bicycle, Expensive, Money, Thief, Location, Building, Establishment	Late, Grandson, Person, Depot, Expensive, Money, Thief, Building, Establishment	Bicycle Depot	Location, Bicycle

11	4	5	I have some problem with my eyes and last night I made an appointment with my family doctor to see him today. At 9:00 am, I got on the bus successfully, however after 10 minutes, there is a terrible car accident and we have to stop and wait. 10 minutes have passed, should I wait here or change to take a train?	Person, Problem, Eye, Body, Health, Night, Day, Date, Time, Appointment, Event, Calendar, Family, Doctor, Morning, Bus, Success, Car, Accident, Stop, Waiting, Vehicle, Transportation, Train, Location, Establishment, Hospital, Department, Treatment, Ticket, Location, Time Table	Person, Problem, Eye, Health, Night, Date, Time, Appointment, Event, Calendar, Family, Doctor, Success, Waiting, Vehicle, Transportation, Train, Location, Establishment, Hospital, Department, Treatment	Bus, Stop, Table	Train, Time	Morning, Location, Accident, Ticket
12	4	8	Today is Thursday and I want to go to buy some cheap commodity from the open market in the city center. Then, I need to come back home to cook my brunch before 11 am, which path should I choose?	Day, Date, Time, Thursday, Money, Price, Market, City, City Center, Home, Establishment, Building, House, Cooking, Kitchen, Morning, Path, Route, Vehicle, Transportation, Location, Person, Brunch, Meal, Time Table, Stop, Car, Bus, Train, Stop, Electric Scooter, Bicycle, Taxi, Cable Car, Ticket	Day, Date, Time, Thursday, Money, Price, City, Home, Establishment, Building, House, City Center, Cooking, Kitchen, Path, Vehicle, Stop, Car, Bus, Train, Stop, Electric Scooter, Bicycle, Taxi, Cable Car, Ticket	Time, Stop, Bus, Train, Electric Scooter, Bicycle, Taxi, Cable Car	Ta-ble, Car, Bus, Train, Elec-tric Scooter, Bicycle, Taxi, Cable Car	Thursday, Market, Morning, Route, Location, Ticket
13	5	1	It's a raining day, I finished my whole day classes and want to go back to my dormitory. Now it's already 5:30pm, I don't want to get too wet, which way I can go back before 6:00pm?	Person, Weather, Raining, Day, Date, Time, Class, Dormitory, House, Establishment, Building, Afternoon, Wet, Vehicle, Transportation, Trip, Route, University, Time Table, Stop, Feeling, Room, Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Cable Car	Person, Weather, Day, Date, Time, Class, Train, Electric Scooter, House, Establishment, Building, Wet, Vehicle, Transportation, Trip, University, Feeling, Room	Time, Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Cable Car	Ta-ble, Stop, Bus, Train, Electric Scooter, Bicycle, Taxi, Cable Car	Raining, Afternoon, Route

14	5	2	<p>I live around San Bartolomeo and as a data-science student, on Monday I need to go to the University at Povo to take the Knowledge and Data Integration class at 9:30 am. Unluckily, the big strike of drivers that are protesting for obtaining a higher monthly income happened. Can I arrive at my classroom within 30 minutes from now?</p>	<p>House, Establishment, Building, Data-Science, Science, Data, Student, Occupation, Monday, Day, Date, Time, University, Course, Class, Morning, Strike, Event, Protest, Income, Job, Money, Location, Time Table, Vehicle, Transportation, Room, Dormitory, Bus, Car, Taxi, Stop, Train, Electric Scooter, Bicycle, Taxi, Cable Car, Route, Path</p>	<p>House, Establishment, Building, Data-Science, Science, Data, Student, Occupation, Monday, Day, Date, Time, University, Course, Class, Morning, Strike, Event, Protest, Income, Job, Money, Location, Time Table, Vehicle, Transportation, Room, Dormitory, Path</p>	<p>Time, Table, Bus, Car, Taxi, Stop, Train, Electric Scooter, Bicycle, Taxi, Cable Car</p>	<p>Monday, Strike, Morning, Location, Route</p>
15	5	8	<p>This morning I borrowed a bike from our dormitory and they told me I can own it for one year. I am so excited and want to have a try. But after 30 minutes, my class in the city center will start, I am not sure the time is enough for me to ride a bike there or not, which one should I choose, bus or bike?</p>	<p>Day, Date, Time, Person, Morning, Afternoon, Borrowing, Bicycle, Dormitory, House, Establishment, Building, Year, Owner, Property, Feeling, Excitement, Class, City, City Center, Bus, Time Table, Stop, Trip, Route, Location, Apartment, University, Vehicle, Transportation, Sensation</p>	<p>Day, Date, Time, Person, Bor- rowing, Dormitory, House, Es- tablishment, Building, Year, Owner, Property, Feeling, Sensation, Excitement, Class, City, Center, Trip, Trans- portation, Apartment, University, Vehicle</p>	<p>Bicycle, Bus, Time Table, Stop</p>	<p>Morning, Afternoon, Route, Location</p>

16	6	3	I joined a party in a bar of the city center until deep night, and now it's quite late. Fortunately, my two friends are my neighbors, what way should we choose to go back home?	Person, Party, Bar, Establishment, Building, Location, City Center, City, Night, Late, Day, Date, Time, Fortune, Friend, Neighbour, Home, Trip, Route, Bus, Car, Time Table, Train, Electric Scooter, Bicycle, Taxi, Cable Car, Stop	Person, Party, Bar, Establishment, Building, Location, City Center, City, Night, Late, Day, Date, Time, Fortune, Friend, Neighbour, Home, Trip	Bus, Car, Night, Route Time Table, Train, Electric Scooter, Bicycle, Taxi, Cable Car, Stop
17	6	5	My car broke and I have to come back home using the public transport. How much does it cost a bus ticket from Trento to Padergnone?	Car, Vehicle, Home, Establishment, Building, Transport, Public Transport, Price, Bus, Ticket, Origin, Destination, Money, Returning, Ticket Price	Vehicle, Home, Establishment, Building, Transport, Public Transport, Money, Returning, Ticket	Bus, Ticket Origin, Destination Price
18	6	6	This afternoon there is a big boxing game in Rovereto. Boxing is my favorite sport and I signed it up one month ago. The game will start at 1:00pm, I still have one hour to go there. But it's really hot outside and I don't want to be too sweat before the game. What kind of transport suits me better?	Day, Date, Time, Person, Afternoon, Box, City, Sport, Event, Building, Establishment, Transportation, Vehicle, Stadium, Firm, Month, Game, Match, Afternoon, Weather, Hot, Sweat, Sensation, Feeling, Car, Bus, Train, Electric Scooter, Taxi, Bicycle, Cable Car, Time Table, Stop, Competition, Location, Air Conditioner	Day, Date, Time, Person, Box, City, Sport, Event, Building, Establishment, Transportation, Vehicle, Stadium, Film, Month, Game, Match, Weather, Hot, Sweat, Sensation, Feeling, Transportation, Competition	Car, Bus, Afternoon, Train, Electric Scooter, Taxi, Bicycle, Cable Car, Time Table, Stop

19	6	8	Today is a good with warm sun and proper temperature, my best friend asks me to go to the mountain for sightseeing. Unluckily, my shoes are not suitable for climbing the mountain, now it's 2 pm and if we choose to go up by cable car, when is the best time for us to take and how long can we arrive at the top of the mountain?	Person, Time, Day, Date, Weather, Warm, Sun, Temperature, Friend, Mountain, Sightseeing, Relax, Emotion, Feeling, Shoe, Bad Luck, Suitability, Climbing, Sport, Location, Afternoon, Cable Car, Time Table, Stop, Transportation, Activity, Path, Trip	Person, Time, Day, Date, Stop, Weather, Warm, Sun, Temperature, Friend, Mountain, Sightseeing, Relax, Emotion, Feeling, Shoe, Bad Luck, Suitability, Climbing, Sport, Transportation, Activity, Path, Trip	Cable Time	Car, Table,	Location, Afternoon
20	7	4	My wife is in the hospital with a leg injury. This morning after sending my kids to the Scuola Sacra Famiglia, I need to go to the Santa Chiara Hospital to take care of her. But the traffic jam is a little scary, which way is more flexible for me to choose?	Wife, Person, Hospital, Building, Establishment, Morning, Time, Date, Day, Injury, Leg, Body, Kid, School, Private School, Traffic, Scary, Emotion, Feeling, Flexibility, Road, Street, Condition, Department, Ward, Classroom, Transportation, Location, Time Table, Bus, Train, Electric Scooter, Taxi, Bicycle, Cable Car, Stop	Wife, Person, Building, Es-tablishment, Train, Elec-tric Scooter, Day, Injury, Taxi, Bicycle, Leg, Body, Cable Car, Kid, School, Stop, Hospital, Scary, Emo-tion, Feeling, Flexibility, Road, Street, Con-dition, Depart-ment, Ward, Classroom, Transporta-tion	Time	Ta- ble, Bus, Train, Elec-tric Scooter, Taxi, Bicycle, Cable Car, Stop	Morning, Lo-cation, Traffic

21	7	6	<p>Today is Sunday and is a beautiful hot and sunny day. I want to get away from the stress and enjoy a day of leisure on a bicycle. A friend of mine, that is a bike's fanatic, told me that near Sardagna there are beautiful bike trails and he convinced me to go. The ideal would be to leave in the morning and then return in the evening. I know that the best way to go to Sardagna is to use the cable car but I don't know the timetables nor the possible limitations/restrictions on bringing bicycles. What is the first available ride that my friend and I can take in the morning?</p>	<p>Day, Time, Date, Person, Hot, Weather, Sunny, Stress, Emotion, Feeling, Bicycle, Friend, Fanatic, Maniac, Place, Location, Trail, Bike Trail, Morning, Evening, Cable Car, Time Table, Limitation, Availability, Place, Building, Establishment, Transportation, Ticket, Stop</p>	<p>Person, Day, Time, Date, Weather, Stop, Sunny, Stress, Hot, Emotion, Feeling, Friend, Fanatic, Maniac, Place, Location, Trail, Bike Trail, Trail, Restriction, Availability, Place, Building, Establishment, Transportation, Ticket</p>	<p>Cable, Car, Bicycle, Morning, Evening, Limitation</p>
22	7	8	<p>I lost my job last month, which means now I don't have a stable income. Today, in Mattarello, I have an important interview for a new job with EnginSoft S.p.A. at 9:30 am. Now it's already 9:10 am and if I'll arrive late they surely reject me. There is a fast and/or short way to get there in time?</p>	<p>Job, Occupation, Month, Day, Date, Time, Income, Stability, Interview, Meeting, Event, Commitment, Agency, Work, Morning, Late, Rejection, Fast, Short, Trip, Route, In Time, Company, Establishmemt, Vehicle, Bus, Train, Electric Scooter, Taxi, Bicycle, Time Table, Stop, Condition, Person, Path, Location, Money, Cable Car, Person</p>	<p>Job, Occupation, Month, Day, Date, Time, Income, Stability, Interview, Meeting, Event, Commitment, Agency, Work, Morning, Late, Condition, Rejection, Trip, Route, Company, Establish- ment, Vehicle, Path, Money, Person</p>	<p>Bus, Train, Fast, Short, Electric Scooter, Taxi, Bicycle, Time Table, Stop, Cable Car</p>

23	8	2	<p>Suddenly the pipe in the bathroom broke up and the water spread everywhere. I've called my colleague to bring me a new replacement part. He needs to get here as soon as possible otherwise my collection of precious stamps will be lost. However, the strikers are demonstrating on the street, no cars are allowed and the crowd moves very slowly. Therefore, trying to avoid them, what is the fastest pedestrian path to my home?</p>	<p>Home, Building, Establishment, Bathroom, Room, Pipe, Inconvenience, Accident, Water, Fluid, Phone, Phone, Number, Colleague, Person, Part, Replacement, Substitution, Time, Date, Day, Man, Fast, Delay, Stamp, Collection, Danger, Ruin, Break, Lost, Disaster, Event, Strike, Mobility, Road, Road Closed, People, Blocked, Car, Truck, Bus, Transport, Taxi, Crowd, Slow, Movement, Fast, Avoid, Obstacle, Position, Current Location, Location, Pedestrian, Path, Time Table, Route, Stop, Route, Time</p>	<p>Home, Building, Establishment, Bathroom, Room, Pipe, Inconvenience, Accident, Water, Fluid, Phone, Phone, Number, Colleague, Person, Part, Replacement, Substitution, Time, Date, Day, Man, Fast, Delay, Stamp, Collection, Danger, Ruin, Break, Lost, Disaster, Event, Strike, Mobility, Road, Road Closed, People, Blocked, Car, Truck, Bus, Transport, Taxi, Crowd, Slow, Movement, Fast, Avoid, Obstacle, Position, Current Location, Location, Pedestrian, Path</p>	<p>Time Route, Table, Route Time, Stop</p>	<p>Fast, Strike, Road Closed, Car, Truck, Bus, Taxi, Current Location</p>
24	8	8	<p>I have a very smart daughter and she has great grades in school. Her dream is to go to college abroad after 5 years. The expense will be much, so I usually save money as much as possible. Today I have a work in povo, which way is the cheapest for me to get there?</p>	<p>Person, Daughter, Grade, School, Building, Establishment, College, Time, Day, Date, Price, Ticket Price, Money, Expense, Path, Ticket, Payment, Work, Income, Location, Occupation, Cheap, Expensive, Bus, Train, Electric Scooter, Taxi, Bicycle, Subscription Card, Time Table, Stop, Cable Car</p>	<p>Person, Daugher, Grade, School, Building, Establishment, College, Time, Day, Date, Price, Ticket Price, Money, Expense, Path, Ticket, Payment, Work, Income, Location, Occupation, Cheap, Expensive, Bus, Train, Electric Scooter, Taxi, Bicycle, Subscription Card, Time Table, Stop, Cable Car</p>	<p>Ticket Price, Bus, Train, Electric Scooter, Taxi, Bicycle, Time Table, Stop, Cable Car</p>	<p>Ticket, Subscription Card</p>

25	9	2	<p>After work, I want to go home without being disturbed too much due to my migraine. Normally, my preferred means of transport is the bicycle or the electric scooter. Today was really stressful and due to the ongoing strike there is a lot of noise and chaos: my head already started to hurt. Today I don't bother to arrive late but my head must stop hurting and the travel must be as quiet as possible. Which means of transport, that is normally soundproof or quiet, should I choose?</p>	<p>Work, Home, Feeling, Quiet, Soundproofed, Migraine, Issue, Illness, Habit, Transport, Bicycle, Public Transport, Private Transport, Vehicle, Electric Scooter, Stress, Complication, Pain, Preference, Day, Date, Strike, Event, Noise, Chaos, Head, Body, Person, Commuter, Time, Delay, Travel, Distance, Path, Bus, Taxi, Train, Decision</p>	<p>Work, Occupation, Establishment, Building, Relax, Quiet, Soundproofed, Migraine, Issue, Illness, Habit, Transport, Bicycle, Public Transport, Private Transport, Vehicle, Electric Scooter, Stress, Complication, Pain, Preference, Day, Date, Strike, Event, Noise, Chaos, Head, Body, Person, Commuter, Time, Delay, Travel, Distance, Path, Bus, Taxi, Train, Decision</p>	<p>Bicycle, Electric Scooter, Bus, Taxi, Train, Time Table, Stop</p>	<p>Soundproofed, Preference, Strike, Delay</p>
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26	9	5	<p>I've an appointment at Naturalmente at 3pm. Naturalmente is in Arco and so I took the extra-urban bus at 1:40 pm to arrive in time. Unfortunately, our bus has stopped near Vigolo Baselga due to engine problems. Due to the fact that the bus is large and heavy (double bus also called "Biscione") it's causing a blockage and a queue of cars and trucks has started to form. The driver has already informed the nearest police station to orchestrate the traffic and the Scania service for the maintenance. I've not downloaded the full timetable. Therefore, I don't know the departure of the next bus. Approximately, at what time it arrives at Vigolo Baselga?</p>	<p>Appointment, Schedule, Building, Establishment, Person, Expertise, Public Transport, Bus, Extra-urban, Urban, City, Location, Vehicle, Date, Time, Day, Precision, Inconvenience, Village, Engine, Problem, Large, Heavy, Bulky, Double Bus, Blockage, Queue, Car, Truck, Traffic, Driver, Person, Police, Police Station, Station, Help, Orchestration, Maintenance, Repair, Tool, Application, Website, Download, Service, Time, Date, Day, Time Table, Stop, Knowledge, Unknown, Departure, Private Service, Accident</p>	<p>Appointment, Schedule, Building, Establishment, Person, Expertise, Public Transport, Private Service, Extra-urban, Urban, City, Vehicle, Date, Day, Precision, Inconvenience, Village, Engine, Problem, Large, Heavy, Bulky, Double Bus, Blockage, Queue, Car, Truck, Traffic, Driver, Police, Police Station, Station, Help, Orchestration, Maintenance, Repair, Tool, Application, Knowledge, Unknown, Private Service</p>	<p>Bus, Table, Stop</p>	<p>Time</p>	<p>Location, Accident, Double Bus, Departure</p>
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27	9	7	Today there are the traditional markets of San Vige-ilio in the city center. This afternoon my husband and I are going to visit my mother near Rovereto so we have to take the car. Most of the roads are closed after 8am due to the event. Therefore we have parked our car at the Zuffo, free public parking away from the city center. Our plan is that in the morning we will visit the markets and in the afternoon my mother's house. We don't know the time table of the NP bus that is used to go from Zuffo parking to the markets and the relative price. When it's available and how much does it cost the first NP bus after 7:45 am?	Person, Market, City, Date, Time, Day, Husband, Establish-ment, Square, Stand, Mother, Distance, Car, Parking, Road, Event, Inconvenience, Closure, Free, Pay, Payment, Crowded, City Center, Suburbs, Location, Plan, Morning, Afternoon, Period, House, Build-ing, Time Table, Stop, Bus, Vehicle, Public Transport, Private Transport, Knowledge, Path, Price, Avail-ability, Cost, Ticket, Threshold, Family, Place	Person, Date, Time, Day, Husband, Es-tablishment, Square, Stand, Mother, Closure, Road, Event, Inconve-nience, Closure, Free, Pay, Payment, Crowded, City Center, Suburbs, Lo-cation, Plan, Morning, Afternoon, Period, House, Build-ing, Vehicle, Public Trans-port, Private Transport, Knowl-edge, Path, Availability, Price, Ticket, Threshold, Family, Place	Car, Time Stop	Bus, Table	Market, City, Distance, Parking, Cost
28	9	8	My friend keeps talking about the bike sharing service and how easy and com-fortable it is. Therefore, I want to try it. Where is the nearest bike-sharing station and how many slots are available?	Person, Vehicle, Feeling, Sensation, Comfortable, Easy, Bike, Bike station, Sharing, Location, Service, Nearest, Station, Building, Establishment, Friend, Slots, Availability, Free Slots, Occupied Slots, Total Slots	Person, Vehi- cle, Feeling, Sensation, Comfort- able, Easy, Sharing, Ser-vice, Station, Building, Es-tablishment, Friend, Slots, Availability	Bike, Station, Stop	Bike	Nearest, Lo-cation, Free Slots, Occupied Slots, Total Slots

29	10	6	<p>Today is one of the hottest day in this summer, the thermometer almost hit the 40 degrees and the city is unlivable. Due to my precarious health me and my husband have decided to go to a wellness resort in the mountains at high altitude. The building is in Malè and we discovered, thanks to the customer service, that the village is served by the Trento-Malè railway. A perfect mean of transport since it's equipped with air conditioning and all necessities for people with wheelchairs. The reservation it's for the 28th of July and the check-in are at 12 am. What's the best train we have to take so we arrive in Malè at most 12 am?</p>	<p>Person, Husband, Establishment, Building, Location, Place, Date, Time, Time Table, Sensation, Feeling, Day, Public Transport, Train, Railway, Station, Health, Mountain, Altitude, Village, Resort, Weather, Hot, Summer, City, Season, Transport, Wheelchair, Air Conditioner, Mobility, Platform, Special Needs, Equipment, Train Station</p>	<p>Person, Husband, Establishment, Building, Location, Place, Date, Time, Time Table, Sensation, Feeling, Day, Public Transport, Train, Railway, Station, Health, Mountain, Altitude, Village, Resort, Weather, Hot, Summer, City, Season, Transport, Mobility, Special Needs, Equipment</p>	<p>Train, Table, Train Station</p>	<p>Time</p>	<p>Railway, Station, Hot, Summer, Wheelchair, Platform, Air Conditioner</p>
30	10	7	<p>I want to go to the Christmas markets in Innsbruck without any public transports. The only solution is to rent a car for the entire day using the car-sharing service. Moreover, our daughter gifted me with a coupon code. Where is the nearest car-sharing stop from Piazza Venezia?</p>	<p>Person, Daughter, Event, Markets, City, Public Transports, Vehicle, Car, Sharing, Car-sharing, Service, Price, Gift, Square, Location, Stop, Near-est, Coupon Code</p>	<p>Person, Daughter, Event, Markets, City, Public Transports, Vehicle, Shar-ing, Service, Price, Gift, Square</p>	<p>Car, sharing, Stop</p>	<p>Car</p>	<p>Location, Coupon Code, Near-est</p>
31	10	8	<p>It's lunch time, I just finished working, and I want to go home eating the lasagne I prepared yesterday together with my husband Brad. Due to my mobility issues I have to take a bus equipped with a platform for the wheelchair. What is the next bus that passes near my shop that suits my needs?</p>	<p>Person, Establishment, Building, Location, Place, Time, Time Table, Day, Date, Husband, Public Transport, Bus, Home, Current Position, Wheelchair, Special Needs, Mobility, Issues, Platform, Equipment, Time Table, Stop, Shop</p>	<p>Person, Establishment, Building, Location, Place, Time, Day, Date, Husband, Public Transport, Home, Special Needs, Mobility, Issues, Equipment, Shop</p>	<p>Bus, Table, Stop</p>	<p>Time</p>	<p>Current Position, Wheelchair, Platform</p>

### 3.2.2.1 Competency Questions Metadata

**Graph:**

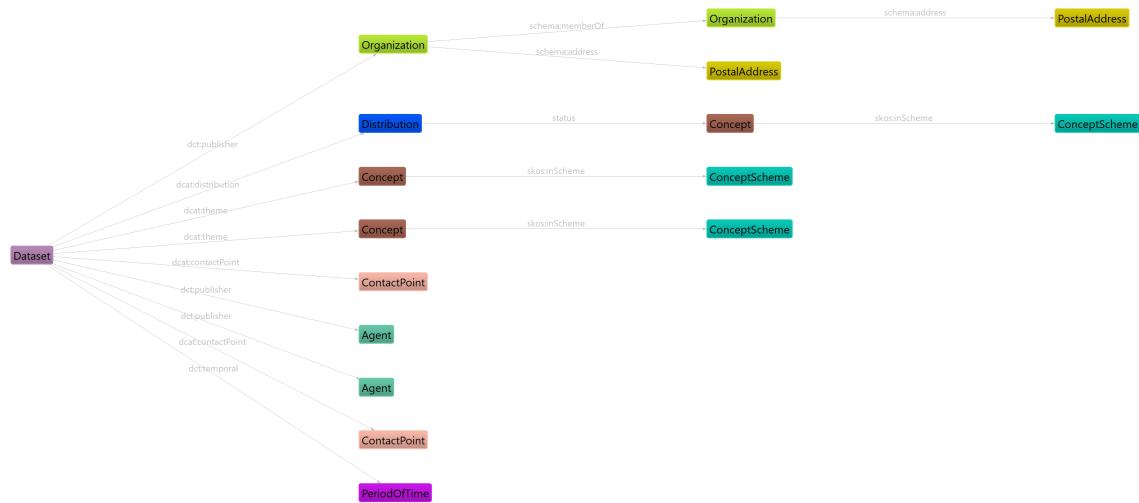


Figure 3.1: *Competency Questions* metadata graph

**RDF Metadata:**

```

1 @prefix : <https://www.epos-eu.org/epos-dcat-ap#> .
2 @prefix schema: <http://schema.org/> .
3 @prefix spdx: <http://spdx.org/rdf/terms#> .
4 @prefix owl: <http://www.w3.org/2002/07/owl#> .
5 @prefix gsp: <http://www.opengis.net/ont/geosparql#> .
6 @prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
7 @prefix skos: <http://www.w3.org/2004/02/skos/core#> .
8 @prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
9 @prefix hydra: <http://www.w3.org/ns/hydra/core#> .
10 @prefix geo: <http://www.w3.org/2003/01/geo/wgs84_pos#> .
11 @prefix oa: <http://www.w3.org/ns/oa#> .
12 @prefix dct: <http://purl.org/dc/terms/> .
13 @prefix sh: <http://www.w3.org/ns/shacl#> .
14 @prefix dcat: <http://www.w3.org/ns/dcat#> .
15 @prefix locn: <http://www.w3.org/ns/locn#> .
16 @prefix foaf: <http://xmlns.com/foaf/0.1/> .
17 @prefix epos: <https://www.epos-eu.org/epos-dcat-ap#> .
18 @prefix adms: <http://www.w3.org/ns/adms#> .
19 @prefix org: <http://www.w3.org/ns/org#> .
20 @prefix cnt: <http://www.w3.org/2011/content#> .
21 @prefix vcard: <http://www.w3.org/2006/vcard/ns#> .
22 @prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
23 @prefix http: <http://www.w3.org/2006/http#> .
24 @prefix dash: <http://datashapes.org/dash#> .
25 @prefix dc: <http://purl.org/dc/elements/1.1/> .
26
27 <https://www.epos-eu.org/epos-dcat-ap#Organization/2dad489f-4ce3-4e0d-9122-b70df55b8ef2>
28     rdf:type schema:Organization ;
29     schema:address <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/b0bb325d-f408-4dac-80e0-2389d8efb97f> ;
30     schema:email "knowdive@disi.unitn.it" ;
31     schema:identifier "http://knowdive.disi.unitn.it"^^xsd:anyURI ;
32     schema:legalName "Knowdive" ;

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33     schema:leiCode "http://knowdive.disi.unitn.it" ;
34     schema:logo "http://knowdive.disi.unitn.it/wp-content/uploads/knowdive-new-logo.png"^^xsd:anyURI ;
35     schema:memberOf <https://www.epos-eu.org/epos-dcat-ap#Organization/78574deb-e40e-4c05-a5c6-40beef01aa0> ;
36     schema:url "http://knowdive.disi.unitn.it"^^xsd:anyURI .
37
38 <https://www.epos-eu.org/epos-dcat-ap#Organization/78574deb-e40e-4c05-a5c6-40beef01aa0>
39     rdf:type schema:Organization ;
40     schema:address <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/cd879ddb-55b6-4620-a0e4-c85a2df9f483> ;
41     schema:email "ateneo@unitn.it" , "ateneo@pec.unitn.it" ;
42     schema:identifier "www.unitn.it"^^xsd:anyURI ;
43     schema:legalName "Università degli Studi di Trento" ;
44     schema:leiCode "00340520220" ;
45     schema:logo "https://static-cdn.unitn.it/sites/www.unitn.it/themes/unitn_theme/images/newlogo_unitn_en.png"
46         ^^xsd:anyURI ;
47     schema:telephone "0461281111" ;
48     schema:url "www.unitn.it"^^xsd:anyURI .
49
50 <https://www.epos-eu.org/epos-dcat-ap#PeriodOfTime/84efa52e-3879-4d09-b0b9-36362e915866>
51     rdf:type dct:PeriodOfTime ;
52     schema:endDate "2022-01-25T00:00:00Z"^^xsd:dateTime ;
53     schema:startDate "2021-09-13T00:00:00Z"^^xsd:dateTime .
54
55 <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/b0bb325d-f408-4dac-80e0-2389d8efb97f>
56     rdf:type schema:PostalAddress ;
57     schema:addressCountry "IT" ;
58     schema:addressLocality "Povo (TN)" ;
59     schema:postalCode "I-38123" ;
60     schema:streetAddress "Via Sommarive 9" .
61
62 <https://www.epos-eu.org/epos-dcat-ap#Concept/4040fa1c-755a-4706-9fcd-b2e9d6fbb755>
63     rdf:type skos:Concept ;
64     skos:definition "Land transport is the transport or movement of people, animals or goods from one location
65         to another location on land." ;
66     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/f913bd20-8e7b-4d82-9688-ca745a432f24> ;
67     skos:prefLabel "Land Transport" .
68
69 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/f913bd20-8e7b-4d82-9688-ca745a432f24>
70     rdf:type skos:ConceptScheme ;
71     dct:description "The movement of people or goods from one place to another." ;
72     dct:title "Transport" .
73
74 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ca07b831-220f-4c49-bc3b-6e8215eb3238>
75     rdf:type schema>ContactPoint ;
76     schema:availableLanguage "en-US" , "it-IT" ;
77     schema:contactType "Member" ;
78     schema:email "carlo.corradini@studenti.unitn.it" ;
79     schema:name "Carlo Corradini" .
80
81 <https://www.epos-eu.org/epos-dcat-ap#Concept/520bf2b3-6fcc-45ad-971a-b17df5fe98f0>
82     rdf:type skos:Concept ;
83     skos:definition "Inception is the first iTelos phase:\r\nInputs:\r\n * Purpose\r\n * List of data sources\r\n
84         * List of reference teleologies\r\nOutputs:\r\n * Classified Competency Questions (CQ)\r\n
85         Datasets\r\n * Reference teleologies\r\nObjectives:\r\n * Start the Purpose formalization process that
86             will be carried on during the second and third phase, leading to the ETG generation\r\n
87         * Collect the
88             data and knowledge resources to be integrated and classify their elements into the reusability
89             categories\r\n
90         In order to identify the level of reusability of the resources collected and handled
91             along the methodology, all the resource elements (such as entities, entity properties, ETypes, and
92             others) are classified into one of three reusability categories, defined as follow:\r\n
93             * Common: This
94                 category involves resources associated to aspects which are common to all domains, also outside the
95                 projects DoI\r\n
96             * Core: This category involves resources associated to the more core aspects of DoI.
97                 They carry information about the most important aspects considered by the purpose, information without
98                 which it would be impossible to develop the EG\r\n
99             * Contextual: This last category involves
100                 resources which carry specific, possibly unique, information from the domain of interest. These are
101                 the resources whose main goal is to create added value. If core resources are necessary for a
102                     
```

---

```

meaningful application, contextual resources are the ones which can make the difference with respect
to the competitors\r\n" ;
82 skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/5edb028b-96af-4035-8d62-c253acd5a3c5> ;
83 skos:prefLabel "Inception Phase" .

84
85 <https://www.epos-eu.org/epos-dcat-ap#Distribution/2d8e5529-0e68-4e0d-af09-49a96f1c6c25>
86 rdf:type dcat:Distribution ;
87 dct:conformsTo "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W4.L7.M3.T8.3.
DataCollection&Preparation.pdf" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/
slides/W4.L7.M3.T8.1-2.PurposeForm&Classification.pdf" , "https://unitn-kdi-2021.github.io/
unitn-kdi-2021-website/material/slides/W2.L2.M2.T4.1.iTelosPrinciples.pdf" , "https://unitn-kdi-2021.
github.io/unitn-kdi-2021-website/material/slides/W2.L3.M2.T4.2.iTelosStructure.pdf" ;
88 dct:description "Inception Sheet template is available at https://unitn-kdi-2021.github.io/
unitn-kdi-2021-website/material/templates/InceptionSheet.xlsx" , "Inception Sheet is in xlsx format.
See https://wikipedia.org/wiki/Microsoft\_Excel for more information." , "Inception Sheet Metadata
regarding Trentino Transportation." ;
89 dct:format "https://en.wikipedia.org/wiki/Microsoft_Excel"^^xsd:anyURI ;
90 dct:identifier "https://github.com/carloccorradini/Trentino-Transportation/tree/main/Datasets/Inception"^^
xsd:anyURI ;
91 dct:issued "2021-12-10T00:00:00Z"^^xsd:dateTime ;
92 dct:language "English" ;
93 dct:license "https://opensource.org/licenses/MIT"^^xsd:anyURI ;
94 dct:modified "2021-12-10T00:00:00Z"^^xsd:dateTime ;
95 dct:rights "https://opensource.org/licenses/MIT" ;
96 dct:title "Inception Sheet" , "Trentino Transportation" ;
97 dct:type "Collection"^^xsd:anyURI ;
98 spdx:checksum "md5 998ade525edfa679bb4390ebfd8d0bea" ;
99 adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/b9645f82-9500-414c-a51d-255ff657c69e> ;
100 dcat:accessURL "https://github.com/carloccorradini/Trentino-Transportation/tree/main/Datasets/Inception"^^
xsd:anyURI , "https://drive.google.com/drive/folders/1-9_sf2hXrcE8GRTSypQHovoOukNaeh8E?usp=sharing"^^
xsd:anyURI ;
101 dcat:byteSize "15434.0"^^xsd:double ;
102 dcat:downloadURL "https://github.com/carloccorradini/Trentino-Transportation/raw/main/Teleologies/Inception/
InceptionSheet.xlsx"^^xsd:anyURI ;
103 dcat:mediaType "application/vnd.openxmlformats-officedocument.spreadsheetml.sheet" ;
104 foaf:page "https://github.com/carloccorradini/Trentino-Transportation" .

105
106 <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/cd879ddb-55b6-4620-a0e4-c85a2df9f483>
107 rdf:type schema:PostalAddress ;
108 schema:addressCountry "IT" ;
109 schema:addressLocality "Trento" ;
110 schema:postalCode "38122" ;
111 schema:streetAddress "Via Calepina 14" .

112
113 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/5edb028b-96af-4035-8d62-c253acd5a3c5>
114 rdf:type skos:ConceptScheme ;
115 dct:description "The DI Purpose, expressed by the final user as a natural language sentence, define the
main goal for the whole data integration. It represent what the final user should be able to do
exploiting the DI final outcome (KG). Due to that, the Purpose leads the whole integration process and
makes iTelos be a Purpose driven DI methodology.\r\nDomain of Interest (DoI): The portion of the
world that involves all the information elements used to satisfy a specific purpose.\r\nIn order to
identify the level of reusability of the resources collected and handled along the methodology.\r\n
iTilos Data Life Cycle:\r\n * Data Collection & Preparation (DTA-1): align the different sources data
formats, and data standards, representing the information carried through a single data format. The
aligned data can be then collected within the methodologies Input Repository\r\n * Syntactic Alignment
(DTA-2.1): align the data value formats by adopting the same data standards for similar data types\r\n
* Semantic Alignment (DTA-2.2): align the semantic of the data (entity schema representation and word
sense disambiguation)\r\n * Entity Matching (DTA-2.3): align modeled entities with already existing
representations of the same entities\r\n * Application Alignment (DTA-3): the last transformation (
considered as out of scope for the DI methodology) aims to align the integrated data in order to let
them suitable to be used by a specific application\r\nTeleology is the study of ends and goals, things
whose existence or occurrence is purposive. Concretely, in our context, teleologies are ontologies
but with the proviso that teleologies focus on function and on how a chosen representation fits a
certain purpose. In other words, the teleologies are the way adopted in the DI methodology (iTilos) to

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model (design, represent) the information that needs to be exploited by final users.\r\nA KG, as result of a DI process, is composed by knowledge (teleologies) and data (datasets) resources combined together in the best way possible in order to achieve the users Purpose. There are three different approaches to build such kind of KGs:\r\n \* Knowledge centric: The data schema design comes first and then the data are aligned to it.\r\n \* Data centric: The data schema is mainly (some adaptation are always required) extracted from the data to be integrated.\r\n \* Middle-out approach: The data schema (teleology) is designed considering already existing knowledge resources AND the data. While the datasets are adapted to the schema designed." ;

```

116   dct:title "iTilos Principles" .
117
118 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/a21146bd-a38c-49fe-a02f-f8575d1d73e2>
119   rdf:type skos:ConceptScheme ;
120   dct:description "The position or rank of someone or something when compared to others in a society, organization, group, etc." ;
121   dct:title "Status" .
122
123 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/3a8a3044-3e7a-463d-94d9-15c4f4822938>
124   rdf:type schema>ContactPoint ;
125   schema:availableLanguage "zh-CN" , "en-US" ;
126   schema:contactType "Member" ;
127   schema:email "xuanli.li@studenti.unitn.it" ;
128   schema:name "Xuanli Li" .
129
130 <https://www.epos-eu.org/epos-dcat-ap#Concept/b9645f82-9500-414c-a51d-255ff657c69e>
131   rdf:type skos:Concept ;
132   skos:definition "Containing all the necessary parts, answers, or information." ;
133   skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/a21146bd-a38c-49fe-a02f-f8575d1d73e2> ;
134   skos:prefLabel "Completed" .
135
136 <https://www.epos-eu.org/epos-dcat-ap#Agent/828bf6b9-9f4b-4355-bcd0-d68b188811cb>
137   rdf:type foaf:Agent ;
138   foaf:name "Carlo Corradini" .
139
140 <https://www.epos-eu.org/epos-dcat-ap#Dataset/3a2e0c02-aebe-44d1-b688-a5e21d81d088>
141   rdf:type dcat:Dataset ;
142   dct:accessRights "Public" ;
143   dct:accrualPeriodicity "Once"^^xsd:anyURI ;
144   dct:conformsTo "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W2.L2.M2.T4.1.iTilosPrinciples.pdf" , "iTilos" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W2.L3.M2.T4.2.iTilosStructure.pdf" ;
145   dct:created "2021-09-13T00:00:00Z"^^xsd:dateTime ;
146   dct:description "For more information see the following websites: https://unitn-kdi-2021.github.io/unitn-kdi-2021-website https://drive.google.com/drive/folders/1p27IFsmy9Us4AD2lw_0fEv1k7BaIMk?usp=sharing https://github.com/carlocorradini/Trentino-Transportation" , "The project is related to the Knowledge and Data integration (KDI) course held in the academic year 2021/2022 at the University of Trento (UNITN)." , "Carlo Corradini (https://github.com/carlocorradini) and Xuanli Li(https://github.com/xuanli666) are the members assigned to the realization and finalization." , "With the development of big data technology and cloud storage technology, we are in an era of the rapid increase in information, with countless data or knowledge. How to manage these data and achieve more efficient sharing and utilization is an area that many researchers are exploring, that is, to fulfill the integration of knowledge and data in specific, rather than leaving information be unorganized. This report focuses on integrating all the public transportation as well as sharing vehicles information within Trentino so that a more complete transport information system could help people make a better decision and save time or money as much as possible. Specifically, we pay attention to the application of vehicles that GTFS has not covered, such as sharing bikes, sharing cars, and so on so forth, which is added to the system, and then residents have more choices when determining paths." , "Inception Sheet Metadata regarding Trentino Transportation." , "This project aims to comprehensively consider the transportation situations under the specific Trentino region, not only involving the public transportation services but also the personal tracks. Collecting the latest temporal and spatial information and integrating the data and knowledge from diverse sources. Public transportation services, vehicles, bus stations, train stations, railways, highways, simple streets, public transportation service timelines, and trip schedules are the main important elements that will be mainly paid attention, besides, the mixed using of some vehicles and the parking path will be exploring." ;
  
```

---

```

147    dct:identifier "https://github.com/carlocorradini/Trentino-Transportation/tree/main/Teleologies/Inception"
148        ^^xsd:anyURI ;
149    dct:issued "2021-12-10T00:00:00Z"^^xsd:dateTime ;
150    dct:language "English" ;
151    dct:publisher <https://www.epos-eu.org/epos-dcat-ap#Organization/2dad489f-4ce3-4e0d-9122-b70df55b8ef2> , <https://www.epos-eu.org/epos-dcat-ap#Agent/828bf6b9-9f4b-4355-bcd0-d68b188811cb> , <https://www.epos-eu.org/epos-dcat-ap#Agent/f9cfb89e-3bb9-41ba-b263-e0386fce30ed> ;
152    dct:temporal <https://www.epos-eu.org/epos-dcat-ap#PeriodOfTime/84efa52e-3879-4d09-b0b9-36362e915866> ;
153    dct:title "Inception Sheet Metadata" ;
154    dct:type "Collection"^^xsd:anyURI ;
155    dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/3a8a3044-3e7a-463d-94d9-15c4f4822938>
156        , <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ca07b831-220f-4c49-bc3b-6e8215eb3238> ;
157    dcat:distribution <https://www.epos-eu.org/epos-dcat-ap#Distribution/2d8e5529-0e68-4e0d-af09-49a96f1c6c25>
158        ;
159    dcat:keyword "Fausto Giunchiglia" , "Xuanli Li" , "fare" , "bike" , "Knowledge and Data integration" , "bus"
160        , "Simone Bocca" , "extra-urban transport" , "trentino trasporti" , "car sharing" , "KDI" , "iTilos"
161        , "public transport" , "UniTN" , "cash" , "taxi" , "cable car" , "Carlo Corradini" , "train" , "
162        University of Trento" , "trento" , "bike sharing" , "transport" , "price" , "trentino" , "mobile" , "
163        trip" , "parking" , "ticket" , "route" , "cartascalare" , "bike parking" , "urban transport" ;
164    dcat:landingPage "https://github.com/carlocorradini/Trentino-Transportation" ;
165    dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/4040fa1c-755a-4706-9fcf-b2e9d6fb755> , <https://www.epos-eu.org/epos-dcat-ap#Concept/520bf2b3-6fcc-45ad-971a-b17df5fe98f0> ;
166    foaf:page "https://github.com/carlocorradini/Trentino-Transportation" .
167
168 <https://www.epos-eu.org/epos-dcat-ap#Agent/f9cfb89e-3bb9-41ba-b263-e0386fce30ed>
169     rdf:type foaf:Agent ;
170     foaf:name "Xuanli Li" .

```

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### 3.3 Resources collection

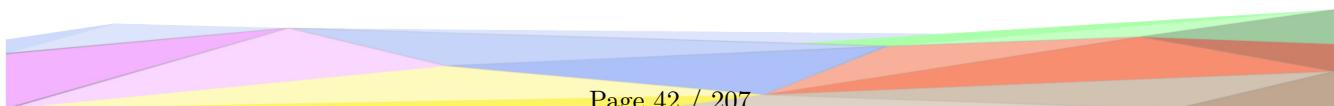
Knowledge and data integration requires us to collect the information about the domain as much as possible. We choose heterogeneous data and knowledge sources and try to extract helpful content from them next steps.

#### 3.3.1 Linguistic Resources

##### 3.3.1.1 Universal Knowledge Core (UKC)

UKC platform has been massively used during the Formal Modeling phase to map and interconnect the various Etype(s), Object properties, and Data properties to their corresponding concept. This procedure is accomplished by assigning a GID (Global IDentifier) to each one. The GID abstract the knowledge of a concept regarding the original language provenance to a common and aligned number. The GID is also connected to the corresponding different values for each natural language. The process solves the language diversity (L2) into a more concise and helpful architecture. The procedure is automatized on the KOS platform and requires only a human interaction for matching the correct (guessed or created) concepts to the value.

Note that on UKC platform we can explore the knowledge graph manually and see how the different concepts are interconnected in different languages.



### 3.3.1.2 Schema.org



During the various phases we've heavily used Schema.org to derive the different knowledge from a single or multiple words. Specifically, during the Formal Modeling phase Schema.org has been used to add new concepts in the KOS platform. E.g The `startDate` concept was missing from the KOS platform. We searched and found the same term on Schema.org; and simply copied the value: <https://schema.org/startDate>. Moreover, Schema.org has been used to view, search, and categorize the hierarchies and correlation between the different concepts and/or their properties.

## 3.3.2 Knowledge Resources

### 3.3.2.1 General Transit Feed Specification (GTFS)



The General Transit Feed Specification (GTFS), also known as *GTFS static* or *static transit* to differentiate it from the GTFS realtime extension, defines a common format for public transportation schedules and associated geographic information. GTFS "feeds" let public transit agencies publish their transit data and developers write applications that consume that data in an interoperable way.

A GTFS feed is composed of a series of text files collected in a ZIP file. Each file models a particular aspect of transit information: stops, routes, trips, and other schedule data.

A transit agency can produce a GTFS feed to share their public transit information with developers, who write tools that consume GTFS feeds to incorporate public transit information into their applications. GTFS can be used to power trip planners, time table publishers, and a variety of applications, too diverse to list here, that use public transit information in some way.

For more information: <https://developers.google.com/transit/gtfs>.

#### Files Requirements:

- All files must be saved as comma-delimited text.
- The first line of each file must contain field names. Each subsection of the Field definitions section corresponds to one of the files in a GTFS dataset and lists the field names that may be used in that file.
- All field names are case-sensitive.
- Field values may not contain tabs, carriage returns or new lines.
- Field values that contain quotation marks or commas must be enclosed within quotation marks. In addition, each quotation mark in the field value must be preceded with a quotation mark. This is consistent with the manner in which Microsoft Excel outputs comma-delimited (CSV) files. For more information on the CSV file format, see <http://tools.ietf.org/html/rfc4180>. The following example demonstrates how a field value would appear in a comma-delimited file:
  - Original field value: Contains "quotes", commas and text
  - Field value in CSV file: "Contains ""quotes""", commas and text"
- Field values must not contain HTML tags, comments or escape sequences.

- Remove any extra spaces between fields or field names. Many parsers consider the spaces to be part of the value, which may cause errors.
- Each line must end with a CRLF or LF linebreak character.
- Files should be encoded in UTF-8 to support all Unicode characters. Files that include the Unicode byte-order mark (BOM) character are acceptable. See [http://unicode.org/faq/utf\\_bom.html#BOM](http://unicode.org/faq/utf_bom.html#BOM) for more information on the BOM character and UTF-8.
- All dataset files must be zipped together.

#### Field Types:

Name	Description
Color	A color encoded as a six-digit hexadecimal number. Refer to <a href="https://htmlcolorcodes.com">https://htmlcolorcodes.com</a> to generate a valid value (the leading "#" is not included). <i>Example: FFFFFF for white, 000000 for black or 0039A6 for the A,C,E lines in NYMTA.</i>
Currency Code	An ISO 4217 alphabetical currency code. For the list of current currency, refer to <a href="https://en.wikipedia.org/wiki/ISO_4217#Active_codes">https://en.wikipedia.org/wiki/ISO_4217#Active_codes</a> . <i>Example: CAD for Canadian dollars, EUR for euros or JPY for Japanese yen.</i>
Date	Service day in the YYYYMMDD format. Since time within a service day can be above 24:00:00, a service day often contains information for the subsequent day(s). <i>Example: 20180913 for September 13th, 2018.</i>
Email	An email address. <i>Example: example@example.com</i>
Enum	An option from a set of predefined constants defined in the "Description" column. <i>Example: The route_type field contains a 0 for tram, a 1 for subway...</i>
ID	An ID field value is an internal ID, not intended to be shown to riders, and is a sequence of any UTF-8 characters. Using only printable ASCII characters is recommended. IDs defined in one .txt file are often referenced in another .txt file. <i>Example: The stop_id field in stops.txt is a ID. The stop_id field in stop_times.txt is an ID referencing stops.stop_id.</i>
Language Code	An IETF BCP 47 language code. For an introduction to IETF BCP 47, refer to <a href="http://www.rfc-editor.org/rfc/bcp/bcp47.txt">http://www.rfc-editor.org/rfc/bcp/bcp47.txt</a> and <a href="http://www.w3.org/International/articles/language-tags">http://www.w3.org/International/articles/language-tags</a> . <i>Example: en for English, en-US for American English or de for German.</i>
Latitude	WGS84 latitude in decimal degrees. The value must be greater than or equal to -90.0 and less than or equal to 90.0. <i>Example: 41.890169 for the Colosseum in Rome.</i>
Longitude	WGS84 longitude in decimal degrees. The value must be greater than or equal to -180.0 and less than or equal to 180.0. <i>Example: 12.492269 for the Colosseum in Rome.</i>
Non-negative Float	A floating point number greater than or equal to 0. <i>Example: 3.14</i>
Non-negative Integer	A integer greater than or equal to 0. <i>Example: 2</i>
Phone number	A phone number. <i>Example: +39 0123 456789</i>

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Time	Time in the HH:MM:SS format (H:MM:SS is also accepted). The time is measured from "noon minus 12h" of the service day (effectively midnight except for days on which daylight savings time changes occur. For more information, see the guidelines article). For times occurring after midnight, enter the time as a value greater than 24:00:00 in HH:MM:SS local time for the day on which the trip schedule begins. <i>Example: 14:30:00 for 2:30PM or 25:35:00 for 1:35AM on the next day.</i>
Text	A string of UTF-8 characters, which is aimed to be displayed and which must therefore be human readable. <i>Example: Hello World!</i>
Timezone	TZ timezone from the <a href="https://www.iana.org/time-zones">https://www.iana.org/time-zones</a> . Timezone names never contain the space character but may contain an underscore. Refer to <a href="http://en.wikipedia.org/wiki/List_of_tz_zones">http://en.wikipedia.org/wiki/List_of_tz_zones</a> for a list of valid values. <i>Example: Asia/Tokyo, America/Los_Angeles or Africa/Cairo.</i>
URL	A fully qualified URL that includes http:// or https://, and any special characters in the URL must be correctly escaped. See the following <a href="http://www.w3.org/Addressing/URL/4_URI_Recommendations.html">http://www.w3.org/Addressing/URL/4_URI_Recommendations.html</a> for a description of how to create fully qualified URL values. <i>Example: https://www.google.com</i>

---

#### Dataset Files:

- **agency.txt**

Transit agencies with service represented in this dataset.

Fields:

Name	Type	Required	Description
agency_id	ID	?	Identifies a transit brand which is often synonymous with a transit agency. Note that in some cases, such as when a single agency operates multiple separate services, agencies and brands are distinct. This document uses the term "agency" in place of "brand". A dataset may contain data from multiple agencies. This field is required when the dataset contains data for multiple transit agencies, otherwise it is optional.
agency_name	Text	✓	Full name of the transit agency.
agency_url	URL	✓	URL of the transit agency.
agency_timezone	Timezone	✓	Timezone where the transit agency is located. If multiple agencies are specified in the dataset, each must have the same <code>agency_timezone</code> .
agency_lang	Language code	✗	Primary language used by this transit agency. This field helps GTFS consumers choose capitalization rules and other language-specific settings for the dataset.
agency_phone	Phone number	✗	A voice telephone number for the specified agency. This field is a string value that presents the telephone number as typical for the agency's service area. It can and should contain punctuation marks to group the digits of the number. Dialable text (for example, TriMet's 503-238-RIDE) is permitted, but the field must not contain any other descriptive text.
agency_fare_url	URL	✗	URL of a web page that allows a rider to purchase tickets or other fare instruments for that agency online.

---

agency_email	Email	✗	Email address actively monitored by the agency's customer service department. This email address should be a direct contact point where transit riders can reach a customer service representative at the agency.
--------------	-------	---	---

---

Example:

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```

1 agency_id,agency_name,agency_url,agency_timezone,agency_phone,agency_lang
2 FunBus,The Fun Bus,http://www.thefunbus.org,America/Los_Angeles,(310) 555-0222,en

```

---

- **stops.txt**

Stops where vehicles pick up or drop off riders. Also defines stations and station entrances.  
Fields:

Name	Type	Required	Description
stop_id	ID	✓	Identifies a stop, station, or station entrance. The term "station entrance" refers to both station entrances and station exits. Stops, stations or station entrances are collectively referred to as locations. Multiple routes may use the same stop.
stop_code	Text	✗	Short text or a number that identifies the location for riders. These codes are often used in phone-based transit information systems or printed on signage to make it easier for riders to get information for a particular location. The <code>stop_code</code> can be the same as <code>stop_id</code> if it is public facing. This field should be left empty for locations without a code presented to riders.
stop_name	Text	?	Name of the location. Use a name that people will understand in the local and tourist vernacular. When the location is a boarding area ( <code>location_type=4</code> ), the <code>stop_name</code> should contain the name of the boarding area as displayed by the agency. It could be just one letter (like on some European intercity railway stations), or text like Wheelchair boarding area (NYC's Subway) or Head of short trains (Paris RER). Conditionally Required: <ul style="list-style-type: none"><li>- <b>Required</b> for locations which are stops (<code>location_type=0</code>), stations (<code>location_type=1</code>) or entrances/exits (<code>location_type=2</code>).</li><li>- <b>Optional</b> for locations which are generic nodes (<code>location_type=3</code>) or boarding areas (<code>location_type=4</code>).</li></ul>
stop_desc	Text	✗	Description of the location that provides useful, quality information. Do not simply duplicate the name of the location.

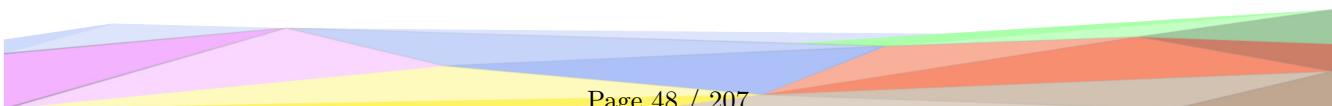
---

stop_lat	Latitude	?	Latitude of the location. Conditionally Required: <ul style="list-style-type: none"> <li>- <b>Required</b> for locations which are stops (<code>location_type=0</code>), stations (<code>location_type=1</code>) or entrances/exits (<code>location_type=2</code>).</li> <li>- <b>Optional</b> for locations which are generic nodes (<code>location_type=3</code>) or boarding areas (<code>location_type=4</code>).</li> </ul>
stop_lon	Longitude	?	Longitude of the location. Conditionally Required: <ul style="list-style-type: none"> <li>- <b>Required</b> for locations which are stops (<code>location_type=0</code>), stations (<code>location_type=1</code>) or entrances/exits (<code>location_type=2</code>).</li> <li>- <b>Optional</b> for locations which are generic nodes (<code>location_type=3</code>) or boarding areas (<code>location_type=4</code>).</li> </ul>
zone_id	ID	?	Identifies the fare zone for a stop. This field is required if providing fare information using <code>fare_rules.txt</code> , otherwise it is optional. If this record represents a station or station entrance, the <code>zone_id</code> is ignored.
stop_url	URL	✗	URL of a web page about the location. This should be different from the <code>agency.agency_url</code> and the <code>routes.route_url</code> field values.
location_type	Enum	✗	Type of the location: 0 (or empty): <b>Stop</b> (or <b>Platform</b> ). A location where passengers board or disembark from a transit vehicle. Is called a platform when defined within a <code>parent_station</code> . 1: <b>Station</b> . A physical structure or area that contains one or more platform. 2: <b>Entrance/Exit</b> . A location where passengers can enter or exit a station from the street. If an entrance/exit belongs to multiple stations, it can be linked by pathways to both, but the data provider must pick one of them as parent. 3: <b>Generic Node</b> . A location within a station, not matching any other <code>location_type</code> , which can be used to link together pathways define in <code>pathways.txt</code> . 4: <b>Boarding Area</b> . A specific location on a platform, where passengers can board and/or alight vehicles.

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<code>parent_station</code>	ID referencing <code>stops.stop_id</code>	?	<p>Defines hierarchy between the different locations defined in stops.txt. It contains the ID of the parent location, as follows:</p> <ul style="list-style-type: none"> <li>- <b>Stop/platform</b> (<code>location_type=0</code>): the <code>parent_station</code> field contains the ID of a station.</li> <li>- <b>Station</b> (<code>location_type=1</code>): this field must be empty.</li> <li>- <b>Entrance/exit</b> (<code>location_type=2</code>) or <b>generic node</b> (<code>location_type=3</code>): the <code>parent_station</code> field contains the ID of a station (<code>location_type=1</code>)</li> <li>- <b>Boarding Area</b> (<code>location_type=4</code>): the <code>parent_station</code> field contains ID of a platform.</li> </ul> <p>Conditionally Required:</p> <ul style="list-style-type: none"> <li>- <b>Required</b> for locations which are entrances (<code>location_type=2</code>), generic nodes (<code>location_type=3</code>) or boarding areas (<code>location_type=4</code>).</li> <li>- <b>Optional</b> for stops/platforms (<code>location_type=0</code>).</li> <li>- <b>Forbidden</b> for stations (<code>location_type=1</code>).</li> </ul>
<code>stop_timezone</code>	Timezone	✗	<p>Timezone of the location. If the location has a parent station, it inherits the parent station's timezone instead of applying its own. Stations and parentless stops with empty <code>stop_timezone</code> inherit the timezone specified by <code>agency.agency_timezone</code>. If <code>stop_timezone</code> values are provided, the times in <code>stop_times.txt</code> should be entered as the time since midnight in the timezone specified by <code>agency.agency_timezone</code>. This ensures that the time values in a trip always increase over the course of a trip, regardless of which timezones the trip crosses.</p>
<code>wheelchair_boarding</code>	Enum	✗	<p>Indicates whether wheelchair boardings are possible from the location. Valid options are:</p> <p>For parentless stops:</p> <ul style="list-style-type: none"> <li><b>0</b> or empty - No accessibility information for the stop.</li> <li><b>1</b> - Some vehicles at this stop can be boarded by a rider in a wheelchair.</li> <li><b>2</b> - Wheelchair boarding is not possible at this stop.</li> </ul> <p>For child stops:</p> <ul style="list-style-type: none"> <li><b>0</b> or empty - Stop will inherit its <code>wheelchair_boarding</code> behavior from the parent station, if specified in the parent.</li> <li><b>1</b> - There exists some accessible path from outside the station to the specific stop/platform.</li> <li><b>2</b> - There exists no accessible path from outside the station to the specific stop/platform.</li> </ul> <p>For station entrances/exits:</p> <ul style="list-style-type: none"> <li><b>0</b> or empty - Station entrance will inherit its <code>wheelchair_boarding</code> behavior from the parent station, if specified for the parent.</li> <li><b>1</b> - Station entrance is wheelchair accessible.</li> <li><b>2</b> - No accessible path from station entrance to stops/platforms.</li> </ul>
<code>level_id</code>	ID referencing <code>levels.level_id</code>	✗	<p>Level of the location. The same level can be used by multiple unlinked stations.</p>



---

<code>platform_code</code>	Text	✗	Platform identifier for a platform stop (a stop belonging to a station). This should be just the platform identifier (eg. G or 3). Words like "platform" or "track" (or the feeds language-specific equivalent) should not be included. This allows feed consumers to more easily internationalize and localize the platform identifier into other languages.
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Example:

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```

1 stop_id,level_id,stop_name,stop_lat,stop_lon,location_type,parent_station
2 F12,,5 Av/53 St,40.760167,-73.975224,1,
3 E1,L0,5 Av/53 St SW,40.760474,-73.976099,2,F12
4 E2,L0,5 Av/53 St NE,40.76035,-73.97546,2,F12
5 E3,L0,5 Av/53 St SE,40.760212,-73.975512,2,F12
6 E4,L0,Madison/53 St NE,40.759612,-73.973731,2,F12
7 E5,L0,Madison/53 St SE,40.759491,-73.973820,2,F12
8 N1,L1,,,40.760457,-73.975912,3,F12
9 N2,L1,,40.760531,-73.976111,3,F12
10 N3,L1,,40.759746,-73.974203,3,F12
11 N4,L1,,40.759679,-73.974064,3,F12
12 F12S,,5 Av/53 St,40.760167,-73.975224,0,F12
13 B1,L2,,40.759746,-73.974203,4,F12S
14 B3,L2,,40.759828,-73.974442,4,F12S
15 F12N,,5 Av/53 St,40.760167,-73.975224,0,F12
16 B2,L3,,40.760457,-73.975912,4,F12N
17 B4,L3,,40.760375,-73.975729,4,F12N

```

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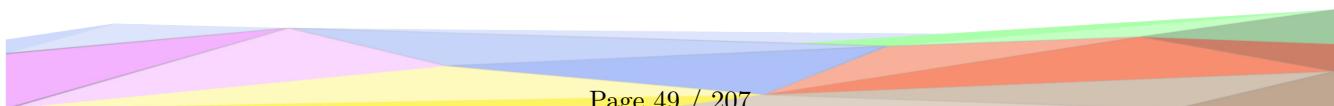
- `routes.txt`

Transit routes. A route is a group of trips that are displayed to riders as a single service.

Fields:

Name	Type	Required	Description
<code>route_id</code>	ID	✓	Identifies a route.
<code>agency_id</code>	ID	?	Agency for the specified route. This field is required when the dataset provides data for routes from more than one agency in <code>agency.txt</code> , otherwise it is optional.
<code>referencing</code>	referencing		
<code>agency.agency_id</code>			
<code>route_short_name</code>	Text	?	Short name of a route. This will often be a short, abstract identifier like "32", "100X", or "Green" that riders use to identify a route, but which doesn't give any indication of what places the route serves. Either <code>route_short_name</code> or <code>route_long_name</code> must be specified, or potentially both if appropriate.
<code>route_long_name</code>	Text	?	Full name of a route. This name is generally more descriptive than the <code>route_short_name</code> and often includes the route's destination or stop. Either <code>route_short_name</code> or <code>route_long_name</code> must be specified, or potentially both if appropriate.
<code>route_desc</code>	Text	✗	Description of a route that provides useful, quality information. Do not simply duplicate the name of the route. <i>Example: "A" trains operate between Inwood-207 St, Manhattan and Far Rockaway-Mott Avenue, Queens at all times. Also from about 6AM until about midnight, additional "A" trains operate between Inwood-207 St and Lefferts Boulevard (trains typically alternate between Lefferts Blvd and Far Rockaway).</i>

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<code>route_type</code>	Enum	✓	Indicates the type of transportation used on a route. Valid options are: <b>0</b> - Tram, Streetcar, Light rail. Any light rail or street level system within a metropolitan area. <b>1</b> - Subway, Metro. Any underground rail system within a metropolitan area. <b>2</b> - Rail. Used for intercity or long-distance travel. <b>3</b> - Bus. Used for short- and long-distance bus routes. <b>4</b> - Ferry. Used for short- and long-distance boat service. <b>5</b> - Cable tram. Used for street-level rail cars where the cable runs beneath the vehicle, e.g., cable car in San Francisco. <b>6</b> - Aerial lift, suspended cable car (e.g., gondola lift, aerial tramway). Cable transport where cabins, cars, gondolas or open chairs are suspended by means of one or more cables. <b>7</b> - Funicular. Any rail system designed for steep inclines. <b>11</b> - Trolleybus. Electric buses that draw power from overhead wires using poles. <b>12</b> - Monorail. Railway in which the track consists of a single rail or a beam.
<code>route_url</code>	URL	✗	URL of a web page about the particular route. Should be different from the <code>agency.agency_url</code> value.
<code>route_color</code>	Color	✗	Route color designation that matches public facing material. Defaults to white (#FFFFFF) when omitted or left empty. The color difference between <code>route_color</code> and <code>route_text_color</code> should provide sufficient contrast when viewed on a black and white screen.
<code>route_text_color</code>	Color	✗	Legible color to use for text drawn against a background of <code>route_color</code> . Defaults to black (#000000) when omitted or left empty. The color difference between <code>route_color</code> and <code>route_text_color</code> should provide sufficient contrast when viewed on a black and white screen.
<code>route_sort_order</code>	Non-negative integer	✗	Orders the routes in a way which is ideal for presentation to customers. Routes with smaller <code>route_sort_order</code> values should be displayed first.
<code>continuous_pickup</code>	Enum	✗	Indicates whether a rider can board the transit vehicle anywhere along the vehicles travel path. The path is described by <code>shapes.txt</code> on every trip of the route. Valid options are: <b>0</b> - Continuous stopping pickup. <b>1</b> or empty - No continuous stopping pickup. <b>2</b> - Must phone an agency to arrange continuous stopping pickup. <b>3</b> - Must coordinate with a driver to arrange continuous stopping pickup. The default continuous pickup behavior defined in <code>routes.txt</code> can be overridden in <code>stop_times.txt</code> .

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<code>continuous_drop_off</code>	Enum	✗	<p>Indicates whether a rider can alight from the transit vehicle at any point along the vehicles travel path. The path is described by <code>shapes.txt</code> on every trip of the route. Valid options are:</p> <ul style="list-style-type: none"> <li>0 - Continuous stopping drop-off.</li> <li>1 or empty - No continuous stopping drop-off.</li> <li>2 - Must phone an agency to arrange continuous stopping drop-off.</li> <li>3 - Must coordinate with a driver to arrange continuous stopping drop-off.</li> </ul> <p>The default continuous drop-off behavior defined in <code>routes.txt</code> can be overridden in <code>stop_times.txt</code>.</p>
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Example:

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```

1 route_id,route_short_name,route_long_name,route_desc,route_type
2 A,17,Mission,"The ""A"" route travels from lower Mission to Downtown.",3

```

---

• **`trips.txt`**

Trips for each route. A trip is a sequence of two or more stops that occur during a specific time period.  
Fields:

Name	Type	Required	Description
<code>route_id</code>	ID	✓	Identifies a route.
	referencing		
	<code>routes.route_id</code>		
<code>service_id</code>	ID	✓	Identifies a set of dates when service is available for one or more routes.
	referencing		
	<code>calendar.service_id</code>		
	or		
	<code>calendar_dates.service_id</code>		
<code>trip_id</code>	ID	✓	Identifies a trip.
<code>trip_headsign</code>	Text	✗	Text that appears on signage identifying the trip's destination to riders. Use this field to distinguish between different patterns of service on the same route. If the headsign changes during a trip, <code>trip_headsign</code> can be overridden by specifying values for the <code>stop_times.stop_headsign</code> .
<code>trip_short_name</code>	Text	✗	Public facing text used to identify the trip to riders, for instance, to identify train numbers for commuter rail trips. If riders do not commonly rely on trip names, leave this field empty. A <code>trip_short_name</code> value, if provided, should uniquely identify a trip within a service day; it should not be used for destination names or limited/express designations.

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direction_id	Enum	✗	<p>Indicates the direction of travel for a trip. This field is not used in routing; it provides a way to separate trips by direction when publishing time tables. Valid options are:</p> <ul style="list-style-type: none"> <li>0 - Travel in one direction (e.g. outbound travel).</li> <li>1 - Travel in the opposite direction (e.g. inbound travel).</li> </ul> <p><i>Example: The trip_headsign and direction_id fields could be used together to assign a name to travel in each direction for a set of trips. A trips.txt file could contain these records for use in time tables:</i></p> <pre>trip_id,...,trip_headsign,direction_id 1234,...,Airport,0 1505,...,Downtown,1</pre>
block_id	ID	✗	<p>Identifies the block to which the trip belongs. A block consists of a single trip or many sequential trips made using the same vehicle, defined by shared service days and block_id. A block_id can have trips with different service days, making distinct blocks.</p>
shape_id	ID	?	<p>Identifies a geospatial shape that describes the vehicle travel path for a trip.</p> <p>Conditionally required:</p> <p>This field is required if the trip has continuous behavior defined, either at the route level or at the stop time level.</p> <p>Otherwise, it's optional.</p>
wheelchair_accessible	Enum	✗	<p>Indicates wheelchair accessibility. Valid options are:</p> <ul style="list-style-type: none"> <li>0 or empty - No accessibility information for the trip.</li> <li>1 - Vehicle being used on this particular trip can accommodate at least one rider in a wheelchair.</li> <li>2 - No riders in wheelchairs can be accommodated on this trip.</li> </ul>
bikes_allowed	Enum	✗	<p>Indicates whether bikes are allowed. Valid options are:</p> <ul style="list-style-type: none"> <li>0 or empty - No bike information for the trip.</li> <li>1 - Vehicle being used on this particular trip can accommodate at least one bicycle.</li> <li>2 - No bicycles are allowed on this trip.</li> </ul>

---

Example:

```
1 route_id,service_id,trip_id,trip_headsign,block_id
2 A,WE,AWE1,Downtown,1
3 A,WE,AWE2,Downtown,2
```

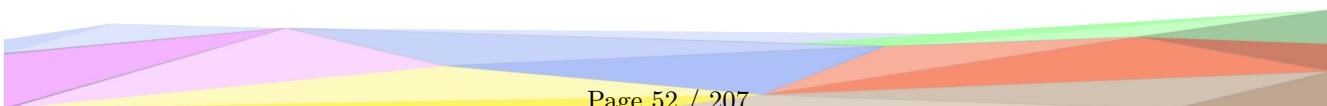
---

- **stop\_times.txt**

Times that a vehicle arrives at and departs from stops for each trip.

Fields:

Name	Type	Required	Description



<code>trip_id</code>	ID referencing <code>trips.trip_id</code>	✓	Identifies a trip.
<code>arrival_time</code>	Time	?	<p>Arrival time at a specific stop for a specific trip on a route. If there are not separate times for arrival and departure at a stop, enter the same value for <code>arrival_time</code> and <code>departure_time</code>. For times occurring after midnight on the service day, enter the time as a value greater than 24:00:00 in HH:MM:SS local time for the day on which the trip schedule begins.</p> <p>Scheduled stops where the vehicle strictly adheres to the specified arrival and departure times are timepoints. If this stop is not a timepoint, it is recommended to provide an estimated or interpolated time. If this is not available, <code>arrival_time</code> can be left empty. Further, indicate that interpolated times are provided with <code>timepoint=0</code>. If interpolated times are indicated with <code>timepoint=0</code>, then time points must be indicated with <code>timepoint=1</code>. Provide arrival times for all stops that are time points. An arrival time must be specified for the first and the last stop in a trip.</p>
<code>departure_time</code>	Time	?	<p>Departure time from a specific stop for a specific trip on a route. For times occurring after midnight on the service day, enter the time as a value greater than 24:00:00 in HH:MM:SS local time for the day on which the trip schedule begins. If there are not separate times for arrival and departure at a stop, enter the same value for <code>arrival_time</code> and <code>departure_time</code>. See the <code>arrival_time</code> description for more details about using timepoints correctly.</p> <p>The <code>departure_time</code> field should specify time values whenever possible, including non-binding estimated or interpolated times between timepoints.</p>
<code>stop_id</code>	ID referencing <code>stops.stop_id</code>	✓	Identifies the serviced stop. All stops serviced during a trip must have a record in <code>stop_times.txt</code> . Referenced locations must be stops, not stations or station entrances. A stop may be serviced multiple times in the same trip, and multiple trips and routes may service the same stop.
<code>stop_sequence</code>	Non-negative integer	✓	<p>Order of stops for a particular trip. The values must increase along the trip but do not need to be consecutive.</p> <p><i>Example: The first location on the trip could have a <code>stop_sequence=1</code>, the second location on the trip could have a <code>stop_sequence=23</code>, the third location could have a <code>stop_sequence=40</code>, and so on.</i></p>
<code>stop_headsign</code>	Text	✗	<p>Text that appears on signage identifying the trip's destination to riders. This field overrides the default <code>trips.trip_headsign</code> when the headsign changes between stops. If the headsign is displayed for an entire trip, <code>trips.trip_headsign</code> instead.</p> <p>A <code>stop_headsign</code> value specified for one <code>stop_time</code> does not apply to subsequent <code>stop_times</code> in the same trip. If you want to override the <code>trip_headsign</code> for multiple <code>stop_times</code> in the same trip, the <code>stop_headsign</code> value must be repeated in each <code>stop_time</code> row.</p>

---

<code>pickup_type</code>	Enum	✗	<p>Indicates pickup method. Valid options are:</p> <ul style="list-style-type: none"> <li><b>0</b> or empty - Regularly scheduled pickup.</li> <li><b>1</b> - No pickup available.</li> <li><b>2</b> - Must phone agency to arrange pickup.</li> <li><b>3</b> - Must coordinate with driver to arrange pickup.</li> </ul>
<code>drop_off_type</code>	Enum	✗	<p>Indicates drop off method. Valid options are:</p> <ul style="list-style-type: none"> <li><b>0</b> or empty - Regularly scheduled drop off</li> <li><b>1</b> - No drop off available.</li> <li><b>2</b> - Must phone agency to arrange drop off.</li> <li><b>3</b> - Must coordinate with driver to arrange drop off.</li> </ul>
<code>continuous_pickup</code>	Enum	✗	<p>Indicates whether a rider can board the transit vehicle at any point along the vehicles travel path. The path is described by <code>shapes.txt</code>, from this <code>stop_time</code> to the next <code>stop_time</code> in the trips <code>stop_sequence</code>. Valid options are:</p> <ul style="list-style-type: none"> <li><b>0</b> - Continuous stopping pickup.</li> <li><b>1</b> or empty - No continuous stopping pickup.</li> <li><b>2</b> - Must phone an agency to arrange continuous pickup.</li> <li><b>3</b> - Must coordinate with a driver to arrange continuous stopping pickup.</li> </ul> <p>The continuous pickup behavior indicated in <code>stop_times.txt</code> overrides any behavior defined in <code>routes.txt</code>.</p>
<code>continuous_drop_off</code>	Enum	✗	<p>Indicates whether a rider can alight from the transit vehicle at any point along the vehicles travel path as described by <code>shapes.txt</code>, from this <code>stop_time</code> to the next <code>stop_time</code> in the trips <code>stop_sequence</code>.</p> <ul style="list-style-type: none"> <li><b>0</b> - Continuous stopping drop off.</li> <li><b>1</b> or empty - No continuous stopping drop off</li> <li><b>2</b> - Must phone an agency to arrange continuous drop off.</li> <li><b>3</b> - Must coordinate with a driver to arrange continuous stopping drop off.</li> </ul> <p>The continuous drop-off behavior indicated in <code>stop_times.txt</code> overrides any behavior defined in <code>routes.txt</code>.</p>
<code>shape_dist_traveled</code>	Non-negative float	✗	<p>Actual distance traveled along the associated shape, from the first stop to the stop specified in this record. This field specifies how much of the shape to draw between any two stops during a trip. Must be in the same units used in <code>shapes.txt</code>. Values used for <code>shape_dist_traveled</code> must increase along with <code>stop_sequence</code>; they cannot be used to show reverse travel along a route.</p> <p><i>Example: If a bus travels a distance of 5.25 kilometers from the start of the shape to the stop, <code>shape_dist_traveled=5.25</code>.</i></p>
<code>timepoint</code>	Enum	✗	<p>Indicates if arrival and departure times for a stop are strictly adhered to by the vehicle or if they are instead approximate and/or interpolated times. This field allows a GTFS producer to provide interpolated stop-times, while indicating that the times are approximate. Valid options are:</p> <ul style="list-style-type: none"> <li><b>0</b> - Times are considered approximate.</li> <li><b>1</b> or empty - Times are considered exact.</li> </ul>

---

---

Example:

```
1 trip_id,arrival_time,departure_time,stop_id,stop_sequence,pickup_type,drop_off_type
2 AWE1,0:06:10,0:06:10,S1,1,0,0
3 AWE1,,,S2,2,1,3
4 AWE1,0:06:20,0:06:30,S3,3,0,0
5 AWE1,,,S5,4,0,0
6 AWE1,0:06:45,0:06:45,S6,5,0,0
7 AWD1,0:06:10,0:06:10,S1,1,0,0
8 AWD1,,,S2,2,0,0
9 AWD1,0:06:20,0:06:20,S3,3,0,0
10 AWD1,,,S4,4,0,0
11 AWD1,,,S5,5,0,0
12 AWD1,0:06:45,0:06:45,S6,6,0,0
```

---

- **calendar.txt**

Service dates specified using a weekly schedule with start and end dates. This file is required unless all dates of service are defined in `calendar_dates.txt`.

Fields:

Name	Type	Required	Description
service_id	ID	✓	Uniquely identifies a set of dates when service is available for one or more routes. Each <code>service_id</code> value can appear at most once in a <code>calendar.txt</code> file.
monday	Enum	✓	Indicates whether the service operates on all Mondays in the date range specified by the <code>start_date</code> and <code>end_date</code> fields. Note that exceptions for particular dates may be listed in <code>calendar_dates.txt</code> . Valid options are: 1 - Service is available for all Mondays in the date range. 0 - Service is not available for Mondays in the date range.
tuesday	Enum	✓	Functions in the same way as <code>monday</code> except applies to Tuesdays
wednesday	Enum	✓	Functions in the same way as <code>monday</code> except applies to Wednesdays
thursday	Enum	✓	Functions in the same way as <code>monday</code> except applies to Thursdays
friday	Enum	✓	Functions in the same way as <code>monday</code> except applies to Fridays
saturday	Enum	✓	Functions in the same way as <code>monday</code> except applies to Saturdays.
sunday	Enum	✓	Functions in the same way as <code>monday</code> except applies to Sundays.
start_date	Date	✓	Start service day for the service interval.
end_date	Date	✓	End service day for the service interval. This service day is included in the interval.

Example:

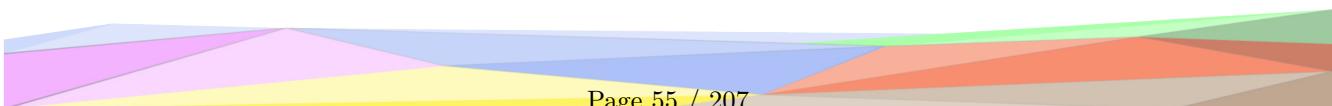
```
1 service_id,monday,tuesday,wednesday,thursday,friday,saturday,sunday,start_date,end_date
2 WE,0,0,0,0,1,1,20060701,20060731
3 WD,1,1,1,1,1,0,0,20060701,20060731
```

---

- **calendar\_dates.txt**

Exceptions for the services defined in the `calendar.txt`. If `calendar.txt` is omitted, then `calendar_dates.txt` is required and must contain all dates of service.

Fields:



Name	Type	Required	Description
service_id	ID referencing calendar.service_id or ID	✓	Identifies a set of dates when a service exception occurs for one or more routes. Each (service_id, date) pair can only appear once in calendar_dates.txt if using calendar.txt and calendar_dates.txt in conjunction. If a service_id value appears in both calendar.txt and calendar_dates.txt, the information in calendar_dates.txt modifies the service information specified in calendar.txt.
date	Date	✓	Date when service exception occurs.
exception_type	Enum	✓	Indicates whether service is available on the date specified in the date field. Valid options are: <b>1</b> - Service has been added for the specified date. <b>2</b> - Service has been removed for the specified date. <i>Example: Suppose a route has one set of trips available on holidays and another set of trips available on all other days. One service_id could correspond to the regular service schedule and another service_id could correspond to the holiday schedule. For a particular holiday, the calendar_dates.txt file could be used to add the holiday to the holiday service_id and to remove the holiday from the regular service_id schedule.</i>

Example:

```

1 service_id,date,exception_type
2 WD,20060703,2
3 WE,20060703,1
4 WD,20060704,2
5 WE,20060704,1

```

- **fare\_attributes.txt**

Fare information for a transit agency's routes.

Fields:

Name	Type	Required	Description
fare_id	ID	✓	Identifies a fare class.
price	Non-negative float	✓	Fare price, in the unit specified by currency_type.
currency_type	Currency code	✓	Currency used to pay the fare.
payment_method	Enum	✓	Indicates when the fare must be paid. Valid options are: <b>0</b> - Fare is paid on board. <b>1</b> - Fare must be paid before boarding.

transfers	Enum	✓	Indicates the number of transfers permitted on this fare. The fact that this field can be left empty is an exception to the requirement that a Required field must not be empty. Valid options are: 0 - No transfers permitted on this fare. 1 - Riders may transfer once. 2 - Riders may transfer twice. empty - Unlimited transfers are permitted.
agency_id	ID referencing agency.agency_id	?	Identifies the relevant agency for a fare. This field is required for datasets with multiple agencies defined in agency.txt, otherwise it is optional.
transfer_duration	Non-negative integer	✗	Length of time in seconds before a transfer expires. When transfers=0 this field can be used to indicate how long a ticket is valid for or it can be left empty.

Example:

```

1 fare_id,price,currency_type,payment_method,transfers,transfer_duration
2 1,0.00,USD,0,0,0
3 2,0.50,USD,0,0,0
4 3,1.50,USD,0,0,0
5 4,2.00,USD,0,0,0
6 5,2.50,USD,0,0,0

```

- **fare\_rules.txt**

Rules to apply fares for itineraries.

Fields:

Name	Type	Required	Description
fare_id	ID referencing fare_attributes.fare_id	✓	Identifies a fare class.
route_id	ID referencing routes.route_id	✗	Identifies a route associated with the fare class. If several routes with the same fare attributes exist, create a record in fare_rules.txt for each route. <i>Example: If fare class "b" is valid on route "TSW" and "TSE", the fare_rules.txt file would contain these records for the fare class:</i> fare_id,route_id b,TSW b,TSE
origin_id	ID referencing stops.zone_id	✗	Identifies an origin zone. If a fare class has multiple origin zones, create a record in fare_rules.txt for each origin_id <i>Example: If fare class "b" is valid for all travel originating from either zone "2" or zone "8", the fare_rules.txt file would contain these records for the fare class:</i> fare_id,...,origin_id b,...,2 b,...,8

---

<code>destination_id</code>	ID referencing <code>stops.zone_id</code>	✖	<p>Identifies a destination zone. If a fare class has multiple destination zones, create a record in <code>fare_rules.txt</code> for each <code>destination_id</code>.</p> <p><i>Example: The <code>origin_id</code> and <code>destination_id</code> fields could be used together to specify that fare class "b" is valid for travel between zones 3 and 4, and for travel between zones 3 and 5, the <code>fare_rules.txt</code> file would contain these records for the fare class:</i></p> <pre>fare_id,...,origin_id,destination_id b,...,3,4 b,...,3,5</pre>
<code>contains_id</code>	ID referencing <code>stops.zone_id</code>	✖	<p>Identifies the zones that a rider will enter while using a given fare class. Used in some systems to calculate correct fare class.</p> <p><i>Example: If fare class "c" is associated with all travel on the GRT route that passes through zones 5, 6, and 7 the <code>fare_rules.txt</code> would contain these records:</i></p> <pre>fare_id,route_id,...,contains_id c,GRT,...,5 c,GRT,...,6 c,GRT,...,7</pre> <p><i>Because all <code>contains_id</code> zones must be matched for the fare to apply, an itinerary that passes through zones 5 and 6 but not zone 7 would not have fare class "c". For more detail, see <a href="https://code.google.com/p/googletransitdatafeed/wiki/FareExamples">https://code.google.com/p/googletransitdatafeed/wiki/FareExamples</a> in the GoogleTransitDataFeed project wiki.</i></p>

---

Example:

---

```

1 fare_id,route_id,origin_id,destination_id,contains_id
2 a,TSW,1,1,
3 a,TSE,1,1,
4 a,GRT,1,1,
5 a,GRJ,1,1,
6 a,SVJ,1,1,
7 a,JSV,1,1,
8 a,GRT,2,4,
9 a,GRJ,4,2,
10 b,GRT,3,3,
11 c,GRT,,,6

```

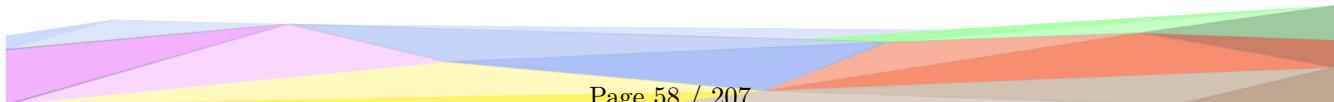
---

- `shapes.txt`

Rules for mapping vehicle travel paths, sometimes referred to as route alignments.

Fields:

Name	Type	Required	Description
<code>shape_id</code>	ID	✓	Identifies a shape.
<code>shape_pt_lat</code>	Latitude	✓	Latitude of a shape point. Each record in <code>shapes.txt</code> represents a shape point used to define the shape.
<code>shape_pt_lon</code>	Longitude	✓	Longitude of a shape point.



shape_pt_sequence	Non-negative integer	✓	<p>Sequence in which the shape points connect to form the shape. Values must increase along the trip but do not need to be consecutive.</p> <p><i>Example: If the shape "A_shp" has three points in its definition, the shapes.txt file might contain these records to define the shape:</i></p> <pre>shape_id,shape_pt_lat,shape_pt_lon,shape_pt_sequence A_shp,37.61956,-122.48161,0 A_shp,37.64430,-122.41070,6 A_shp,37.65863,-122.30839,11</pre>
shape_dist_traveled	Non-negative float	✗	<p>Actual distance traveled along the shape from the first shape point to the point specified in this record. Used by trip planners to show the correct portion of the shape on a map. Values must increase along with <code>shape_pt_sequence</code>; they cannot be used to show reverse travel along a route. Distance units must be consistent with those used in <code>stop_times.txt</code>.</p> <p><i>Example: If a bus travels along the three points defined above for A_shp, the additional <code>shape_dist_traveled</code> values (shown here in kilometers) would look like this:</i></p> <pre>shape_id,shape_pt_lat,shape_pt_lon,shape_dist_traveled A_shp,37.61956,-122.48161,0,0 A_shp,37.64430,-122.41070,6,6.8310 A_shp,37.65863,-122.30839,11,15.8765</pre>

Example:

---

```

1 shape_id,shape_pt_lat,shape_pt_lon,shape_pt_sequence,shape_dist_traveled
2 A_shp,37.61956,-122.48161,1,0
3 A_shp,37.64430,-122.41070,2,6.8310
4 A_shp,37.65863,-122.30839,3,15.8765

```

---

- **frequencies.txt**

Headway (time between trips) for headway-based service or a compressed representation of fixed-schedule service.  
Fields:

Name	Type	Required	Description
trip_id	ID referencing trips.trip_id	✓	Identifies a trip to which the specified headway of service applies.
start_time	Time	✓	Time at which the first vehicle departs from the first stop of the trip with the specified headway.
end_time	Time	✓	Time at which service changes to a different headway (or ceases) at the first stop in the trip.
headway_secs	Non-negative integer	✓	Time, in seconds, between departures from the same stop (headway) for the trip, during the time interval specified by <code>start_time</code> and <code>end_time</code> . Multiple headways for the same trip are allowed, but may not overlap. New headways may start at the exact time the previous headway ends.

---

<code>exact_times</code>	Enum	✗	Indicates the type of service for a trip. See the file description for more information. Valid options are: <b>0</b> or empty - Frequency-based trips. <b>1</b> - Schedule-based trips with the exact same headway throughout the day. In this case the <code>end_time</code> value must be greater than the last desired trip <code>start_time</code> but less than the last desired trip <code>start_time + headway_secs</code> .
--------------------------	------	---	---

---

Example:

```

1 trip_id,start_time,end_time,headway_secs
2 AWE1,05:30:00,06:30:00,300
3 AWE1,06:30:00,20:30:00,180
4 AWE1,20:30:00,28:00:00,420

```

---

- `transfers.txt`

Rules for making connections at transfer points between routes.

Fields:

Name	Type	Required	Description
<code>from_stop_id</code>	ID	✓	Identifies a stop or station where a connection between routes begins.
	referencing		If this field refers to a station, the transfer rule applies to all its child stops.
	<code>stops.stop_id</code>		
<code>to_stop_id</code>	ID	✓	Identifies a stop or station where a connection between routes ends.
	referencing		If this field refers to a station, the transfer rule applies to all child stops.
	<code>stops.stop_id</code>		
<code>transfer_type</code>	Enum	✓	Indicates the type of connection for the specified ( <code>from_stop_id</code> , <code>to_stop_id</code> ) pair. Valid options are: <b>0</b> or empty - Recommended transfer point between routes. <b>1</b> - Timed transfer point between two routes. The departing vehicle is expected to wait for the arriving one and leave sufficient time for a rider to transfer between routes. <b>2</b> - Transfer requires a minimum amount of time between arrival and departure to ensure a connection. The time required to transfer is specified by <code>min_transfer_time</code> . <b>3</b> - Transfers are not possible between routes at the location.
<code>min_transfer_time</code>	Non-negative integer	✗	Amount of time, in seconds, that must be available to permit a transfer between routes at the specified stops. The <code>min_transfer_time</code> should be sufficient to permit a typical rider to move between the two stops, including buffer time to allow for schedule variance on each route.

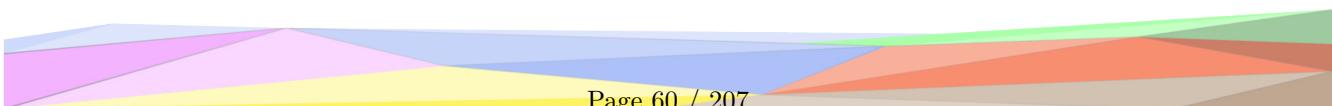
---

Example:

```

1 from_stop_id,to_stop_id,transfer_type,min_transfer_time
2 S6,S7,2,300
3 S7,S6,3,
4 S23,S7,1,

```



- **pathways.txt**

Pathways linking together locations within stations.

Fields:

Name	Type	Required	Description
pathway_id	ID	✓	The <code>pathway_id</code> field contains an ID that uniquely identifies the pathway. The <code>pathway_id</code> is used by systems as an internal identifier of this record (e.g., primary key in database), and therefore the <code>pathway_id</code> must be dataset unique. Different pathways can go from the same <code>from_stop_id</code> to the same <code>to_stop_id</code> . For example, this happens when two escalators are side by side in opposite direction, or when a stair is nearby and elevator and both go from the same place to the same place.
from_stop_id	ID referencing <code>stops.stop_id</code>	✓	Location at which the pathway begins. It contains a <code>stop_id</code> that identifies a platform, entrance/exit, generic node or boarding area from the <code>stops.txt</code> file.
to_stop_id	ID referencing <code>stops.stop_id</code>	✓	Location at which the pathway begins. It contains a <code>stop_id</code> that identifies a platform, entrance/exit, generic node or boarding area from the <code>stops.txt</code> file.
pathway_mode	Enum	✓	Type of pathway between the specified ( <code>from_stop_id</code> , <code>to_stop_id</code> ) pair. Valid values for this field are: 1: walkway 2: stairs 3: moving sidewalk/travelator 4: escalator 5: elevator 6: fare gate (or payment gate): A pathway that crosses into an area of the station where a proof of payment is required (usually via a physical payment gate). Fare gates may either separate paid areas of the station from unpaid ones, or separate different payment areas within the same station from each other. This information can be used to avoid routing passengers through stations using shortcuts that would require passengers to make unnecessary payments, like directing a passenger to walk through a subway platform to reach a busway. 7: exit gate: Indicates a pathway exiting an area where proof-of-payment is required into an area where proof-of-payment is no longer required.
is_bidirectional	Enum	✓	Indicates in which direction the pathway can be used: 0: Unidirectional pathway, it can only be used from <code>from_stop_id</code> to <code>to_stop_id</code> . 1: Bidirectional pathway, it can be used in the two directions. Fare gates ( <code>pathway_mode=6</code> ) and exit gates ( <code>pathway_mode=7</code> ) cannot be bidirectional.

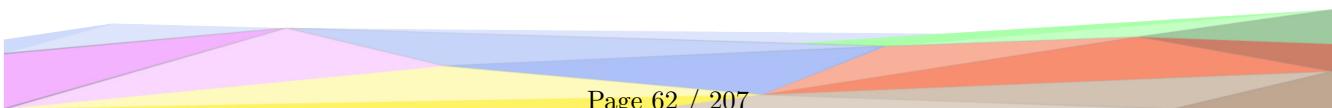
length	Non-negative Float	✗	Horizontal length in meters of the pathway from the origin location (defined in <code>from_stop_id</code> ) to the destination location (defined in <code>to_stop_id</code> ). This field is recommended for walkways ( <code>pathway_mode=1</code> ), fare gates ( <code>pathway_mode=6</code> ) and exit gates ( <code>pathway_mode=7</code> ).
traversal_time	Positive Integer	✗	Average time in seconds needed to walk through the pathway from the origin location (defined in <code>from_stop_id</code> ) to the destination location (defined in <code>to_stop_id</code> ). This field is recommended for moving sidewalks ( <code>pathway_mode=3</code> ), escalators ( <code>pathway_mode=4</code> ) and elevator ( <code>pathway_mode=5</code> ).
stair_count	Non-null Integer	✗	Number of stairs of the pathway. Best Practices: one could use the approximation of 1 floor = 15 stairs to generate approximative values. A positive <code>stair_count</code> implies that the rider walk up from <code>from_stop_id</code> to <code>to_stop_id</code> . And a negative <code>stair_count</code> implies that the rider walk down from <code>from_stop_id</code> to <code>to_stop_id</code> . This field is recommended for stairs ( <code>pathway_mode=2</code> ).
max_slope	Float	✗	Maximum slope ratio of the pathway. Valid values for this field are: <b>0</b> or (empty): no slope. <b>A float</b> : slope ratio of the pathway, positive for upwards, negative for downwards. This field should be used only with walkways ( <code>pathway_type=1</code> ) and moving sidewalks ( <code>pathway_type=3</code> ). <i>Example: In the US, 0.083 (also written 8.3%) is the maximum slope ratio for hand-propelled wheelchair, which mean an increase of 0.083m (so 8.3cm) for each 1m.</i>
min_width	Positive Float	✗	Minimum width of the pathway in meters. This field is highly recommended if the minimum width is less than 1 meter.
signposted_as	Text	✗	String of text from physical signage visible to transit riders. The string can be used to provide text directions to users, such as 'follow signs to'. The language text should appear in this field exactly how it is printed on the signs - it should not be translated.
reversed_signposted_as	Text	✗	Same than the <code>signposted_as</code> field, but when the pathways is used backward, i.e. from the <code>to_stop_id</code> to the <code>from_stop_id</code> .

Example:

```

1 pathway_id,from_stop_id,to_stop_id,pathway_mode,is_bidirectional
2 E1N1,E1,N1,2,1
3 E2N1,E2,N1,2,1
4 E3N1,E3,N1,2,1
5 N1-N2,N1,N2,6,1
6 N2-N1,N2,N1,7,1
7 N2N3,N2,N3,2,1
8 N2-B1,N2,B1,4,0
9 B1-N2,B1,N2,4,0
10 B1B2,B1,B2,2,1
11
12 B1B3,B1,B3,1,1
13 B2B4,B2,B4,1,1
14
15 E4N3,E4,N3,2,1

```



---

```
16 E5N3,E5,N3,2,1
17 N3-N4,N3,N4,6,1
18 N4-N3,N4,N3,7,1
19 N4B3,N4,B3,2,1
20 N4-B3,N4,B3,4,0
21 B3-N4,B3,N4,4,0
22 B3B4,B3,B4,2,1
```

---

- **levels.txt**  
Levels within stations.  
Fields:

Name	Type	Required	Description
level_id	ID	✓	Id of the level that can be referenced from stops.txt.
level_index	Float	✓	Numeric index of the level that indicates relative position of this level in relation to other levels (levels with higher indices are assumed to be located above levels with lower indices). Ground level should have index 0, with levels above ground indicated by positive indices and levels below ground by negative indices.
level_name	Text	✗	Optional name of the level (that matches level lettering/numbering used inside the building or the station). Is useful for elevator routing (e.g. take the elevator to level Mezzanine or Platforms or -1).

Example:

---

```
1 level_id,level_index,level_name,elevation
2 L0,0,Street,0
3 L1,-1,Mezzanine,-6
4 L2,-2,Southbound,-18
5 L3,-3,Northbound,-24
```

---

- **feed\_info.txt**  
Dataset metadata, including publisher, version, and expiration information.  
Fields:

Name	Type	Required	Description
feed_publisher_name	Text	✓	Full name of the organization that publishes the dataset. This might be the same as one of the agency.agency_name values.
feed_publisher_url	URL	✓	URL of the dataset publishing organization's website. This may be the same as one of the agency.agency_url values.

<code>feed_lang</code>	Language code	✓	<p>Default language for the text in this dataset. This setting helps GTFS consumers choose capitalization rules and other language-specific settings for the dataset.</p> <p>To define another language, use the <code>language</code> field in <code>translations.txt</code>.</p> <p>Multilingual datasets might be the default language with the original text in multiple languages. In such cases, use the ISO 639-2 language code <code>mul</code> in the <code>feed_lang</code> field. Provide a translation for each of the languages used in the dataset in <code>translations.txt</code>. If all of the original text in the dataset is in the same language, don't use <code>mul</code>.</p> <p>For example, a dataset in Switzerland might set the original <code>stops.stop_name</code> field populated with stop names in different languages. Each stop name is written in accordance with the dominant language in that stops geographic location. Stop names include Genève for the French-speaking city of Geneva, Zürich for the German-speaking city of Zurich, and Biel/Bienne for the bilingual city of Biel/Bienne. Set <code>feed_lang=mul</code> and provide the following translations in <code>translations.txt</code>:</p> <ul style="list-style-type: none"> <li>– <b>German:</b> "Genf," "Zürich," and "Biel"</li> <li>– <b>French:</b> "Genève," "Zurich," and "Bienne"</li> <li>– <b>Italian:</b> "Ginevra," "Zurigo," and "Bienna"</li> <li>– <b>English:</b> "Geneva," "Zurich," and "Biel/Bienne"</li> </ul>
<code>default_lang</code>	Language code	✗	Defines the language used when the data consumer doesn't know the language of the rider. It's often defined as <code>en</code> , English.
<code>feed_start_date</code>	Date	✗	The dataset provides complete and reliable schedule information for service in the period from the beginning of the <code>feed_start_date</code> day to the end of the <code>feed_end_date</code> day. Both days can be left empty if unavailable. The <code>feed_end_date</code> date must not precede the <code>feed_start_date</code> date if both are given. Dataset providers are encouraged to give schedule data outside this period to advise of likely future service, but dataset consumers should treat it mindful of its non-authoritative status. If <code>feed_start_date</code> or <code>feed_end_date</code> extend beyond the active calendar dates defined in <code>calendar.txt</code> and <code>calendar_dates.txt</code> , the dataset is making an explicit assertion that there is no service for dates within the <code>feed_start_date</code> to <code>feed_end_date</code> range but not included in the active calendar dates.
<code>feed_end_date</code>	Date	✗	Refer to the <code>feed_start_date</code> row in this table.
<code>feed_version</code>	Text	✗	String that indicates the current version of their GTFS dataset. GTFS-consuming applications can display this value to help dataset publishers determine whether the latest dataset has been incorporated.
<code>feed_contact_email</code>	Email	✗	Email address for communication regarding the GTFS dataset and data publishing practices. <code>feed_contact_email</code> is a technical contact for GTFS-consuming applications. Provide customer service contact information through <code>agency.txt</code> .

---

<code>feed_contact_url</code>	URL	✗	URL for contact information, a web-form, support desk, or other tools for communication regarding the GTFS dataset and data publishing practices. <code>feed_contact_url</code> is a technical contact for GTFS-consuming applications. Provide customer service contact information through <code>agency.txt</code> .
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Example:

---

- **`translations.txt`**

Translated information of a transit agency.

Fields:

Name	Type	Required	Description
<code>table_name</code>	Enum	✓	Defines the dataset table that contains the field to be translated. The following values are allowed: <ul style="list-style-type: none"> <li>– <code>agency</code></li> <li>– <code>stops</code></li> <li>– <code>routes</code></li> <li>– <code>trips</code></li> <li>– <code>stop_times</code></li> <li>– <code>feed_info</code></li> <li>– <code>pathways</code></li> <li>– <code>levels</code></li> <li>– <code>attribution</code></li> </ul>
<code>field_name</code>	Text	✓	Provides the name of the field to be translated. Fields with the type "Text" can be translated, while fields with the types "URL," "Email," and "Phone number" can be included here to provide those resources in the correct language.
<code>language</code>	Language code	✓	Provides the language of translation. If this language is the same as the one from <code>feed_lang</code> in <code>feed_info.txt</code> , the original value of the field is the default value used in languages without specific translations. <i>For example, in Switzerland, a city in a bilingual canton is officially called "Biel/Bienne," but it would simply be called "Bienne" in French and "Biel" in German.</i>
<code>translation</code>	Text, URL, Email, or Phone number	✓	Provides the translated value for the specified <code>field_name</code> .

---

record_id	ID	?	<p>Defines the record that corresponds to the field to be translated. The value in <code>record_id</code> needs to be a main ID from a dataset table, as defined in the following table:</p> <table border="1"> <thead> <tr> <th>table_name</th> <th>record_id</th> </tr> </thead> <tbody> <tr><td>agency</td><td>agency_id</td></tr> <tr><td>stops</td><td>stop_id</td></tr> <tr><td>routes</td><td>route_id</td></tr> <tr><td>trips</td><td>trip_id</td></tr> <tr><td>stop_times</td><td>trip_id</td></tr> <tr><td>pathways</td><td>pathway_id</td></tr> <tr><td>levels</td><td>level_id</td></tr> <tr><td>attributions</td><td>attribution_id</td></tr> </tbody> </table> <p>The following conditions determine how this field can be used:</p> <ul style="list-style-type: none"> <li>– <b>Forbidden</b> if <code>table_name</code> equals <code>feed_info</code>.</li> <li>– <b>Forbidden</b> if <code>field_value</code> is defined.</li> <li>– <b>Required</b> if <code>field_value</code> is empty.</li> </ul>	table_name	record_id	agency	agency_id	stops	stop_id	routes	route_id	trips	trip_id	stop_times	trip_id	pathways	pathway_id	levels	level_id	attributions	attribution_id
table_name	record_id																				
agency	agency_id																				
stops	stop_id																				
routes	route_id																				
trips	trip_id																				
stop_times	trip_id																				
pathways	pathway_id																				
levels	level_id																				
attributions	attribution_id																				
record_sub_id	ID	?	<p>Helps to translate the record that contains the field when the table referenced in <code>record_id</code> doesn't have a unique ID. The value in <code>record_sub_id</code> is the secondary ID of a dataset table, as defined in the following table:</p> <table border="1"> <thead> <tr> <th>table_name</th> <th>record_sub_id</th> </tr> </thead> <tbody> <tr><td>agency</td><td>NONE</td></tr> <tr><td>stops</td><td>NONE</td></tr> <tr><td>routes</td><td>NONE</td></tr> <tr><td>trips</td><td>NONE</td></tr> <tr><td>stop_times</td><td>stop_sequence</td></tr> <tr><td>pathways</td><td>NONE</td></tr> <tr><td>levels</td><td>NONE</td></tr> <tr><td>attributions</td><td>NONE</td></tr> </tbody> </table> <p>The following conditions determine how this field can be used:</p> <ul style="list-style-type: none"> <li>– <b>Forbidden</b> if <code>table_name</code> equals <code>feed_info</code>.</li> <li>– <b>Forbidden</b> if <code>field_value</code> is defined.</li> <li>– <b>Required</b> if <code>table_name</code> equals <code>stop_times</code> and <code>record_id</code> is defined.</li> </ul>	table_name	record_sub_id	agency	NONE	stops	NONE	routes	NONE	trips	NONE	stop_times	stop_sequence	pathways	NONE	levels	NONE	attributions	NONE
table_name	record_sub_id																				
agency	NONE																				
stops	NONE																				
routes	NONE																				
trips	NONE																				
stop_times	stop_sequence																				
pathways	NONE																				
levels	NONE																				
attributions	NONE																				

---

---

<code>field_value</code>	Text, URL, Email, or Phone number	?	<p>Instead of using <code>record_id</code> and <code>record_sub_id</code> to define which record needs to be translated, <code>field_value</code> can be used to define the value for translation. When used, the translation is applied when the field identified by <code>table_name</code> and <code>field_name</code> contains the exact same value defined in <code>field_value</code>.</p> <p>The field must exactly match the value defined in <code>field_value</code>. If only a subset of the value matches <code>field_value</code>, the translation isn't applied.</p> <p>If two translation rules match the same record, one with <code>field_value</code> and the other one with <code>record_id</code>, then the rule with <code>record_id</code> is the one that needs to be used.</p> <p>The following conditions determine how this field can be used:</p> <ul style="list-style-type: none"> <li>– <b>Forbidden</b> if <code>table_name</code> equals <code>feed_info</code>.</li> <li>– <b>Forbidden</b> if <code>record_id</code> is defined.</li> <li>– <b>Required</b> if <code>record_id</code> is empty.</li> </ul>
--------------------------	--	---	--

---

Example:

---

```

1 table_name,field_name,language,translation,record_id
2 stops,stop_name,en,Tokyo Station,stopid000001
3 stops,stop_name,fr,Gare de Tokyo,stopid000001
4 stops,stop_name,zh,,stopid000001

```

---

- **attributions.txt**

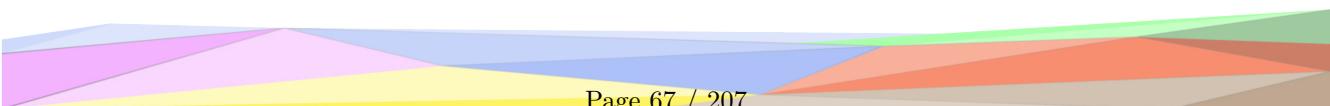
Specifies the attributions that are applied to the dataset.

Fields:

Name	Type	Required	Description
<code>attribution_id</code>	ID	✗	Identifies an attribution for the dataset, or a subset of it. This field is useful for translations.
<code>agency_id</code>	ID referencing	✗	The agency to which the attribution applies. If one <code>agency_id</code> , <code>route_id</code> , or <code>trip_id</code> attribution is defined, the other fields must be empty. If none are specified, the attribution applies to the whole dataset.
<code>route_id</code>	ID referencing	✗	This field functions in the same way as <code>agency_id</code> , except the attribution applies to a route. Multiple attributions can apply to the same route.
<code>trip_id</code>	ID referencing	✗	This field functions in the same way as <code>agency_id</code> , except the attribution applies to a trip. Multiple attributions can apply to the same trip.
<code>organization_name</code>	Text	✓	The name of the organization that the dataset is attributed to.
<code>is_producer</code>	Enum	✗	The role of the organization is producer. Allowed values include the following:

noitemsep,topsep=0pt,label=

- **0** or empty: Organization doesn't have this role.
  - **1** Organization does have this role. At least one of the fields, either `is_producer`, `is_operator`, or `is_authority`, must be set at 1
- 



<code>is_operator</code>	Enum	✗	Functions in the same way as <code>is_producer</code> , except the role of the organization is operator.
<code>is_authority</code>	Enum	✗	Functions in the same way as <code>is_producer</code> , except the role of the organization is authority.
<code>attribution_url</code>	URL	✗	The URL of the organization.
<code>attribution_email</code>	Email	✗	The email of the organization.
<code>attribution_phone</code>	Phone number	✗	The phone number of the organization.

Example:

```

1 attribution_id, is_producer, is_operator, organization_name, agency_id
2 attribution001, 1, 0, Transit Feed Solutions USA, agency001
3 attribution002, 0, 1, Transit Bus Operations USA , agency001

```

### 3.3.2.2 Keyhole Markup Language (KML)



KML is a file format used to display geographic data in an Earth browser such as Google Earth. KML uses a tag-based structure with nested elements and attributes and is based on the XML standard. All tags are case-sensitive and must appear exactly as they are listed in the KML Reference. The Reference indicates which tags are optional. Within a given element, tags must appear in the order shown in the Reference. KML is an international standard maintained by the Open Geospatial Consortium, Inc. (OGC).

For more information: <https://developers.google.com/kml>.

#### Basic KML Documents:

- **Placemarks**

It marks a position on the Earth's surface, using a yellow pushpin as the icon. The simplest Placemark includes only a `<Point>` element, which specifies the location of the Placemark. It can specify a name and a custom icon for the Placemark, and can also add other geometry elements to it.

Example:

```

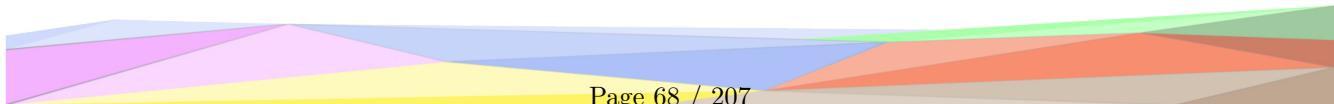
1 <?xml version="1.0" encoding="UTF-8"?>
2 <kml xmlns="http://www.opengis.net/kml/2.2">
3   <Placemark>
4     <name>Simple placemark</name>
5     <description>Attached to the ground. Intelligently places itself
6       at the height of the underlying terrain.</description>
7     <Point>
8       <coordinates>-122.0822035425683,37.42228990140251,0</coordinates>
9     </Point>
10    </Placemark>
11 </kml>

```

- **Descriptive HTML in Placemarks**

Add links, font sizes, styles, and colors, and specify text alignment and tables to Placemark text.

Write standard HTML inside a `<description>` tag, put it inside a CDATA tag. If not, the angle brackets need to be written as entity references to prevent from parsing the HTML incorrectly (for example, the symbol `>` is



---

written as &gt; and the symbol < is written as &lt;).

Example:

```
1 <?xml version="1.0" encoding="UTF-8"?>
2 <kml xmlns="http://www.opengis.net/kml/2.2">
3   <Document>
4     <Placemark>
5       <name>CDATA example</name>
6       <description>
7         <! [CDATA[
8           <h1>CDATA Tags are useful!</h1>
9           <p><font color="red">Text is <i>more readable</i> and
10             <b>easier to write</b> when you can avoid using entity
11               references.</font></p>
12         ]]>
13       </description>
14       <Point>
15         <coordinates>102.595626,14.996729</coordinates>
16       </Point>
17     </Placemark>
18   </Document>
19 </kml>
```

---

- **Ground Overlays**

Ground overlays enable to "drape" an image onto the Earth's terrain. The <Icon> element contains the link to the file with the overlay image.

Example:

```
1 <?xml version="1.0" encoding="UTF-8"?>
2 <kml xmlns="http://www.opengis.net/kml/2.2">
3   <Folder>
4     <name>Ground Overlays</name>
5     <description>Examples of ground overlays</description>
6     <GroundOverlay>
7       <name>Large-scale overlay on terrain</name>
8       <description>Overlay shows Mount Etna erupting
9         on July 13th, 2001.</description>
10      <Icon>
11        <href>https://developers.google.com/kml/documentation/images/etna.jpg</href>
12      </Icon>
13      <LatLonBox>
14        <north>37.91904192681665</north>
15        <south>37.46543388598137</south>
16        <east>15.35832653742206</east>
17        <west>14.60128369746704</west>
18        <rotation>-0.1556640799496235</rotation>
19      </LatLonBox>
20    </GroundOverlay>
21  </Folder>
22 </kml>
```

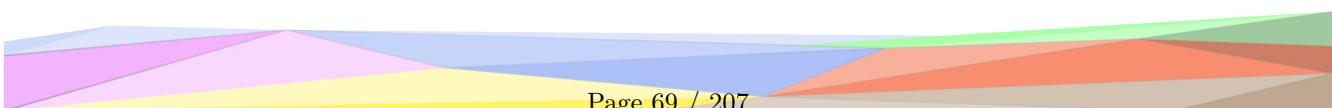
---

- **Paths**

Many different types of paths can be created, and it is easy to be very creative with the data. In KML, a path is created by a <LineString> element.

Example:

```
1 <?xml version="1.0" encoding="UTF-8"?>
2 <kml xmlns="http://www.opengis.net/kml/2.2">
```



---

```

3  <Document>
4    <name>Paths</name>
5    <description>Examples of paths. Note that the tessellate tag is by default
6      set to 0. If you want to create tessellated lines, they must be authored
7      (or edited) directly in KML.</description>
8    <Style id="yellowLineGreenPoly">
9      <LineStyle>
10        <color>7f00ffff</color>
11        <width>4</width>
12    </LineStyle>
13    <PolyStyle>
14      <color>7f00ff00</color>
15    </PolyStyle>
16  </Style>
17  <Placemark>
18    <name>Absolute Extruded</name>
19    <description>Transparent green wall with yellow outlines</description>
20    <styleUrl>#yellowLineGreenPoly</styleUrl>
21    <LineString>
22      <extrude>1</extrude>
23      <tessellate>1</tessellate>
24      <altitudeMode>absolute</altitudeMode>
25      <coordinates> -112.2550785337791,36.07954952145647,2357
26        -112.2549277039738,36.08117083492122,2357
27        -112.2552505069063,36.08260761307279,2357
28        -112.2564540158376,36.08395660588506,2357
29        -112.2580238976449,36.08511401044813,2357
30        -112.2595218489022,36.08584355239394,2357
31        -112.2608216347552,36.08612634548589,2357
32        -112.262073428656,36.08626019085147,2357
33        -112.2633204928495,36.08621519860091,2357
34        -112.2644963846444,36.08627897945274,2357
35        -112.2656969554589,36.08649599090644,2357
36      </coordinates>
37    </LineString>
38  </Placemark>
39 </Document>
40 </kml>

```

---

- **Polygons**

Use Polygons to create simple buildings and other shapes.

Example:

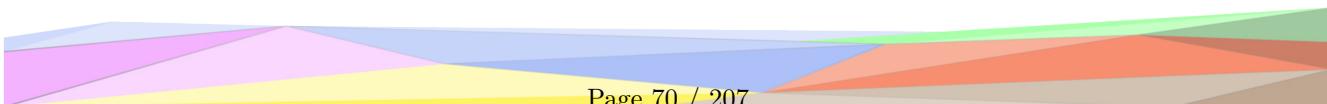
---

```

1 <?xml version="1.0" encoding="UTF-8"?>
2 <kml xmlns="http://www.opengis.net/kml/2.2">
3   <Placemark>
4     <name>The Pentagon</name>
5     <Polygon>
6       <extrude>1</extrude>
7       <altitudeMode>relativeToGround</altitudeMode>
8       <outerBoundaryIs>
9         <LinearRing>
10           <coordinates>
11             -77.05788457660967,38.87253259892824,100
12             -77.05465973756702,38.87291016281703,100
13             -77.05315536854791,38.87053267794386,100
14             -77.05552622493516,38.868757801256,100
15             -77.05844056290393,38.86996206506943,100
16             -77.05788457660967,38.87253259892824,100
17           </coordinates>
18         </LinearRing>

```

---



---

```

19      </outerBoundaryIs>
20      <innerBoundaryIs>
21          <LinearRing>
22              <coordinates>
23                  -77.05668055019126,38.87154239798456,100
24                  -77.05542625960818,38.87167890344077,100
25                  -77.05485125901024,38.87076535397792,100
26                  -77.05577677433152,38.87008686581446,100
27                  -77.05691162017543,38.87054446963351,100
28                  -77.05668055019126,38.87154239798456,100
29          </coordinates>
30      </LinearRing>
31  </innerBoundaryIs>
32 </Polygon>
33 </Placemark>
34 </kml>

```

---

## Advanced KML Documents:

- **Styles for Geometry**

Styles are an important part of how your data is displayed. Power users will want to learn how to define their own styles.

Define a Style at the beginning of a KML Document and also define an ID for it, it can be used in Geometry, Placemarks, and Overlays that are defined elsewhere in the Document. Because more than one element can use the same Style, styles defined and used in this way are referred to as shared styles. Define a given Style once, and then reference it multiple times, using the `<styleUrl>` element. If the Style definition is within the same file, precede the Style ID with a # sign. If the Style definition is in an external file, include the complete URL in the `<styleUrl>` element.

Example:

---

```

1 <?xml version="1.0" encoding="UTF-8"?>
2 <kml xmlns="http://www.opengis.net/kml/2.2">
3     <Document>
4         <Style id="transBluePoly">
5             <LineStyle>
6                 <width>1.5</width>
7             </LineStyle>
8             <PolyStyle>
9                 <color>7dff0000</color>
10            </PolyStyle>
11        </Style>
12        <Placemark>
13            <name>Building 41</name>
14            <styleUrl>#transBluePoly</styleUrl>
15            <Polygon>
16                <extrude>1</extrude>
17                <altitudeMode>relativeToGround</altitudeMode>
18                <outerBoundaryIs>
19                    <LinearRing>
20                        <coordinates> -122.0857412771483,37.42227033155257,17
21                            -122.0858169768481,37.42231408832346,17
22                            -122.085852582875,37.42230337469744,17
23                            -122.0858799945639,37.42225686138789,17
24                            -122.0858860101409,37.4222311076138,17
25                            -122.0858069157288,37.42220250173855,17
26                            -122.0858379542653,37.42214027058678,17
27                            -122.0856732640519,37.42208690214408,17
28                            -122.0856022926407,37.42214885429042,17

```

---

```

29             -122.0855902778436,37.422128290487,17
30             -122.0855841672237,37.42208171967246,17
31             -122.0854852065741,37.42210455874995,17
32             -122.0855067264352,37.42214267949824,17
33             -122.0854430712915,37.42212783846172,17
34             -122.0850990714904,37.42251282407603,17
35             -122.0856769818632,37.42281815323651,17
36             -122.0860162273783,37.42244918858722,17
37             -122.0857260327004,37.42229239604253,17
38             -122.0857412771483,37.42227033155257,17
39         </coordinates>
40     </LinearRing>
41   </outerBoundaryIs>
42 </Polygon>
43 </Placemark>
44 </Document>
45 </kml>

```

---

- **Styles for Highlighted Icons**

The Document defines two styles, one for the "normalPlacemark" and one for the "highlightPlacemark" (shown when the cursor rolls over the Icon). The `<StyleMap>` element has two key/value pairs that map each icon style to an icon state. There are two icon states: normal and highlight.

Example:

---

```

1 <?xml version="1.0" encoding="UTF-8"?>
2 <kml xmlns="http://www.opengis.net/kml/2.2">
3   <Document>
4     <name>Highlighted Icon</name>
5     <description>Place your mouse over the icon to see it display the new icon</description>
6     <Style id="highlightPlacemark">
7       <IconStyle>
8         <Icon>
9           <href>http://maps.google.com/mapfiles/kml/paddle/red-stars.png</href>
10      </Icon>
11    </IconStyle>
12  </Style>
13  <Style id="normalPlacemark">
14    <IconStyle>
15      <Icon>
16        <href>http://maps.google.com/mapfiles/kml/paddle/wht-blank.png</href>
17      </Icon>
18    </IconStyle>
19  </Style>
20  <StyleMap id="exampleStyleMap">
21    <Pair>
22      <key>normal</key>
23      <styleUrl>#normalPlacemark</styleUrl>
24    </Pair>
25    <Pair>
26      <key>highlight</key>
27      <styleUrl>#highlightPlacemark</styleUrl>
28    </Pair>
29  </StyleMap>
30  <Placemark>
31    <name>Roll over this icon</name>
32    <styleUrl>#exampleStyleMap</styleUrl>
33    <Point>
34      <coordinates>-122.0856545755255,37.42243077405461,0</coordinates>
35    </Point>
36  </Placemark>
37 </Document>

```

- **Screen Overlays**

Screen overlays cannot be authored directly and are thus more difficult to create than ground overlays. Positioning is controlled by mapping a point in the image specified by `<overlayXY>` to a point on the screen specified by `<screenXY>`. In this case, the top-left corner of the image (0,1) has been made coincident with the same point on the screen.

Example:

```

1 <?xml version="1.0" encoding="UTF-8"?>
2 <kml xmlns="http://www.opengis.net/kml/2.2">
3   <ScreenOverlay>
4     <name>Absolute Positioning: Top left</name>
5     <Icon>
6       <href>http://developers.google.com/kml/documentation/images/top_left.jpg</href>
7     </Icon>
8     <overlayXY x="0" y="1" xunits="fraction" yunits="fraction"/>
9     <screenXY x="0" y="1" xunits="fraction" yunits="fraction"/>
10    <rotationXY x="0" y="0" xunits="fraction" yunits="fraction"/>
11    <size x="0" y="0" xunits="fraction" yunits="fraction"/>
12  </ScreenOverlay>
13 </kml>

```

- **Network Links**

A network link contains a `<Link>` element with an `<href>` (a hypertext reference) that loads a file. The `<href>` can be a local file specification or an absolute URL. Despite the name, a `<NetworkLink>` does not necessarily load files from the network.

The `<href>` in a link specifies the location of any of the following:

- An image file used by icons in icon styles, ground overlays, and screen overlays.
- A model file used in the `<Model>` element.
- A KML or KMZ file loaded by a Network Link.

The specified file can be either a local file or a file on a remote server. In their simplest form, network links are a useful way to split one large KML file into smaller, more manageable files on the same computer.

In addition to pointing to files containing static data, a network link's `<href>` can point to data that is dynamically generated for example, by a CGI script located on a network server.

Two things are necessary for delivering KML through a network CGI:

When a call is made from the client (Google Earth) to the server, the server must (1) return a response code of HTTP 200 and (2) set the response's content type to `text/plain` or `application/vnd.google-earth.kml+xml`.

The response must be valid KML. For complex applications, proper error handling is very important.

Example:

```

1 <?xml version="1.0" encoding="UTF-8"?>
2 <kml xmlns="http://www.opengis.net/kml/2.2">
3   <Folder>
4     <name>Network Links</name>
5     <visibility>0</visibility>
6     <open>0</open>
7     <description>Network link example 1</description>
8     <NetworkLink>
9       <name>Random Placemark</name>
10      <visibility>0</visibility>

```

---

```

11      <open>0</open>
12      <description>A simple server-side script that generates a new random
13          placemark on each call</description>
14      <refreshVisibility>0</refreshVisibility>
15      <flyToView>0</flyToView>
16      <Link>
17          <href>http://yourserver.com/cgi-bin/randomPlacemark.py</href>
18      </Link>
19  </NetworkLink>
20 </Folder>
21 </kml>

```

---

## KML MIME Types

When responding to a request from any Earth browser, a KML server must follow a certain set of rules so that it can correctly interpret its responses.

Upon success, the server must return a response code of HTTP 200 and set the response's content-type to a suitable MIME type.

The body of the response must contain valid KML data, including the XML declaration (`<?xml version="1.0" encoding="UTF-8"?>`). If the server returns invalid KML, the Network Link will stop, deactivate, and output an error message.

## Fields

Type	Value
altitudeModeEnum	clampToGround, relativeToGround, absolute
angle90	a value $\geq -90$ and $\leq 90$
anglepos90	a value $\geq 0$ and $\leq 90$
angle180	a value $\geq 180$ and $\leq 180$
angle360	a value $\geq 360$ and $\leq 360$
color	hexBinary value: <i>aabbggrr</i>
colorModeEnum	normal, random
dateTime	<i>dateTime</i> , <i>date</i> , <i>gYearMonth</i> , <i>gYear</i>
displayModeEnum	default, hide
gridOrigin	lowerLeft, upperLeft
refreshModeEnum	onChange, onInterval, onExpire
shapeEnum	rectangle, cylinder, sphere
styleStateEnum	normal, highlight
unitsEnum	fraction, pixels, insetPixels
vec2	<i>x</i> = <i>double</i> <i>xunits</i> = <i>kml:unitsEnum</i> <i>y</i> = <i>double</i> <i>yunits</i> = <i>kml:unitsEnum</i>
viewRefreshEnum	never, onRequest, onStop, onRegion

## Reference

This section contains an alphabetical reference for all KML elements defined in KML Version 2.2. In the diagram, elements to the right on a particular branch in the tree are extensions of the elements to their left. For example, Placemark is a special kind of Feature. It contains all of the elements that belong to Feature, and it adds some elements that are specific to the Placemark element.

Note that abstract elements (shown in boxes in the diagram) are not actually used in KML files. They are a useful way for a single element to serve as the programmatic foundation for multiple similar (but different) derived elements.

All elements derived from Object can have an id assigned to them. This id is used by the KML update mechanism

---

(see `<Update>`) for files loaded with a NetworkLink. It is also used by shared styles (see `<Style>`). The id is a standard XML ID.

Because KML is an XML grammar and file format, tag names are case-sensitive and must appear exactly as shown here.

KML versions have a double numbering system: `majorVersion.minorVersion`. All versions with the same majorVersion are compatible. For this reason, change the namespace to "2.2" (that is, `xmlns="http://www.opengis.net/kml/2.2"`), all KML 2.1 files validate in the KML 2.2 schema.

- **<AbstractView>**

This is an abstract element and cannot be used directly in a KML file. This element is extended by the `<Camera>` and `<LookAt>` elements.

Extends:

- `<Object>`

Extended By:

- `<Camera>`
- `<LookAt>`

- **<BalloonStyle>**

Specifies how the description balloon for placemarks is drawn. The `<bgColor>`, if specified, is used as the background color of the balloon. See `<Feature>` for a diagram illustrating how the default description balloon appears.

Extends:

- `<ColorStyle>`

Contained By:

- `<Style>`

- **<Camera>**

Defines the virtual camera that views the scene. This element defines the position of the camera relative to the Earth's surface as well as the viewing direction of the camera. The camera position is defined by `<longitude>`, `<latitude>`, `<altitude>` or `<altitudeMode>`. The viewing direction of the camera is defined by `<heading>`, `<tilt>`, and `<roll>`. `<Camera>` can be a child element of any Feature or of `<NetworkLinkControl>`. A parent element cannot contain both a `<Camera>` and a `<LookAt>` at the same time.

`<Camera>` provides full six-degrees-of-freedom control over the view, so it can be positioned in space and then rotate it around the X, Y, and Z axes. Most importantly, it can tilt the camera view so that it looks above the horizon into the sky.

`<Camera>` can also contain a TimePrimitive. Time values in Camera affect historical imagery, sunlight, and the display of time-stamped features. For more information, read Time with AbstractViews in the Time and Animation chapter of the Developer's Guide.

Extends:

- `<AbstractView>`

Contained By:

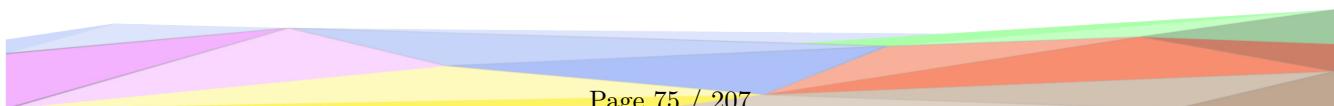
- Any element derived from `<Feature>`
- `<NetworkLinkControl>`

- **<ColorStyle>**

This is an abstract element and cannot be used directly in a KML file. It provides elements for specifying the color and color mode of extended style types.

Extends:

- `<Object>`



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Extended By:

- <IconStyle>
- <LabelStyle>
- <LineStyle>
- <PolyStyle>

- **<Container>**

This is an abstract element and cannot be used directly in a KML file. A Container element holds one or more Features and allows the creation of nested hierarchies.

Extends:

- <Feature>

Extended By:

- <Document>
- <Folder>

- **<Document>**

A Document is a container for features and styles. This element is required if the KML file uses shared styles. It is recommended to use shared styles, which require the following steps:

1. Define all Styles in a Document. Assign a unique ID to each Style.
2. Within a given Feature or StyleMap, reference the Style's ID using a <styleUrl> element.

Note that shared styles are not inherited by the Features in the Document.

Each Feature must explicitly reference the styles it uses in a <styleUrl> element. For a Style that applies to a Document (such as ListStyle), the Document itself must explicitly reference the <styleUrl>.

Extends:

- <Container>

Contains:

- 0 or more elements derived from <Feature>.
- 0 or more elements derived from <StyleSelector>.
- 0 or more elements derived from <Schema>.

- **<ExtendedData>**

The ExtendedData element offers three techniques for adding custom data to a KML Feature (NetworkLink, Placemark, GroundOverlay, PhotoOverlay, ScreenOverlay, Document, Folder). These techniques are:

- Adding untyped data/value pairs using the <Data> element (basic).
- Declaring new typed fields using the <Schema> element and then instancing them using the <SchemaData> element (advanced)
- Referring to XML elements defined in other namespaces by referencing the external namespace within the KML file (basic)

These techniques can be combined within a single KML file or Feature for different pieces of data.

Contained By:

- Any element derived from <Feature>

- **<Feature>**

This is an abstract element and cannot be used directly in a KML file.

Extends:

- <Object>

Contains:

- <Container>

- <Overlay>
- <Placemark>
- <NetworkLink>

- <Folder>

A Folder is used to arrange other Features hierarchically (Folders, Placemarks, NetworkLinks, or Overlays). A Feature is visible only if it and all its ancestors are visible.

Extends:

- <Container>

Contains:

- Any element derived from <Feature>

- <Geometry>

This is an abstract element and cannot be used directly in a KML file. It provides a placeholder object for all derived Geometry objects.

Extends:

- <Object>

Extended By:

- <Point>
- <LineString>
- <LinearRing>
- <Polygon>
- <MultiGeometry>
- <Model>

- <GroundOverlay>

This element draws an image overlay draped onto the terrain. The <href> child of <Icon> specifies the image to be used as the overlay. This file can be either on a local file system or on a web server. If this element is omitted or contains no <href>, a rectangle is drawn using the color and LatLonBox bounds defined by the ground overlay.

Extends:

- <Feature>
- <Overlay>

Contained By:

- <Document>
- <Folder>

- <Icon>

Defines an image associated with an Icon style or overlay. The required <href> child element defines the location of the image to be used as the overlay or as the icon for the placemark. This location can either be on a local file system or a remote web server.

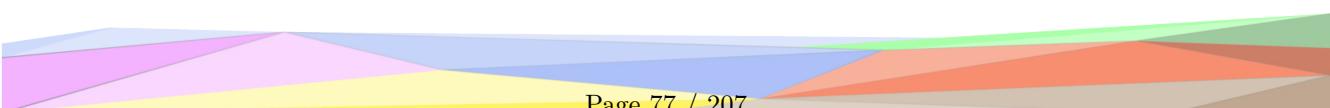
Contained By:

- <GroundOverlay>
- <ScreenOverlay>
- <IconStyle>

- <IconStyle>

Specifies how icons for point Placemarks are drawn, both in the Places panel and in the 3D viewer of Google Earth. The <Icon> element specifies the icon image. The <scale> element specifies the x, y scaling of the icon. The color specified in the <color> element of <IconStyle> is blended with the color of the <Icon>.

Extends:



- <ColorStyle>

Contained By:

- <Style>

Contains:

- <href> as a child of <Icon>

- <kml>

The root element of a KML file. This element is required. It follows the xml declaration at the beginning of the file. The hint attribute is used as a signal to Google Earth to display the file as celestial data.

The <kml> element may also include the namespace for any external XML schemas that are referenced within the file.

- <LabelStyle>

Specifies how the <name> of a Feature is drawn in the 3D viewer. A custom color, color mode, and scale for the label (name) can be specified.

Extends:

- <ColorStyle>

Contained By:

- <Style>

- <LinearRing>

Defines a closed line string, typically the outer boundary of a Polygon. Optionally, a LinearRing can also be used as the inner boundary of a Polygon to create holes in the Polygon. A Polygon can contain multiple <LinearRing> elements used as inner boundaries.

Extends:

- <Geometry>

Contained By:

- <MultiGeometry>
- <Placemark>
- <innerBoundaryIs>
- <outerBoundaryIs>

- <LineString>

Defines a connected set of line segments. Use <LineStyle> to specify the color, color mode, and width of the line. When a LineString is extruded, the line is extended to the ground, forming a polygon that looks somewhat like a wall or fence. For extruded LineStrings, the line itself uses the current LineStyle, and the extrusion uses the current PolyStyle. See the KML Tutorial for examples of LineStrings (or paths).

Extends:

- <Geometry>

Contained By:

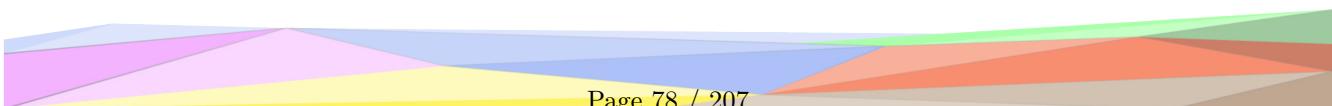
- <MultiGeometry>
- <Placemark>

- <LineStyle>

Specifies the drawing style (color, color mode, and line width) for all line geometry. Line geometry includes the outlines of outlined polygons and the extruded "tether" of Placemark icons (if extrusion is enabled).

Extends:

- <ColorStyle>



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Contained By:

- <Style>

- <Link>

<Link> specifies the location of any of the following:

- KML files fetched by network links
- Image files used in any Overlay (the <Icon> element specifies the image in an Overlay; <Icon> has the same fields as <Link>)
- Model files used in the <Model> element

The file is conditionally loaded and refreshed, depending on the refresh parameters supplied here. Two different sets of refresh parameters can be specified: one set is based on time (<refreshMode> and <refreshInterval>) and one is based on the current "camera" view (<viewRefreshMode> and <viewRefreshTime>). In addition, Link specifies whether to scale the bounding box parameters that are sent to the server (<viewBoundScale>) and provides a set of optional viewing parameters that can be sent to the server (<viewFormat>) as well as a set of optional parameters containing version and language information.

When a file is fetched, the URL that is sent to the server is composed of three pieces of information:

- the href (Hypertext Reference) that specifies the file to load.
- an arbitrary format string that is created from (a) parameters that you specify in the <viewFormat> element or (b) bounding box parameters (this is the default and is used if no <viewFormat> element is included in the file).
- a second format string that is specified in the <httpQuery> element.

If the file specified in <href> is a local file, the <viewFormat> and <httpQuery> elements are not used.

The <Link> element replaces the <Url> element of <NetworkLink> contained in earlier KML releases and adds functionality for the <Region> element (introduced in KML 2.1). In Google Earth releases 3.0 and earlier, the <Link> element is ignored.

Extends:

- <Object>

Contained By:

- <Model>
- <NetworkLink>

- <ListStyle>

Specifies how a Feature is displayed in the list view. The list view is a hierarchy of containers and children; in Google Earth, this is the Places panel.

Extends:

- <Object>

Contained By:

- <Style>

- <LookAt>

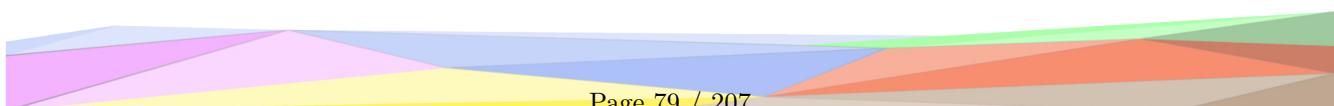
Defines a virtual camera that is associated with any element derived from Feature. The LookAt element positions the "camera" in relation to the object that is being viewed. In Google Earth, the view "flies to" this LookAt viewpoint when the user double-clicks an item in the Places panel or double-clicks an icon in the 3D viewer.

Extends:

- <AbstractView>

Contained By:

- Any element derived from <Feature>
- <NetworkLinkControl>



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- **<Model>**

A 3D object described in a COLLADA file (referenced in the <Link> tag). COLLADA files have a .dae file extension. Models are created in their own coordinate space and then located, positioned, and scaled.

Extends:

- <Geometry>

Contained By:

- <MultiGeometry>
- <Placemark>

- **<MultiGeometry>**

A container for zero or more geometry primitives associated with the same feature.

Extends:

- <Geometry>

Contained By:

- <MultiGeometry>
- <Placemark>

- **<NetworkLink>**

References a KML file or KMZ archive on a local or remote network. Use the <Link> element to specify the location of the KML file. Within that element, you can define the refresh options for updating the file, based on time and camera change. NetworkLinks can be used in combination with Regions to handle very large datasets efficiently.

Extends:

- <Feature>

Contained By:

- any element derived from <Container>

- **<NetworkLinkControl>**

Controls the behavior of files fetched by a <NetworkLink>.

Extends:

- This is a direct child of the <kml> element.

Contained By:

- <kml>

- **<Object>**

This is an abstract base class and cannot be used directly in a KML file. It provides the id attribute, which allows unique identification of a KML element, and the targetId attribute, which is used to reference objects that have already been loaded into Google Earth. The id attribute must be assigned if the <Update> mechanism is to be used.

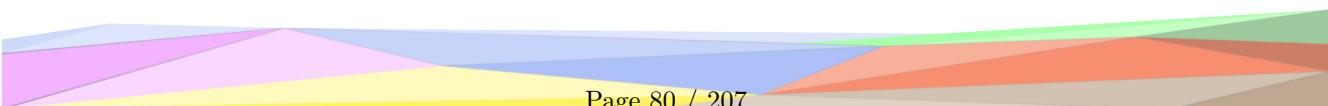
- **<Overlay>**

This is an abstract element and cannot be used directly in a KML file. <Overlay> is the base type for image overlays drawn on the planet surface or on the screen. <Icon> specifies the image to use and can be configured to reload images based on a timer or by camera changes. This element also includes specifications for stacking order of multiple overlays and for adding color and transparency values to the base image.

Extends:

- <Feature>

Extended By:



- <GroundOverlay>
- <PhotoOverlay>
- <ScreenOverlay>

- <PhotoOverlay>

The <PhotoOverlay> element allows you to geographically locate a photograph on the Earth and to specify viewing parameters for this PhotoOverlay. The PhotoOverlay can be a simple 2D rectangle, a partial or full cylinder, or a sphere (for spherical panoramas). The overlay is placed at the specified location and oriented toward the viewpoint.

Because <PhotoOverlay> is derived from <Feature>, it can contain one of the two elements derived from <AbstractView> either <Camera> or <LookAt>. The Camera (or LookAt) specifies a viewpoint and a viewing direction (also referred to as a view vector). The PhotoOverlay is positioned in relation to the viewpoint. Specifically, the plane of a 2D rectangular image is orthogonal (at right angles to) the view vector. The normal of this plane—that is, its front, which is the part with the photo—is oriented toward the viewpoint.

The URL for the PhotoOverlay image is specified in the <Icon> tag, which is inherited from <Overlay>. The <Icon> tag must contain an <href> element that specifies the image file to use for the PhotoOverlay. In the case of a very large image, the <href> is a special URL that indexes into a pyramid of images of varying resolutions (see ImagePyramid).

Extends:

- <Overlay>

Contained By:

- <Folder>
- <Document>
- <kml>

- <Placemark>

A Placemark is a Feature with associated Geometry. In Google Earth, a Placemark appears as a list item in the Places panel. A Placemark with a Point has an icon associated with it that marks a point on the Earth in the 3D viewer.

Extends:

- <Feature>

Contained By:

- <Document>
- <Folder>

- Point

A geographic location defined by longitude, latitude, and (optional) altitude. When a Point is contained by a Placemark, the point itself determines the position of the Placemark's name and icon. When a Point is extruded, it is connected to the ground with a line. This "tether" uses the current LineStyle.

Extends:

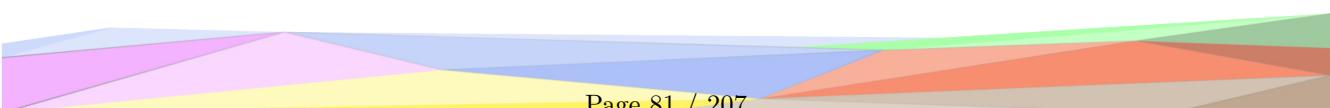
- <Geometry>

Contained By:

- <MultiGeometry>
- <Placemark>

- <Polygon>

A Polygon is defined by an outer boundary and 0 or more inner boundaries. The boundaries, in turn, are defined by LinearRings. When a Polygon is extruded, its boundaries are connected to the ground to form additional polygons, which gives the appearance of a building or a box. Extruded Polygons use <PolyStyle> for their color, color mode, and fill.



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The <coordinates> for polygons must be specified in counterclockwise order. Polygons follow the "right-hand rule," which states that if you place the fingers of your right hand in the direction in which the coordinates are specified, your thumb points in the general direction of the geometric normal for the polygon. (In 3D graphics, the geometric normal is used for lighting and points away from the front face of the polygon.) Since Google Earth fills only the front face of polygons, you will achieve the desired effect only when the coordinates are specified in the proper order. Otherwise, the polygon will be gray.

Extends:

- <Geometry>

Contained By:

- <MultiGeometry>
- <Placemark>

- <**PolyStyle**>

Specifies the drawing style for all polygons, including polygon extrusions (which look like the walls of buildings) and line extrusions (which look like solid fences).

Extends:

- <ColorStyle>

Contained By:

- <Style>

- <**Region**>

A region contains a bounding box (<LatLonAltBox>) that describes an area of interest defined by geographic coordinates and altitudes. In addition, a Region contains an LOD (level of detail) extent (<Lod>) that defines a validity range of the associated Region in terms of projected screen size. A Region is said to be "active" when the bounding box is within the user's view and the LOD requirements are met. Objects associated with a Region are drawn only when the Region is active. When the <viewRefreshMode> is onRegion, the Link or Icon is loaded only when the Region is active. See the "Topics in KML" page on Regions for more details. In a Container or NetworkLink hierarchy, this calculation uses the Region that is the closest ancestor in the hierarchy.

Extends:

- <Object>

Contained By:

- any element derived from <Feature>

- <**Schema**>

Specifies a custom KML schema that is used to add custom data to KML Features. The "id" attribute is required and must be unique within the KML file. <Schema> is always a child of <Document>.

Extends:

This is a root element.

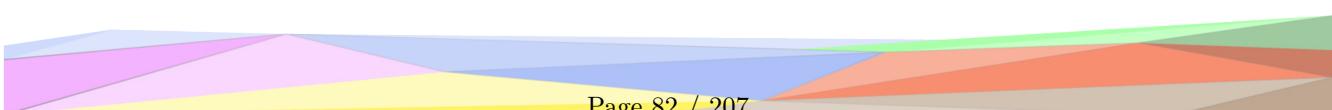
Contained By:

- <Document>

- <**ScreenOverlay**>

This element draws an image overlay fixed to the screen. Sample uses for ScreenOverlays are compasses, logos, and heads-up displays. ScreenOverlay sizing is determined by the <size> element. Positioning of the overlay is handled by mapping a point in the image specified by <overlayXY> to a point on the screen specified by <screenXY>. Then the image is rotated by <rotation> degrees about a point relative to the screen specified by <rotationXY>.

The <href> child of <Icon> specifies the image to be used as the overlay. This file can be either on a local file system or on a web server. If this element is omitted or contains no <href>, a rectangle is drawn using the color



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and size defined by the screen overlay.

Extends:

- <Feature>
- <Overlay>

Contained By:

- <Document>
- <Folder>

- **<Style>**

A Style defines an addressable style group that can be referenced by StyleMaps and Features. Styles affect how Geometry is presented in the 3D viewer and how Features appear in the Places panel of the List view. Shared styles are collected in a <Document> and must have an id defined for them so that they can be referenced by the individual Features that use them.

Use an id to refer to the style from a <styleUrl>.

Extends:

- <StyleSelector>

Contained By:

- any <Feature>

- **<StyleMap>**

A <StyleMap> maps between two different Styles. Typically a <StyleMap> element is used to provide separate normal and highlighted styles for a placemark, so that the highlighted version appears when the user mouses over the icon.

Extends:

- <StyleSelector>

Contained By:

- any <Feature>

- **<StyleSelector>**

This is an abstract element and cannot be used directly in a KML file. It is the base type for the <Style> and <StyleMap> elements. The StyleMap element selects a style based on the current mode of the Placemark. An element derived from StyleSelector is uniquely identified by its id and its url.

Extends:

- <Object>

Extended By:

- <Style>
- <StyleMap>

- **<TimePrimitive>**

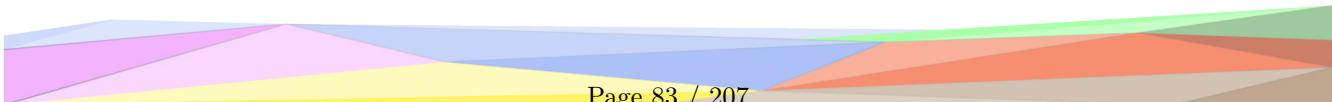
This is an abstract element and cannot be used directly in a KML file. This element is extended by the <TimeSpan> and <TimeStamp> elements.

Extends:

- <Object>

Extended By:

- <TimeSpan>
- <TimeStamp>



- **<TimeSpan>**

Represents an extent in time bounded by begin and end dateTimes.

If <begin> or <end> is missing, then that end of the period is unbounded.

The dateTime is defined according to XML Schema time (see XML Schema Part 2: Datatypes Second Edition).

The value can be expressed as yyyy-mm-ddThh:mm:ss.ssszzzzz, where T is the separator between the date and the time, and the time zone is either Z (for UTC) or zzzzzz, which represents \$hh:mm in relation to UTC.

Additionally, the value can be expressed as a date only. See <TimeStamp> for examples.

Extends:

- <Timeprimitive>

Contained By:

- any element derived from <Feature>

- **<TimeStamp>**

Represents a single moment in time. This is a simple element and contains no children. Its value is a dateTime, specified in XML time. The precision of the TimeStamp is dictated by the dateTime value in the <when> element.

Extends:

- <Timeprimitive>

Contained By:

- any element that extends <Feature>

- **<Update>**

Specifies an addition, change, or deletion to KML data that has already been loaded using the specified URL. The <targetHref> specifies the .kml or .kmz file whose data (within Google Earth) is to be modified. <Update> is always contained in a NetworkLinkControl. Furthermore, the file containing the NetworkLinkControl must have been loaded by a NetworkLink. See the "Topics in KML" page on Updates for a detailed example of how Update works.

Contained By:

- <NetworkLinkControl>

- **<Url>**

Use this element to set the location of the link to the KML file, to define the refresh options for the server and viewer changes, and to populate a variable to return useful client information to the server.

### 3.3.3 Data Resources

Comparing with knowledge resources, data resources is much easier to gather, the main channels of data acquisition are as follows:

#### 3.3.3.1 Trentino Trasporti



§ <https://www.trentinotrasporti.it/open-data>

Urban and suburban public transport data in GTFS format. Main information available: stop records (georeferenced), a list of lines, list of routes, list of arrival and departure times.

The published zip files comply with the General Transit Feed Specification (GTFS). See the section General Transit Feed Specification (GTFS) for more information about the GTFS specification.

**Data & Resources:**



- **google\_transit\_extraurbano.zip (csv)**  
[https://www.trentinotrasporti.it/opendata/google\\_transit\\_extraurbano\\_tte.zip](https://www.trentinotrasporti.it/opendata/google_transit_extraurbano_tte.zip)  
 ZIP archive containing extra-urban transport data in CSV-GTFS format.
- **google\_transit\_urbano.zip (csv)**  
[https://www.trentinotrasporti.it/opendata/google\\_transit\\_urbano\\_tte.zip](https://www.trentinotrasporti.it/opendata/google_transit_urbano_tte.zip)  
 ZIP archive containing urban transport data in CSV-GTFS format.

**Format:**

All data are in GTFS format. Please refer to General Transit Feed Specification (GTFS) section for more information.

**Metadata:**

Format	GTFS
Holder	Trentino Trasporti S.p.A.
Geographic Coverage	Trentino
Temporal Coverage (Start Date)	11/06/2021
Temporal Coverage (End Date)	24/06/2022
Modification Date	11/11/2021
Character Encoding	UTF-8
Language	Italian   English
Origin	Trentino Trasporti S.p.A.
Author	Trentino Trasporti S.p.A.
Referent	Trentino Trasporti S.p.A. - <a href="mailto:info@trentinotrasporti.it">info@trentinotrasporti.it</a>
Reference Site	<a href="https://www.trentinotrasporti.it/open-data">https://www.trentinotrasporti.it/open-data</a>
License	CC BY 2.5

### 3.3.3.2 Trasporti pubblici del Trentino



§ <https://dati.trentino.it/dataset/trasporti-pubblici-del-trentino-formato-gtfs>  
 Urban and suburban public transport data in GTFS format. Main information available: stop records (georeferenced), a list of lines, list of routes, list of arrival and departure times. The data are available in the Trentino Transport Integrated Mobility System (MITT). Data provided by the MITT Management. See the section General Transit Feed Specification (GTFS) for more information about the GTFS specification.

Trentino Trasporti extended dataset containing fares information. The **Trentino Trasporti** dataset available on the official site does not contain information about ticket prices and payment methods. Therefore, this dataset is an extension that contains both the information contained in the official dataset and information about prices.

**Data & Resources:**

- **GTFS Extraurbano TTE**  
[https://www.trentinotrasporti.it/opendata/google\\_transit\\_extraurbano\\_tte.zip](https://www.trentinotrasporti.it/opendata/google_transit_extraurbano_tte.zip)  
 ZIP archive containing extra-urban transport data in CSV-GTFS format.
- **GTFS Urbano TTE**  
[https://www.trentinotrasporti.it/opendata/google\\_transit\\_urbano\\_tte.zip](https://www.trentinotrasporti.it/opendata/google_transit_urbano_tte.zip)  
 ZIP archive containing urban transport data in CSV-GTFS format.
- **tariffe\_gtfs\_extraurbano**  
<https://dati.trentino.it/dataset/6d5c2000-972e-4c21-aef6-fdbba94418a8/resource/10e93dd1-3463-4664-8c24-300a7403780a/download/tariffegtfsextraurbano.zip> ZIP archive containing tariff data in extraurban areas in CSV-GTFS format.

- **tariffe\_gtfs\_urbano**  
<https://dati.trentino.it/dataset/6d5c2000-972e-4c21-aef6-fdbba94418a8/resource/44efc0bd-223a-49c7-b3b0-16128e32813c/download/tariffegtfsurbano.zip>  
ZIP archive containing tariff data in urban areas in CSV-GTFS format.
- **MITT - Manuale OpenData - v.7**  
<https://dati.trentino.it/dataset/6d5c2000-972e-4c21-aef6-fdbba94418a8/resource/3394a64e-b7a6-4b6f-87ec-03f06ff7f2b7/download/mittopendatav7.pdf>  
Dataset manual in PDF format.

#### Format:

All data are in GTFS format. Please refer to General Transit Feed Specification (GTFS) section for more information.

#### Metadata:

Format	GTFS
Holder	Provincia Autonoma di Trento
Geographic Coverage	Trentino
Temporal Coverage (Start Date)	11/06/2021
Temporal Coverage (End Date)	24/06/2022
Modification Date	01/07/2021
Character Encoding	UTF-8
Language	Italian   English
Author	Servizio Trasporti pubblici
Referent	Servizio Trasporti pubblici - <a href="http://www.trasporti.provincia.tn.it/">http://www.trasporti.provincia.tn.it/</a>
Reference Site	<a href="http://www.trasporti.provincia.tn.it">http://www.trasporti.provincia.tn.it</a>
License	CC BY 4.0

#### 3.3.3.3 Parcheggio protetto per biciclette



§ <https://dati.trentino.it/dataset/parcheggio-protetto-per-biciclette-open-data>  
The Municipality of Trento has opened three protected car parks to the public for long-term parking of bicycles.

To meet the need to park bicycles safely and comfortably and reduce indiscriminate parking in places not used for this function, the Municipality of Trento has opened three protected parking lots to the public for long-term parking of bicycles (in via Dogana, in via della Saluga and at the ex Zuffo area car park) whose management has been entrusted to Trentino Mobilità spa.

Access to the car parks takes place through the validation of the Mitt card of the provincial public transport (smart card) and their use is free for subscribers to the public, urban, and extra-urban transport and to Trenitalia, while it is paid for others.

##### Parking "Trento Station":

The guarded parking lot for bicycles "Stazione di Trento" is located in via Dogana, 14, in an area that is strategically important for the city because it is a short walk from the railway station.

The number of bike stalls are a total of 200, arranged on two-level racks. A video-surveillance system consisting of 8 cameras is in operation within the area.

There are two validators for access control and management: one at the entrance and one at the exit from the car park.

##### Parking "Former public warehouse at Saluga":

The guarded parking lot for bicycles "Ex-public warehouse alla Saluga" is located in via della Saluga, 4, near the interchange point between the urban and extra-urban public transport lines in Piazza Venezia and near the Buonconsiglio Castle.

It is a protected and equipped area for the long-term parking of bicycles, located on the ground floor of a small

building, a former public wash house owned by the municipality, recently restored. The building is located a few meters from the kiosk-newsstand and in a strategic position, because it is in the city center and close to bus stops in the Port'Aquila area. The parking can accommodate 38 bicycles arranged on two-level racks. Inside there is a video-surveillance system and a validator, near the entrance gate, guarantees access control, and management.

#### Parking "Zuffo":

The guarded parking lot for bicycles "Zuffo" is located in via Dos Trento at the southern end of the Ex-Zuffo parking lot, in the immediate vicinity of the Trento Centro motorway exit and is connected to the city by bus lines NP and 6 and the cycle / pedestrian path on via Drusus.

It looks like a fenced, video-monitored, and partially covered area for the long-term parking of 228 bicycles (12 stalls for the "E - motion" bike sharing service for electric bikes and 216 stalls for private bicycles). Externally, near the entrance, there are also 8 stations of the C'entro in ciclo bike sharing service.

#### Data & Resources:

- **GML (Geographic Markup Language)**  
[http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=parcheggio\\_protetto\\_bike&fr=gml](http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=parcheggio_protetto_bike&fr=gml)  
Dataset in GML format.
- **SHP (Shapefile)**  
[http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=parcheggio\\_protetto\\_bike&fr=shp](http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=parcheggio_protetto_bike&fr=shp)  
Dataset in SHP format.
- **KML (Keyhole Markup Language)**  
[http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=parcheggio\\_protetto\\_bike&fr=kml](http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=parcheggio_protetto_bike&fr=kml)  
Dataset in KML format.
- **DXF (AutoCAD)**  
[http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=parcheggio\\_protetto\\_bike&fr=dxf](http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=parcheggio_protetto_bike&fr=dxf)  
Dataset in DXF format.

#### Format:

The data are in KML format. Please refer to Keyhole Markup Language (KML) section for more information.

Please refer to the following table for more information about the dataset:

Name	Type	Description
park	string	Name of the parking.
via	string	Address of the parking.
layer	string	Name of the dataset.
posti	int	Total number of available bikes slots in the parking.
coordinates	string	Position of the parking in Geographic Coordinate System. The coordinate is a comma separated string: first one is longitude and second one is latitude.

#### Metadata:

Format	GML   SHP   KML   DXF
Dataset Identifier	c_1378-1128872
Holder	Comune di Trento
Dataset Themes	Regions and cities

Geographic Coverage	Trento
Release Date	08/11/2017
Modification Date	07/07/2021
Character Encoding	UTF-8
Language	Italian   English
Author	Comune di Trento
Referent	Comune di Trento - <a href="mailto:ufficio.mobilita@comune.trento.it">ufficio.mobilita@comune.trento.it</a>
Reference Site	<a href="https://www.comune.trento.it/Aree-tematiche/Cartografia/Download/Parcheggio-protetto">https://www.comune.trento.it/Aree-tematiche/Cartografia/Download/Parcheggio-protetto</a>
License	CCO 1.0

### 3.3.3.4 Stazioni Bikesharing Trentino



§ <https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino>

Real-time data, from the e-Motion project, relating to the availability of bicycles at bikesharing stations in the municipalities of Lavis, Mezzolombardo, Mezzocorona, Pergine Valsugana, Rovereto, San Michele all'Adige and Trento.

The data are georeferenced and constantly updated thanks to the use of sensors.

#### Data & Resources:

- **Bikesharing Lavis**  
<https://os.smartcommunitylab.it/core.mobility/bikesharing/lavis>  
e-Motion station of Lavis.
- **Bikesharing Mezzocorona**  
<https://os.smartcommunitylab.it/core.mobility/bikesharing/mezzocorona>  
e-Motion station of Mezzocorona.
- **Bikesharing Mezzolombardo**  
<https://os.smartcommunitylab.it/core.mobility/bikesharing/mezzolombardo>  
e-Motion station of Mezzolombardo.
- **Bikesharing Pergine**  
[https://os.smartcommunitylab.it/core.mobility/bikesharing/pergine\\_valsugana](https://os.smartcommunitylab.it/core.mobility/bikesharing/pergine_valsugana)  
e-Motion station of Pergine.
- **Bikesharing Rovereto**  
<https://os.smartcommunitylab.it/core.mobility/bikesharing/rovereto>  
e-Motion station of Rovereto.
- **Bikesharing San Michele All'Adige**  
<https://os.smartcommunitylab.it/core.mobility/bikesharing/sanmichelealladige>  
e-Motion station of San Michele All'Adige.
- **Bikesharing Trento**  
<https://os.smartcommunitylab.it/core.mobility/bikesharing/trento>  
e-Motion station of Trento.

#### Format:

The data are in JSON format. For more information about the JSON format refer to the following site: <https://www.json.org>.

Please refer to the following table for more information about the dataset:

Name	Type	Description
id	string	Unique identification name of the station.
name	string	Human friendly name of the station.
address	string	Real address where the station is located.
totalSlots	number	Total number of available bike's slots in the station.
bikes	number	Available bikes that are charged and ready for usage.
slots	number	Free slots without a bike.
position	array	Array of length of 2 that represents the position of the station in Geographic Coordinate System. The first element is the Latitude and the second element is the Longitude.

#### Metadata:

Format	JSON
Dataset Identifier	p_TN:9b9c14d6-ee20-4802-a274-4c17ac96cdd5
Holder	Provincia Autonoma di Trento
Dataset Themes	Transport   Energy
Geographic Coverage	Trentino
Release Date	18/11/2014
Modification Date	03/07/2017
Character Encoding	UTF-8
Language	Italian   English
Author	Servizio Trasporti Pubblici
Referent	Servizio Trasporti Pubblici - bikesharing@provincia.tn.it
Reference Site	<a href="http://www.provincia.tn.it/bikesharing">http://www.provincia.tn.it/bikesharing</a>
License	CC BY 4.0

#### 3.3.3.5 C'entro in bici



§ <https://dati.trentino.it/dataset/c-entro-in-bici-open-data>

C'entro in bici is a service that offers citizens the opportunity to use bicycles made available by the Municipality.

In the territory of the Municipality of Trento there is a bicycle rental service for public use for travel within the city center.

The service, managed by Trentino Mobilità spa, offers citizens the opportunity to use the bicycles made available by the Municipality and located in various parts of the city in a simple and free way, where modal interchange with private or public transport is possible.

The C'entro in bici service is a closed system with a key that is mainly aimed at commuting users who make round trips, keeping the bicycle at their place of work for a long time. The user is obliged to return the bicycle to the same point of withdrawal in order to be able to recover the personal key that has remained fixed to the rack.

#### Data & Resources:

- **GML (Geographic Markup Language)**  
[http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=centro\\_in\\_bici&fr=gml](http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=centro_in_bici&fr=gml)  
 Dataset in GML format.
- **SHP (Shapefile)**  
[http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=centro\\_in\\_bici&fr=shp](http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=centro_in_bici&fr=shp)  
 Dataset in SHP format.

- **KML (Keyhole Markup Language)**  
[http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=centro\\_in\\_bici&fr=kml](http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=centro_in_bici&fr=kml)  
Dataset in KML format.
- **DXF (AutoCAD)**  
[http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=centro\\_in\\_bici&fr=dxf](http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=centro_in_bici&fr=dxf)  
Dataset in DXF format.

#### Format:

The data are in KML format. Please refer to Keyhole Markup Language (KML) section for more information.  
Please refer to the following table for more information about the dataset:

Name	Type	Description
desc	string	Name and address of the parking.
layer	string	Name of the dataset.
ciclopostegegi	int	Total number of available bikes slots in the parking.
coordinates	string	Position of the parking in Geographic Coordinate System. The coordinate is a comma separated string: first one is longitude and second one is latitude.

#### Metadata:

Format	GML   SHP   KML   DXF
Dataset Identifier	c_1378-1128870
Holder	Comune di Trento
Dataset Themes	Regions and cities
Geographic Coverage	Trento
Release Date	08/11/2017
Modification Date	07/07/2021
Character Encoding	UTF-8
Language	Italian   English
Author	Comune di Trento
Referent	Comune di Trento - <a href="mailto:ufficio.mobilita@comune.trento.it">ufficio.mobilita@comune.trento.it</a>
Reference Site	<a href="http://www.comune.trento.it/Aree-tematiche/Cartografia/Download/C-entro-in-bici">http://www.comune.trento.it/Aree-tematiche/Cartografia/Download/C-entro-in-bici</a>
License	CCO 1.0

#### 3.3.3.6 Car sharing



§ <https://dati.trentino.it/dataset/car-sharing-open-data>

Car sharing stalls location. Parking spaces dedicated to the collection and delivery of Car sharing vehicles. Data taken directly from the site <https://www.carsharing.tn.it>.

Car sharing allows you to have a car suitable for family or business needs without owning one and without incurring fixed costs (road tax, insurance, maintenance, garage, or parking), but paying only in proportion to use.

#### Data & Resources:

- **GML (Geographic Markup Language)**  
[http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=car\\_bici&fr=gml](http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=car_bici&fr=gml)

sharing&fr=gml

Dataset in GML format.

- **SHP (Shapefile)**

[http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=car\\_sharing&fr=shp](http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=car_sharing&fr=shp)

Dataset in SHP format.

- **KML (Keyhole Markup Language)**

[http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=car\\_sharing&fr=kml](http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=car_sharing&fr=kml)

Dataset in KML format.

- **DXF (AutoCAD)**

[http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=car\\_sharing&fr=dxr](http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=car_sharing&fr=dxr)

Dataset in DXF format.

#### Format:

The data are in KML format. Please refer to Keyhole Markup Language (KML) section for more information.

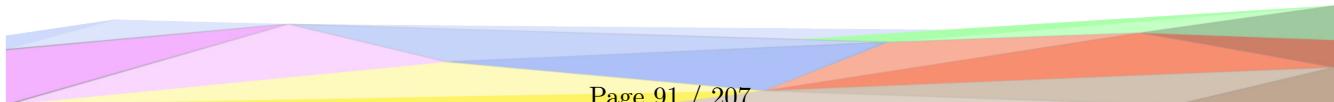
Please refer to the following table for more information about the dataset:

Name	Type	Description
nomepos	string	Name of the parking.
via	string	Address of the parking.
auto	int	Total number of available cars slots in the parking.
coordinates	string	Position of the parking in Geographic Coordinate System. The coordinate is a comma separated string: first one is longitude and second one is latitude.

#### Metadata:

Format	GML   SHP   KML   DXF
Dataset Identifier	c_1378-1157737
Holder	Comune di Trento
Dataset Themes	Regions and cities
Geographic Coverage	Trento
Release Date	04/05/2018
Modification Date	08/07/2021
Character Encoding	UTF-8
Language	Italian   English
Author	Comune di Trento
Referent	Comune di Trento - servizio.innovazionedigitale@comune.trento.it
Reference Site	<a href="https://www.comune.trento.it/Aree-tematiche/Cartografia/Download/Car-sharing">https://www.comune.trento.it/Aree-tematiche/Cartografia/Download/Car-sharing</a>
License	CCO 1.0

#### 3.3.3.7 Taxi





§ <https://dati.trentino.it/dataset/taxi-open-data>  
Taxi stands within the territory of the Municipality of Trento.  
Data provided by TAXI Trento.

#### Data & Resources:

- **GML (Geographic Markup Language)**  
<http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=taxi&fr=gml>  
Dataset in GML format.
- **SHP (Shapefile)**  
<http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=taxi&fr=shp>  
Dataset in SHP format.
- **KML (Keyhole Markup Language)**  
<http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=taxi&fr=kml>  
Dataset in KML format.
- **DXF (AutoCAD)**  
<http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=taxi&fr=dxr>  
Dataset in DXF format.

#### Format:

The data are in KML format. Please refer to Keyhole Markup Language (KML) section for more information.  
Please refer to the following table for more information about the dataset:

Name	Type	Description
nome	string	Name of the parking.
indirizzo	string	Address of the parking.
x	float	Latitude of the parking in Geographic Coordinate System.
y	float	Longitude of the parking in Geographic Coordinate System.
coordinates	string	Position of the parking in Geographic Coordinate System. The coordinate is a comma separated string: first one is longitude and second one is latitude.

#### Metadata:

Format	GML   SHP   KML   DXF
Dataset Identifier	c_1378-1157755
Holder	Comune di Trento
Dataset Themes	Regions and cities
Geographic Coverage	Trento
Release Date	04/05/2018
Modification Date	08/07/2021
Character Encoding	UTF-8
Language	Italian   English
Author	Comune di Trento

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Referent	Comune di Trento - servizio.innovazionedigitale@comune.trento.it
Reference Site	<a href="https://www.comune.trento.it/Aree-tematiche/Cartografia/Download/Taxi">https://www.comune.trento.it/Aree-tematiche/Cartografia/Download/Taxi</a>
License	CCO 1.0

### 3.3.4 Resources Metadata

Metadata aims to describe the datasets in more explicit. And RDF is a standard model for data interchange on the Web. RDF has features that facilitate data merging even if the underlying schemas differ, and it specifically supports the evolution of schemas over time without requiring all the data consumers to be changed. Thus here we display our datasets metadata in RDF format, the specific graphs and tables are displayed below.

#### 3.3.4.1 Trentino Trasporti

Graph:

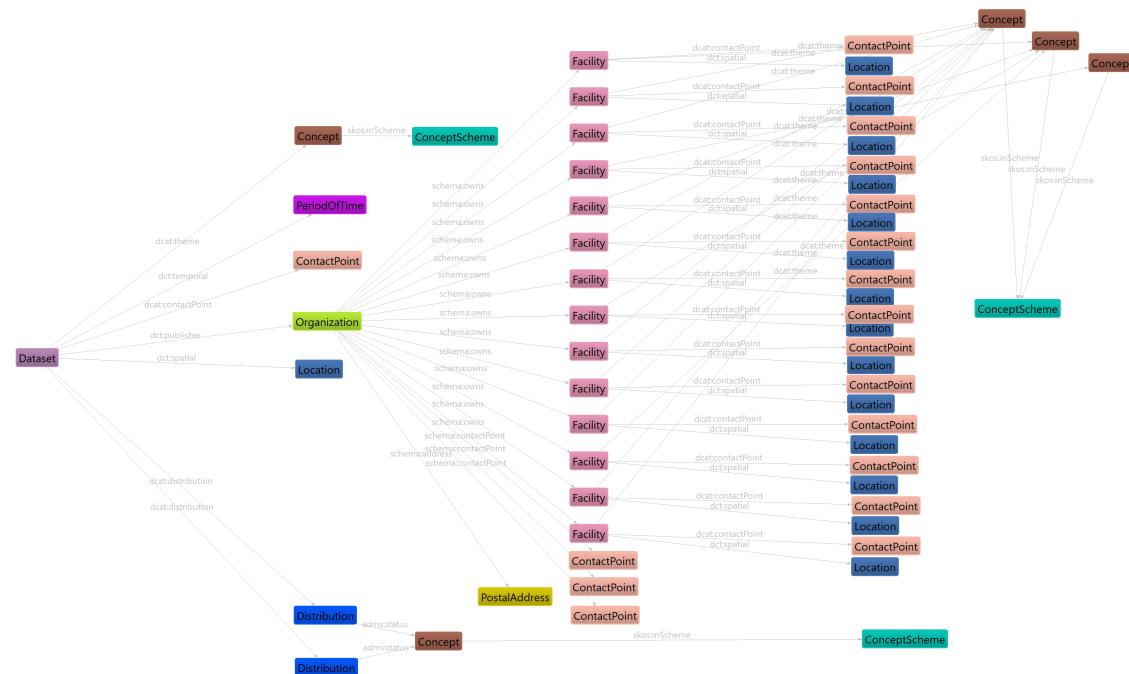


Figure 3.2: *Trentino Trasporti* metadata graph

#### RDF Metadata:

```

1 @prefix : <https://www.epos-eu.org/epos-dcat-ap#> .
2 @prefix schema: <http://schema.org/> .
3 @prefix spdx: <http://spdx.org/rdf/terms#> .
4 @prefix owl: <http://www.w3.org/2002/07/owl#> .
5 @prefix gsp: <http://www.opengis.net/ont/geosparql#> .
6 @prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
7 @prefix skos: <http://www.w3.org/2004/02/skos/core#> .
8 @prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
9 @prefix hydra: <http://www.w3.org/ns/hydra/core#> .
10 @prefix geo: <http://www.w3.org/2003/01/geo/wgs84_pos#> .
11 @prefix oa: <http://www.w3.org/ns/oa#> .
12 @prefix dct: <http://purl.org/dc/terms/> .

```

```

13 @prefix sh: <http://www.w3.org/ns/shacl#> .
14 @prefix dcat: <http://www.w3.org/ns/dcat#> .
15 @prefix locn: <http://www.w3.org/ns/locn#> .
16 @prefix foaf: <http://xmlns.com/foaf/0.1/> .
17 @prefix epos: <https://www.epos-eu.org/epos-dcat-ap#> .
18 @prefix adms: <http://www.w3.org/ns/adms#> .
19 @prefix org: <http://www.w3.org/ns/org#> .
20 @prefix cnt: <http://www.w3.org/2011/content#> .
21 @prefix vcard: <http://www.w3.org/2006/vcard/ns#> .
22 @prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
23 @prefix http: <http://www.w3.org/2006/http#> .
24 @prefix dash: <http://datashapes.org/dash#> .
25 @prefix dc: <http://purl.org/dc/elements/1.1/> .

26
27 <https://www.epos-eu.org/epos-dcat-ap#Location/a0c20590-47ee-4a36-bbe9-943eb53b89b0>
28     rdf:type dct:Location ;
29     locn:geometry "POINT(11.0312586 45.8930301)"^^gsp:wktLiteral .

30
31 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ff5a1ea3-6faa-4189-a06b-0bc559c6cfb7>
32     rdf:type schema>ContactPoint ;
33     schema:availableLanguage "it-IT" ;
34     schema:contactType "Sede centrale" ;
35     schema:name "Sede centrale" ;
36     schema:telephone "0461031000" , "0461821000" .

37
38 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/6b8f5555-fa61-4b8d-8809-38a76a0f0779>
39     rdf:type skos:ConceptScheme ;
40     dct:description "A structure with walls and a roof, such as a house or factory." ;
41     dct:title "Building" .

42
43 <https://www.epos-eu.org/epos-dcat-ap#Concept/a72fdead-47a4-4732-8f9b-dac0e14a00d9>
44     rdf:type skos:Concept ;
45     skos:definition "Containing all the necessary parts, answers, or information." ;
46     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/f548ba2c-d089-4edc-810d-4f513c7fb8a6> ;
47     skos:prefLabel "Completed" .

48
49 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/41619c42-8a4f-4188-b326-762f6fd249b9>
50     rdf:type schema>ContactPoint ;
51     schema:availableLanguage "it-IT" ;
52     schema:contactType "Sede di Fondo (Autoservizio)" ;
53     schema:name "Sede di Fondo (Autoservizio)" ;
54     schema:telephone "0463831284" .

55
56 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/b6b4ab14-dc2b-436f-b5e4-a3e33cf62441>
57     rdf:type schema>ContactPoint ;
58     schema:availableLanguage "it-IT" ;
59     schema:contactType "Sede di Tione (Autoservizio)" ;
60     schema:name "Sede di Tione (Autoservizio)" ;
61     schema:telephone "0465321222" .

62
63 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/9719e0bf-0510-4e14-b13c-5c28cf8aa257>
64     rdf:type schema>ContactPoint ;
65     schema:availableLanguage "it-IT" ;
66     schema:contactType "Sede di Riva del Garda (Autoservizio)" ;
67     schema:name "Sede di Riva del Garda (Autoservizio)" ;
68     schema:telephone "0464552385" .

69
70 <https://www.epos-eu.org/epos-dcat-ap#Facility/25375c0c-3b49-4830-8443-74fffea6c91b4>
71     rdf:type epos:Facility ;
72     dct:description "Sede di Cles (Autoservizio)" ;
73     dct:identifier "Sede di Cles (Autoservizio)" ;
74     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/2d9bd745-a739-4b82-a7fe-16c6b6f7f0e4> ;
75     dct:title "Sede di Cles (Autoservizio)" ;
76     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/1df268d3-757b-4cd5-b5b5-70dc8cbded9> ;

```

```

77    dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ec11768e-be23-4711-aa93-17c5093a8439>
78    ;
79    dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/1df268d3-757b-4cd5-b5b5-70dcb8cbded9> ,
80    foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
81
81 <https://www.epos-eu.org/epos-dcat-ap#Facility/fab3a153-bf54-4199-9674-d2dc6bd0ef8d>
82    rdf:type epos:Facility ;
83    dct:description "Stazione FTM Trento" ;
84    dct:identifier "Stazione FTM Trento" ;
85    dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/8a47c1bb-03e5-42a0-bf11-85ce457eaf77> ;
86    dct:title "Stazione FTM Trento" ;
87    dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
88    dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/2c730cbb-5cee-4a7b-909e-b977a8f2494b>
89    ;
90    dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
91    foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
92
92 <https://www.epos-eu.org/epos-dcat-ap#Location/e18b96be-7b30-4848-adf4-3c3e297be16b>
93    rdf:type dct:Location ;
94    locn:geometry "POINT(11.0918214 46.2133611)"^^gsp:wktLiteral .
95
96 <https://www.epos-eu.org/epos-dcat-ap#Distribution/b9293f85-39a1-456f-b757-f03456948461>
97    rdf:type dcat:Distribution ;
98    dct:conformsTo "https://developers.google.com/transit/gtfs" ;
99    dct:description "Extra-urban public transport data in GTFS format. Main information available: stop records
        (georeferenced), list of lines, list of routes, list of arrival and departure times. The published
        zip files comply with the General Transit Feed Specification (GTFS)." ;
100   dct:format "https://developers.google.com/transit/gtfs"^^xsd:anyURI ;
101   dct:identifier "https://www.trentinotrasporti.it/opendata/google_transit_extraurbano_tte.zip"^^xsd:anyURI ;
102   dct:issued "2021-06-11T00:00:00Z"^^xsd:dateTime ;
103   dct:language "Italian" , "English" ;
104   dct:license "https://creativecommons.org/licenses/by/2.5"^^xsd:anyURI ;
105   dct:modified "2021-11-11T00:00:00Z"^^xsd:dateTime ;
106   dct:rights "https://creativecommons.org/licenses/by/2.5" ;
107   dct:title "google_transit_extraurbano.zip (csv)" ;
108   dct:type "Collection"^^xsd:anyURI ;
109   spdx:checksum "md5 272a5c380933e0ab415b771660249079" ;
110   adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/a72fdead-47a4-4732-8f9b-dac0e14a00d9> ;
111   dcat:accessURL "https://www.trentinotrasporti.it/open-data"^^xsd:anyURI ;
112   dcat:byteSize "9801295.0"^^xsd:double ;
113   dcat:downloadURL "https://www.trentinotrasporti.it/opendata/google_transit_extraurbano_tte.zip"^^xsd:anyURI
        ;
114   dcat:mediaType "application/zip" ;
115   foaf:page "https://www.trentinotrasporti.it/open-data" .
116
117 <https://www.epos-eu.org/epos-dcat-ap#Facility/dc994c58-c753-4f65-8ec1-cbe4be1fefea9>
118    rdf:type epos:Facility ;
119    dct:description "Stazione FTM Cles" ;
120    dct:identifier "Stazione FTM Cles" ;
121    dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/6901d78a-723b-4a80-a4f1-7f1f70c85ebe> ;
122    dct:title "Stazione FTM Cles" ;
123    dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
124    dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/91393752-b419-43e7-9016-f54f65a42e19>
        ;
125    dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
126    foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
127
128 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ec11768e-be23-4711-aa93-17c5093a8439>
129    rdf:type schema>ContactPoint ;
130    schema:availableLanguage "it-IT" ;
131    schema:contactType "Sede di Cles (Autoservizio)" ;
132    schema:name "Sede di Cles (Autoservizio)" ;
133    schema:telephone "0463421563" .
134

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135 <https://www.epos-eu.org/epos-dcat-ap#Location/8a47c1bb-03e5-42a0-bf11-85ce457eaf77>
136     rdf:type dct:Location ;
137     locn:geometry "POINT(11.1178873 46.072452)"^^gsp:wktLiteral .
138
139 <https://www.epos-eu.org/epos-dcat-ap#Location/58853c06-d471-485e-bcb3-da73dd6ec045>
140     rdf:type dct:Location ;
141     locn:geometry "POINT(11.8262686 46.1745397)"^^gsp:wktLiteral .
142
143 <https://www.epos-eu.org/epos-dcat-ap#Organization/5d619701-ad73-42fa-90f8-70def507b4d5>
144     rdf:type schema:Organization ;
145     schema:address <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/e12581ec-4386-4610-91f7-6993807379c6> ;
146     schema:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/32359fe2-56e3-42c3-b052-bb12a8e96a63>
147         , <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/492c2ef1-c2d3-4877-92dd-8a969d97d590> , <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/07d615b7-aab1-462d-8ba0-1a33f7bcc15a> ;
148     schema:email "info@trentinotrasporti.it" ;
149     schema:identifier "https://www.trentinotrasporti.it"^^xsd:anyURI ;
150     schema:legalName "Trentino Trasporti S.p.A." ;
151     schema:leiCode "P.IVA 01807370224" ;
152     schema:logo "https://www.trentinotrasporti.it/images/simboli/logo.svg"^^xsd:anyURI ;
153     schema:owns <https://www.epos-eu.org/epos-dcat-ap#Facility/25375c0c-3b49-4830-8443-74ffea6c91b4> , <https://www.epos-eu.org/epos-dcat-ap#Facility/fc5e4827-1193-4e2c-a0ef-41769e510d9e> , <https://www.epos-eu.org/epos-dcat-ap#Facility/dc994c58-c753-4f65-8ec1-cbe4be1fef9a> , <https://www.epos-eu.org/epos-dcat-ap#Facility/be46d762-249f-4260-9807-617437305bdd> , <https://www.epos-eu.org/epos-dcat-ap#Facility/734164e5-be4d-4436-89be-97169100f5f6> , <https://www.epos-eu.org/epos-dcat-ap#Facility/b8936-133f-4e6d-addc-917d8b908c35> , <https://www.epos-eu.org/epos-dcat-ap#Facility/88d54552-a938-4a5d-8f13-8fd376880ffd> , <https://www.epos-eu.org/epos-dcat-ap#Facility/be75b0a6-4c31-431b-8b6e-e5dc9af53dec> , <https://www.epos-eu.org/epos-dcat-ap#Facility/e4cd1c7f-28d0-4476-a763-fb7ed3fb3199> , <https://www.epos-eu.org/epos-dcat-ap#Facility/c69e71e2-2655-4abf-8cc3-a47f481249f4> , <https://www.epos-eu.org/epos-dcat-ap#Facility/fab3a153-bf54-4199-9674-d2dc6bd0ef8d> , <https://www.epos-eu.org/epos-dcat-ap#Facilitydbcf2dba-8759-46e1-8e60-04dda9e1c65f> , <https://www.epos-eu.org/epos-dcat-ap#Facilityc958073-99cf-4f91-b916-2e6c21d2f987> , <https://www.epos-eu.org/epos-dcat-ap#Facilitye6fb8892-43bd-4b98-8a20-0e6633524c89> ;
154     schema:telephone "0461821000" ;
155     schema:url "https://www.trentinotrasporti.it"^^xsd:anyURI .
156
157 <https://www.epos-eu.org/epos-dcat-ap#Location/5dcc7b0d-8fff-4d02-869a-b91cc63e0bd1>
158     rdf:type dct:Location ;
159     locn:geometry "POINT(11.6048292 46.3099271)"^^gsp:wktLiteral .
160
161 <https://www.epos-eu.org/epos-dcat-ap#Facility/fc5e4827-1193-4e2c-a0ef-41769e510d9e>
162     rdf:type epos:Facility ;
163     dct:description "Sede di Tione (Autoservizio)" ;
164     dct:identifier "Sede di Tione (Autoservizio)" ;
165     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/35b1b85e-6480-4483-aced-c870ca3c1bf0> ;
166     dct:title "Sede di Tione (Autoservizio)" ;
167     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
168     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/b6b4ab14-dc2b-436f-b5e4-a3e33cf62441> ;
169     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
170     foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
171
172 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/fb59b429-a56b-435b-a9f7-83e559313e48>
173     rdf:type skos:ConceptScheme ;
174     dct:description "The movement of people or goods from one place to another." ;
175     dct:title "Transport" .
176
177 <https://www.epos-eu.org/epos-dcat-ap#Location/0e1bad88-fa39-46c2-b0ac-df33c1e4cb9b>
178     rdf:type dct:Location ;
179     locn:geometry "POINT(10.8449596 45.8917099)"^^gsp:wktLiteral .
180
181 <https://www.epos-eu.org/epos-dcat-ap#Facility/be46d762-249f-4260-9807-617437305bdd>
182     rdf:type epos:Facility ;
183     dct:description "Sede centrale" ;

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183     dct:identifier "Sede centrale" ;
184     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/cde37938-7c56-4a7f-b225-469e9abea12e> ;
185     dct:title "Sede centrale" ;
186     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/313c34aa-f836-4402-9b6e-71358d4f92b2> ;
187     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ff5a1ea3-6faa-4189-a06b-0bc559c6cfb7>
188         ;
189     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/313c34aa-f836-4402-9b6e-71358d4f92b2> ;
190     foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
191
191 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/e329dd5e-974e-4adc-93ed-9507bbbf268b>
192     rdf:type schema>ContactPoint ;
193     schema:availableLanguage "it-IT" ;
194     schema:contactType "Stazione FTM Mezzolombardo" ;
195     schema:name "Stazione FTM Mezzolombardo" ;
196     schema:telephone "0461601361" .
197
198 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ee4d3397-861f-49db-a341-45692d1ef548>
199     rdf:type schema>ContactPoint ;
200     schema:availableLanguage "it-IT" ;
201     schema:contactType "Stazione FTM Malè" ;
202     schema:name "Stazione FTM Malè" ;
203     schema:telephone "0463901150" .
204
205 <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/e12581ec-4386-4610-91f7-6993807379c6>
206     rdf:type schema:PostalAddress ;
207     schema:addressCountry "IT" ;
208     schema:addressLocality "Trento" ;
209     schema:postalCode "38121" ;
210     schema:streetAddress "Via Innsbruck 65" .
211
212 <https://www.epos-eu.org/epos-dcat-ap#Facility/e6fb8892-43bd-4b98-8a20-0e6633524c89>
213     rdf:type epos:Facility ;
214     dct:description "Sede di Fiera di Primiero (Autoservizio)" ;
215     dct:identifier "Sede di Fiera di Primiero (Autoservizio)" ;
216     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/58853c06-d471-485e-bcb3-da73dd6ec045> ;
217     dct:title "Sede di Fiera di Primiero (Autoservizio)" ;
218     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
219     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/c3649df2-7dc4-4923-9e38-35bcff4218df>
220         ;
221     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
222     foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
223
223 <https://www.epos-eu.org/epos-dcat-ap#Location/cde37938-7c56-4a7f-b225-469e9abea12e>
224     rdf:type dct:Location ;
225     locn:geometry "POINT(11.089731 46.1086814)"^^gsp:wktLiteral .
226
227 <https://www.epos-eu.org/epos-dcat-ap#Location/26412772-d28b-4f5f-98de-6098eaff869a>
228     rdf:type dct:Location ;
229     locn:geometry "POINT(10.9047012 46.3449115)"^^gsp:wktLiteral .
230
231 <https://www.epos-eu.org/epos-dcat-ap#Distribution/ad298d32-6801-475b-a737-3e17be21a8a4>
232     rdf:type dcat:Distribution ;
233     dct:conformsTo "https://developers.google.com/transit/gtfs" ;
234     dct:description "Urban public transport data in GTFS format. Main information available: stop records (georeferenced), list of lines, list of routes, list of arrival and departure times. The published zip files comply with the General Transit Feed Specification (GTFS)." ;
235     dct:format "https://developers.google.com/transit/gtfs"^^xsd:anyURI ;
236     dct:identifier "https://www.trentinotrasporti.it/opendata/google\_transit\_urbano\_tte.zip"^^xsd:anyURI ;
237     dct:issued "2021-06-11T00:00:00Z"^^xsd:dateTime ;
238     dct:language "English" , "Italian" ;
239     dct:license "https://creativecommons.org/licenses/by/2.5"^^xsd:anyURI ;
240     dct:modified "2021-11-11T00:00:00Z"^^xsd:dateTime ;
241     dct:rights "https://creativecommons.org/licenses/by/2.5" ;
242     dct:title "google_transit_urbano.zip (csv)" ;

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243     dct:type "Collection"^^xsd:anyURI ;
244     spdx:checksum "md5 378a7dd0117c61e422452258a445ec48" ;
245     adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/a72fdead-47a4-4732-8f9b-dac0e14a00d9> ;
246     dcat:accessURL "https://www.trentinotrasporti.it/open-data"^^xsd:anyURI ;
247     dcat:byteSize "1162843.0"^^xsd:double ;
248     dcat:downloadURL "https://www.trentinotrasporti.it/opendata/google_transit_urbano_tte.zip"^^xsd:anyURI ;
249     dcat:mediaType "application/zip" ;
250     foaf:page "https://www.trentinotrasporti.it/open-data" .
251
252 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/b0200c37-cf41-4bd0-87f8-b599c50e445c>
253     rdf:type schema>ContactPoint ;
254     schema:availableLanguage "it-IT" ;
255     schema:contactType "Sede di Rovereto (Autoservizio)" ;
256     schema:name "Sede di Rovereto (Autoservizio)" ;
257     schema:telephone "0464434299" .
258
259 <https://www.epos-eu.org/epos-dcat-ap#Facility/88d54552-a938-4a5d-8f13-8fd376880ffd>
260     rdf:type epos:Facility ;
261     dct:description "Sede di Borgo Valsugana (Autoservizio)" ;
262     dct:identifier "Sede di Borgo Valsugana (Autoservizio)" ;
263     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/2ab61512-2c32-4c8e-9613-e510c8a2eab0> ;
264     dct:title "Sede di Borgo Valsugana (Autoservizio)" ;
265     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
266     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/b07d1a2b-54c3-4aaa-adec-f032bd4c53cf>
267     ;
268     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
269     foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
270
271 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/f548ba2c-d089-4edc-810d-4f513c7fb8a6>
272     rdf:type skos:ConceptScheme ;
273     dct:description "The position or rank of someone or something when compared to others in a society, organization, group, etc." ;
274     dct:title "Status" .
275
276 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/91393752-b419-43e7-9016-f54f65a42e19>
277     rdf:type schema>ContactPoint ;
278     schema:availableLanguage "it-IT" ;
279     schema:contactType "Stazione FTM Cles" ;
280     schema:name "Stazione FTM Cles" ;
281     schema:telephone "0463421042" .
282
283 <https://www.epos-eu.org/epos-dcat-ap#Location/2d9bd745-a739-4b82-a7fe-16c6b6f7f0e4>
284     rdf:type dct:Location ;
285     locn:geometry "POINT(11.0380046 46.3635158)"^^gsp:wktLiteral .
286
287 <https://www.epos-eu.org/epos-dcat-ap#PeriodOfTime/283e8268-801e-4bc0-b445-26ea163e25f3>
288     rdf:type dct:PeriodOfTime ;
289     schema:endDate "2022-06-24T00:00:00Z"^^xsd:dateTime ;
290     schema:startDate "2021-06-11T00:00:00Z"^^xsd:dateTime .
291
292 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/492c2ef1-c2d3-4877-92dd-8a969d97d590>
293     rdf:type schema>ContactPoint ;
294     schema:availableLanguage "it-IT" ;
295     schema:contactType "Servizio Clienti" ;
296     schema:email "segnalazioni@trentinotrasporti.it" ;
297     schema:name "Servizio Clienti" ;
298     schema:telephone "0461031000" .
299
300 <https://www.epos-eu.org/epos-dcat-ap#Location/2ab61512-2c32-4c8e-9613-e510c8a2eab0>
301     rdf:type dct:Location ;
302     locn:geometry "POINT(11.4604201 46.0523401)"^^gsp:wktLiteral .
303
304 <https://www.epos-eu.org/epos-dcat-ap#Facility/c69e71e2-2655-4abf-8cc3-a47f481249f4>
305     rdf:type epos:Facility ;

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305     dct:description "Sede di Predazzo (Autoservizio)" ;
306     dct:identifier "Sede di Predazzo (Autoservizio)" ;
307     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/5dcc7b0d-8fff-4d02-869a-b91cc63e0bd1> ;
308     dct:title "Sede di Predazzo (Autoservizio)" ;
309     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
310     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/1b045dab-ba6c-4494-bb98-71550e2afa1f>
311     ;
312     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
313     foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
314 <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d>
315     rdf:type skos:Concept ;
316     skos:definition "The area or building at a station, airport, or port that is used by passengers leaving or
317         arriving by train, aircraft, or ship." ;
318     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/6b8f5555-fa61-4b8d-8809-38a76a0f0779> ;
319     skos:prefLabel "Terminal" .
320 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/c3649df2-7dc4-4923-9e38-35bcff4218df>
321     rdf:type schema>ContactPoint ;
322     schema:availableLanguage "it-IT" ;
323     schema:contactType "Sede di Fiera di Primiero (Autoservizio)" ;
324     schema:name "Sede di Fiera di Primiero (Autoservizio)" ;
325     schema:telephone "043964165" .
326
327 <https://www.epos-eu.org/epos-dcat-ap#Facility/be75b0a6-4c31-431b-8b6e-e5dc9af53dec>
328     rdf:type epos:Facility ;
329     dct:description "Sede di Rovereto (Autoservizio)" ;
330     dct:identifier "Sede di Rovereto (Autoservizio)" ;
331     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/a0c20590-47ee-4a36-bbe9-943eb53b89b0> ;
332     dct:title "Sede di Rovereto (Autoservizio)" ;
333     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/1df268d3-757b-4cd5-b5b5-70dcb8cbded9> ;
334     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/b0200c37-cf41-4bd0-87f8-b599c50e445c>
335     ;
336     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/1df268d3-757b-4cd5-b5b5-70dcb8cbded9> ;
337     foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
338 <https://www.epos-eu.org/epos-dcat-ap#Concept/313c34aa-f836-4402-9b6e-71358d4f92b2>
339     rdf:type skos:Concept ;
340     skos:definition "The main offices of an organization such as the army, the police, or a business company."
341     ;
342     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/6b8f5555-fa61-4b8d-8809-38a76a0f0779> ;
343     skos:prefLabel "Headquarter" .
344 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/1b045dab-ba6c-4494-bb98-71550e2afa1f>
345     rdf:type schema>ContactPoint ;
346     schema:availableLanguage "it-IT" ;
347     schema:contactType "Sede di Predazzo (Autoservizio)" ;
348     schema:name "Sede di Predazzo (Autoservizio)" ;
349     schema:telephone "0462501104" .
350
351 <https://www.epos-eu.org/epos-dcat-ap#Concept/1df268d3-757b-4cd5-b5b5-70dcb8cbded9>
352     rdf:type skos:Concept ;
353     skos:definition "A building where vehicles are kept." ;
354     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/6b8f5555-fa61-4b8d-8809-38a76a0f0779> ;
355     skos:prefLabel "Garage" .
356
357 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/323359fe2-56e3-42c3-b052-bb12a8e96a63>
358     rdf:type schema>ContactPoint ;
359     schema:availableLanguage "it-IT" ;
360     schema:contactType "Tutela assicurativa" ;
361     schema:email "serviziostinistri@trentinotrasporti.it" ;
362     schema:name "Tutela assicurativa" ;
363     schema:telephone "0461031000" .
364

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365 <https://www.epos-eu.org/epos-dcat-ap#Facility/320b8936-133f-4e6d-addc-917d8b908c35>
366     rdf:type epos:Facility ;
367     dct:description "Stazione FTM Malè" ;
368     dct:identifier "Stazione FTM Malè" ;
369     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/f6c3c4b5-cc82-44e6-9010-68ca435421fd> ;
370     dct:title "Stazione FTM Malè" ;
371     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
372     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ee4d3397-861f-49db-a341-45692d1ef548>
373         ;
374     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
375     foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
376
376 <https://www.epos-eu.org/epos-dcat-ap#Facility/734164e5-be4d-4436-89be-97169100f5f6>
377     rdf:type epos:Facility ;
378     dct:description "Sede di Croviana (Autoservizio)" ;
379     dct:identifier "Sede di Croviana (Autoservizio)" ;
380     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/26412772-d28b-4f5f-98de-6098eaff869a> ;
381     dct:title "Sede di Croviana (Autoservizio)" ;
382     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/1df268d3-757b-4cd5-b5b5-70dcb8cbded9> ;
383     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/61768f80-210a-45d3-8d4a-5883a2f90dfe>
384         ;
384     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/1df268d3-757b-4cd5-b5b5-70dcb8cbded9> ;
385     foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
386
387 <https://www.epos-eu.org/epos-dcat-ap#Location/f6c3c4b5-cc82-44e6-9010-68ca435421fd>
388     rdf:type dct:Location ;
389     locn:geometry "POINT(10.9116843 46.3514471)"^^gsp:wktLiteral .
390
391 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/3aa32c9c-cea2-4fa4-a379-19ffe36971dc>
392     rdf:type schema>ContactPoint ;
393     schema:availableLanguage "it-IT" ;
394     schema:contactType "Information" ;
395     schema:email "info@trentinotrasporti.it" ;
396     schema:name "Information" ;
397     schema:telephone "0461821000" .
398
399 <https://www.epos-eu.org/epos-dcat-ap#Dataset/a4acb0c8-9f36-42ec-891c-a2becb5a8cb2>
400     rdf:type dcat:Dataset ;
401     dct:accessRights "Public" ;
402     dct:accrualPeriodicity "Semiannual"^^xsd:anyURI ;
403     dct:conformsTo "https://developers.google.com/transit/gtfs" ;
404     dct:created "2013-01-01T00:00:00Z"^^xsd:dateTime ;
405     dct:description "Trentino Trasporti is the public transport company of the Autonomous Province of Trento, which also operates as the infrastructure manager of the Trento-Malé-Mezzana railway. The company is the concessionaire for the urban service in the cities of Trento and Rovereto, for the suburban service in all the Trentino valleys and for the management of the infrastructure of the Trento-Malé-Mezzana railway line." ;
406     dct:identifier "https://www.trentinotrasporti.it/open-data"^^xsd:anyURI ;
407     dct:issued "2013-01-01T00:00:00Z"^^xsd:dateTime ;
408     dct:language "English" , "Italian" ;
409     dct:modified "2021-11-11T00:00:00Z"^^xsd:dateTime ;
410     dct:publisher <https://www.epos-eu.org/epos-dcat-ap#Organization/5d619701-ad73-42fa-90f8-70def507b4d5> ;
411     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/c8bbfb55-cf38-4cfb-ae57-279897cd7e5c> ;
412     dct:temporal <https://www.epos-eu.org/epos-dcat-ap#PeriodOfTime/283e8268-801e-4bc0-b445-26ea163e25f3> ;
413     dct:title "Trentino Trasporti" ;
414     dct:type "Collection"^^xsd:anyURI ;
415     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/3aa32c9c-cea2-4fa4-a379-19ffe36971dc>
416         ;
416     dcat:distribution <https://www.epos-eu.org/epos-dcat-ap#Distribution/b9293f85-39a1-456f-b757-f03456948461> ,
417         <https://www.epos-eu.org/epos-dcat-ap#Distribution/ad298d32-6801-475b-a737-3e17be21a8a4> ;
417     dcat:keyword "urban transport" , "bus" , "extra-urban transport" , "train" , "gtfs" , "transports" , "cable car" , "public transport" , "trentino" , "ticket" ;
418     dcat:landingPage "https://www.trentinotrasporti.it/open-data" ;
419     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/2ce7d048-f2e4-4f42-9bd8-6c6ea18539ae> ;

```

```

420     foaf:page "https://www.trentinotrasporti.it/open-data" .
421
422 <https://www.epos-eu.org/epos-dcat-ap#Location/6901d78a-723b-4a80-a4f1-7f1f70c85ebe>
423     rdf:type dct:Location ;
424     locn:geometry "POINT(11.0383143 46.3638203)"^^gsp:wktLiteral .
425
426 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/b07d1a2b-54c3-4aaa-adec-f032bd4c53cf>
427     rdf:type schema:ContactPoint ;
428     schema:availableLanguage "it-IT" ;
429     schema:contactType "Sede di Borgo Valsugana (Autoservizio)" ;
430     schema:name "Sede di Borgo Valsugana (Autoservizio)" ;
431     schema:telephone "0461754049" .
432
433 <https://www.epos-eu.org/epos-dcat-ap#Facility/e4cd1c7f-28d0-4476-a763-fb7ed3fb3199>
434     rdf:type epos:Facility ;
435     dct:description "Stazione FTM Mezzolombardo" ;
436     dct:identifier "Stazione FTM Mezzolombardo" ;
437     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/e18b96be-7b30-4848-adf4-3c3e297be16b> ;
438     dct:title "Stazione FTM Mezzolombardo" ;
439     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
440     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/e329dd5e-974e-4adc-93ed-9507bbbf268b>
441     ;
442     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
443     foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
444
445 <https://www.epos-eu.org/epos-dcat-ap#Concept/2ce7d048-f2e4-4f42-9bd8-6c6ea18539ae>
446     rdf:type skos:Concept ;
447     skos:definition "Land transport is the transport or movement of people, animals or goods from one location
448         to another location on land." ;
449     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/fb59b429-a56b-435b-a9f7-83e559313e48> ;
450     skos:prefLabel "Land Transport" .
451
452 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/2c730ccb-5cee-4a7b-909e-b977a8f2494b>
453     rdf:type schema:ContactPoint ;
454     schema:availableLanguage "it-IT" ;
455     schema:contactType "Stazione FTM Trento" ;
456     schema:name "Stazione FTM Trento" ;
457     schema:telephone "0461238350" .
458
459 <https://www.epos-eu.org/epos-dcat-ap#Facility/8c958073-99cf-4f91-b916-2e6c21d2f987>
460     rdf:type epos:Facility ;
461     dct:description "Sede di Riva del Garda (Autoservizio)" ;
462     dct:identifier "Sede di Riva del Garda (Autoservizio)" ;
463     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/0e1bad88-fa39-46c2-b0ac-df33c1e4cb9b> ;
464     dct:title "Sede di Riva del Garda (Autoservizio)" ;
465     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
466     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/9719e0bf-0510-4e14-b13c-5c28cf8aa257>
467     ;
468     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
469     foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
470
471 <https://www.epos-eu.org/epos-dcat-ap#Location/d449227b-535c-4da0-838f-95bf27d58eba>
472     rdf:type dct:Location ;
473     locn:geometry "POINT(11.1417921 46.4658486)"^^gsp:wktLiteral .
474
475 <https://www.epos-eu.org/epos-dcat-ap#Location/c8bbfb55-cf38-4cfb-ae57-279897cd7e5c>
476     rdf:type dct:Location ;
477     locn:geometry "POINT(11.12108 46.06787)"^^gsp:wktLiteral .
478
479 <https://www.epos-eu.org/epos-dcat-ap#Location/35b1b85e-6480-4483-aced-c870ca3c1bf0>
480     rdf:type dct:Location ;
481     locn:geometry "POINT(10.726113 46.033131)"^^gsp:wktLiteral .
482
483 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/61768f80-210a-45d3-8d4a-5883a2f90dfe>

```

```

481     rdf:type schema>ContactPoint ;
482     schema:availableLanguage "it-IT" ;
483     schema:contactType "Sede di Croviana (Autoservizio)" ;
484     schema:name "Sede di Croviana (Autoservizio)" ;
485     schema:telephone "0463901587" .
486
487 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/07d615b7-aab1-462d-8ba0-1a33f7bcc15a>
488     rdf:type schema>ContactPoint ;
489     schema:availableLanguage "it-IT" ;
490     schema:contactType "Call Center" ;
491     schema:name "Call Center" ;
492     schema:telephone "0461821000" .
493
494 <https://www.epos-eu.org/epos-dcat-ap#Facility/dbcf2dba-8759-46e1-8e60-04dda9e1c65f>
495     rdf:type epos:Facility ;
496     dct:description "Sede di Fondo (Autoservizio)" ;
497     dct:identifier "Sede di Fondo (Autoservizio)" ;
498     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/d449227b-535c-4da0-838f-95bf27d58eba> ;
499     dct:title "Sede di Fondo (Autoservizio)" ;
500     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/1df268d3-757b-4cd5-b5b5-70dc8cbded9> ;
501     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/41619c42-8a4f-4188-b326-762f6fd249b9>
502     ;
503     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/1df268d3-757b-4cd5-b5b5-70dc8cbded9> ;
      foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .

```

### 3.3.4.2 Trasporti pubblici del Trentino

**Graph: RDF Metadata:**

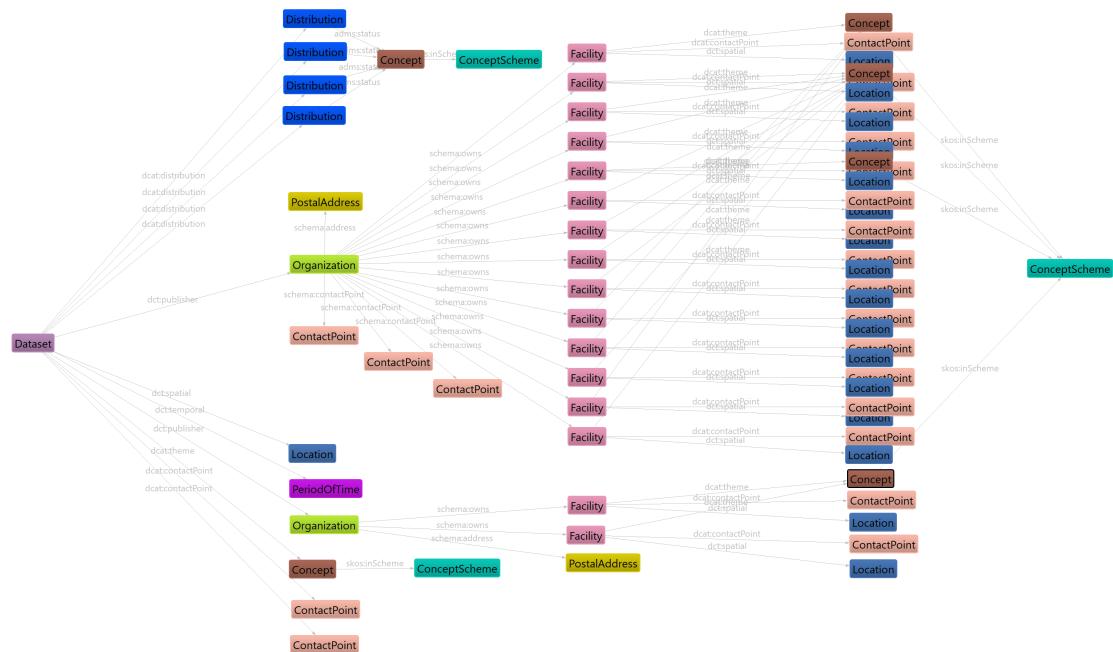


Figure 3.3: *Trasporti pubblici del Trentino* metadata graph

<sup>1</sup> @prefix : <<https://www.epos-eu.org/epos-dcat-ap#>> .

```

2 @prefix schema: <http://schema.org/> .
3 @prefix spdx: <http://spdx.org/rdf/terms#> .
4 @prefix owl: <http://www.w3.org/2002/07/owl#> .
5 @prefix gsp: <http://www.opengis.net/ont/geosparql#> .
6 @prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
7 @prefix skos: <http://www.w3.org/2004/02/skos/core#> .
8 @prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
9 @prefix hydra: <http://www.w3.org/ns/hydra/core#> .
10 @prefix geo: <http://www.w3.org/2003/01/geo/wgs84_pos#> .
11 @prefix oa: <http://www.w3.org/ns/oa#> .
12 @prefix dct: <http://purl.org/dc/terms/> .
13 @prefix sh: <http://www.w3.org/ns/shacl#> .
14 @prefix dcat: <http://www.w3.org/ns/dcat#> .
15 @prefix locn: <http://www.w3.org/ns/locn#> .
16 @prefix foaf: <http://xmlns.com/foaf/0.1/> .
17 @prefix epos: <https://www.epos-eu.org/epos-dcat-ap#> .
18 @prefix adms: <http://www.w3.org/ns/adms#> .
19 @prefix org: <http://www.w3.org/ns/org#> .
20 @prefix cnt: <http://www.w3.org/2011/content#> .
21 @prefix vcard: <http://www.w3.org/2006/vcard/ns#> .
22 @prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
23 @prefix http: <http://www.w3.org/2006/http#> .
24 @prefix dash: <http://datashapes.org/dash#> .
25 @prefix dc: <http://purl.org/dc/elements/1.1/> .

26
27 <https://www.epos-eu.org/epos-dcat-ap#Facility/dbcf2dba-8759-46e1-8e60-04dda9e1c65f>
28     rdf:type epos:Facility ;
29     dct:description "Sede di Fondo (Autoservizio)" ;
30     dct:identifier "Sede di Fondo (Autoservizio)" ;
31     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/d449227b-535c-4da0-838f-95bf27d58eba> ;
32     dct:title "Sede di Fondo (Autoservizio)" ;
33     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/1df268d3-757b-4cd5-b5b5-70dc8cbded9> ;
34     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/41619c42-8a4f-4188-b326-762f6fd249b9>
35     ;
36     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/1df268d3-757b-4cd5-b5b5-70dc8cbded9> ;
37     foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .

38 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ff5a1ea3-6faa-4189-a06b-0bc559c6cfb7>
39     rdf:type schema:ContactPoint ;
40     schema:availableLanguage "it-IT" ;
41     schema:contactType "Sede centrale" ;
42     schema:name "Sede centrale" ;
43     schema:telephone "0461031000" , "0461821000" .

44
45 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/6b8f5555-fa61-4b8d-8809-38a76a0f0779>
46     rdf:type skos:ConceptScheme ;
47     dct:description "A structure with walls and a roof, such as a house or factory." ;
48     dct:title "Building" .

49
50 <https://www.epos-eu.org/epos-dcat-ap#Concept/a72fdead-47a4-4732-8f9b-dac0e14a00d9>
51     rdf:type skos:Concept ;
52     skos:definition "Containing all the necessary parts, answers, or information." ;
53     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/f548ba2c-d089-4edc-810d-4f513c7fb8a6> ;
54     skos:prefLabel "Completed" .

55
56 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/41619c42-8a4f-4188-b326-762f6fd249b9>
57     rdf:type schema:ContactPoint ;
58     schema:availableLanguage "it-IT" ;
59     schema:contactType "Sede di Fondo (Autoservizio)" ;
60     schema:name "Sede di Fondo (Autoservizio)" ;
61     schema:telephone "0463831284" .

62
63 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/b6b4ab14-dc2b-436f-b5e4-a3e33cf62441>
64     rdf:type schema:ContactPoint ;

```

```

65     schema:availableLanguage "it-IT" ;
66     schema:contactType "Sede di Tione (Autoservizio)" ;
67     schema:name "Sede di Tione (Autoservizio)" ;
68     schema:telephone "0465321222" .
69
70 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/9719e0bf-0510-4e14-b13c-5c28cf8aa257>
71     rdf:type schema:ContactPoint ;
72     schema:availableLanguage "it-IT" ;
73     schema:contactType "Sede di Riva del Garda (Autoservizio)" ;
74     schema:name "Sede di Riva del Garda (Autoservizio)" ;
75     schema:telephone "0464552385" .
76
77 <https://www.epos-eu.org/epos-dcat-ap#Facility/25375c0c-3b49-4830-8443-74ffea6c91b4>
78     rdf:type epos:Facility ;
79     dct:description "Sede di Cles (Autoservizio)" ;
80     dct:identifier "Sede di Cles (Autoservizio)" ;
81     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/2d9bd745-a739-4b82-a7fe-16c6b6f7f0e4> ;
82     dct:title "Sede di Cles (Autoservizio)" ;
83     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/1df268d3-757b-4cd5-b5b5-70dc8cbded9> ;
84     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ec11768e-be23-4711-aa93-17c5093a8439>
85     ;
86     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/1df268d3-757b-4cd5-b5b5-70dc8cbded9> ;
87     foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
88
89 <https://www.epos-eu.org/epos-dcat-ap#Facility/fab3a153-bf54-4199-9674-d2dc6bd0ef8d>
90     rdf:type epos:Facility ;
91     dct:description "Stazione FTM Trento" ;
92     dct:identifier "Stazione FTM Trento" ;
93     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/8a47c1bb-03e5-42a0-bf11-85ce457eaf77> ;
94     dct:title "Stazione FTM Trento" ;
95     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
96     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/2c730cb5-5cee-4a7b-909e-b977a8f2494b>
97     ;
98     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
99     foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
100
101 <https://www.epos-eu.org/epos-dcat-ap#Location/e18b96be-7b30-4848-adf4-3c3e297be16b>
102     rdf:type dct:Location ;
103     locn:geometry "POINT(11.0918214 46.2133611)"^^gsp:wktLiteral .
104
105 <https://www.epos-eu.org/epos-dcat-ap#Distribution/b9293f85-39a1-456f-b757-f03456948461>
106     rdf:type dcat:Distribution ;
107     dct:conformsTo "https://developers.google.com/transit/gtfs" ;
108     dct:description "Extra-urban public transport data in GTFS format. Main information available: stop records (georeferenced), list of lines, list of routes, list of arrival and departure times. The published zip files comply with the General Transit Feed Specification (GTFS)." ;
109     dct:format "https://developers.google.com/transit/gtfs"^^xsd:anyURI ;
110     dct:identifier "https://dati.trentino.it/dataset/trasporti-pubblici-del-trentino-formato-gtfs/resource/0b1db5d6-8d2b-4f06-97f2-f65d605dfeda"^^xsd:anyURI ;
111     dct:issued "2021-06-11T00:00:00Z"^^xsd:dateTime ;
112     dct:language "Italian" , "English" ;
113     dct:license "https://creativecommons.org/licenses/by/4.0"^^xsd:anyURI ;
114     dct:modified "2021-07-01T00:00:00Z"^^xsd:dateTime ;
115     dct:rights "https://creativecommons.org/licenses/by/4.0" ;
116     dct:title "GTFS Extraurbano TTE" ;
117     dct:type "Collection"^^xsd:anyURI ;
118     spdx:checksum "md5 272a5c380933e0ab415b771660249079" ;
119     adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/a72fdead-47a4-4732-8f9b-dac0e14a00d9> ;
120     dcat:accessURL "https://dati.trentino.it/dataset/trasporti-pubblici-del-trentino-formato-gtfs/resource/0b1db5d6-8d2b-4f06-97f2-f65d605dfeda"^^xsd:anyURI ;
121     dcat:byteSize "9801295.0"^^xsd:double ;
122     dcat:downloadURL "https://www.trentinotrasporti.it/opendata/google\_transit\_extraurbano\_tte.zip"^^xsd:anyURI ;
123     dcat:mediaType "application/zip" ;

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```

122    foaf:page "https://dati.trentino.it/dataset/trasporti-pubblici-del-trentino-formato-gtfs/resource/0
123      b1db5d6-8d2b-4f06-97f2-f65d605dfeda" .
124
124 <https://www.epos-eu.org/epos-dcat-ap#Facility/dc994c58-c753-4f65-8ec1-cbe4be1fefafa9>
125   rdf:type epos:Facility ;
126   dct:description "Stazione FTM Cles" ;
127   dct:identifier "Stazione FTM Cles" ;
128   dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/6901d78a-723b-4a80-a4f1-7f1f70c85ebe> ;
129   dct:title "Stazione FTM Cles" ;
130   dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
131   dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/91393752-b419-43e7-9016-f54f65a42e19>
132   ;
132   dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
133   foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
134
135 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/a50ccd08-603e-4e13-9c95-a2a5f6f81f3c>
136   rdf:type schema>ContactPoint ;
137   schema:availableLanguage "it-IT" ;
138   schema:contactType "Ufficio programmazione dei servizi pubblici di trasporto e di supporto" ;
139   schema:email "dip.taec@pec.provincia.tn.it" , "dip.taec@provincia.tn.it" ;
140   schema:name "Ufficio programmazione dei servizi pubblici di trasporto e di supporto" ;
141   schema:telephone "0461497942" , "0461497977" .
142
143 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ec11768e-be23-4711-aa93-17c5093a8439>
144   rdf:type schema>ContactPoint ;
145   schema:availableLanguage "it-IT" ;
146   schema:contactType "Sede di Cles (Autoservizio)" ;
147   schema:name "Sede di Cles (Autoservizio)" ;
148   schema:telephone "0463421563" .
149
150 <https://www.epos-eu.org/epos-dcat-ap#Location/8a47c1bb-03e5-42a0-bf11-85ce457eaf77>
151   rdf:type dct:Location ;
152   locn:geometry "POINT(11.1178873 46.072452)"^^gsp:wktLiteral .
153
154 <https://www.epos-eu.org/epos-dcat-ap#Location/58853c06-d471-485e-bcb3-da73dd6ec045>
155   rdf:type dct:Location ;
156   locn:geometry "POINT(11.8262686 46.1745397)"^^gsp:wktLiteral .
157
158 <https://www.epos-eu.org/epos-dcat-ap#Location/5dcc7b0d-8fff-4d02-869a-b91cc63e0bd1>
159   rdf:type dct:Location ;
160   locn:geometry "POINT(11.6048292 46.3099271)"^^gsp:wktLiteral .
161
162 <https://www.epos-eu.org/epos-dcat-ap#Facility/fc5e4827-1193-4e2c-a0ef-41769e510d9e>
163   rdf:type epos:Facility ;
164   dct:description "Sede di Tione (Autoservizio)" ;
165   dct:identifier "Sede di Tione (Autoservizio)" ;
166   dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/35b1b85e-6480-4483-aced-c870ca3c1bf0> ;
167   dct:title "Sede di Tione (Autoservizio)" ;
168   dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
169   dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/b6b4abi4-dc2b-436f-b5e4-a3e33cf62441>
170   ;
171   dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
172   foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
173
173 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/fb59b429-a56b-435b-a9f7-83e559313e48>
174   rdf:type skos:ConceptScheme ;
175   dct:description "The movement of people or goods from one place to another." ;
176   dct:title "Transport" .
177
178 <https://www.epos-eu.org/epos-dcat-ap#Facility/be46d762-249f-4260-9807-617437305bdd>
179   rdf:type epos:Facility ;
180   dct:description "Sede centrale" ;
181   dct:identifier "Sede centrale" ;
182   dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/cde37938-7c56-4a7f-b225-469e9abea12e> ;

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183     dct:title "Sede centrale" ;
184     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/313c34aa-f836-4402-9b6e-71358d4f92b2> ;
185     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ff5a1ea3-6faa-4189-a06b-0bc559c6cfb7>
186     ;
187     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/313c34aa-f836-4402-9b6e-71358d4f92b2> ;
188     foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
189
189 <https://www.epos-eu.org/epos-dcat-ap#Location/0e1bad88-fa39-46c2-b0ac-df33c1e4cb9b>
190     rdf:type dct:Location ;
191     locn:geometry "POINT(10.8449596 45.8917099)"^^gsp:wktLiteral .
192
193 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/e329dd5e-974e-4adc-93ed-9507bbbf268b>
194     rdf:type schema>ContactPoint ;
195     schema:availableLanguage "it-IT" ;
196     schema:contactType "Stazione FTM Mezzolombardo" ;
197     schema:name "Stazione FTM Mezzolombardo" ;
198     schema:telephone "0461601361" .
199
200 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ee4d3397-861f-49db-a341-45692d1ef548>
201     rdf:type schema>ContactPoint ;
202     schema:availableLanguage "it-IT" ;
203     schema:contactType "Stazione FTM Malè" ;
204     schema:name "Stazione FTM Malè" ;
205     schema:telephone "0463901150" .
206
207 <https://www.epos-eu.org/epos-dcat-ap#Distribution/920f414c-cf24-4da3-8a91-331b34226c3f>
208     rdf:type dcat:Distribution ;
209     dct:conformsTo "https://developers.google.com/transit/gtfs" ;
210     dct:description "ZIP archive containing tariff data in extraurban areas in CSV-GTFS format. The published
211         zip files comply with the General Transit Feed Specification (GTFS)." ;
212     dct:format "https://developers.google.com/transit/gtfs"^^xsd:anyURI ;
213     dct:identifier "https://dati.trentino.it/dataset/trasporti-pubblici-del-trentino-formato-gtfs/resource/10
214         e93dd1-3463-4664-8c24-300a7403780a"^^xsd:anyURI ;
215     dct:issued "2021-06-11T00:00:00Z"^^xsd:dateTime ;
216     dct:language "English" , "Italian" ;
217     dct:license "https://creativecommons.org/licenses/by/4.0"^^xsd:anyURI ;
218     dct:modified "2021-07-01T00:00:00Z"^^xsd:dateTime ;
219     dct:rights "https://creativecommons.org/licenses/by/4.0" ;
220     dct:title "tariffe_gtfs_extraurbano" ;
221     dct:type "Collection"^^xsd:anyURI ;
222     spdx:checksum "md5 6b7071ef68eaf46ce6be360cd159c66c" ;
223     adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/a72fdead-47a4-4732-8f9b-dac0e14a00d9> ;
224     dcat:accessURL "https://dati.trentino.it/dataset/trasporti-pubblici-del-trentino-formato-gtfs/resource/10
225         e93dd1-3463-4664-8c24-300a7403780a"^^xsd:anyURI ;
226     dcat:byteSize "4054251.0"^^xsd:double ;
227     dcat:downloadURL "https://dati.trentino.it/dataset/6d5c2000-972e-4c21-aef6-fdbba94418a8/resource/10
228         e93dd1-3463-4664-8c24-300a7403780a/download/tariffegtfsextraurbano.zip"^^xsd:anyURI ;
229     dcat:mediaType "application/zip" ;
230     foaf:page "https://dati.trentino.it/dataset/trasporti-pubblici-del-trentino-formato-gtfs/resource/10
231         e93dd1-3463-4664-8c24-300a7403780a" .
232
232 <https://www.epos-eu.org/epos-dcat-ap#Organization/258fe2f7-91c0-4fc4-a84e-eb9b018fec41>
233     rdf:type schema:Organization ;
234     schema:address <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/24cc731f-b1ff-446e-b4cf-42f46e9051df> ;
235     schema:identifier "https://www.provincia.tn.it"^^xsd:anyURI ;
236     schema:legalName "Provincia autonoma di Trento" ;
237     schema:leiCode "P.IVA 00337460224" ;
238     schema:logo "https://www.provincia.tn.it/var/opencitypat/storage/images/1284-242-ita-IT/
239         Homepage_header_logo.png"^^xsd:anyURI ;
240     schema:owns <https://www.epos-eu.org/epos-dcat-ap#Facility/0940c634-9980-4179-9728-a34a179f0c36> , <https://www.epos-eu.org/epos-dcat-ap#Facility/0119a8f7-9527-4961-807e-ef21cc3d340a> ;
241     schema:telephone "0461495111" , "800903606" ;
242     schema:url "https://www.provincia.tn.it"^^xsd:anyURI .
243
243

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239 <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/e12581ec-4386-4610-91f7-6993807379c6>
240     rdf:type schema:PostalAddress ;
241     schema:addressCountry "IT" ;
242     schema:addressLocality "Trento" ;
243     schema:postalCode "38121" ;
244     schema:streetAddress "Via Innsbruck 65" .
245
246 <https://www.epos-eu.org/epos-dcat-ap#Facility/e6fb8892-43bd-4b98-8a20-0e6633524c89>
247     rdf:type epos:Facility ;
248     dct:description "Sede di Fiera di Primiero (Autoservizio)" ;
249     dct:identifier "Sede di Fiera di Primiero (Autoservizio)" ;
250     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/58853c06-d471-485e-bcb3-da73dd6ec045> ;
251     dct:title "Sede di Fiera di Primiero (Autoservizio)" ;
252     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
253     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/c3649df2-7dc4-4923-9e38-35bcff4218df>
254     ;
255     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
256     foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
257
258 <https://www.epos-eu.org/epos-dcat-ap#Location/cde37938-7c56-4a7f-b225-469e9abea12e>
259     rdf:type dct:Location ;
260     locn:geometry "POINT(11.089731 46.1086814)"^^gsp:wktLiteral .
261
262 <https://www.epos-eu.org/epos-dcat-ap#Location/26412772-d28b-4f5f-98de-6098eaff869a>
263     rdf:type dct:Location ;
264     locn:geometry "POINT(10.9047012 46.3449115)"^^gsp:wktLiteral .
265
266 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/b0200c37-cf41-4bd0-87f8-b599c50e445c>
267     rdf:type schema>ContactPoint ;
268     schema:availableLanguage "it-IT" ;
269     schema:contactType "Sede di Rovereto (Autoservizio)" ;
270     schema:name "Sede di Rovereto (Autoservizio)" ;
271     schema:telephone "0464434299" .
272
273 <https://www.epos-eu.org/epos-dcat-ap#Distribution/ad298d32-6801-475b-a737-3e17be21a8a4>
274     rdf:type dcat:Distribution ;
275     dct:conformsTo "https://developers.google.com/transit/gtfs" ;
276     dct:description "Urban public transport data in GTFS format. Main information available: stop records (georeferenced), list of lines, list of routes, list of arrival and departure times. The published zip files comply with the General Transit Feed Specification (GTFS)." ;
277     dct:format "https://developers.google.com/transit/gtfs"^^xsd:anyURI ;
278     dct:identifier "https://dati.trentino.it/dataset/trasporti-pubblici-del-trentino-formato-gtfs/resource/57869023-adfa-467e-8100-76403257d2d1"^^xsd:anyURI ;
279     dct:issued "2021-06-11T00:00:00Z"^^xsd:dateTime ;
280     dct:language "English" , "Italian" ;
281     dct:license "https://creativecommons.org/licenses/by/4.0"^^xsd:anyURI ;
282     dct:modified "2021-07-01T00:00:00Z"^^xsd:dateTime ;
283     dct:rights "https://creativecommons.org/licenses/by/4.0" ;
284     dct:title "GTFS Urbano TTE" ;
285     dct:type "Collection"^^xsd:anyURI ;
286     spdx:checksum "md5 378a7dd0117c61e422452258a445ec48" ;
287     adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/a72fdead-47a4-4732-8f9b-dac0e14a00d9> ;
288     dcat:accessURL "https://dati.trentino.it/dataset/trasporti-pubblici-del-trentino-formato-gtfs/resource/57869023-adfa-467e-8100-76403257d2d1"^^xsd:anyURI ;
289     dcat:byteSize "1162843.0"^^xsd:double ;
290     dcat:downloadURL "https://www.trentinotrasporti.it/opendata/google\_transit\_urbano\_tte.zip"^^xsd:anyURI ;
291     dcat:mediaType "application/zip" ;
292     foaf:page "https://dati.trentino.it/dataset/trasporti-pubblici-del-trentino-formato-gtfs/resource/57869023-adfa-467e-8100-76403257d2d1" .
293
294 <https://www.epos-eu.org/epos-dcat-ap#Facility/88d54552-a938-4a5d-8f13-8fd376880ffd>
295     rdf:type epos:Facility ;
296     dct:description "Sede di Borgo Valsugana (Autoservizio)" ;
297     dct:identifier "Sede di Borgo Valsugana (Autoservizio)" ;

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297     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/2ab61512-2c32-4c8e-9613-e510c8a2eab0> ;
298     dct:title "Sede di Borgo Valsugana (Autoservizio)" ;
299     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
300     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/b07d1a2b-54c3-4aaa-adec-f032bd4c53cf>
301     ;
302     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
303     foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
304
304 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/91393752-b419-43e7-9016-f54f65a42e19>
305     rdf:type schema>ContactPoint ;
306     schema:availableLanguage "it-IT" ;
307     schema:contactType "Stazione FTM Cles" ;
308     schema:name "Stazione FTM Cles" ;
309     schema:telephone "0463421042" .
310
311 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/f548ba2c-d089-4edc-810d-4f513c7fb8a6>
312     rdf:type skos:ConceptScheme ;
313     dct:description "The position or rank of someone or something when compared to others in a society, organization, group, etc." ;
314     dct:title "Status" .
315
316 <https://www.epos-eu.org/epos-dcat-ap#Location/2d9bd745-a739-4b82-a7fe-16c6b6f7f0e4>
317     rdf:type dct:Location ;
318     locn:geometry "POINT(11.0380046 46.3635158)"^^gsp:wktLiteral .
319
320 <https://www.epos-eu.org/epos-dcat-ap#PeriodOfTime/283e8268-801e-4bc0-b445-26ea163e25f3>
321     rdf:type dct:PeriodOfTime ;
322     schema:endDate "2022-06-24T00:00:00Z"^^xsd:dateTime ;
323     schema:startDate "2021-06-11T00:00:00Z"^^xsd:dateTime .
324
325 <https://www.epos-eu.org/epos-dcat-ap#Location/9088ff3a-db08-4baa-a067-8a1401f17658>
326     rdf:type dct:Location ;
327     locn:geometry "POINT(11.1209891 46.0722834)"^^gsp:wktLiteral .
328
329 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/492c2ef1-c2d3-4877-92dd-8a969d97d590>
330     rdf:type schema>ContactPoint ;
331     schema:availableLanguage "it-IT" ;
332     schema:contactType "Servizio Clienti" ;
333     schema:email "segnalazioni@trentinotrasporti.it" ;
334     schema:name "Servizio Clienti" ;
335     schema:telephone "0461031000" .
336
337 <https://www.epos-eu.org/epos-dcat-ap#Location/2ab61512-2c32-4c8e-9613-e510c8a2eab0>
338     rdf:type dct:Location ;
339     locn:geometry "POINT(11.4604201 46.0523401)"^^gsp:wktLiteral .
340
341 <https://www.epos-eu.org/epos-dcat-ap#Facility/c69e71e2-2655-4abf-8cc3-a47f481249f4>
342     rdf:type epos:Facility ;
343     dct:description "Sede di Predazzo (Autoservizio)" ;
344     dct:identifier "Sede di Predazzo (Autoservizio)" ;
345     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/5dcc7b0d-8fff-4d02-869a-b91cc63e0bd1> ;
346     dct:title "Sede di Predazzo (Autoservizio)" ;
347     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
348     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/1b045dab-ba6c-4494-bb98-71550e2afa1f>
349     ;
350     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
351     foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
352
352 <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d>
353     rdf:type skos:Concept ;
354     skos:definition "The area or building at a station, airport, or port that is used by passengers leaving or arriving by train, aircraft, or ship." ;
355     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/6b8f5555-fa61-4b8d-8809-38a76a0f0779> ;
356     skos:prefLabel "Terminal" .

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357
358 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/c3649df2-7dc4-4923-9e38-35bcff4218df>
359   rdf:type schema>ContactPoint ;
360   schema:availableLanguage "it-IT" ;
361   schema:contactType "Sede di Fiera di Primiero (Autoservizio)" ;
362   schema:name "Sede di Fiera di Primiero (Autoservizio)" ;
363   schema:telephone "043964165" .
364
365 <https://www.epos-eu.org/epos-dcat-ap#Facility/be75b0a6-4c31-431b-8b6e-e5dc9af53dec>
366   rdf:type epos:Facility ;
367   dct:description "Sede di Rovereto (Autoservizio)" ;
368   dct:identifier "Sede di Rovereto (Autoservizio)" ;
369   dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/a0c20590-47ee-4a36-bbe9-943eb53b89b0> ;
370   dct:title "Sede di Rovereto (Autoservizio)" ;
371   dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/1df268d3-757b-4cd5-b5b5-70dcb8cbded9> ;
372   dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/b0200c37-cf41-4bd0-87f8-b599c50e445c>
373   ;
374   dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/1df268d3-757b-4cd5-b5b5-70dcb8cbded9> ;
375   foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
376
377 <https://www.epos-eu.org/epos-dcat-ap#Concept/313c34aa-f836-4402-9b6e-71358d4f92b2>
378   rdf:type skos:Concept ;
379   skos:definition "The main offices of an organization such as the army, the police, or a business company."
380   ;
381   skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/6b8f5555-fa61-4b8d-8809-38a76a0f0779> ;
382   skos:prefLabel "Headquarter" .
383
384 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/1b045dab-ba6c-4494-bb98-71550e2afa1f>
385   rdf:type schema>ContactPoint ;
386   schema:availableLanguage "it-IT" ;
387   schema:contactType "Sede di Predazzo (Autoservizio)" ;
388   schema:name "Sede di Predazzo (Autoservizio)" ;
389   schema:telephone "0462501104" .
390
391 <https://www.epos-eu.org/epos-dcat-ap#Concept/1df268d3-757b-4cd5-b5b5-70dcb8cbded9>
392   rdf:type skos:Concept ;
393   skos:definition "A building where vehicles are kept." ;
394   skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/6b8f5555-fa61-4b8d-8809-38a76a0f0779> ;
395   skos:prefLabel "Garage" .
396
397 <https://www.epos-eu.org/epos-dcat-ap#Concept/cccf9c98-7a3e-41cd-bca9-a7c6b5e00c89>
398   rdf:type skos:Concept ;
399   skos:definition "A room or part of a building in which people work, especially sitting at tables with
400   computers, phones, etc., usually as a part of a business or other organization." ;
401   skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/6b8f5555-fa61-4b8d-8809-38a76a0f0779> ;
402   skos:prefLabel "Office" .
403
404 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/32359fe2-56e3-42c3-b052-bb12a8e96a63>
405   rdf:type schema>ContactPoint ;
406   schema:availableLanguage "it-IT" ;
407   schema:contactType "Tutela assicurativa" ;
408   schema:email "serviziostinistri@trentinotrasporti.it" ;
409   schema:name "Tutela assicurativa" ;
410   schema:telephone "0461031000" .
411
412 <https://www.epos-eu.org/epos-dcat-ap#Facility/0119a8f7-9527-4961-807e-ef21cc3d340a>
413   rdf:type epos:Facility ;
414   dct:description "Palazzo della Provincia Autonoma di Trento" ;
415   dct:identifier "Palazzo della Provincia Autonoma di Trento" ;
416   dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/9088ff3a-db08-4baa-a067-8a1401f17658> ;
417   dct:title "Palazzo della Provincia Autonoma di Trento" ;
418   dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/cccf9c98-7a3e-41cd-bca9-a7c6b5e00c89> ;
419   dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/a09d4df2-1fa3-4e00-8934-e4d61335bb44>
420   ;

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417      dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/ccc9c98-7a3e-41cd-bca9-a7c6b5e00c89> ;
418      foaf:page "https://www.provincia.tn.it"^^xsd:anyURI .
419
420  <https://www.epos-eu.org/epos-dcat-ap#Facility/320b8936-133f-4e6d-addc-917d8b908c35>
421      rdf:type epos:Facility ;
422      dct:description "Stazione FTM Malè" ;
423      dct:identifier "Stazione FTM Malè" ;
424      dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/f6c3c4b5-cc82-44e6-9010-68ca435421fd> ;
425      dct:title "Stazione FTM Malè" ;
426      dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
427      dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ee4d3397-861f-49db-a341-45692d1ef548>
428      ;
429      dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
430      foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
431
432  <https://www.epos-eu.org/epos-dcat-ap#Facility/734164e5-be4d-4436-89be-97169100f5f6>
433      rdf:type epos:Facility ;
434      dct:description "Sede di Croviana (Autoservizio)" ;
435      dct:identifier "Sede di Croviana (Autoservizio)" ;
436      dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/26412772-d28b-4f5f-98de-6098eaff869a> ;
437      dct:title "Sede di Croviana (Autoservizio)" ;
438      dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/1df268d3-757b-4cd5-b5b5-70dc8cbded9> ;
439      dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/61768f80-210a-45d3-8d4a-5883a2f90dfe>
440      ;
441      dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/1df268d3-757b-4cd5-b5b5-70dc8cbded9> ;
442      foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
443
444  <https://www.epos-eu.org/epos-dcat-ap#Location/f6c3c4b5-cc82-44e6-9010-68ca435421fd>
445      rdf:type dct:Location ;
446      locn:geometry "POINT(10.9116843 46.3514471)"^^gsp:wktLiteral .
447
448  <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/3aa32c9c-cea2-4fa4-a379-19ffe36971dc>
449      rdf:type schema>ContactPoint ;
450      schema:availableLanguage "it-IT" ;
451      schema:contactType "Information" ;
452      schema:email "info@trentinotrasporti.it" ;
453      schema:name "Information" ;
454      schema:telephone "0461821000" .
455
456  <https://www.epos-eu.org/epos-dcat-ap#Dataset/a4acb0c8-9f36-42ec-891c-a2becb5a8cb2>
457      rdf:type dcat:Dataset ;
458      dct:accessRights "Public" ;
459      dct:accrualPeriodicity "Semiannual"^^xsd:anyURI ;
460      dct:conformsTo "https://developers.google.com/transit/gtfs" ;
461      dct:created "2013-01-01T00:00:00Z"^^xsd:dateTime ;
462      dct:description "Trentino Trasporti is the public transport company of the Autonomous Province of Trento,
463      which also operates as the infrastructure manager of the Trento-Malé-Mezzana railway. The company is
464      the concessionaire for the urban service in the cities of Trento and Rovereto, for the suburban
465      service in all the Trentino valleys and for the management of the infrastructure of the
466      Trento-Malé-Mezzana railway line." ;
467      dct:identifier "d3c9f167-3271-4a43-b5c1-e0879aa5ad3f"^^xsd:anyURI ;
468      dct:issued "2013-01-01T00:00:00Z"^^xsd:dateTime ;
469      dct:language "English" , "Italian" ;
470      dct:modified "2021-07-01T00:00:00Z"^^xsd:dateTime ;
471      dct:publisher <https://www.epos-eu.org/epos-dcat-ap#Organization/a38ce2e8-c59f-402d-b00f-c3fc08a6f398> , <
472      https://www.epos-eu.org/epos-dcat-ap#Organization/258fe2f7-91c0-4fc4-a84e-eb9b018fec41> ;
473      dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/c8bbfb55-cf38-4cfb-ae57-279897cd7e5c> ;
474      dct:temporal <https://www.epos-eu.org/epos-dcat-ap#PeriodOfTime/283e8268-801e-4bc0-b445-26ea163e25f3> ;
475      dct:title "Trasporti pubblici del Trentino" ;
476      dct:type "Collection"^^xsd:anyURI ;
477      dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/b62942da-5d94-4925-b41a-ba2d946ae41f>
478      , <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/3aa32c9c-cea2-4fa4-a379-19ffe36971dc> ;
479      dcat:distribution <https://www.epos-eu.org/epos-dcat-ap#Distribution/b9293f85-39a1-456f-b757-f03456948461>
480      , <https://www.epos-eu.org/epos-dcat-ap#Distribution/ad298d32-6801-475b-a737-3e17be21a8a4> , <https://www.epos-eu.org/epos-dcat-ap#Distribution/1df268d3-757b-4cd5-b5b5-70dc8cbded9>
```

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```

        www.epos-eu.org/epos-dcat-ap#Distribution/920f414c-cf24-4da3-8a91-331b34226c3f> , <https://www.epos-eu
        .org/epos-dcat-ap#Distribution/18647c87-5dcc-4d83-ae91-d90b52cc9c0a> ;
472 dcat:keyword "money" , "bus" , "fare" , "urban transport" , "gtfs" , "price" , "cable car" , "ticket" , "
        transports" , "cartascalare" , "cash" , "trentino" , "train" , "extra-urban transport" , "mobile" , "
        public transport" ;
473 dcat:landingPage "https://dati.trentino.it/dataset/trasporti-pubblici-del-trentino-formato-gtfs" ;
474 dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/2ce7d048-f2e4-4f42-9bd8-6c6ea18539ae> ;
475 foaf:page "https://dati.trentino.it/dataset/trasporti-pubblici-del-trentino-formato-gtfs" , "http://www.
        trasporti.provincia.tn.it" .

476 <https://www.epos-eu.org/epos-dcat-ap#Distribution/18647c87-5dcc-4d83-ae91-d90b52cc9c0a>
477 rdf:type dcat:Distribution ;
478 dct:conformsTo "https://developers.google.com/transit/gtfs" ;
479 dct:description "ZIP archive containing tariff data in urban areas in CSV-GTFS format. The published zip
        files comply with the General Transit Feed Specification (GTFS)." ;
480 dct:format "https://developers.google.com/transit/gtfs"^^xsd:anyURI ;
481 dct:identifier "https://dati.trentino.it/dataset/trasporti-pubblici-del-trentino-formato-gtfs/resource/44
        efc0bd-223a-49c7-b3b0-16128e32813c"^^xsd:anyURI ;
482 dct:issued "2021-06-11T00:00:00Z"^^xsd:dateTime ;
483 dct:language "English" , "Italian" ;
484 dct:license "https://creativecommons.org/licenses/by/4.0"^^xsd:anyURI ;
485 dct:modified "2021-07-01T00:00:00Z"^^xsd:dateTime ;
486 dct:rights "https://creativecommons.org/licenses/by/4.0" ;
487 dct:title "tariffe_gtfs_urbano" ;
488 dct:type "Collection"^^xsd:anyURI ;
489 spdx:checksum "md5 0217a5d7eef680d2cc36b3b6cc5dcd10" ;
490 adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/a72fdead-47a4-4732-8f9b-dac0e14a00d9> ;
491 dcat:accessURL "https://dati.trentino.it/dataset/trasporti-pubblici-del-trentino-formato-gtfs/resource/44
        efc0bd-223a-49c7-b3b0-16128e32813c"^^xsd:anyURI ;
492 dcat:byteSize "6556.0"^^xsd:double ;
493 dcat:downloadURL "https://dati.trentino.it/dataset/6d5c2000-972e-4c21-aef6-fdbba94418a8/resource/44
        efc0bd-223a-49c7-b3b0-16128e32813c/download/tariffegtfsurbano.zip"^^xsd:anyURI ;
494 dcat:mediaType "application/zip" ;
495 foaf:page "https://dati.trentino.it/dataset/trasporti-pubblici-del-trentino-formato-gtfs/resource/44
        efc0bd-223a-49c7-b3b0-16128e32813c" .

496 <https://www.epos-eu.org/epos-dcat-ap#Facility/0940c634-9980-4179-9728-a34a179f0c36>
497 rdf:type epos:Facility ;
498 dct:description "Ufficio programmazione dei servizi pubblici di trasporto e di supporto" ;
499 dct:identifier "Ufficio programmazione dei servizi pubblici di trasporto e di supporto" ;
500 dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/abf210db-7ae1-4bd3-ab88-38294b394335> ;
501 dct:title "Ufficio programmazione dei servizi pubblici di trasporto e di supporto" ;
502 dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/cccf9c98-7a3e-41cd-bca9-a7c6b5e00c89> ;
503 dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/a50ccd08-603e-4e13-9c95-a2a5f6f81f3c>
504 ;
505 dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/cccf9c98-7a3e-41cd-bca9-a7c6b5e00c89> ;
506 foaf:page "https://www.provincia.tn.it/Amministrazione/Strutture-organizzative/
507 Ufficio-programmazione-dei-servizi-pubblici-di-trasporto-e-di-supporto"^^xsd:anyURI .

508 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/b62942da-5d94-4925-b41a-ba2d946ae4if>
509 rdf:type schema>ContactPoint ;
510 schema:availableLanguage "it-IT" ;
511 schema:contactType "Servizio Trasporti pubblici" ;
512 schema:email "umst.mobilita@provincia.tn.it" , "umst.mobilita@pec.provincia.tn.it" ;
513 schema:name "Servizio Trasporti pubblici" ;
514 schema:telephone "800903606" , "0461495111" .

515 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/a09d4df2-1fa3-4e00-8934-e4d61335bb44>
516 rdf:type schema>ContactPoint ;
517 schema:availableLanguage "it-IT" ;
518 schema:contactType "Palazzo della Provincia Autonoma di Trento" ;
519 schema:name "Palazzo della Provincia Autonoma di Trento" ;
520 schema:telephone "0461495111" .
521
522
523
```

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524 <https://www.epos-eu.org/epos-dcat-ap#Location/6901d78a-723b-4a80-a4f1-7f1f70c85ebe>
525     rdf:type dct:Location ;
526     locn:geometry "POINT(11.0383143 46.3638203)"^^gsp:wktLiteral .
527
528 <https://www.epos-eu.org/epos-dcat-ap#Location/abf210db-7ae1-4bd3-ab88-38294b394335>
529     rdf:type dct:Location ;
530     locn:geometry "POINT(11.119378 46.070912)"^^gsp:wktLiteral .
531
532 <https://www.epos-eu.org/epos-dcat-ap#Organization/a38ce2e8-c59f-402d-b00f-c3fc08a6f398>
533     rdf:type schema:Organization ;
534     schema:address <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/e12581ec-4386-4610-91f7-6993807379c6> ;
535     schema:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/07d615b7-aab1-462d-8ba0-1a33f7bcc15a> ,
536         <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/32359fe2-56e3-42c3-b052-bb12a8e96a63> , <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/492c2ef1-c2d3-4877-92dd-8a969d97d590> ;
537     schema:email "info@trentinotrasporti.it" ;
538     schema:identifier "https://www.trentinotrasporti.it"^^xsd:anyURI ;
539     schema:legalName "Trentino Trasporti S.p.A." ;
540     schema:leiCode "P.IVA 01807370224" ;
541     schema:logo "https://www.trentinotrasporti.it/images/simboli/logo.svg"^^xsd:anyURI ;
542     schema:owns <https://www.epos-eu.org/epos-dcat-ap#Facility/dbcf2dba-8759-46e1-8e60-04dda9e1c65f> , <https://www.epos-eu.org/epos-dcat-ap#Facility/8c958073-99cf-4f91-b916-2e6c21d2f987> , <https://www.epos-eu.org/epos-dcat-ap#Facility/c69e71e2-2655-4abf-8cc3-a47f481249f4> , <https://www.epos-eu.org/epos-dcat-ap#Facility/fc5e4827-1193-4e2c-a0ef-41769e510d9e> , <https://www.epos-eu.org/epos-dcat-ap#Facility/be46d762-249f-4260-9807-617437305bdd> , <https://www.epos-eu.org/epos-dcat-ap#Facility/e4cd1c7f-28d0-4476-a763-fb7ed3fb3199> , <https://www.epos-eu.org/epos-dcat-ap#Facility/fab3a153-bf54-4199-9674-d2dc6bd0ef8d> , <https://www.epos-eu.org/epos-dcat-ap#Facility/dc994c58-c753-4f65-8ec1-cbe4befefa9> , <https://www.epos-eu.org/epos-dcat-ap#Facility/e6fb8892-43bd-4b98-8a20-0e6633524c89> , <https://www.epos-eu.org/epos-dcat-ap#Facility/25375c0c-3b49-4830-8443-74ffea6c91b4> , <https://www.epos-eu.org/epos-dcat-ap#Facility/be75b0a6-4c31-431b-8b6e-e5dc9af53dec> , <https://www.epos-eu.org/epos-dcat-ap#Facility/734164e5-be4d-4436-89be-97169100f5f6> , <https://www.epos-eu.org/epos-dcat-ap#Facility/88d54552-a938-4a5d-8f13-8fd376880ffd> , <https://www.epos-eu.org/epos-dcat-ap#Facility/320b8936-133f-4e6d-addc-917d8b908c35> ;
543     schema:telephone "0461821000" ;
544     schema:url "https://www.trentinotrasporti.it"^^xsd:anyURI .
545
546 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/b07d1a2b-54c3-4aaa-adec-f032bd4c53cf>
547     rdf:type schema>ContactPoint ;
548     schema:availableLanguage "it-IT" ;
549     schema:contactType "Sede di Borgo Valsugana (Autoservizio)" ;
550     schema:name "Sede di Borgo Valsugana (Autoservizio)" ;
551     schema:telephone "0461754049" .
552
553 <https://www.epos-eu.org/epos-dcat-ap#Concept/2ce7d048-f2e4-4f42-9bd8-6c6ea18539ae>
554     rdf:type skos:Concept ;
555     skos:definition "Land transport is the transport or movement of people, animals or goods from one location to another location on land." ;
556     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/fb59b429-a56b-435b-a9f7-83e559313e48> ;
557     skos:prefLabel "Land Transport" .
558
559 <https://www.epos-eu.org/epos-dcat-ap#Facility/e4cd1c7f-28d0-4476-a763-fb7ed3fb3199>
560     rdf:type epos:Facility ;
561     dct:description "Stazione FTM Mezzolombardo" ;
562     dct:identifier "Stazione FTM Mezzolombardo" ;
563     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/e18b96be-7b30-4848-adf4-3c3e297be16b> ;
564     dct:title "Stazione FTM Mezzolombardo" ;
565     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
566     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/e329dd5e-974e-4adc-93ed-9507bbbf268b> ;
567     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
568     foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .
569
570 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/2c730ccb-5cee-4a7b-909e-b977a8f2494b>
      rdf:type schema>ContactPoint ;

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571     schema:availableLanguage "it-IT" ;
572     schema:contactType "Stazione FTM Trento" ;
573     schema:name "Stazione FTM Trento" ;
574     schema:telephone "0461238350" .

575 <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/24cc731f-b1ff-446e-b4cf-42f46e9051df>
576     rdf:type schema:PostalAddress ;
577     schema:addressCountry "IT" ;
578     schema:addressLocality "Trento" ;
579     schema:postalCode "38122" ;
580     schema:streetAddress "Piazza Dante 15" .

581 <https://www.epos-eu.org/epos-dcat-ap#Facility/8c958073-99cf-4f91-b916-2e6c21d2f987>
582     rdf:type epos:Facility ;
583     dct:description "Sede di Riva del Garda (Autoservizio)" ;
584     dct:identifier "Sede di Riva del Garda (Autoservizio)" ;
585     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/0e1bad88-fa39-46c2-b0ac-df33c1e4cb9b> ;
586     dct:title "Sede di Riva del Garda (Autoservizio)" ;
587     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
588     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/9719e0bf-0510-4e14-b13c-5c28cf8aa257>
589     ;
590     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/7d8be6da-3f96-474f-ad26-f1a81305e39d> ;
591     foaf:page "https://www.trentinotrasporti.it/contatti/contatti"^^xsd:anyURI .

592 <https://www.epos-eu.org/epos-dcat-ap#Location/d449227b-535c-4da0-838f-95bf27d58eba>
593     rdf:type dct:Location ;
594     locn:geometry "POINT(11.1417921 46.4658486)"^^gsp:wktLiteral .

595 <https://www.epos-eu.org/epos-dcat-ap#Location/c8bbfb55-cf38-4cfb-ae57-279897cd7e5c>
596     rdf:type dct:Location ;
597     locn:geometry "POINT(11.12108 46.06787)"^^gsp:wktLiteral .

598 <https://www.epos-eu.org/epos-dcat-ap#Location/35b1b85e-6480-4483-aced-c870ca3c1bf0>
599     rdf:type dct:Location ;
600     locn:geometry "POINT(10.726113 46.033131)"^^gsp:wktLiteral .

601 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/61768f80-210a-45d3-8d4a-5883a2f90dfe>
602     rdf:type schema:ContactPoint ;
603     schema:availableLanguage "it-IT" ;
604     schema:contactType "Sede di Croviana (Autoservizio)" ;
605     schema:name "Sede di Croviana (Autoservizio)" ;
606     schema:telephone "0463901587" .

607 <https://www.epos-eu.org/epos-dcat-ap#Location/a0c20590-47ee-4a36-bbe9-943eb53b89b0>
608     rdf:type dct:Location ;
609     locn:geometry "POINT(11.0312586 45.8930301)"^^gsp:wktLiteral .

610 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/07d615b7-aab1-462d-8ba0-1a33f7bcc15a>
611     rdf:type schema:ContactPoint ;
612     schema:availableLanguage "it-IT" ;
613     schema:contactType "Call Center" ;
614     schema:name "Call Center" ;
615     schema:telephone "0461821000" .

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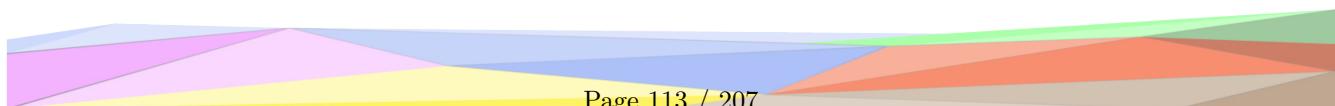
### 3.3.4.3 Parcheggio protetto per biciclette

**Graph:**

**RDF Metadata:**

---

<sup>1</sup> @prefix : <<https://www.epos-eu.org/epos-dcat-ap#>> .



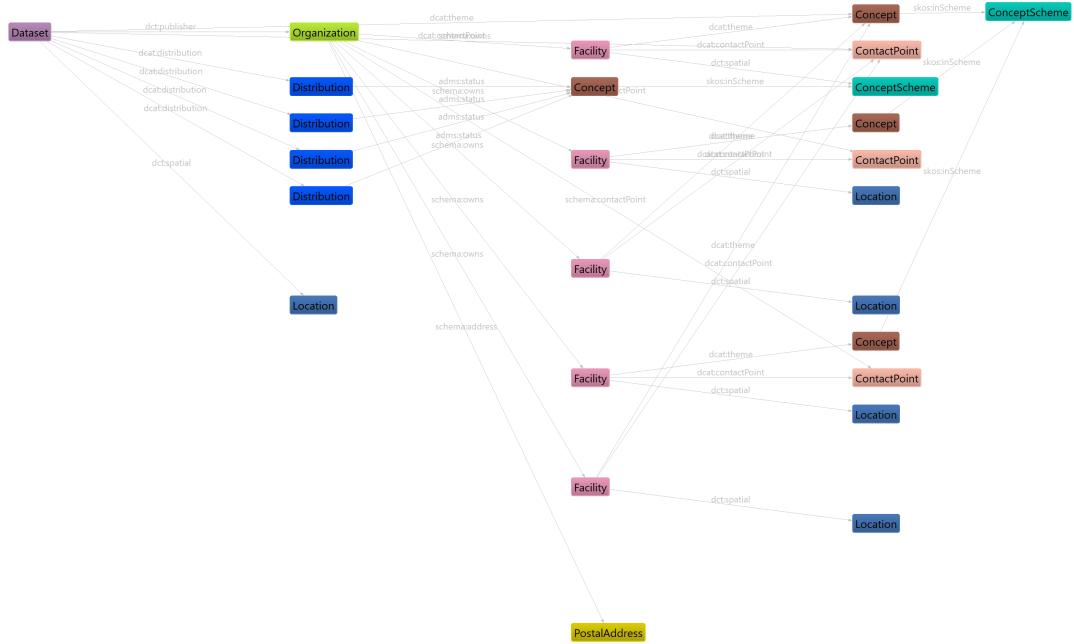


Figure 3.4: *Parcheggio protetto per biciclette* metadata graph

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2 @prefix schema: <http://schema.org/> .
3 @prefix spdx: <http://spdx.org/rdf/terms#> .
4 @prefix owl: <http://www.w3.org/2002/07/owl#> .
5 @prefix gsp: <http://www.opengis.net/ont/geosparql#> .
6 @prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
7 @prefix skos: <http://www.w3.org/2004/02/skos/core#> .
8 @prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
9 @prefix hydra: <http://www.w3.org/ns/hydra/core#> .
10 @prefix geo: <http://www.w3.org/2003/01/geo/wgs84_pos#> .
11 @prefix oa: <http://www.w3.org/ns/oa#> .
12 @prefix dct: <http://purl.org/dc/terms/> .
13 @prefix sh: <http://www.w3.org/ns/shacl#> .
14 @prefix dcat: <http://www.w3.org/ns/dcat#> .
15 @prefix locn: <http://www.w3.org/ns/locn#> .
16 @prefix foaf: <http://xmlns.com/foaf/0.1/> .
17 @prefix epos: <https://www.epos-eu.org/epos-dcat-ap#> .
18 @prefix adms: <http://www.w3.org/ns/adms#> .
19 @prefix org: <http://www.w3.org/ns/org#> .
20 @prefix cnt: <http://www.w3.org/2011/content#> .
21 @prefix vcard: <http://www.w3.org/2006/vcard/ns#> .
22 @prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
23 @prefix http: <http://www.w3.org/2006/http#> .
24 @prefix dash: <http://datashapes.org/dash#> .
25 @prefix dc: <http://purl.org/dc/elements/1.1/> .

26
27 <https://www.epos-eu.org/epos-dcat-ap#Location/c219cb05-d000-4343-88b0-16854d29f2ef>
28     rdf:type dct:Location ;
29     locn:geometry "POINT(11.1210985 46.0694727)"^^gsp:wktLiteral .

30
31 <https://www.epos-eu.org/epos-dcat-ap#Distribution/b28a2cf7-3c79-4af0-974b-d529538191ea>
32     rdf:type dcat:Distribution ;
33     dct:conformsTo "https://www.ogc.org/standards/gml" ;
34     dct:description "Protected car parks for long-term parking of bicycles in GML format." ;

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35     dct:format "https://www.opengis.net/standards/gml"^^xsd:anyURI ;
36     dct:identifier "https://dati.trentino.it/dataset/parcheggio-protetto-per-biciclette-open-data/resource/
37         bbccaeef-5dff-4b8d-b7b0-122887a1a091"^^xsd:anyURI ;
38     dct:issued "2017-11-08T00:00:00Z"^^xsd:dateTime ;
39     dct:language "Italian" , "English" ;
40     dct:license "https://creativecommons.org/publicdomain/zero/1.0"^^xsd:anyURI ;
41     dct:modified "2021-07-07T00:00:00Z"^^xsd:dateTime ;
42     dct:rights "https://creativecommons.org/publicdomain/zero/1.0" ;
43     dct:title "parcheggio_protetto_bike.zip (GML)" ;
44     dct:type "Collection"^^xsd:anyURI ;
45     SPDX:checksum "md5 243a4665732d42cd44798125797af1ca" ;
46     adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/d5422c66-839f-423b-bfe6-22f7c936f57a> ;
47     dcat:accessURL "https://dati.trentino.it/dataset/parcheggio-protetto-per-biciclette-open-data/resource/
48         bbccaeef-5dff-4b8d-b7b0-122887a1a091"^^xsd:anyURI ;
49     dcat:byteSize "1616.0"^^xsd:double ;
50     dcat:downloadURL "http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=
51         parcheggio_protetto_bike&fr=gml"^^xsd:anyURI ;
52     dcat:mediaType "application/zip" ;
53     foaf:page "https://dati.trentino.it/dataset/parcheggio-protetto-per-biciclette-open-data/resource/
54         bbccaeef-5dff-4b8d-b7b0-122887a1a091" .
55
56 <https://www.epos-eu.org/epos-dcat-ap#Location/a4286369-445f-42d3-acfd-697c6030746b>
57     rdf:type dct:Location ;
58     locn:geometry "POINT(11.1207054 46.0690622)"^^gsp:wktLiteral .
59
60 <https://www.epos-eu.org/epos-dcat-ap#Distribution/d8242f76-f8c6-4c66-9ddb-b78a87fb7a3e>
61     rdf:type dcat:Distribution ;
62     dct:conformsTo "https://wikipedia.org/wiki/AutoCAD_DXF" ;
63     dct:description "Protected car parks for long-term parking of bicycles in DXF format." ;
64     dct:format "https://wikipedia.org/wiki/AutoCAD_DXF"^^xsd:anyURI ;
65     dct:identifier "https://dati.trentino.it/dataset/parcheggio-protetto-per-biciclette-open-data/resource/5
66         a4f0d3d-10c2-412f-b04b-c1fb542e0aed"^^xsd:anyURI ;
67     dct:issued "2017-11-08T00:00:00Z"^^xsd:dateTime ;
68     dct:language "Italian" , "English" ;
69     dct:license "https://creativecommons.org/publicdomain/zero/1.0"^^xsd:anyURI ;
70     dct:modified "2021-07-07T00:00:00Z"^^xsd:dateTime ;
71     dct:rights "https://creativecommons.org/publicdomain/zero/1.0" ;
72     dct:title "parcheggio_protetto_bike.zip (DXF)" ;
73     dct:type "Collection"^^xsd:anyURI ;
74     SPDX:checksum "md5 c2bb55eb864cd7719103871fdf975d2e" ;
75     adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/d5422c66-839f-423b-bfe6-22f7c936f57a> ;
76     dcat:accessURL "https://dati.trentino.it/dataset/parcheggio-protetto-per-biciclette-open-data/resource/5
77         a4f0d3d-10c2-412f-b04b-c1fb542e0aed"^^xsd:anyURI ;
78     dcat:byteSize "3884.0"^^xsd:double ;
79     dcat:downloadURL "http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=
80         parcheggio_protetto_bike&fr=dx"^^xsd:anyURI ;
81     dcat:mediaType "application/zip" ;
82     foaf:page "https://dati.trentino.it/dataset/parcheggio-protetto-per-biciclette-open-data/resource/5
83         a4f0d3d-10c2-412f-b04b-c1fb542e0aed" .
84
85 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/df3069df-1446-4737-8c62-dbeebc052872>
86     rdf:type skos:ConceptScheme ;
87     skos:description "The position or rank of someone or something when compared to others in a society,
88         organization, group, etc." ;
89     skos:title "Status" .
90
91 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/4b11c132-26b0-4c53-b577-eface5f83d75>
92     rdf:type schema>ContactPoint ;
93     schema:availableLanguage "it-IT" ;
94     schema:contactType "Ufficio relazioni con il pubblico" ;
95     schema:email "comurp@comune.trento.it" ;
96     schema:name "Ufficio relazioni con il pubblico" ;
97     schema:telephone "800017615" , "0461884005" , "0461884453" .

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90 <https://www.epos-eu.org/epos-dcat-ap#Location/1db8460f-a8ca-4e39-b3a2-b1ec43d1b8d2>
91     rdf:type dct:Location ;
92     locn:geometry "POINT(11.12011609584675 46.072966313811349)"^^gsp:wktLiteral .
93
94 <https://www.epos-eu.org/epos-dcat-ap#Concept/582dd406-b44e-4dab-80fb-d2d86f3ba39b>
95     rdf:type skos:Concept ;
96     skos:definition "The Safe Parking Area and other onsite areas accessed by persons utilizing Safe Parking
97         shall be maintained in a safe, clean and orderly condition and manner." ;
98     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/4fb52b1f-1f57-4f67-9bcf-597557c4758a> ;
99     skos:prefLabel "Safe Parking" .
100
100 <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/266a2b24-28ef-4bea-8274-4665545f69ed>
101     rdf:type schema:PostalAddress ;
102     schema:addressCountry "IT" ;
103     schema:addressLocality "Trento" ;
104     schema:postalCode "38122" ;
105     schema:streetAddress " Via Belenzani 19" .
106
107 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/5145cf86-c423-4304-ab2d-6c5be6513498>
108     rdf:type schema>ContactPoint ;
109     schema:availableLanguage "it-IT" ;
110     schema:contactType "Information" ;
111     schema:email "comurp@comune.trento.it" , "ufficio.mobilita@comune.trento.it" ;
112     schema:name "Comune di Trento" ;
113     schema:telephone "0461884111" .
114
115 <https://www.epos-eu.org/epos-dcat-ap#Facility/1491832a-32e9-4870-a089-3fd6697d91d3>
116     rdf:type epos:Facility ;
117     dct:description "Parcheggio Ex lavatoio pubblico alla Saluga" ;
118     dct:identifier "Parcheggio Ex lavatoio pubblico alla Saluga" ;
119     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/e33fdc22-3255-4b49-a574-a3ce9810e35b> ;
120     dct:title "Parcheggio Ex lavatoio pubblico alla Saluga" ;
121     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/582dd406-b44e-4dab-80fb-d2d86f3ba39b> ;
122     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/5145cf86-c423-4304-ab2d-6c5be6513498>
123     ;
124     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/582dd406-b44e-4dab-80fb-d2d86f3ba39b> ;
125     foaf:page "https://www.comune.trento.it/Aree-tematiche/Cartografia/Download/
126     Parcheggio-protetto-per-biciclette"^^xsd:anyURI .
127
126 <https://www.epos-eu.org/epos-dcat-ap#Distribution/a89e4c66-3cd7-4807-bc00-a2c8c30858e4>
127     rdf:type dcat:Distribution ;
128     dct:conformsTo "https://wikipedia.org/wiki/Shapfile" ;
129     dct:description "Protected car parks for long-term parking of bicycles in SHP format." ;
130     dct:format "https://wikipedia.org/wiki/Shapfile"^^xsd:anyURI ;
131     dct:identifier "https://dati.trentino.it/dataset/parcheggio-protetto-per-biciclette-open-data/resource/
132         bb3ad878-505e-4ec6-8c6e-738c3958ee0c"^^xsd:anyURI ;
133     dct:issued "2017-11-08T00:00:00Z"^^xsd:dateTime ;
134     dct:language "English" , "Italian" ;
135     dct:license "https://creativecommons.org/publicdomain/zero/1.0"^^xsd:anyURI ;
136     dct:modified "2021-07-07T00:00:00Z"^^xsd:dateTime ;
137     dct:rights "https://creativecommons.org/publicdomain/zero/1.0" ;
138     dct:title "parcheggio_protetto_bike.zip (SHP)" ;
139     dct:type "Collection"^^xsd:anyURI ;
140     spdx:checksum "md5 5ca3a9f5be66902ce4fbde53d2428351" ;
141     adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/d5422c66-839f-423b-bfe6-22f7c936f57a> ;
142     dcat:accessURL "https://dati.trentino.it/dataset/parcheggio-protetto-per-biciclette-open-data/resource/
143         bb3ad878-505e-4ec6-8c6e-738c3958ee0c"^^xsd:anyURI ;
144     dcat:byteSize "1406.0"^^xsd:double ;
145     dcat:downloadURL "http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=
146         parcheggio_protetto_bike&fr=shp"^^xsd:anyURI ;
147     dcat:mediaType "application/zip" ;
148     foaf:page "https://dati.trentino.it/dataset/parcheggio-protetto-per-biciclette-open-data/resource/
149         bb3ad878-505e-4ec6-8c6e-738c3958ee0c" .

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147 <https://www.epos-eu.org/epos-dcat-ap#Location/e33fdc22-3255-4b49-a574-a3ce9810e35b>
148     rdf:type dct:Location ;
149     locn:geometry "POINT(11.128581022728055 46.070092240988942)"^^gsp:wktLiteral .
150
151 <https://www.epos-eu.org/epos-dcat-ap#Organization/028ab36a-6fde-4622-9d18-839d550e0bdb>
152     rdf:type schema:Organization ;
153     schema:address <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/266a2b24-28ef-4bea-8274-4665545f69ed> ;
154     schema:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/7adc3dde-302d-4a86-8356-010ebd36fb0> ,
155         <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/4b11c132-26b0-4c53-b577-eface5f83d75> ;
156     schema:email "protocollo@pec.comune.trento.it" , "comurp@comune.trento.it" ;
157     schema:identifier "https://www.comune.trento.it"^^xsd:anyURI ;
158     schema:legalName "Comune di Trento" ;
159     schema:leiCode "P.IVA 00355870221" ;
160     schema:logo "https://www.comune.trento.it/var/comunetc/storage/images/10010715-1020-ita-IT/Trento-Citta-Sito-ufficiale-del-Comune-di-Trento\_header\_logo.jpg"^^xsd:anyURI ;
161     schema:owns <https://www.epos-eu.org/epos-dcat-ap#Facility/1491832a-32e9-4870-a089-3fd6697d91d3> , <https://www.epos-eu.org/epos-dcat-ap#Facility/b2babd57-0b6d-4dc7-a4e5-f0200bdc84cd> , <https://www.epos-eu.org/epos-dcat-ap#Facility/1489ca6a-332d-4dca-84dc-1b0bbc62b25d> , <https://www.epos-eu.org/epos-dcat-ap#Facility/2e0e4c74-7994-4e0b-8161-bb9d664ff5ee> , <https://www.epos-eu.org/epos-dcat-ap#Facility/fec31560-16ad-4052-bc8e-0d3d6b06c6ff> ;
162     schema:telephone "0461884111" ;
163     schema:url "https://www.comune.trento.it"^^xsd:anyURI .
164
165 <https://www.epos-eu.org/epos-dcat-ap#Concept/78818685-c3d2-4849-8e1e-1b30e6535d35>
166     rdf:type skos:Concept ;
167     skos:definition "A city or town with its own local government, or the local government itself." ;
168     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/4fb52b1f-1f57-4f67-9bcf-597557c4758a> ;
169     skos:prefLabel "Municipality" .
170
171 <https://www.epos-eu.org/epos-dcat-ap#Facility/1489ca6a-332d-4dca-84dc-1b0bbc62b25d>
172     rdf:type epos:Facility ;
173     dct:description "Parcheggio Zuffo" ;
174     dct:identifier "Parcheggio Zuffo" ;
175     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/19e4dee2-26c0-4c67-85dd-cb91b4f3d69e> ;
176     dct:title "Parcheggio Zuffo" ;
177     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/582dd406-b44e-4dab-80fb-d2d86f3ba39b> ;
178     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/5145cf86-c423-4304-ab2d-6c5be6513498> ;
179     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/582dd406-b44e-4dab-80fb-d2d86f3ba39b> ;
180     foaf:page "https://www.comune.trento.it/Aree-tematiche/Cartografia/Download/Parcheggio-protetto-per-biciclette"^^xsd:anyURI .
181
182 <https://www.epos-eu.org/epos-dcat-ap#Facility/fec31560-16ad-4052-bc8e-0d3d6b06c6ff>
183     rdf:type epos:Facility ;
184     dct:description "Parcheggio Stazione Trento" ;
185     dct:identifier "Parcheggio Stazione Trento" ;
186     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/1db8460f-a8ca-4e39-b3a2-b1ec43d1b8d2> ;
187     dct:title "Parcheggio Stazione Trento" ;
188     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/582dd406-b44e-4dab-80fb-d2d86f3ba39b> ;
189     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/5145cf86-c423-4304-ab2d-6c5be6513498> ;
190     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/582dd406-b44e-4dab-80fb-d2d86f3ba39b> ;
191     foaf:page "https://www.comune.trento.it/Aree-tematiche/Cartografia/Download/Parcheggio-protetto-per-biciclette"^^xsd:anyURI .
192
193 <https://www.epos-eu.org/epos-dcat-ap#Distribution/5c446c07-3a1a-464f-ba25-86c1d9f1f9aa>
194     rdf:type dcat:Distribution ;
195     dct:conformsTo "https://developers.google.com/kml" ;
196     dct:description "Protected car parks for long-term parking of bicycles in KML format." ;
197     dct:format "https://developers.google.com/kml"^^xsd:anyURI ;
198     dct:identifier "https://dati.trentino.it/dataset/parcheggio-protetto-per-biciclette-open-data/resource/de34ee61-9cb4-4ab1-83cb-9d54c141c859"^^xsd:anyURI ;
199     dct:issued "2017-11-08T00:00:00Z"^^xsd:date ;
200     dct:language "English" , "Italian" ;

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200     dct:license "https://creativecommons.org/publicdomain/zero/1.0"^^xsd:anyURI ;
201     dct:modified "2021-07-07T00:00:00Z"^^xsd:dateTime ;
202     dct:rights "https://creativecommons.org/publicdomain/zero/1.0" ;
203     dct:title "parcheggio_protetto_bike.zip (KML)" ;
204     dct:type "Collection"^^xsd:anyURI ;
205     SPDX:checksum "md5 23d270721c57d20ebdcc9012985d1218" ;
206     ADMS:status <https://www.epos-eu.org/epos-dcat-ap#Concept/d5422c66-839f-423b-bfe6-22f7c936f57a> ;
207     DCAT:accessURL "https://dati.trentino.it/dataset/parcheggio-protetto-per-biciclette-open-data/resource/
208         de34ee61-9cb4-4ab1-83cb-9d54c141c859"^^xsd:anyURI ;
209     DCAT:byteSize "774.0"^^xsd:double ;
210     DCAT:downloadURL "http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=
211         parcheggio_protetto_bike&fr=kml"^^xsd:anyURI ;
212     DCAT:mediaType "application/zip" ;
213     FOAF:page "https://dati.trentino.it/dataset/parcheggio-protetto-per-biciclette-open-data/resource/
214         de34ee61-9cb4-4ab1-83cb-9d54c141c859" .
215
216 <https://www.epos-eu.org/epos-dcat-ap#Concept/ecea9de3-6096-4fd7-9bc9-0d0443e43df0>
217     rdf:type skos:Concept ;
218     SKOS:definition "A room or part of a building in which people work, especially sitting at tables with
219         computers, phones, etc., usually as a part of a business or other organization." ;
220     SKOS:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/4fb52b1f-1f57-4f67-9bcf-597557c4758a> ;
221     SKOS:prefLabel "Office" .
222
223 <https://www.epos-eu.org/epos-dcat-ap#Dataset/e4ca0d15-6813-438c-a603-30602361a8eb>
224     rdf:type DCAT:Dataset ;
225     DCAT:accessRights "Public" ;
226     DCAT:accrualPeriodicity "Continuously"^^xsd:anyURI ;
227     DCAT:conformsTo "https://wikipedia.org/wiki/Shapefile" , "https://developers.google.com/kml" , "https://
228         wikipedia.org/wiki/AutoCAD_DXF" , "https://www.ogc.org/standards/gml" ;
229     DCAT:created "2017-11-08T00:00:00Z"^^xsd:dateTime ;
230     DCAT:description "Parking Trento Station: The guarded parking lot for bicycles Stazione di Trento is located
231         in via Dogana, 14, in an area that is strategically important for the city because it is a short walk
232         from the railway station. The number of bike stalls are a total of 200, arranged on two-level racks.
233         A video surveillance system consisting of 8 cameras is in operation within the area. There are two
234         validators for access control and management: one at the entrance and one at the exit from the car
235         park." , "The Municipality of Trento has opened three protected car parks to the public for long-term
236         parking of bicycles. To meet the need to park bicycles safely and comfortably and reduce
237         indiscriminate parking in places not used for this function, the Municipality of Trento has opened
238         three protected parking lots to the public for long-term parking of bicycles (in via Dogana, in via
239         della Saluga and at the ex Zuffo area car park) whose management has been entrusted to Trentino
240         Mobilità spa. Access to the car parks takes place through the validation of the Mitt card of the
241         provincial public transport (smart card) and their use is free for subscribers to public, urban and
242         extra-urban transport and to Trenitalia, while it is paid for others." , "Parking Zuffo: The guarded
243         parking lot for bicycles Zuffo is located in via Dos Trento at the southern end of the Ex Zuffo
244         parking lot, in the immediate vicinity of the Trento Centro motorway exit and is connected to the city
245         by bus lines NP and 6 and the cycle pedestrian path on via Drusus. It looks like a fenced,
246         video-monitored and partially covered area for the long-term parking of 228 bicycles (12 stalls for
247         the E - motion bike sharing service for electric bikes and 216 stalls for private bicycles).
248         Externally, near the entrance, there are also 8 stations of the C'entro in ciclo bike sharing service.
249         " , "Parking Former public washhouse at Saluga: The guarded parking lot for bicycles Ex public
250         washhouse alla Saluga is located in via della Saluga, 4, near the interchange point between the urban
251         and extra-urban public transport lines in Piazza Venezia and near the Buonconsiglio Castle. It is a
252         protected and equipped area for the long-term parking of bicycles, located on the ground floor of a
253         small building, a former public wash house owned by the municipality, recently restored. The building
254         is located a few meters from the kiosk-newsstand and in a strategic position, because it is in the
255         city center and close to bus stops in the Port'Aquila area. The parking can accommodate 38 bicycles
256         arranged on two-level racks. Inside there is a video surveillance system and a validator, near the
257         entrance gate, guarantees access control and management." ;
258     DCAT:identifier "c_1378-1128872" ;
259     DCAT:issued "2017-11-08T00:00:00Z"^^xsd:dateTime ;
260     DCAT:language "English" , "Italian" ;
261     DCAT:modified "2021-07-07T00:00:00Z"^^xsd:dateTime ;
262     DCAT:publisher <https://www.epos-eu.org/epos-dcat-ap#Organization/028ab36a-6fde-4622-9d18-839d550e0bdb> ;
263     DCAT:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/702cf24e-b361-4b36-9232-f4a8d29c3831> ;

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232     dct:title "Parcheggio protetto per biciclette" ;
233     dct:type "Collection"^^xsd:anyURI ;
234     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/5145cf86-c423-4304-ab2d-6c5be6513498>
235         ;
236     dcat:distribution <https://www.epos-eu.org/epos-dcat-ap#Distribution/a89e4c66-3cd7-4807-bc00-a2c8c30858e4>
237         , <https://www.epos-eu.org/epos-dcat-ap#Distribution/5c446c07-3a1a-464f-ba25-86c1d9f1f9aa> , <https://www.epos-eu.org/epos-dcat-ap#Distribution/b28a2cf7-3c79-4af0-974b-d529538191ea> , <https://www.epos-eu.org/epos-dcat-ap#Distribution/d8242f76-f8c6-4c66-9ddb-b78a87fb7a3e> ;
238     dcat:keyword "parking" , "bicycle" , "protected" , "safe" , "transports" , "trento" , "ticket" , "trentino"
239         ;
240     dcat:landingPage "https://dati.trentino.it/dataset/parcheggio-protetto-per-biciclette-open-data" , "https://www.comune.trento.it/Aree-tematiche/Cartografia/Download/Parcheggio-protetto-per-biciclette" ;
241     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/582dd406-b44e-4dab-80fb-d2d86f3ba39b> ;
242     foaf:page "https://www.comune.trento.it/Aree-tematiche/Cartografia/Download/
243         Parcheggio-protetto-per-biciclette" , "https://dati.trentino.it/dataset/
244         parcheggio-protetto-per-biciclette-open-data" .
245
246 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/4fb52b1f-1f57-4f67-9bcf-597557c4758a>
247     rdf:type skos:ConceptScheme ;
248     dct:description "A structure with walls and a roof, such as a house or factory." ;
249     dct:title "Building" .
250
251 <https://www.epos-eu.org/epos-dcat-ap#Facility/b2babd57-0b6d-4dc7-a4e5-f0200bdc84cd>
252     rdf:type epos:Facility ;
253     dct:description "Municipality" ;
254     dct:identifier "Municipality" ;
255     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/a4286369-445f-42d3-acfd-697c6030746b> ;
256     dct:title "Municipality" ;
257     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/78818685-c3d2-4849-8e1e-1b30e6535d35> ;
258     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/7adc3dde-302d-4a86-8356-010ebd36fb0>
259         ;
260     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/78818685-c3d2-4849-8e1e-1b30e6535d35> ;
261     foaf:page "https://www.comune.trento.it/Comune/Organizzazione-comunale/Organigramma/Uffici"^^xsd:anyURI .
262
263 <https://www.epos-eu.org/epos-dcat-ap#Location/702cf24e-b361-4b36-9232-f4a8d29c3831>
264     rdf:type dct:Location ;
265     locn:geometry "POINT(11.12108 46.06787)"^^gsp:wktLiteral .
266
267 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/7adc3dde-302d-4a86-8356-010ebd36fb0>
268     rdf:type schema>ContactPoint ;
269     schema:availableLanguage "it-IT" ;
270     schema:contactType "Centralino" ;
271     schema:name "Centralino" ;
272     schema:telephone "0461889444" , "0461884111" .
273
274 <https://www.epos-eu.org/epos-dcat-ap#Facility/2e0e4c74-7994-4e0b-8161-bb9d664ff5ee>
275     rdf:type epos:Facility ;
276     dct:description "Ufficio relazioni con il pubblico" ;
277     dct:identifier "Ufficio relazioni con il pubblico" ;
278     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/c219cb05-d000-4343-88b0-16854d29f2ef> ;
279     dct:title "Ufficio relazioni con il pubblico" ;
280     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/ecea9de3-6096-4fd7-9bc9-0d0443e43df0> ;
281     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/4b11c132-26b0-4c53-b577-eface5f83d75>
282         ;
283     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/ecea9de3-6096-4fd7-9bc9-0d0443e43df0> ;
284     foaf:page "https://www.comune.trento.it/Comunicazione/Dialoga-con-noi/Contattaci/URP"^^xsd:anyURI .
285
286 <https://www.epos-eu.org/epos-dcat-ap#Location/19e4dee2-26c0-4c67-85dd-cb91b4f3d69e>
287     rdf:type dct:Location ;
288     locn:geometry "POINT(11.110395659535598 46.075066830564751)"^^gsp:wktLiteral .
289
290 <https://www.epos-eu.org/epos-dcat-ap#Concept/d5422c66-839f-423b-bfe6-22f7c936f57a>
291     rdf:type skos:Concept ;
292     skos:definition "Containing all the necessary parts, answers, or information." ;

```

---

```

286      skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/df3069df-1446-4737-8c62-dbeebc052872> ;
287      skos:prefLabel "Completed" .

```

---

### 3.3.4.4 Stazioni Bikesharing Trentino

Graph:

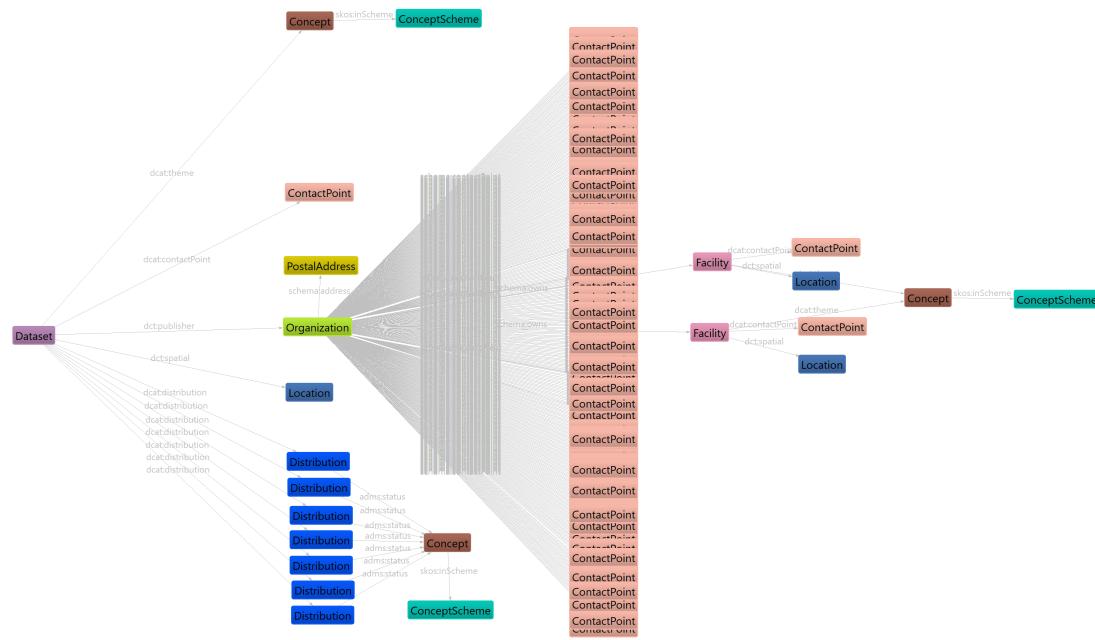


Figure 3.5: *Stazioni Bikesharing Trentino* metadata graph

#### RDF Metadata:

```

1 @prefix : <https://www.epos-eu.org/epos-dcat-ap#> .
2 @prefix schema: <http://schema.org/> .
3 @prefix spdx: <http://spdx.org/rdf/terms#> .
4 @prefix owl: <http://www.w3.org/2002/07/owl#> .
5 @prefix gsp: <http://www.opengis.net/ont/geosparql#> .
6 @prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
7 @prefix skos: <http://www.w3.org/2004/02/skos/core#> .
8 @prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
9 @prefix hydra: <http://www.w3.org/ns/hydra/core#> .
10 @prefix geo: <http://www.w3.org/2003/01/geo/wgs84\_pos#> .
11 @prefix oa: <http://www.w3.org/ns/oa#> .
12 @prefix dct: <http://purl.org/dc/terms/> .
13 @prefix sh: <http://www.w3.org/ns/shacl#> .
14 @prefix dcat: <http://www.w3.org/ns/dcat#> .
15 @prefix locn: <http://www.w3.org/ns/locn#> .
16 @prefix foaf: <http://xmlns.com/foaf/0.1/> .
17 @prefix epos: <https://www.epos-eu.org/epos-dcat-ap#> .
18 @prefix adms: <http://www.w3.org/ns/adms#> .
19 @prefix org: <http://www.w3.org/ns/org#> .
20 @prefix cnt: <http://www.w3.org/2011/content#> .
21 @prefix vcard: <http://www.w3.org/2006/vcard/ns#> .

```

```

22 @prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
23 @prefix http: <http://www.w3.org/2006/http#> .
24 @prefix dash: <http://datashapes.org/dash#> .
25 @prefix dc: <http://purl.org/dc/elements/1.1/> .

26
27 <https://www.epos-eu.org/epos-dcat-ap#Location/abf210db-7ae1-4bd3-ab88-38294b394335>
28     rdf:type dct:Location ;
29     locn:geometry "POINT(11.119378 46.070912)"^^gsp:wktLiteral .

30
31 <https://www.epos-eu.org/epos-dcat-ap#Distribution/594015ef-6259-4e94-9c83-168eb9d7bcc8>
32     rdf:type dcat:Distribution ;
33     dct:conformsTo "https://www.json.org" ;
34     dct:description "Real-time data, from the e-Motion project, relating to the availability of bicycles at
35         bikesharing stations in the municipality of San Michele All'Adige." ;
36     dct:format "https://www.json.org"^^xsd:anyURI ;
37     dct:identifier "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino/resource/3
38         ba183a3-592f-4ab0-a734-7874776abd68"^^xsd:anyURI ;
39     dct:issued "2014-11-18T00:00:00Z"^^xsd:dateTime ;
40     dct:language "English" , "Italian" ;
41     dct:license "https://creativecommons.org/licenses/by/4.0"^^xsd:anyURI ;
42     dct:modified "2017-07-03T00:00:00Z"^^xsd:dateTime ;
43     dct:rights "https://creativecommons.org/licenses/by/4.0" ;
44     dct:title "Bikesharing San Michele All'Adige" ;
45     dct:type "Collection"^^xsd:anyURI ;
46     spdx:checksum "md5 ca2947356c3271a6a1a3857dedf448e6" ;
47     adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/304ed5b5-65f0-4d5b-b690-ddbc6f8416d3> ;
48     dcat:accessURL "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino/resource/3
49         ba183a3-592f-4ab0-a734-7874776abd68"^^xsd:anyURI ;
50     dcat:byteSize "368.0"^^xsd:double ;
51     dcat:downloadURL "https://os.smartcommunitylab.it/core.mobility/bikesharing/sanmichelealladige"^^xsd:anyURI
52     ;
53     dcat:mediaType "application/json" ;
54     foaf:page "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino/resource/3
55         ba183a3-592f-4ab0-a734-7874776abd68" .
```

56 <<https://www.epos-eu.org/epos-dcat-ap#Distribution/44874295-a996-4fdd-9130-b30e425b580b>>

57 rdf:type dcat:Distribution ;
58 dct:conformsTo "https://www.json.org" ;
59 dct:description "Real-time data, from the e-Motion project, relating to the availability of bicycles at
60 bikesharing stations in the municipality of Mezzolombardo." ;
61 dct:format "https://www.json.org"^^xsd:anyURI ;
62 dct:identifier "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino/resource/891719
63 e8-3ecd-4169-b150-819dfc933f0f"^^xsd:anyURI ;
64 dct:issued "2014-11-18T00:00:00Z"^^xsd:dateTime ;
65 dct:language "Italian" , "English" ;
66 dct:license "https://creativecommons.org/licenses/by/4.0"^^xsd:anyURI ;
67 dct:modified "2017-07-03T00:00:00Z"^^xsd:dateTime ;
68 dct:rights "https://creativecommons.org/licenses/by/4.0" ;
69 dct:title "Bikesharing Mezzolombardo" ;
70 dct:type "Collection"^^xsd:anyURI ;
71 spdx:checksum "md5 4a9cc08351f5aeb01b8124d5b22abab1" ;
72 adms:status <<https://www.epos-eu.org/epos-dcat-ap#Concept/304ed5b5-65f0-4d5b-b690-ddbc6f8416d3>> ;
73 dcat:accessURL "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino/resource/891719
74 e8-3ecd-4169-b150-819dfc933f0f"^^xsd:anyURI ;
75 dcat:byteSize "545.0"^^xsd:double ;
76 dcat:downloadURL "https://os.smartcommunitylab.it/core.mobility/bikesharing/mezzolombardo"^^xsd:anyURI ;
 dcat:mediaType "application/json" ;
 foaf:page "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino/resource/891719
 e8-3ecd-4169-b150-819dfc933f0f" .

77 <<https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/6765af7a-30f3-4a2c-bcef-c53e8c69754a>>

78 rdf:type skos:ConceptScheme ;
79 dct:description "To divide food, money, goods, etc. and give part of it to someone else." ;
80 dct:title "Sharing" .

```

77
78 <https://www.epos-eu.org/epos-dcat-ap#Concept/cccf9c98-7a3e-41cd-bca9-a7c6b5e00c89>
79   rdf:type skos:Concept ;
80   skos:definition "A room or part of a building in which people work, especially sitting at tables with
81     computers, phones, etc., usually as a part of a business or other organization." ;
82   skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/a0753e02-ebe7-4d80-8dbf-0d94ccb9bb43> ;
83   skos:prefLabel "Office" .
84
85 <https://www.epos-eu.org/epos-dcat-ap#Distribution/0bf9acd9-a91d-408a-a2c9-4f658061bd15>
86   rdf:type dcat:Distribution ;
87   dct:conformsTo "https://www.json.org" ;
88   dct:description "Real-time data, from the e-Motion project, relating to the availability of bicycles at
89     bikesharing stations in the municipality of Pergine Valsugana." ;
90   dct:format "https://www.json.org"^^xsd:anyURI ;
91   dct:identifier "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino/resource/ffaa1b8e-4074-4523-8aa6-d0a7977fc08d"^^xsd:anyURI ;
92   dct:issued "2014-11-18T00:00:00Z"^^xsd:dateTime ;
93   dct:language "Italian" , "English" ;
94   dct:license "https://creativecommons.org/licenses/by/4.0"^^xsd:anyURI ;
95   dct:modified "2017-07-03T00:00:00Z"^^xsd:dateTime ;
96   dct:rights "https://creativecommons.org/licenses/by/4.0" ;
97   dct:title "Bikesharing Pergine Valsugana" ;
98   dct:type "Collection"^^xsd:anyURI ;
99   spdx:checksum "md5 d751713988987e9331980363e24189ce" ;
100  adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/304ed5b5-65f0-4d5b-b690-ddbc6f8416d3> ;
101  dcat:accessURL "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino/resource/ffa1b8e-4074-4523-8aa6-d0a7977fc08d"^^xsd:anyURI ;
102  dcat:byteSize "2.0"^^xsd:double ;
103  dcat:downloadURL "https://os.smartcommunitylab.it/core.mobility/bikesharing/pergine\_valsugana"^^xsd:anyURI
104
105 <https://www.epos-eu.org/epos-dcat-ap#Facility/0119a8f7-9527-4961-807e-ef21cc3d340a>
106   rdf:type epos:Facility ;
107   dct:description "Palazzo della Provincia Autonoma di Trento" ;
108   dct:identifier "Palazzo della Provincia Autonoma di Trento" ;
109   dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/9088ff3a-db08-4baa-a067-8a1401f17658> ;
110   dct:title "Palazzo della Provincia Autonoma di Trento" ;
111   dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/cccf9c98-7a3e-41cd-bca9-a7c6b5e00c89> ;
112   dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/a09d4df2-1fa3-4e00-8934-e4d61335bb44>
113   ;
114   dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/cccf9c98-7a3e-41cd-bca9-a7c6b5e00c89> ;
115   foaf:page "https://www.provincia.tn.it"^^xsd:anyURI .
116
117 <https://www.epos-eu.org/epos-dcat-ap#Dataset/12c0668b-3752-487d-b894-59ad11ad23f0>
118   rdf:type dcat:Dataset ;
119   dct:accessRights "Public" ;
120   dct:accrualPeriodicity "Continuously"^^xsd:anyURI ;
121   dct:conformsTo "https://developers.google.com/kml" , "https://wikipedia.org/wiki/Shapefile" , "https://wikipedia.org/wiki/AutoCAD\_DXF" , "https://www.ogc.org/standards/gml" ;
122   dct:created "2014-11-18T00:00:00Z"^^xsd:dateTime ;
123   dct:description "Real-time data, from the e-Motion project, relating to the availability of bicycles at
124     bikesharing stations in the municipalities of Lavis, Mezzolombardo, Mezzocorona, Pergine Valsugana,
125     Rovereto, San Michele all'Adige and Trento. The data are georeferenced and constantly updated thanks to
126     the use of sensors." ;
127   dct:identifier "9b9c14d6-ee20-4802-a274-4c17ac96cdd5"^^xsd:anyURI ;
128   dct:issued "2014-11-18T00:00:00Z"^^xsd:dateTime ;
129   dct:language "English" , "Italian" ;
130   dct:modified "2017-07-03T00:00:00Z"^^xsd:dateTime ;
131   dct:publisher <https://www.epos-eu.org/epos-dcat-ap#Organization/258fe2f7-91c0-4fc4-a84e-eb9b018fec41> ;
132   dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/a9158c72-2769-4cd0-be41-943e00f7d9a6> ;
133   dct:title "Stazioni Bikesharing Trentino" ;

```

```

130     dct:type "Collection"^^xsd:anyURI ;
131     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/64aa77a7-6829-4b24-af81-94249c875208>
132     ;
132     dcat:distribution <https://www.epos-eu.org/epos-dcat-ap#Distribution/e09210f0-8ac8-4388-a1f8-c271680df880>
132     , <https://www.epos-eu.org/epos-dcat-ap#Distribution/77a675a0-bea1-462b-8000-a9b9b6f7c3f9> , <https://www.epos-eu.org/epos-dcat-ap#Distribution/0bf9acd9-a91d-408a-a2c9-4f658061bd15> , <https://www.epos-eu.org/epos-dcat-ap#Distribution/44874295-a996-4fdd-9130-b30e425b580b> , <https://www.epos-eu.org/epos-dcat-ap#Distribution/594015ef-6259-4e94-9c83-168eb9d7bcc8> , <https://www.epos-eu.org/epos-dcat-ap#Distribution/90ff3e0c-4439-41d4-988c-33dbf4875e12> , <https://www.epos-eu.org/epos-dcat-ap#Distribution/566b7c9e-adcd-4f36-8b64-582e296acad4> ;
133     dcat:keyword "trento" , "rovereto" , "bicycle" , "transports" , "mezzolombardo" , "sensors" , "
133     georeferenced" , "pergine" , "real time" , "san michele all'adige" , "trentino" , "mezzocorona" , "
133     sharing" , "parking" , "lavis" ;
134     dcat:landingPage "https://www.provincia.tn.it/Servizi/Accesso-al-servizio-di-Bikesharing" , "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino" ;
135     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/062845df-9905-42d2-9251-7ca64e28d2c8> ;
136     foaf:page "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino" , "https://www.provincia.tn.it/Servizi/Accesso-al-servizio-di-Bikesharing" .
137
138 <https://www.epos-eu.org/epos-dcat-ap#Distribution/566b7c9e-adcd-4f36-8b64-582e296acad4>
139     rdf:type dcat:Distribution ;
140     dct:conformsTo "https://www.json.org" ;
141     dct:description "Real-time data, from the e-Motion project, relating to the availability of bicycles at
141     bikesharing stations in the municipality of Mezzocorona." ;
142     dct:format "https://www.json.org"^^xsd:anyURI ;
143     dct:identifier "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino/resource/9e8c38c7-b996-4ccc-9bad-fe63682fbc4d"^^xsd:anyURI ;
144     dct:issued "2014-11-18T00:00:00Z"^^xsd:dateTime ;
145     dct:language "English" , "Italian" ;
146     dct:license "https://creativecommons.org/licenses/by/4.0"^^xsd:anyURI ;
147     dct:modified "2017-07-03T00:00:00Z"^^xsd:dateTime ;
148     dct:rights "https://creativecommons.org/licenses/by/4.0" ;
149     dct:title "Bikesharing Mezzocorona" ;
150     dct:type "Collection"^^xsd:anyURI ;
151     spdx:checksum "md5 fdb621d387810084569cdbdf0fbbfb78" ;
152     adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/304ed5b5-65f0-4d5b-b690-ddbc6f8416d3> ;
153     dcat:accessURL "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino/resource/9e8c38c7-b996-4ccc-9bad-fe63682fbc4d"^^xsd:anyURI ;
154     dcat:byteSize "562.0"^^xsd:double ;
155     dcat:downloadURL "https://os.smartcommunitylab.it/core.mobility/bikesharing/mezzocorona"^^xsd:anyURI ;
156     dcat:mediaType "application/json" ;
157     foaf:page "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino/resource/9e8c38c7-b996-4ccc-9bad-fe63682fbc4d" .
158
159 <https://www.epos-eu.org/epos-dcat-ap#Distribution/77a675a0-bea1-462b-8000-a9b9b6f7c3f9>
160     rdf:type dcat:Distribution ;
161     dct:conformsTo "https://www.json.org" ;
162     dct:description "Real-time data, from the e-Motion project, relating to the availability of bicycles at
162     bikesharing stations in the municipality of Trento." ;
163     dct:format "https://www.json.org"^^xsd:anyURI ;
164     dct:identifier "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino/resource/b5242797-fe4e-4687-a471-2662d2cb8f8d"^^xsd:anyURI ;
165     dct:issued "2014-11-18T00:00:00Z"^^xsd:dateTime ;
166     dct:language "Italian" , "English" ;
167     dct:license "https://creativecommons.org/licenses/by/4.0"^^xsd:anyURI ;
168     dct:modified "2017-07-03T00:00:00Z"^^xsd:dateTime ;
169     dct:rights "https://creativecommons.org/licenses/by/4.0" ;
170     dct:title "Bikesharing Trento" ;
171     dct:type "Collection"^^xsd:anyURI ;
172     spdx:checksum "md5 d6d905b25efd63ad0ac810f4cebf8864" ;
173     adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/304ed5b5-65f0-4d5b-b690-ddbc6f8416d3> ;
174     dcat:accessURL "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino/resource/b5242797-fe4e-4687-a471-2662d2cb8f8d"^^xsd:anyURI ;
175     dcat:byteSize "16763.0"^^xsd:double ;

```

```

176 dcat:downloadURL "https://os.smartcommunitylab.it/core.mobility/bikesharing/trento"^^xsd:anyURI ;
177 dcat:mediaType "application/json" ;
178 foaf:page "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino/resource/
179 b5242797-fe4e-4687-a471-2662d2cb8f8d" .
180 <https://www.epos-eu.org/epos-dcat-ap#Distribution/e09210f0-8ac8-4388-a1f8-c271680df880>
181 rdf:type dcat:Distribution ;
182 dct:conformsTo "https://www.json.org" ;
183 dct:description "Real-time data, from the e-Motion project, relating to the availability of bicycles at
184 bikesharing stations in the municipality of Rovereto." ;
185 dct:format "https://www.json.org"^^xsd:anyURI ;
186 dct:identifier "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino/resource/0755
187 cb74-4d97-470b-96ef-d4f5ccb34c8e"^^xsd:anyURI ;
188 dct:issued "2014-11-18T00:00:00Z"^^xsd:dateTime ;
189 dct:language "English" , "Italian" ;
190 dct:license "https://creativecommons.org/licenses/by/4.0"^^xsd:anyURI ;
191 dct:modified "2017-07-03T00:00:00Z"^^xsd:dateTime ;
192 dct:rights "https://creativecommons.org/licenses/by/4.0" ;
193 dct:title "Bikesharing Rovereto" ;
194 dct:type "Collection"^^xsd:anyURI ;
195 spdx:checksum "md5 d67734da2d41c2011f3be2be76042d68" ;
adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/304ed5b5-65f0-4d5b-b690-ddbc6f8416d3> ;
dcat:accessURL "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino/resource/0755
196 cb74-4d97-470b-96ef-d4f5ccb34c8e"^^xsd:anyURI ;
197 dcat:byteSize "3233.0"^^xsd:double ;
198 dcat:downloadURL "https://os.smartcommunitylab.it/core.mobility/bikesharing/rovereto"^^xsd:anyURI ;
199 dcat:mediaType "application/json" ;
200 foaf:page "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino/resource/0755
201 cb74-4d97-470b-96ef-d4f5ccb34c8e" .

202 <https://www.epos-eu.org/epos-dcat-ap#Distribution/90ff3e0c-4439-41d4-988c-33dbf4875e12>
203 rdf:type dcat:Distribution ;
204 dct:conformsTo "https://www.json.org" ;
205 dct:description "Real-time data, from the e-Motion project, relating to the availability of bicycles at
206 bikesharing stations in the municipality of Lavis." ;
207 dct:format "https://www.json.org"^^xsd:anyURI ;
208 dct:identifier "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino/resource/
209 e642bac9-06db-43a8-80df-684d031db2ec"^^xsd:anyURI ;
210 dct:issued "2014-11-18T00:00:00Z"^^xsd:dateTime ;
211 dct:language "Italian" , "English" ;
212 dct:license "https://creativecommons.org/licenses/by/4.0"^^xsd:anyURI ;
213 dct:modified "2017-07-03T00:00:00Z"^^xsd:dateTime ;
214 dct:rights "https://creativecommons.org/licenses/by/4.0" ;
215 dct:title "Bikesharing Lavis" ;
216 dct:type "Collection"^^xsd:anyURI ;
217 spdx:checksum "md5 0c4d8a4287cf5efc8080d4a14a523130" ;
218 adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/304ed5b5-65f0-4d5b-b690-ddbc6f8416d3> ;
219 dcat:accessURL "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino/resource/
220 e642bac9-06db-43a8-80df-684d031db2ec"^^xsd:anyURI ;
221 dcat:byteSize "510.0"^^xsd:double ;
222 dcat:downloadURL "https://os.smartcommunitylab.it/core.mobility/bikesharing/lavis"^^xsd:anyURI ;
223 dcat:mediaType "application/json" ;
224 foaf:page "https://dati.trentino.it/dataset/stazioni-bike-sharing-emotion-trentino/resource/
225 e642bac9-06db-43a8-80df-684d031db2ec" .

226 <https://www.epos-eu.org/epos-dcat-ap#Concept/304ed5b5-65f0-4d5b-b690-ddbc6f8416d3>
227 rdf:type skos:Concept ;
228 skos:definition "Containing all the necessary parts, answers, or information." ;
229 skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/82b8e0b4-8587-4750-86d4-929a29732118> ;
230 skos:prefLabel "Completed" .

231 <https://www.epos-eu.org/epos-dcat-ap#Location/a9158c72-2769-4cd0-be41-943e00f7d9a6>
232 rdf:type dct:Location ;
233 locn:geometry "POINT(11.116667 46.066666)"^^gsp:wktLiteral .

```

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```

231
232 <https://www.epos-eu.org/epos-dcat-ap#Organization/258fe2f7-91c0-4fc4-a84e-eb9b018fec41>
233   rdf:type schema:Organization ;
234   schema:address <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/24cc731f-b1ff-446e-b4cf-42f46e9051df> ;
235   schema:contactPoint
236     <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/3e96bfb6-022b-4d0c-bd47-08307e515d8f> ,
237     # Omitted #
238     <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/c7ac88ac-ed2f-4a66-aaed-233b0160bdea> ;
239   schema:identifier "https://www.provincia.tn.it"^^xsd:anyURI ;
240   schema:legalName "Provincia autonoma di Trento" ;
241   schema:leiCode "P.IVA 00337460224" ;
242   schema:logo "https://www.provincia.tn.it/var/opencitypat/storage/images/1284-242-ita-IT/
243     Homepage_header_logo.png"^^xsd:anyURI ;
244   schema:owns <https://www.epos-eu.org/epos-dcat-ap#Facility/0119a8f7-9527-4961-807e-ef21cc3d340a> , <https://www.epos-eu.org/epos-dcat-ap#Facility/0940c634-9980-4179-9728-a34a179f0c36> ;
245   schema:telephone "0461495111" , "800903606" ;
246   schema:url "https://www.provincia.tn.it"^^xsd:anyURI .

247 <https://www.epos-eu.org/epos-dcat-ap#Concept/062845df-9905-42d2-9251-7ca64e28d2c8>
248   rdf:type skos:Concept ;
249   skos:definition "Bike share can be broadly defined as any setting where bicycles are pooled for multiple
250     users. Models include Public Bike Share (PBS) self-service on-street docked or dockless stations
251     workplace pool bikes, railway station hubs, loans, lockers and peer to peer sharing." ;
252   skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/6765af7a-30f3-4a2c-bcef-c53e8c69754a> ;
253   skos:prefLabel "Bike Sharing" .

254 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/43140374-9ffb-4a70-9dc5-68cba1e30276>
255   rdf:type schema:ContactPoint ;
256   schema:availableLanguage "it-IT" ;
257   schema:contactType "Ufficio contratti" ;
258   schema:email "uff.contratti@provincia.tn.it" , "uff.contratti@pec.provincia.tn.it" ;
259   schema:name "Ufficio contratti" ;
260   schema:telephone "0461493460" .

261 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/2f90e6cd-b811-4ded-af58-3013d56f0468>
262   rdf:type schema:ContactPoint ;
263   schema:availableLanguage "it-IT" ;
264   schema:contactType "Ufficio pianificazione supporto tecnico e demanio idrico" ;
265   schema:email "bacinimontani.upstdi@provincia.tn.it" ;
266   schema:name "Ufficio pianificazione supporto tecnico e demanio idrico" ;
267   schema:telephone "0461495562" .

268 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/19413251-7478-45e1-891e-0101c43341fb>
269   rdf:type schema:ContactPoint ;
270   schema:availableLanguage "it-IT" ;
271   schema:contactType "Unita' organizzativa laboratorio aria suolo rifiuti radioattività" ;
272   schema:email "sl.appa@provincia.tn.it" , "sl.appa@pec.provincia.tn.it" ;
273   schema:name "Unita' organizzativa laboratorio aria suolo rifiuti radioattività" ;
274   schema:telephone "0461493001" .

275 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/04a77140-13f0-46aa-97fd-29afe2d4e006>
276   rdf:type schema:ContactPoint ;
277   schema:availableLanguage "it-IT" ;
278   schema:contactType "Servizio minoranze linguistiche locali e audit europeo" ;
279   schema:email "serv.minoranzeauditeuropeo@provincia.tn.it" , "serv.minoranzeauditeuropeo@pec.provincia.tn.it
280     " ;
281   schema:name "Servizio minoranze linguistiche locali e audit europeo" ;
282   schema:telephone "0461491417" .

283 # Omitted #
284

```

---

### 3.3.4.5 C'entro in bici

Graph:



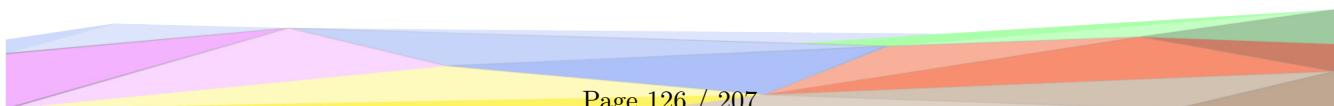
Figure 3.6: *C'entro in bici* metadata graph

#### RDF Metadata:

```

1 @prefix : <https://www.epos-eu.org/epos-dcat-ap#> .
2 @prefix schema: <http://schema.org/> .
3 @prefix spdx: <http://spdx.org/rdf/terms#> .
4 @prefix owl: <http://www.w3.org/2002/07/owl#> .
5 @prefix gsp: <http://www.opengis.net/ont/geosparql#> .
6 @prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
7 @prefix skos: <http://www.w3.org/2004/02/skos/core#> .
8 @prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
9 @prefix hydra: <http://www.w3.org/ns/hydra/core#> .
10 @prefix geo: <http://www.w3.org/2003/01/geo/wgs84_pos#> .
11 @prefix oa: <http://www.w3.org/ns/oa#> .
12 @prefix dct: <http://purl.org/dc/terms/> .
13 @prefix sh: <http://www.w3.org/ns/shacl#> .
14 @prefix dcat: <http://www.w3.org/ns/dcat#> .
15 @prefix locn: <http://www.w3.org/ns/locn#> .
16 @prefix foaf: <http://xmlns.com/foaf/0.1/> .
17 @prefix epos: <https://www.epos-eu.org/epos-dcat-ap#> .
18 @prefix adms: <http://www.w3.org/ns/adms#> .
19 @prefix org: <http://www.w3.org/ns/org#> .
20 @prefix cnt: <http://www.w3.org/2011/content#> .
21 @prefix vcard: <http://www.w3.org/2006/vcard/ns#> .
22 @prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
23 @prefix http: <http://www.w3.org/2006/http#> .
24 @prefix dash: <http://datashapes.org/dash#> .
25 @prefix dc: <http://purl.org/dc/elements/1.1/> .
26
27 <https://www.epos-eu.org/epos-dcat-ap#Location/c219cb05-d000-4343-88b0-16854d29f2ef>
28     rdf:type dct:Location ;

```



```

29     locn:geometry "POINT(11.1210985 46.0694727)"^^gsp:wktLiteral .
30
31 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/5d4c8a86-2f98-453a-9314-228b9f1cbcd3>
32     rdf:type skos:ConceptScheme ;
33     dct:description "The position or rank of someone or something when compared to others in a society, organization, group, etc." ;
34     dct:title "Status" .
35
36 <https://www.epos-eu.org/epos-dcat-ap#Location/a4286369-445f-42d3-acfd-697c6030746b>
37     rdf:type dct:Location ;
38     locn:geometry "POINT(11.1207054 46.0690622)"^^gsp:wktLiteral .
39
40 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/4b11c132-26b0-4c53-b577-eface5f83d75>
41     rdf:type schema>ContactPoint ;
42     schema:availableLanguage "it-IT" ;
43     schema:contactType "Ufficio relazioni con il pubblico" ;
44     schema:email "comurp@comune.trento.it" ;
45     schema:name "Ufficio relazioni con il pubblico" ;
46     schema:telephone "800017615" , "0461884005" , "0461884453" .
47
48 <https://www.epos-eu.org/epos-dcat-ap#Concept/155680df-c330-4c53-9fec-ca690516d6ce>
49     rdf:type skos:Concept ;
50     skos:definition "Bike share can be broadly defined as any setting where bicycles are pooled for multiple users. Models include Public Bike Share (PBS) self-service on-street docked or dockless stations workplace pool bikes, railway station hubs, loans, lockers and peer to peer sharing." ;
51     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/0398ad3c-a4ed-477a-a65d-bce371a7e3c4> ;
52     skos:prefLabel "Bike Sharing" .
53
54 <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/266a2b24-28ef-4bea-8274-4665545f69ed>
55     rdf:type schema:PostalAddress ;
56     schema:addressCountry "IT" ;
57     schema:addressLocality "Trento" ;
58     schema:postalCode "38122" ;
59     schema:streetAddress "Via Belenzani 19" .
60
61 <https://www.epos-eu.org/epos-dcat-ap#Organization/028ab36a-6fde-4622-9d18-839d550e0bdb>
62     rdf:type schema:Organization ;
63     schema:address <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/266a2b24-28ef-4bea-8274-4665545f69ed> ;
64     schema:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/7adc3dde-302d-4a86-8356-010ebd36fb0> ,
65     <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/4b11c132-26b0-4c53-b577-eface5f83d75> ;
66     schema:email "protocollo@pec.comune.trento.it" , "comurp@comune.trento.it" ;
67     schema:identifier "https://www.comune.trento.it"^^xsd:anyURI ;
68     schema:legalName "Comune di Trento" ;
69     schema:leiCode "P.IVA 00355870221" ;
70     schema:logo "https://www.comune.trento.it/var/comunetc/storage/images/10010715-1020-ita-IT/Trento-Citta-Sito-ufficiale-del-Comune-di-Trento\_header\_logo.jpg"^^xsd:anyURI ;
71     schema:owns <https://www.epos-eu.org/epos-dcat-ap#Facility/b2babd57-0b6d-4dc7-a4e5-f0200bdc84cd> , <https://www.epos-eu.org/epos-dcat-ap#Facility/2e0e4c74-7994-4e0b-8161-bb9d664ff5ee> ;
72     schema:telephone "0461884111" ;
73     schema:url "https://www.comune.trento.it"^^xsd:anyURI .
74
75 <https://www.epos-eu.org/epos-dcat-ap#Concept/78818685-c3d2-4849-8e1e-1b30e6535d35>
76     rdf:type skos:Concept ;
77     skos:definition "A city or town with its own local government, or the local government itself." ;
78     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/4fb52b1f-1f57-4f67-9bcf-597557c4758a> ;
79     skos:prefLabel "Municipality" .
80
81 <https://www.epos-eu.org/epos-dcat-ap#Distribution/c502fec8-315b-447e-bfdc-dcdd0a433998>
82     rdf:type dcat:Distribution ;
83     dct:conformsTo "https://wikipedia.org/wiki/Shapefile" ;
84     dct:description "Bike sharing in SHP format." ;
85     dct:format "https://wikipedia.org/wiki/Shapefile"^^xsd:anyURI ;
     dct:identifier "https://dati.trentino.it/dataset/c-entro-in-bici-open-data/resource/8a75d8ec-c7b2-45c8-bd53-c7b5a2ace36b"^^xsd:anyURI ;

```

```

86     dct:issued "2017-11-08T00:00:00Z"^^xsd:dateTime ;
87     dct:language "English" , "Italian" ;
88     dct:license "https://creativecommons.org/publicdomain/zero/1.0"^^xsd:anyURI ;
89     dct:modified "2021-07-07T00:00:00Z"^^xsd:dateTime ;
90     dct:rights "https://creativecommons.org/publicdomain/zero/1.0" ;
91     dct:title "centro_in_bici.zip (SHP)" ;
92     dct:type "Collection"^^xsd:anyURI ;
93     SPDX:checksum "md5 d01b9f18629fd41dde3fa29dc2acd2c5" ;
94     ADMS:status <https://www.epos-eu.org/epos-dcat-ap#Concept/a003f6ce-fe57-4ad8-983d-20c718935f9f> ;
95     DCAT:accessURL "https://dati.trentino.it/dataset/c-entro-in-bici-open-data/resource/8
96         a75d8ec-c7b2-45c8-bd53-c7b5a2ace36b"^^xsd:anyURI ;
97     DCAT:byteSize "1575.0"^^xsd:double ;
98     DCAT:downloadURL "http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=
99         centro_in_bici&fr=shp"^^xsd:anyURI ;
100    DCAT:mediaType "application/zip" ;
101    FOAF:page "https://dati.trentino.it/dataset/c-entro-in-bici-open-data/resource/8
102        a75d8ec-c7b2-45c8-bd53-c7b5a2ace36b" .
103
104 <https://www.epos-eu.org/epos-dcat-ap#Location/74862c5c-00cf-4578-a6d8-958d4a9dac7d>
105    RDF:type DCAT:Location ;
106    LOCN:geometry "POINT(11.116667 46.066666)"^^GSP:WKTLiteral .
107
108 <https://www.epos-eu.org/epos-dcat-ap#Distribution/a51bd148-c9bf-462a-bb1b-823b2c17f0bf>
109    RDF:type DCAT:Distribution ;
110    DCT:conformsTo "https://developers.google.com/kml" ;
111    DCT:description "Bike sharing in KML format." ;
112    DCT:format "https://developers.google.com/kml"^^xsd:anyURI ;
113    DCT:identifier "https://dati.trentino.it/dataset/c-entro-in-bici-open-data/resource/7
114        b21d527-a2ee-4590-8bae-6e0e3d8c2ce6"^^xsd:anyURI ;
115    DCT:issued "2017-11-08T00:00:00Z"^^xsd:dateTime ;
116    DCT:language "Italian" , "English" ;
117    DCT:license "https://creativecommons.org/publicdomain/zero/1.0"^^xsd:anyURI ;
118    DCT:modified "2021-07-07T00:00:00Z"^^xsd:dateTime ;
119    DCT:rights "https://creativecommons.org/publicdomain/zero/1.0" ;
120    DCT:title "centro_in_bici.zip (KML)" ;
121    DCT:type "Collection"^^xsd:anyURI ;
122    SPDX:checksum "md5 ebc657547dccfa75c216eecc6632fc5" ;
123    ADMS:status <https://www.epos-eu.org/epos-dcat-ap#Concept/a003f6ce-fe57-4ad8-983d-20c718935f9f> ;
124    DCAT:accessURL "https://dati.trentino.it/dataset/c-entro-in-bici-open-data/resource/7
125        b21d527-a2ee-4590-8bae-6e0e3d8c2ce6"^^xsd:anyURI ;
126    DCAT:byteSize "1095.0"^^xsd:double ;
127    DCAT:downloadURL "http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=
128        centro_in_bici&fr=kml"^^xsd:anyURI ;
129    DCAT:mediaType "application/zip" ;
130    FOAF:page "https://dati.trentino.it/dataset/c-entro-in-bici-open-data/resource/7
131        b21d527-a2ee-4590-8bae-6e0e3d8c2ce6" .
132
133 <https://www.epos-eu.org/epos-dcat-ap#Concept/ecea9de3-6096-4fd7-9bc9-0d0443e43df0>
134    RDF:type SKOS:Concept ;
135    SKOS:definition "A room or part of a building in which people work, especially sitting at tables with
136        computers, phones, etc., usually as a part of a business or other organization." ;
137    SKOS:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/4fb52b1f-1f57-4f67-9bcf-597557c4758a> ;
138    SKOS:prefLabel "Office" .
139
140 <https://www.epos-eu.org/epos-dcat-ap#Distribution/d4226954-643a-460d-91aa-aac0995f8dc9>
141    RDF:type DCAT:Distribution ;
142    DCT:conformsTo "https://wikipedia.org/wiki/AutoCAD_DXF" ;
143    DCT:description "Bike sharing in DXF format." ;
144    DCT:format "https://wikipedia.org/wiki/AutoCAD_DXF"^^xsd:anyURI ;
145    DCT:identifier "https://dati.trentino.it/dataset/c-entro-in-bici-open-data/resource/
146        a25a8795-33c9-4761-8b01-7d0c186bc16c"^^xsd:anyURI ;
147    DCT:issued "2017-11-08T00:00:00Z"^^xsd:dateTime ;
148    DCT:language "Italian" , "English" ;
149    DCT:license "https://creativecommons.org/publicdomain/zero/1.0"^^xsd:anyURI ;

```

```

141     dct:modified "2021-07-07T00:00:00Z"^^xsd:dateTime ;
142     dct:rights "https://creativecommons.org/publicdomain/zero/1.0" ;
143     dct:title "centro_in_bici.zip (DXF)" ;
144     dct:type "Collection"^^xsd:anyURI ;
145     SPDX:checksum "md5 a1984c7f79bd4bbb6f39ddbc4e55919b" ;
146     ADMS:status <https://www.epos-eu.org/epos-dcat-ap#Concept/a003f6ce-fe57-4ad8-983d-20c718935f9f> ;
147     DCAT:accessURL "https://dati.trentino.it/dataset/c-entro-in-bici-open-data/resource/
148         a25a8795-33c9-4761-8b01-7d0c186bc16c"^^xsd:anyURI ;
149     DCAT:byteSize "4017.0"^^xsd:double ;
150     DCAT:downloadURL "http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=
151         centro_in_bici&fr=gml"^^xsd:anyURI ;
152     DCAT:mediaType "application/zip" ;
153     FOAF:page "https://dati.trentino.it/dataset/c-entro-in-bici-open-data/resource/
154         a25a8795-33c9-4761-8b01-7d0c186bc16c" .
155
156 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/4fb52b1f-1f57-4f67-9bcf-597557c4758a>
157     RDF:type SKOS:ConceptScheme ;
158     DCT:description "A structure with walls and a roof, such as a house or factory." ;
159     DCT:title "Building" .
160
161 <https://www.epos-eu.org/epos-dcat-ap#Concept/a003f6ce-fe57-4ad8-983d-20c718935f9f>
162     RDF:type SKOS:Concept ;
163     SKOS:definition "Containing all the necessary parts, answers, or information." ;
164     SKOS:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/5d4c8a86-2f98-453a-9314-228b9f1cbcd3> ;
165     SKOS:prefLabel "Completed" .
166
167 <https://www.epos-eu.org/epos-dcat-ap#Distribution/a1a1f69b-0f5c-4316-a1b4-7146553807c4>
168     RDF:type DCAT:Distribution ;
169     DCT:conformsTo "https://www.ogc.org/standards/gml" ;
170     DCT:description "Bike sharing in GML format." ;
171     DCT:format "https://www.ogc.org/standards/gml"^^xsd:anyURI ;
172     DCT:identifier "https://dati.trentino.it/dataset/c-entro-in-bici-open-data/resource/
173         dd2c0cb7-d121-418e-9950-3abbe883a63"^^xsd:anyURI ;
174     DCT:issued "2017-11-08T00:00:00Z"^^xsd:dateTime ;
175     DCT:language "Italian" , "English" ;
176     DCT:license "https://creativecommons.org/publicdomain/zero/1.0"^^xsd:anyURI ;
177     DCT:modified "2021-07-07T00:00:00Z"^^xsd:dateTime ;
178     DCT:rights "https://creativecommons.org/publicdomain/zero/1.0" ;
179     DCT:title "centro_in_bici.zip (GML)" ;
180     DCT:type "Collection"^^xsd:anyURI ;
181     SPDX:checksum "md5 b8a8dbbbc4034aa4d61586e87d352c9f" ;
182     ADMS:status <https://www.epos-eu.org/epos-dcat-ap#Concept/a003f6ce-fe57-4ad8-983d-20c718935f9f> ;
183     DCAT:accessURL "https://dati.trentino.it/dataset/c-entro-in-bici-open-data/resource/
184         dd2c0cb7-d121-418e-9950-3abbe883a63"^^xsd:anyURI ;
185     DCAT:byteSize "1905.0"^^xsd:double ;
186     DCAT:downloadURL "http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=
187         centro_in_bici&fr=gml"^^xsd:anyURI ;
188     DCAT:mediaType "application/zip" ;
189     FOAF:page "https://dati.trentino.it/dataset/c-entro-in-bici-open-data/resource/
190         dd2c0cb7-d121-418e-9950-3abbe883a63" .
191
192 <https://www.epos-eu.org/epos-dcat-ap#Facility/b2babd57-0b6d-4dc7-a4e5-f0200bdc84cd>
193     RDF:type EPOS:Facility ;
194     DCT:description "Municipality" ;
195     DCT:identifier "Municipality" ;
196     DCT:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/a4286369-445f-42d3-acfd-697c6030746b> ;
197     DCT:title "Municipality" ;
198     DCT:type <https://www.epos-eu.org/epos-dcat-ap#Concept/78818685-c3d2-4849-8e1e-1b30e6535d35> ;
199     DCAT:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/7adc3dde-302d-4a86-8356-010ebd36fb0>
200         ;
201     DCAT:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/78818685-c3d2-4849-8e1e-1b30e6535d35> ;
202     FOAF:page "https://www.comune.trento.it/Comune/Organizzazione-comunale/Organigramma/Uffici"^^xsd:anyURI .
203
204 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/681cb431-6622-4898-bd84-386d856c995e>

```

```

197    rdf:type schema>ContactPoint ;
198    schema:availableLanguage "it-IT" ;
199    schema:contactType "Information" ;
200    schema:email "ufficio.mobilita@comune.trento.it" , "comurp@comune.trento.it" ;
201    schema:name "Comune di Trento" ;
202    schema:telephone "0461884111" .
203
204 <https://www.epos-eu.org/epos-dcat-ap#Dataset/ca858e96-f543-4adf-86a3-dee83959bf6e>
205    rdf:type dcat:Dataset ;
206    dct:accessRights "Public" ;
207    dct:accrualPeriodicity "Continuously"^^xsd:anyURI ;
208    dct:conformsTo "https://wikipedia.org/wiki/AutoCAD_DXF" , "https://wikipedia.org/wiki/Shapefile" , "https://developers.google.com/kml" , "https://www.ogc.org/standards/gml" ;
209    dct:created "2017-11-08T00:00:00Z"^^xsd:dateTime ;
210    dct:description "Centro in bici is a service that offers citizens the opportunity to use bicycles made available by the Municipality. In the territory of the Municipality of Trento there is a bicycle rental service for public use for travel within the city center. The service, managed by Trentino Mobilità spa, offers citizens the opportunity to use the bicycles made available by the Municipality and located in various parts of the city in a simple and free way, where modal interchange with private or public transport is possible. The Centro in bici service is a closed system with a key that is mainly aimed at commuting users who make round trips, keeping the bicycle at their place of work for a long time. The user is obliged to return the bicycle to the same point of withdrawal in order to be able to recover the personal key that has remained fixed to the rack." ;
211    dct:identifier "c_1378-1128870" ;
212    dct:issued "2017-11-08T00:00:00Z"^^xsd:dateTime ;
213    dct:language "Italian" , "English" ;
214    dct:modified "2021-07-07T00:00:00Z"^^xsd:dateTime ;
215    dct:publisher <https://www.epos-eu.org/epos-dcat-ap#Organization/028ab36a-6fde-4622-9d18-839d550e0bdb> ;
216    dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/74862c5c-00cf-4578-a6d8-958d4a9dac7d> ;
217    dct:title "Parcheggio protetto per biciclette" ;
218    dct:type "Collection"^^xsd:anyURI ;
219    dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/681cb431-6622-4898-bd84-386d856c995e>
220        ;
221    dcat:distribution <https://www.epos-eu.org/epos-dcat-ap#Distribution/d4226954-643a-460d-91aa-aac0995f8dc9>
222        , <https://www.epos-eu.org/epos-dcat-ap#Distribution/c502fec8-315b-447e-bfdc-dcdd0a433998> , <https://www.epos-eu.org/epos-dcat-ap#Distribution/a51bd148-c9bf-462a-bb1b-823b2c17f0bf> , <https://www.epos-eu.org/epos-dcat-ap#Distribution/a1a1f69b-0f5c-4316-a1b4-7146553807c4> ;
223    dcat:keyword "parking" , "transports" , "trento" , "city center" , "trentino" , "ticket" , "sharing" , "bicycle" ;
224    dcat:landingPage "https://dati.trentino.it/dataset/c-entro-in-bici-open-data" , "https://www.comune.trento.it/Aree-tematiche/Cartografia/Download/C-entro-in-bici" ;
225    dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/155680df-c330-4c53-9fec-ca690516d6ce> ;
226    foaf:page "https://www.comune.trento.it/Aree-tematiche/Cartografia/Download/C-entro-in-bici" , "https://dati.trentino.it/dataset/c-entro-in-bici-open-data" .
227
228 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/7adc3dde-302d-4a86-8356-010ebd36fb0>
229    rdf:type schema>ContactPoint ;
230    schema:availableLanguage "it-IT" ;
231    schema:contactType "Centralino" ;
232    schema:name "Centralino" ;
233    schema:telephone "0461889444" , "0461884111" .
234
235 <https://www.epos-eu.org/epos-dcat-ap#Facility/2e0e4c74-7994-4e0b-8161-bb9d664ff5ee>
236    rdf:type epos:Facility ;
237    dct:description "Ufficio relazioni con il pubblico" ;
238    dct:identifier "Ufficio relazioni con il pubblico" ;
239    dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/c219cb05-d000-4343-88b0-16854d29f2ef> ;
240    dct:title "Ufficio relazioni con il pubblico" ;
241    dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/ecea9de3-6096-4fd7-9bc9-0d0443e43df0> ;
242    dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/4b11c132-26b0-4c53-b577-eface5f83d75> ;
243    dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/ecea9de3-6096-4fd7-9bc9-0d0443e43df0> ;
244    foaf:page "https://www.comune.trento.it/Comunicazione/Dialoga-con-noi/Contattaci/URP"^^xsd:anyURI .

```

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```

244 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/0398ad3c-a4ed-477a-a65d-bce371a7e3c4>
245     rdf:type skos:ConceptScheme ;
246     dct:description "To divide food, money, goods, etc. and give part of it to someone else." ;
247     dct:title "Sharing" .

```

---

### 3.3.4.6 Car sharing

Graph:

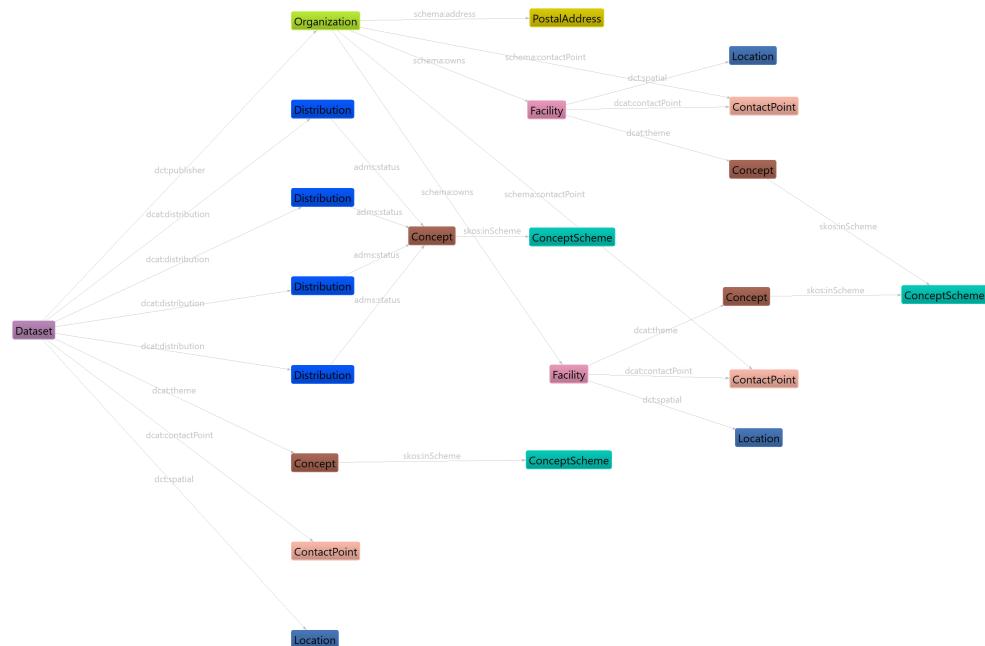


Figure 3.7: *Car sharing* metadata graph

#### RDF Metadata:

---

```

1 @prefix : <https://www.epos-eu.org/epos-dcat-ap#> .
2 @prefix schema: <http://schema.org/> .
3 @prefix spdx: <http://spdx.org/rdf/terms#> .
4 @prefix owl: <http://www.w3.org/2002/07/owl#> .
5 @prefix gsp: <http://www.opengis.net/ont/geosparql#> .
6 @prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
7 @prefix skos: <http://www.w3.org/2004/02/skos/core#> .
8 @prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
9 @prefix hydra: <http://www.w3.org/ns/hydra/core#> .
10 @prefix geo: <http://www.w3.org/2003/01/geo/wgs84_pos#> .
11 @prefix oa: <http://www.w3.org/ns/oa#> .
12 @prefix dct: <http://purl.org/dc/terms/> .
13 @prefix sh: <http://www.w3.org/ns/shacl#> .
14 @prefix dcat: <http://www.w3.org/ns/dcat#> .
15 @prefix locn: <http://www.w3.org/ns/locn#> .
16 @prefix foaf: <http://xmlns.com/foaf/0.1/> .
17 @prefix epos: <https://www.epos-eu.org/epos-dcat-ap#> .
18 @prefix adms: <http://www.w3.org/ns/adms#> .
19 @prefix org: <http://www.w3.org/ns/org#> .

```

```

20 @prefix cnt: <http://www.w3.org/2011/content#> .
21 @prefix vcard: <http://www.w3.org/2006/vcard/ns#> .
22 @prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
23 @prefix http: <http://www.w3.org/2006/http#> .
24 @prefix dash: <http://datashapes.org/dash#> .
25 @prefix dc: <http://purl.org/dc/elements/1.1/> .

26
27 <https://www.epos-eu.org/epos-dcat-ap#Location/c219cb05-d000-4343-88b0-16854d29f2ef>
28     rdf:type dct:Location ;
29     locn:geometry "POINT(11.1210985 46.0694727)"^^gsp:wktLiteral .

30
31 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/48a4bb61-bfec-4eed-9275-1351d9cc9e39>
32     rdf:type skos:ConceptScheme ;
33     dct:description "To divide food, money, goods, etc. and give part of it to someone else." ;
34     dct:title "Sharing" .

35
36 <https://www.epos-eu.org/epos-dcat-ap#Location/a4286369-445f-42d3-acfd-697c6030746b>
37     rdf:type dct:Location ;
38     locn:geometry "POINT(11.1207054 46.0690622)"^^gsp:wktLiteral .

39
40 <https://www.epos-eu.org/epos-dcat-ap#Concept/9bdbc17a-901c-45c6-af0d-aa1ab9c78981>
41     rdf:type skos:Concept ;
42     skos:definition "Containing all the necessary parts, answers, or information." ;
43     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/42ff9885-e108-423d-9293-89a3215ab623> ;
44     skos:prefLabel "Completed" .

45
46 <https://www.epos-eu.org/epos-dcat-ap#Distribution/5ff7b4f1-9d4c-45b4-8023-8a428b578c75>
47     rdf:type dcat:Distribution ;
48     dct:conformsTo "https://www.ogc.org/standards/gml" ;
49     dct:description "Car sharing in GML format." ;
50     dct:format "https://www.ogc.org/standards/gml"^^xsd:anyURI ;
51     dct:identifier "https://dati.trentino.it/dataset/car-sharing-open-data/resource/4
      f0e4ee2-ebc8-4cda-a87a-9f3bf358ad9d"^^xsd:anyURI ;
52     dct:issued "2018-05-04T00:00:00Z"^^xsd:dateTime ;
53     dct:language "English" , "Italian" ;
54     dct:license "https://creativecommons.org/publicdomain/zero/1.0"^^xsd:anyURI ;
55     dct:modified "2021-07-08T00:00:00Z"^^xsd:dateTime ;
56     dct:rights "https://creativecommons.org/publicdomain/zero/1.0" ;
57     dct:title "car_sharing.zip (GML)" ;
58     dct:type "Collection"^^xsd:anyURI ;
59     spdx:checksum "md5 352cc5b1e2f7deec5b29e81769497066" ;
60     adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/9bdbc17a-901c-45c6-af0d-aa1ab9c78981> ;
61     dcat:accessURL "https://dati.trentino.it/dataset/car-sharing-open-data/resource/4
      f0e4ee2-ebc8-4cda-a87a-9f3bf358ad9d"^^xsd:anyURI ;
62     dcat:byteSize "1772.0"^^xsd:double ;
63     dcat:downloadURL "http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=
      car_sharing&fr=gml"^^xsd:anyURI ;
64     dcat:mediaType "application/zip" ;
65     foaf:page "https://dati.trentino.it/dataset/car-sharing-open-data/resource/4
      f0e4ee2-ebc8-4cda-a87a-9f3bf358ad9d" .

66
67 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/4b11c132-26b0-4c53-b577-eface5f83d75>
68     rdf:type schema>ContactPoint ;
69     schema:availableLanguage "it-IT" ;
70     schema:contactType "Ufficio relazioni con il pubblico" ;
71     schema:email "comurp@comune.trento.it" ;
72     schema:name "Ufficio relazioni con il pubblico" ;
73     schema:telephone "800017615" , "0461884005" , "0461884453" .

74
75 <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/266a2b24-28ef-4bea-8274-4665545f69ed>
76     rdf:type schema:PostalAddress ;
77     schema:addressCountry "IT" ;
78     schema:addressLocality "Trento" ;
79     schema:postalCode "38122" ;

```

```

80     schema:streetAddress " Via Belenzani 19" .
81
82 <https://www.epos-eu.org/epos-dcat-ap#Distribution/2c1697ce-8aa7-4c95-898b-9155469e8cf3>
83     rdf:type dcat:Distribution ;
84     dct:conformsTo "https://developers.google.com/kml" ;
85     dct:description "Car sharing in KML format." ;
86     dct:format "https://developers.google.com/kml"^^xsd:anyURI ;
87     dct:identifier "https://dati.trentino.it/dataset/car-sharing-open-data/resource/78301418
88         -dceb-4347-ae7c-ba582c9c8a53"^^xsd:anyURI ;
89     dct:issued "2018-05-04T00:00:00Z"^^xsd:dateTime ;
90     dct:language "Italian" , "English" ;
91     dct:license "https://creativecommons.org/publicdomain/zero/1.0"^^xsd:anyURI ;
92     dct:modified "2021-07-08T00:00:00Z"^^xsd:dateTime ;
93     dct:rights "https://creativecommons.org/publicdomain/zero/1.0" ;
94     dct:title "car_sharing.zip (KML)" ;
95     dct:type "Collection"^^xsd:anyURI ;
96     spdx:checksum "md5 fe75f949c1dde608a7b32d54292159fc" ;
97     adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/9bdbc17a-901c-45c6-af0d-aa1ab9c78981> ;
98     dcat:accessURL "https://dati.trentino.it/dataset/car-sharing-open-data/resource/78301418
99         -dceb-4347-ae7c-ba582c9c8a53"^^xsd:anyURI ;
100    dcat:byteSize "912.0"^^xsd:double ;
101    dcat:downloadURL "http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=
102        car_sharing&fr=kml"^^xsd:anyURI ;
103    dcat:mediaType "application/zip" ;
104    foaf:page "https://dati.trentino.it/dataset/car-sharing-open-data/resource/78301418
105        -dceb-4347-ae7c-ba582c9c8a53" .
106
107 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/2ed52e76-600f-4d85-bb76-adc1fa99c6d6>
108     rdf:type schema>ContactPoint ;
109     schema:availableLanguage "it-IT" ;
110     schema:contactType "Information" ;
111     schema:email "servizio.innovazionedigitale@pec.comune.trento.it" , "servizio.innovazionedigitale@comune.
112         trento.it" ;
113     schema:name "Comune di Trento" ;
114     schema:telephone "0461889600" .
115
116 <https://www.epos-eu.org/epos-dcat-ap#Concept/78818685-c3d2-4849-8e1e-1b30e6535d35>
117     rdf:type skos:Concept ;
118     skos:definition "A city or town with its own local government, or the local government itself." ;
119     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/4fb52b1f-1f57-4f67-9bcf-597557c4758a> ;
120     skos:prefLabel "Municipality" .
121
122 <https://www.epos-eu.org/epos-dcat-ap#Distribution/0f33e543-58c9-48c9-b779-409621ab2942>
123     rdf:type dcat:Distribution ;
124     dct:conformsTo "https://wikipedia.org/wiki/AutoCAD_DXF" ;
125     dct:description "Car sharing in DXF format." ;
126     dct:format "https://wikipedia.org/wiki/AutoCAD_DXF"^^xsd:anyURI ;
127     dct:identifier "https://dati.trentino.it/dataset/car-sharing-open-data/resource/9936
128         abfa-8996-4e95-a990-43f4ffb0c48a"^^xsd:anyURI ;
129     dct:issued "2018-05-04T00:00:00Z"^^xsd:dateTime ;
130     dct:language "Italian" , "English" ;
131     dct:license "https://creativecommons.org/publicdomain/zero/1.0"^^xsd:anyURI ;
132     dct:modified "2021-07-08T00:00:00Z"^^xsd:dateTime ;
133     dct:rights "https://creativecommons.org/publicdomain/zero/1.0" ;
134     dct:title "car_sharing.zip (DXF)" ;
135     dct:type "Collection"^^xsd:anyURI ;
136     spdx:checksum "md5 0f513cb1930c829b3aa2566ff9089292" ;
137     adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/9bdbc17a-901c-45c6-af0d-aa1ab9c78981> ;
138     dcat:accessURL "https://dati.trentino.it/dataset/car-sharing-open-data/resource/9936
139         abfa-8996-4e95-a990-43f4ffb0c48a"^^xsd:anyURI ;
140     dcat:byteSize "3913.0"^^xsd:double ;
141     dcat:downloadURL "http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=
142         car_sharing&fr=dx"^^xsd:anyURI ;
143     dcat:mediaType "application/zip" ;

```

```

136     foaf:page "https://dati.trentino.it/dataset/car-sharing-open-data/resource/9936
137         abfa-8996-4e95-a990-43f4ffb0c48a" .
138 <https://www.epos-eu.org/epos-dcat-ap#Location/aad52e3d-5c01-47fc-a8c8-19e2321e252b>
139     rdf:type dct:Location ;
140     locn:geometry "POINT(11.116667 46.066666)"^^gsp:wktLiteral .
141
142 <https://www.epos-eu.org/epos-dcat-ap#Concept/ecea9de3-6096-4fd7-9bc9-0d0443e43df0>
143     rdf:type skos:Concept ;
144     skos:definition "A room or part of a building in which people work, especially sitting at tables with
145         computers, phones, etc., usually as a part of a business or other organization." ;
146     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/4fb52b1f-1f57-4f67-9bcf-597557c4758a> ;
147     skos:prefLabel "Office" .
148
149 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/42ff9885-e108-423d-9293-89a3215ab623>
150     rdf:type skos:ConceptScheme ;
151     dct:description "The position or rank of someone or something when compared to others in a society,
152         organization, group, etc." ;
153     dct:title "Status" .
154
155 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/4fb52b1f-1f57-4f67-9bcf-597557c4758a>
156     rdf:type skos:ConceptScheme ;
157     dct:description "A structure with walls and a roof, such as a house or factory." ;
158     dct:title "Building" .
159
160 <https://www.epos-eu.org/epos-dcat-ap#Distribution/af842fc6-7e87-4f78-b6a9-7a64470ec757>
161     rdf:type dcat:Distribution ;
162     dct:conformsTo "https://wikipedia.org/wiki/Shapfile" ;
163     dct:description "Car sharing in SHP format." ;
164     dct:format "https://wikipedia.org/wiki/Shapfile"^^xsd:anyURI ;
165     dct:identifier "https://dati.trentino.it/dataset/car-sharing-open-data/resource/
166         b8a114a1-2e7a-4ded-80c5-4480f19d941e"^^xsd:anyURI ;
167     dct:issued "2018-05-04T00:00:00Z"^^xsd:dateTime ;
168     dct:language "Italian" , "English" ;
169     dct:license "https://creativecommons.org/publicdomain/zero/1.0"^^xsd:anyURI ;
170     dct:modified "2021-07-08T00:00:00Z"^^xsd:dateTime ;
171     dct:rights "https://creativecommons.org/publicdomain/zero/1.0" ;
172     dct:title "car_sharing.zip (SHP)" ;
173     dct:type "Collection"^^xsd:anyURI ;
174     spdx:checksum "md5 efb253352e2c3e1811025868121ba1ea" ;
175     adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/9bdbc17a-901c-45c6-af0d-aa1ab9c78981> ;
176     dcat:accessURL "https://dati.trentino.it/dataset/car-sharing-open-data/resource/
177         b8a114a1-2e7a-4ded-80c5-4480f19d941e"^^xsd:anyURI ;
178     dcat:byteSize "1496.0"^^xsd:double ;
179     dcat:downloadURL "http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=
180         car_sharing&fr=shp"^^xsd:anyURI ;
181     dcat:mediaType "application/zip" ;
182     foaf:page "https://dati.trentino.it/dataset/car-sharing-open-data/resource/
183         b8a114a1-2e7a-4ded-80c5-4480f19d941e" .
184
185 <https://www.epos-eu.org/epos-dcat-ap#Organization/1a0bbd53-7b4d-461a-b406-7ea480250e1f>
186     rdf:type schema:Organization ;
187     schema:address <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/266a2b24-28ef-4bea-8274-4665545f69ed> ;
188     schema:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/4b11c132-26b0-4c53-b577-eface5f83d75
189         > , <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/7adc3dde-302d-4a86-8356-010ebd36fbb0> ;
190     schema:email "protocollo@pec.comune.trento.it" , "comurp@comune.trento.it" ;
191     schema:identifier "https://www.comune.trento.it"^^xsd:anyURI ;
192     schema:legalName "Comune di Trento" ;
193     schema:leiCode "P.IVA 00355870221" ;
194     schema:logo "https://www.comune.trento.it/var/comunetn/storage/images/10010715-1020-ita-IT/
195         Trento-Citta-Sito-ufficiale-del-Comune-di-Trento_header_logo.jpg"^^xsd:anyURI ;
196     schema:owns <https://www.epos-eu.org/epos-dcat-ap#Facility/2e0e4c74-7994-4e0b-8161-bb9d664ff5ee> , <https
197         ://www.epos-eu.org/epos-dcat-ap#Facility/b2babd57-0b6d-4dc7-a4e5-f0200bdc84cd> ;
198     schema:telephone "0461884111" ;

```

```

190 schema:url "https://www.comune.trento.it"^^xsd:anyURI .
191
192 <https://www.epos-eu.org/epos-dcat-ap#Dataset/af56576-cad8-45e5-84ee-aaae59b9c5d1>
193   rdf:type dcat:Dataset ;
194   dct:accessRights "Public" ;
195   dct:accrualPeriodicity "Continuously"^^xsd:anyURI ;
196   dct:conformsTo "https://www.ogc.org/standards/gml" , "https://developers.google.com/kml" , "https://
197     wikipedia.org/wiki/Shapefile" , "https://wikipedia.org/wiki/AutoCAD_DXF" ;
198   dct:created "2018-05-04T00:00:00Z"^^xsd:dateTime ;
199   dct:description "Car sharing allows you to have a car suitable for family or business needs without owning
200     one and without incurring fixed costs (road tax, insurance, maintenance, garage or parking), but
201     paying only in proportion to use." , "Car sharing stalls location. Parking spaces dedicated to the
202     collection and delivery of Car sharing vehicles. Data taken directly from the site https://www.
203     carsharing.tn.it." ;
204   dct:identifier "c_1378-1157737" ;
205   dct:issued "2018-05-04T00:00:00Z"^^xsd:dateTime ;
206   dct:language "Italian" , "English" ;
207   dct:modified "2021-07-08T00:00:00Z"^^xsd:dateTime ;
208   dct:publisher <https://www.epos-eu.org/epos-dcat-ap#Organization/1a0bbd53-7b4d-461a-b406-7ea480250e1f> ;
209   dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/aad52e3d-5c01-47fc-a8c8-19e2321e252b> ;
210   dct:title "Car sharing" ;
211   dct:type "Collection"^^xsd:anyURI ;
212   dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/2ed52e76-600f-4d85-bb76-adc1fa99c6d6>
213     ;
214   dcat:distribution <https://www.epos-eu.org/epos-dcat-ap#Distribution/0f33e543-58c9-48c9-b779-409621ab2942>
215     , <https://www.epos-eu.org/epos-dcat-ap#Distribution/af842fc6-7e87-4f78-b6a9-7a64470ec757> , <https://www.epos-eu.org/epos-dcat-ap#Distribution/5ff7b4f1-9d4c-45b4-8023-8a428b578c75> , <https://www.epos-eu.org/epos-dcat-ap#Distribution/2c1697ce-8aa7-4c95-898b-9155469e8cf3> ;
216   dcat:keyword "driving" , "transports" , "students" , "driving license" , "parking" , "car sharing" , "
217     trento" , "family" , "trentino" , "car" , "sharing" ;
218   dcat:landingPage "https://dati.trentino.it/dataset/car-sharing-open-data" ;
219   dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/036a954c-8ce4-4066-8084-ccf5e7638d86> ;
220   foaf:page "https://www.comune.trento.it/Aree-tematiche/Cartografia/Download/Car-sharing" , "https://dati.
221     trentino.it/dataset/car-sharing-open-data" .
222
223 <https://www.epos-eu.org/epos-dcat-ap#Facility/b2babd57-0b6d-4dc7-a4e5-f0200bdc84cd>
224   rdf:type epos:Facility ;
225   dct:description "Municipality" ;
226   dct:identifier "Municipality" ;
227   dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/a4286369-445f-42d3-acfd-697c6030746b> ;
228   dct:title "Municipality" ;
229   dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/78818685-c3d2-4849-8e1e-1b30e6535d35> ;
230   dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/7adc3dde-302d-4a86-8356-010ebd36fb0>
231     ;
232   dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/78818685-c3d2-4849-8e1e-1b30e6535d35> ;
233   foaf:page "https://www.comune.trento.it/Comune/Organizzazione-comunale/Organigramma/Uffici"^^xsd:anyURI .
234
235 <https://www.epos-eu.org/epos-dcat-ap#Concept/036a954c-8ce4-4066-8084-ccf5e7638d86>
236   rdf:type skos:Concept ;
237   skos:definition "Car sharing means the practice where a number of people share the use of one or more cars
238     that are owned by a profit or non-profit car-sharing organization and where such organization may
239     require that use of cars to be reserved in advance, charge fees based on time and/or kilometres driven
240     , and set membership requirements of the car-sharing organization, including the payment of a
241     membership fee that may or may not be refundable." ;
242   skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/48a4bb61-bfec-4eed-9275-1351d9cc9e39> ;
243   skos:prefLabel "Car sharing" .
244
245 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/7adc3dde-302d-4a86-8356-010ebd36fb0>
246   rdf:type schema>ContactPoint ;
247   schema:availableLanguage "it-IT" ;
248   schema:contactType "Centralino" ;
249   schema:name "Centralino" ;
250   schema:telephone "0461889444" , "0461884111" .

```

```

238 <https://www.epos-eu.org/epos-dcat-ap#Facility/2e0e4c74-7994-4e0b-8161-bb9d664ff5ee>
239     rdf:type epos:Facility ;
240     dct:description "Ufficio relazioni con il pubblico" ;
241     dct:identifier "Ufficio relazioni con il pubblico" ;
242     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/c219cb05-d000-4343-88b0-16854d29f2ef> ;
243     dct:title "Ufficio relazioni con il pubblico" ;
244     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/ecea9de3-6096-4fd7-9bc9-0d0443e43df0> ;
245     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/4b11c132-26b0-4c53-b577-eface5f83d75>
246         ;
247     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/ecea9de3-6096-4fd7-9bc9-0d0443e43df0> ;
foaf:page "https://www.comune.trento.it/Comunicazione/Dialoga-con-noi/Contattaci/URP"^^xsd:anyURI .

```

### 3.3.4.7 Taxi

**Graph:**

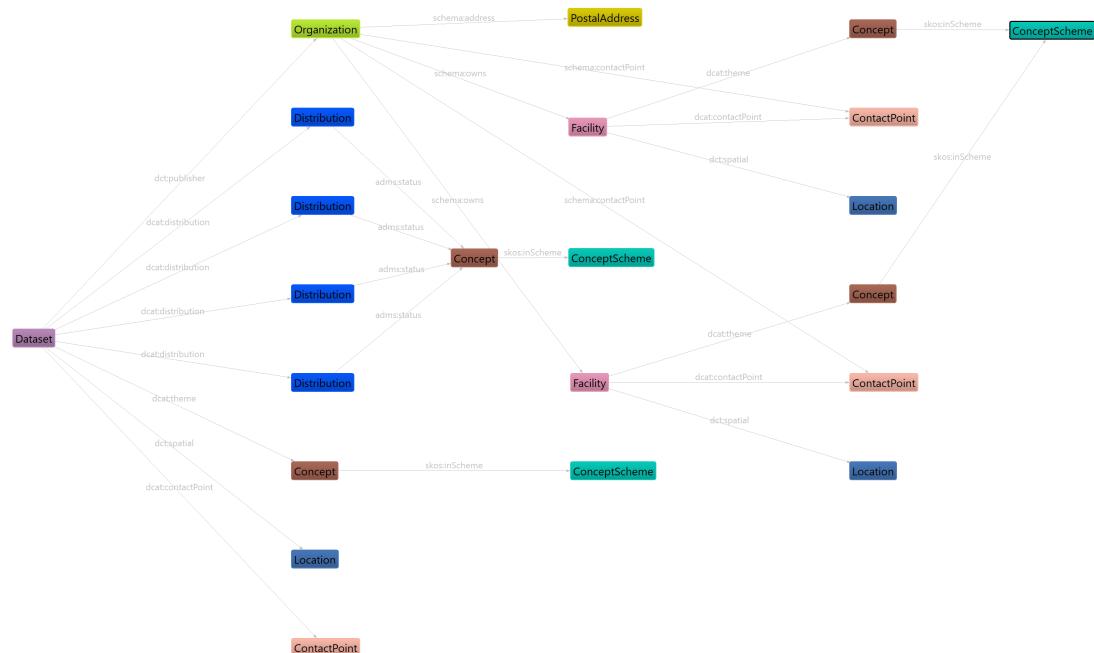


Figure 3.8: *Taxi* metadata graph

#### RDF Metadata:

```

1 @prefix : <https://www.epos-eu.org/epos-dcat-ap#> .
2 @prefix schema: <http://schema.org/> .
3 @prefix spdx: <http://spdx.org/rdf/terms#> .
4 @prefix owl: <http://www.w3.org/2002/07/owl#> .
5 @prefix gsp: <http://www.opengis.net/ont/geosparql#> .
6 @prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
7 @prefix skos: <http://www.w3.org/2004/02/skos/core#> .
8 @prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
9 @prefix hydra: <http://www.w3.org/ns/hydra/core#> .
10 @prefix geo: <http://www.w3.org/2003/01/geo/wgs84_pos#> .
11 @prefix oa: <http://www.w3.org/ns/oa#> .
12 @prefix dct: <http://purl.org/dc/terms/> .

```

```

13 @prefix sh: <http://www.w3.org/ns/shacl#> .
14 @prefix dcat: <http://www.w3.org/ns/dcat#> .
15 @prefix locn: <http://www.w3.org/ns/locn#> .
16 @prefix foaf: <http://xmlns.com/foaf/0.1/> .
17 @prefix epos: <https://www.epos-eu.org/epos-dcat-ap#> .
18 @prefix adms: <http://www.w3.org/ns/adms#> .
19 @prefix org: <http://www.w3.org/ns/org#> .
20 @prefix cnt: <http://www.w3.org/2011/content#> .
21 @prefix vcard: <http://www.w3.org/2006/vcard/ns#> .
22 @prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
23 @prefix http: <http://www.w3.org/2006/http#> .
24 @prefix dash: <http://datashapes.org/dash#> .
25 @prefix dc: <http://purl.org/dc/elements/1.1/> .

26
27 <https://www.epos-eu.org/epos-dcat-ap#Location/c219cb05-d000-4343-88b0-16854d29f2ef>
28     rdf:type dct:Location ;
29     locn:geometry "POINT(11.1210985 46.0694727)"^^gsp:wktLiteral .
30
31 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/48a4bb61-bfec-4eed-9275-1351d9cc9e39>
32     rdf:type skos:ConceptScheme ;
33     dct:description "A system of vehicles, such as buses, trains, aircraft, etc. for getting from one place to
34     another." ;
35     dct:title "Transport" .
36
37 <https://www.epos-eu.org/epos-dcat-ap#Location/a4286369-445f-42d3-acfd-697c6030746b>
38     rdf:type dct:Location ;
39     locn:geometry "POINT(11.1207054 46.0690622)"^^gsp:wktLiteral .
40
41 <https://www.epos-eu.org/epos-dcat-ap#Concept/9bdbc17a-901c-45c6-af0d-aa1ab9c78981>
42     rdf:type skos:Concept ;
43     skos:definition "Containing all the necessary parts, answers, or information." ;
44     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/42ff9885-e108-423d-9293-89a3215ab623> ;
45     skos:prefLabel "Completed" .
46
47 <https://www.epos-eu.org/epos-dcat-ap#Distribution/5ff7b4f1-9d4c-45b4-8023-8a428b578c75>
48     rdf:type dcat:Distribution ;
49     dct:conformsTo "https://www.ogc.org/standards/gml" ;
50     dct:description "Taxi stands in GML format." ;
51     dct:format "https://www.ogc.org/standards/gml"^^xsd:anyURI ;
52     dct:identifier "https://dati.trentino.it/dataset/taxi-open-data/resource/
53         aa8f9fcc-6d19-40b9-9210-f0eb3bb2e689"^^xsd:anyURI ;
54     dct:issued "2018-05-04T00:00:00Z"^^xsd:dateTime ;
55     dct:language "English" , "Italian" ;
56     dct:license "https://creativecommons.org/publicdomain/zero/1.0"^^xsd:anyURI ;
57     dct:modified "2021-07-08T00:00:00Z"^^xsd:dateTime ;
58     dct:rights "https://creativecommons.org/publicdomain/zero/1.0" ;
59     dct:title "taxi.zip (GML)" ;
60     dct:type "Collection"^^xsd:anyURI ;
61     spdx:checksum "md5 e79df49911305fc1ab9db22d190c723a" ;
62     adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/9bdbc17a-901c-45c6-af0d-aa1ab9c78981> ;
63     dcat:accessURL "https://dati.trentino.it/dataset/taxi-open-data/resource/
64         aa8f9fcc-6d19-40b9-9210-f0eb3bb2e689"^^xsd:anyURI ;
65     dcat:byteSize "1894.0"^^xsd:double ;
66     dcat:downloadURL "http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=taxi&fr=
67         gml"^^xsd:anyURI ;
68     dcat:mediaType "application/zip" ;
69     foaf:page "https://dati.trentino.it/dataset/taxi-open-data/resource/aa8f9fcc-6d19-40b9-9210-f0eb3bb2e689" .

70 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/4b11c132-26b0-4c53-b577-eface5f83d75>
71     rdf:type schema>ContactPoint ;
72     schema:availableLanguage "it-IT" ;
73     schema:contactType "Ufficio relazioni con il pubblico" ;
74     schema:email "comurp@comune.trento.it" ;
75     schema:name "Ufficio relazioni con il pubblico" ;

```

```

73     schema:telephone "800017615" , "0461884005" , "0461884453" .
74
75 <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/266a2b24-28ef-4bea-8274-4665545f69ed>
76     rdf:type schema:PostalAddress ;
77     schema:addressCountry "IT" ;
78     schema:addressLocality "Trento" ;
79     schema:postalCode "38122" ;
80     schema:streetAddress " Via Belenzani 19" .
81
82 <https://www.epos-eu.org/epos-dcat-ap#Distribution/0b2c79e2-e865-4cdf-9d39-706d3e4ad026>
83     rdf:type dcat:Distribution ;
84     dct:conformsTo "https://wikipedia.org/wiki/Shapfile" ;
85     dct:description "Taxi stands in SHP format." ;
86     dct:format "https://wikipedia.org/wiki/Shapfile"^^xsd:anyURI ;
87     dct:identifier "https://dati.trentino.it/dataset/taxi-open-data/resource/5c424577-24da-4920-a210-877aee2394be"^^xsd:anyURI ;
88     dct:issued "2018-05-04T00:00:00Z"^^xsd:dateTime ;
89     dct:language "English" , "Italian" ;
90     dct:license "https://creativecommons.org/publicdomain/zero/1.0"^^xsd:anyURI ;
91     dct:modified "2021-07-08T00:00:00Z"^^xsd:dateTime ;
92     dct:rights "https://creativecommons.org/publicdomain/zero/1.0" ;
93     dct:title "taxi.zip (SHP)" ;
94     dct:type "Collection"^^xsd:anyURI ;
95     spdx:checksum "md5 79b978ba3f51edf3f1d65f9c7dc16af4" ;
96     adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/9bdbc17a-901c-45c6-af0d-aa1ab9c78981> ;
97     dcat:accessURL "https://dati.trentino.it/dataset/taxi-open-data/resource/5c424577-24da-4920-a210-877aee2394be"^^xsd:anyURI ;
98     dcat:byteSize "1634.0"^^xsd:double ;
99     dcat:downloadURL "http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=taxi&fr=shp"^^xsd:anyURI ;
100    dcat:mediaType "application/zip" ;
101    foaf:page "https://dati.trentino.it/dataset/taxi-open-data/resource/5c424577-24da-4920-a210-877aee2394be" .
102
103 <https://www.epos-eu.org/epos-dcat-ap#Dataset/c1b25074-c755-478b-bbb1-87cae5176e1c>
104     rdf:type dcat:Dataset ;
105     dct:accessRights "Public" ;
106     dct:accrualPeriodicity "Continuously"^^xsd:anyURI ;
107     dct:conformsTo "https://developers.google.com/kml" , "https://www.ogc.org/standards/gml" , "https://wikipedia.org/wiki/AutoCAD\_DXF" , "https://wikipedia.org/wiki/Shapfile" ;
108     dct:created "2018-05-04T00:00:00Z"^^xsd:dateTime ;
109     dct:description "Data provided by TAXI Trento (https://www.taxitrento.it).", "Taxi stands within the territory of the Municipality of Trento." ;
110     dct:identifier "c_1378-1157755" ;
111     dct:issued "2018-05-04T00:00:00Z"^^xsd:dateTime ;
112     dct:language "English" , "Italian" ;
113     dct:modified "2021-07-08T00:00:00Z"^^xsd:dateTime ;
114     dct:publisher <https://www.epos-eu.org/epos-dcat-ap#Organization/1a0bbd53-7b4d-461a-b406-7ea480250e1f> ;
115     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/aad52e3d-5c01-47fc-a8c8-19e2321e252b> ;
116     dct:title "Car sharing" ;
117     dct:type "Collection"^^xsd:anyURI ;
118     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/2ed52e76-600f-4d85-bb76-adc1fa99c6d6>
119     ;
120     dcat:distribution <https://www.epos-eu.org/epos-dcat-ap#Distribution/0826cb75-f863-416f-9d7a-26354ef78d0a> ,
121     <https://www.epos-eu.org/epos-dcat-ap#Distribution/4fd7faac-b557-48db-8f9c-d6f2380eb429> ,
122     <https://www.epos-eu.org/epos-dcat-ap#Distribution/0b2c79e2-e865-4cdf-9d39-706d3e4ad026> ,
123     <https://www.epos-eu.org/epos-dcat-ap#Distribution/5ff7b4f1-9d4c-45b4-8023-8a428b578c75> ;
124     dcat:keyword "trentino" , "transports" , "taxi" , "family" , "car" , "tourist" , "students" , "trento" , "private" , "price" ;
125     dcat:landingPage "https://dati.trentino.it/dataset/taxi-open-data" ;
126     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/036a954c-8ce4-4066-8084-ccf5e7638d86> ;
127     foaf:page "https://www.comune.trento.it/Aree-tematiche/Cartografia/Download/Taxi" , "https://dati.trentino.it/dataset/taxi-open-data" .
128
129 <https://www.epos-eu.org/epos-dcat-ap#Distribution/4fd7faac-b557-48db-8f9c-d6f2380eb429>
```

```

126    rdf:type dcat:Distribution ;
127    dct:conformsTo "https://developers.google.com/kml" ;
128    dct:description "Taxi stands in KML format." ;
129    dct:format "https://developers.google.com/kml"^^xsd:anyURI ;
130    dct:identifier "https://dati.trentino.it/dataset/taxi-open-data/resource/4119
131        d0c4-a89c-48bb-a802-4e84afea8650"^^xsd:anyURI ;
132    dct:issued "2018-05-04T00:00:00Z"^^xsd:dateTime ;
133    dct:language "Italian" , "English" ;
134    dct:license "https://creativecommons.org/publicdomain/zero/1.0"^^xsd:anyURI ;
135    dct:modified "2021-07-08T00:00:00Z"^^xsd:dateTime ;
136    dct:rights "https://creativecommons.org/publicdomain/zero/1.0" ;
137    dct:title "taxi.zip (KML)" ;
138    dct:type "Collection"^^xsd:anyURI ;
139    SPDX:checksum "md5 9f582e669d57dad35934b706c1aed9a7" ;
140    adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/9bdbc17a-901c-45c6-af0d-aa1ab9c78981> ;
141    dcat:accessURL "https://dati.trentino.it/dataset/taxi-open-data/resource/4119
142        d0c4-a89c-48bb-a802-4e84afea8650"^^xsd:anyURI ;
143    dcat:byteSize "998.0"^^xsd:double ;
144    dcat:downloadURL "http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=taxi&fr=
145        kml"^^xsd:anyURI ;
146    dcat:mediaType "application/zip" ;
147    foaf:page "https://dati.trentino.it/dataset/taxi-open-data/resource/4119d0c4-a89c-48bb-a802-4e84afea8650" .
148
149 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/2ed52e76-600f-4d85-bb76-adc1fa99c6d6>
150    rdf:type schema>ContactPoint ;
151    schema:availableLanguage "it-IT" ;
152    schema:contactType "Information" ;
153    schema:email "servizio.innovazionedigitale@pec.comune.trento.it" , "servizio.innovazionedigitale@comune.
154        trento.it" ;
155    schema:name "Comune di Trento" ;
156    schema:telephone "0461889600" .
157
158 <https://www.epos-eu.org/epos-dcat-ap#Concept/78818685-c3d2-4849-8e1e-1b30e6535d35>
159    rdf:type skos:Concept ;
160    skos:definition "A city or town with its own local government, or the local government itself." ;
161    skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/4fb52b1f-1f57-4f67-9bcf-597557c4758a> ;
162    skos:prefLabel "Municipality" .
163
164 <https://www.epos-eu.org/epos-dcat-ap#Location/aad52e3d-5c01-47fc-a8c8-19e2321e252b>
165    rdf:type dct:Location ;
166    locn:geometry "POINT(11.116667 46.066666)"^^gsp:wktLiteral .
167
168 <https://www.epos-eu.org/epos-dcat-ap#Concept/ecea9de3-6096-4fd7-9bc9-0d0443e43df0>
169    rdf:type skos:Concept ;
170    skos:definition "A room or part of a building in which people work, especially sitting at tables with
171        computers, phones, etc., usually as a part of a business or other organization." ;
172    skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/4fb52b1f-1f57-4f67-9bcf-597557c4758a> ;
173    skos:prefLabel "Office" .
174
175 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/42ff9885-e108-423d-9293-89a3215ab623>
176    rdf:type skos:ConceptScheme ;
177    dct:description "The position or rank of someone or something when compared to others in a society,
178        organization, group, etc." ;
179    dct:title "Status" .
180
181 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/4fb52b1f-1f57-4f67-9bcf-597557c4758a>
182    rdf:type skos:ConceptScheme ;
183    dct:description "A structure with walls and a roof, such as a house or factory." ;
184    dct:title "Building" .
185
186 <https://www.epos-eu.org/epos-dcat-ap#Facility/b2babd57-0b6d-4dc7-a4e5-f0200bdc84cd>
187    rdf:type epos:Facility ;
188    dct:description "Municipality" ;
189    dct:identifier "Municipality" ;

```

```

184     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/a4286369-445f-42d3-acfd-697c6030746b> ;
185     dct:title "Municipality" ;
186     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/78818685-c3d2-4849-8e1e-1b30e6535d35> ;
187     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/7adc3dde-302d-4a86-8356-010ebd36fbb0>
188     ;
189     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/78818685-c3d2-4849-8e1e-1b30e6535d35> ;
190     foaf:page "https://www.comune.trento.it/Comune/Organizzazione-comunale/Organigramma/Uffici"^^xsd:anyURI .
191 <https://www.epos-eu.org/epos-dcat-ap#Organization/1a0bbd53-7b4d-461a-b406-7ea480250e1f>
192     rdf:type schema:Organization ;
193     schema:address <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/266a2b24-28ef-4bea-8274-4665545f69ed> ;
194     schema:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/4b11c132-26b0-4c53-b577-eface5f83d75> ,
195     <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/7adc3dde-302d-4a86-8356-010ebd36fbb0> ;
196     schema:email "protocollo@pec.comune.trento.it" , "comurp@comune.trento.it" ;
197     schema:identifier "https://www.comune.trento.it"^^xsd:anyURI ;
198     schema:legalName "Comune di Trento" ;
199     schema:leiCode "P.IVA 00355870221" ;
200     schema:logo "https://www.comune.trento.it/var/comunetn/storage/images/10010715-1020-ita-IT/
Trento-Citta-Sito-ufficiale-del-Comune-di-Trento_header_logo.jpg"^^xsd:anyURI ;
201     schema:owns <https://www.epos-eu.org/epos-dcat-ap#Facility/2e0e4c74-7994-4e0b-8161-bb9d664ff5ee> , <https://www.epos-eu.org/epos-dcat-ap#Facility/b2babd57-0b6d-4dc7-a4e5-f0200bdc84cd> ;
202     schema:telephone "0461884111" ;
203     schema:url "https://www.comune.trento.it"^^xsd:anyURI .

204 <https://www.epos-eu.org/epos-dcat-ap#Distribution/0826cb75-f863-416f-9d7a-26354ef78d0a>
205     rdf:type dcat:Distribution ;
206     dct:conformsTo "https://wikipedia.org/wiki/AutoCAD_DXF" ;
207     dct:description "Taxi stands in DXF format." ;
208     dct:format "https://wikipedia.org/wiki/AutoCAD_DXF"^^xsd:anyURI ;
209     dct:identifier "https://dati.trentino.it/dataset/taxi-open-data/resource/
cc348fab-4d88-478c-9c8e-ce10834d13f6"^^xsd:anyURI ;
210     dct:issued "2018-05-04T00:00:00Z"^^xsd:dateTime ;
211     dct:language "Italian" , "English" ;
212     dct:license "https://creativecommons.org/publicdomain/zero/1.0"^^xsd:anyURI ;
213     dct:modified "2021-07-08T00:00:00Z"^^xsd:dateTime ;
214     dct:rights "https://creativecommons.org/publicdomain/zero/1.0" ;
215     dct:title "taxi.zip (DXF)" ;
216     dct:type "Collection"^^xsd:anyURI ;
217     spdx:checksum "md5 44726027a30e9bd006c4c8bb620c9c1" ;
218     adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/9bdbc17a-901c-45c6-af0d-aa1ab9c78981> ;
219     dcat:accessURL "https://dati.trentino.it/dataset/taxi-open-data/resource/
cc348fab-4d88-478c-9c8e-ce10834d13f6"^^xsd:anyURI ;
220     dcat:byteSize "3998.0"^^xsd:double ;
221     dcat:downloadURL "http://webapps.comune.trento.it/cartografia/gis/dbexport?db=base&sc=mobilita&ly=taxi&fr=
.dxf"^^xsd:anyURI ;
222     dcat:mediaType "application/zip" ;
223     foaf:page "https://dati.trentino.it/dataset/taxi-open-data/resource/cc348fab-4d88-478c-9c8e-ce10834d13f6" .
224
225 <https://www.epos-eu.org/epos-dcat-ap#Concept/036a954c-8ce4-4066-8084-ccf5e7638d86>
226     rdf:type skos:Concept ;
227     skos:definition "A motor vehicle licensed to transport passengers in return for payment of a fare and
typically fitted with a taximeter." ;
228     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/48a4bb61-bfec-4eed-9275-1351d9cc9e39> ;
229     skos:prefLabel "Taxi" .
230
231 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/7adc3dde-302d-4a86-8356-010ebd36fbb0>
232     rdf:type schema:ContactPoint ;
233     schema:availableLanguage "it-IT" ;
234     schema:contactType "Centralino" ;
235     schema:name "Centralino" ;
236     schema:telephone "0461889444" , "0461884111" .
237
238 <https://www.epos-eu.org/epos-dcat-ap#Facility/2e0e4c74-7994-4e0b-8161-bb9d664ff5ee>
239     rdf:type epos:Facility ;

```

---

```

240     dct:description "Ufficio relazioni con il pubblico" ;
241     dct:identifier "Ufficio relazioni con il pubblico" ;
242     dct:spatial <https://www.epos-eu.org/epos-dcat-ap#Location/c219cb05-d000-4343-88b0-16854d29f2ef> ;
243     dct:title "Ufficio relazioni con il pubblico" ;
244     dct:type <https://www.epos-eu.org/epos-dcat-ap#Concept/ecea9de3-6096-4fd7-9bc9-0d0443e43df0> ;
245     dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/4b11c132-26b0-4c53-b577-eface5f83d75>
246     ;
247     dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/ecea9de3-6096-4fd7-9bc9-0d0443e43df0> ;
foaf:page "https://www.comune.trento.it/Comunicazione/Dialoga-con-noi/Contattaci/URP"^^xsd:anyURI .

```

---

### 3.4 Evaluation

It's necessary to evaluate each phase from the schema and data level. In terms of schema and data level, we compare the class or Etype(s) in CQs with that in reference teleology and datasets respectively.

For the schema layer, we regard the GTFS as the reference ontology. Every field file of GTFS is considered as a class and the properties are the attributes inside every file. It can be counted that GTFS has 17 classes and 137 properties. Our CQs comprises 22 classes and 67 properties. Comparing our CQs and the reference ontology, it's not hard to find that they have 5 common classes and 22 common properties. Normally, we compute the Coverage and Extensiveness on knowledge level.

Hence the Etype Coverage is  $Cov(CQ_c) = 0.2273$  and the properties Coverage is  $Cov(CQ_p) = 0.3284$ . And the Etype Extensiveness is  $Ext(CQ_c) = 0.3529$  and the Property Extensiveness is  $Ext(CQ_p) = 0.6319$ . From the results, we can notice that the coverage metric achieves a low level due to our reference ontology that is a general purpose one. On the other hand, the extensiveness seems to suggest that our CQs are covering more specific concepts.

For the data layer, our datasets have 16 classes and 102 properties. And same as above, our CQs comprises 22 classes and 67 properties, among them 7 common classes and 25 common properties shared with datasets. We tend to apply Coverage and Sparsity.

Therefore the Etype Coverage is  $Cov(CQ_c) = 0.3182$  and the Properties Coverage is  $Cov(CQ_p) = 0.3731$ . In addition, the Etype Sparsity is  $Spr(CQ_c) = 0.7742$  and the Properties Coverage is  $Spr(CQ_p) = 0.8264$ .

# 4 Informal Modeling

This section is dedicated to the description of the informal modeling phase. Like in the previous section, the current one aims to describe the different sub activities performed by all the team members, as well as the phase outcomes produced.

More in details, this section provides a description of the following activities:

- Purpose formalization (informal modeling part) and Modeling sheet description
- ER model description
- Informal Modeling evaluation

## 4.1 Purpose Formalization

Informal modeling phase is an important connecting stage of iTelos, which forms the essential Etypes and concludes their corresponding properties from CQs. The extracted Etypes and the properties are the basis of the ER model. The whole procedures are divided into two parts. One associates with knowledge layer and the other is about data layer. Further purpose formalization is the crucial process of this phase concerning the knowledge layer, which is designed to improve analyzed CQs to classified and attributed CQs.

Classified CQs have confirmed the objects, functions, and actions, which are the components of the foundational teleology (FT). The accomplishment of the FT means it's closer to Entity Type Graph(ETG) since ETG is domain-specific top-level categories FT. After classified CQs, attributed CQs were created. Compared with classified CQs, attributed CQs concludes Etypes, Object properties, and data properties.

### 4.1.1 Classified Competency Questions

Classified CQs aims to find out the objects, functions, actions, which are the components of foundational teleology (FT). The accomplishment of the FT means it's closer to Entity Type Graph(ETG) since ETG is domain-specific top-level categories FT. The classified CQs table is as follows:

Competency Question	Common Kernel Concepts			Core Kernel Concepts			Contextual Kernel Concepts		
	Object	Function	Action	Object	Function	Action	Object	Function	Action

1	Person, Establishment, Building, Time, Place, Date, Weather, Vehicle, Location	Day, Public Transport, Commuter, Current Position	Stop, Time Table	Car, Train, Electric Scooter, Bicycle, Taxi, Cable Car	Library, School, Subscription Card	Raining
2	Person, Establishment, Building, Event, Place, Vehicle, Tool, Date, Time, Experience, Location, Unexpected	Public Transport, Private Transport	Stop	Electric Scooter, Electric Scooter, Depot, Bus	Application	Protest, Coupon, Delay, Distance, Current Position
3	Person, Establishment, Building, Time, Place, Date, Tool, Feeling, Sensation, Location	Day, Public Transport, Private Transport, Home, Friend	Time Table	Taxi, Taxi Station	Application, Money	Cinema, City, Safe, Phone Number, Distance, Current Position
4	Person, Time, Date, Area, Place, Experience, Location	Friend, Day		Bike, Bike Depot, Place		Subscription Card, Distance, Current Position

5	Person, Group, Establish- ment, Building, Street, Transport, Event, Time, Date, Emotion	Family, Home, House, Avenue, Relatives, Birthday, Party, Day, Fun, Late, Safety, Comfort- able	Time Table, Stop	Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Ca- ble Car	Location	Night, Sun- day	
6	Person, Job, Money, Building, Estab- lishment, Time, Date, Trip, Path, Route, Trans- portation, Vehicle, Occu- pation, Income	Waitress, Bar, Work- place, Day, Customer, Client, Fast, Drive	Stop, Time Table	Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Ca- ble Car	Driving License, Morning, In Time		
7	Person, Schedule, Class, Building, Estab- lishment, Time, Date, Weather, Body, Trans- portation, Vehicle, Health	School, Student, Day, Wa- ter, Eye, Window, Eyesight, Safe, Late	Stop, Time Table	Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Ca- ble Car	Location	Morning, Driving License	Raining

8	Date, Time, Per- son, Event, City, Country, Vehicle, Class, Internet, Reliability	Day, Academy, Confer- ence, Meeting, Capital, Airplane, Check-in, Smart- phone, Online, Late	Stop, Time Table	Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Ca- ble Car	Location	Airport
9	Person, Vehicle, Transport	Curiosity		Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Ca- ble Car	Trento	
10	Person, Money, Building, Establish- ment	Grandson, Depot, Thief, Ex- pensive, Late		Bicycle De- pot	Location	Bicycle
11	Person, Problem, Health, Date, Time, Ap- pointment, Event, Calendar, Vehicle, Trans- portation, Estab- lishment, Depart- ment, Treatment	Eye, Night, Waiting Family, Doctor, Hospital, Success	Time Table, Stop	Bus, Train	Ticket, Ac- cident, Lo- cation	Morning

12	Date, Time, Money, Price, City, Establish- ment, Build- ing, Path, Vehicle, Trans- portation, Person, Meal	Party, Bar, City Center	Cooking	Time Table, Stop	Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Ca- ble Car	Market, Route, Ticket, Location	Thursday, Morning
13	Person, Weather, Date, Time, Class, Estab- lishment, Building, Vehicle, Trans- portation, Trip, Feel- ing	Day, Dor- mitory, House,	University, Room, Wet	Time Table, Stop	Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Ca- ble Car	Route	Afternoon
14	Estab- lishment, Building, Science, Science, Data, Occupa- tion, Date, Time, Course, Class, Event, In- come, Job, Money, Vehicle, Trans- portation, Path	House, Data- Science, Student, Day, Uni- versity, Protest, Room, Dormitory	Time Table, Stop	Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Ca- ble Car	Route, Lo- cation	Monday, Strike, Morning	

15	Date, Time, Person, Establish- ment, Building, Property, Class, City, Trip, Vehicle, Trans- portation, Sensation, Feeling	Day, Dor- mitory, House, Year, Apart- ment, University, Center, Owner, Excitement	Borrowing Table, Stop	Time Table, Stop Bus, Stop Bicy- cle	Route, Lo- cation	Morning, Afternoon
16	Person, Establish- ment, Building, City, Date, Time, Trip, Location	Party, Bar, Day, Friend, Neighbour, Home, Fortune, Late	Table, Stop	Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Ca- ble Car	Route	Night
17	Vehicle, Estab- lishment, Building, Transport, Money	Home, Public Transprt, Ticket	Returning	Bus, Ticket Price		Origin, Destina- tion
18	Date, Time, Per- son, City, Sport, Event, Building, Estab- lishment, Trans- portation, Vehicle, Game, Weather, Compe- tition, Feeling, Sensation	Day, Box, Stadium, Film, Month, Match, Hot, Sweat	Table, Stop	Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Ca- ble Car	Location	Afternoon, Air Condi- tioner

19	Person, Time, Date, Weather, Temper- ature, Moun- tain, Shoe, Sport, Trans- portation, Activity, Path, Trip, Feeling, Emotion	Day, Sun, Climbing Friend, Warm, Sightsee- ing, Relax, Bad Luck, Suitable	Time Table, Stop	Cable Car	Location	Afternoon
20	Person, Building, Estab- lishment, Time, Date, In- jury, Body, Road, Street, Condition, Depart- ment, Trans- portation, Emotion, Feeling	Wife, Day, Leg, Kid, School, Hospital, Ward, Classroom, Scary, Flexibility	Time Table, Stop	Car, Bus, Train, Electric Scooter, Bicycle, Taxi, Ca-ble Car	Traffic, Lo- cation	Morning
21	Person, Date, Time, Weather, Place, Trail, Re- striction, Availabil- ity, Place, Building, Estab- lishment, Trans- portation, Ticket, Emotion, Feeling, Location	Day, Sunny Friend, Bike Trail, Stress, Hot, Fa- natic, Maniac	Time Table, Stop	Cable Car	Limitation	Bicycle, Morning, Evening

22	Job, Occupation, Date, Time, Income, Event, Commitment, Work, Condition, Trip, Route, Company, Establishment, Vehicle, Path, Money, Person	Month, Day, Stability, Interview, Meeting, Agency, Morning, Rejection, Late	Time Table, Stop	Bus, Train, Electric Scooter, Bicycle, Taxi, Cable Car	Location	In Time, Short, Fast
23	Building, Establishment, Inconvenience, Accident, Fluid, Person, Part, Time, Date, Collection, Event, Mobility, Road, People, Movement, Position, Path, Location	Home, Bathroom, Room, Pipe, Water, Phone, Phone Number, Colleague, Replace-ment, Day, Man, De-lay, Stamp, Danger, Ruin, Break, Lost, Sub-stitution, Disaster, Blocked, Crowd, Avoidm, Obstacle, Pedestrian, Slow, Fast	Time Table, Stop	Route Time Route		Strike, Road Closed, Car, Truck, Bus, Taxi, Fast, Current Location

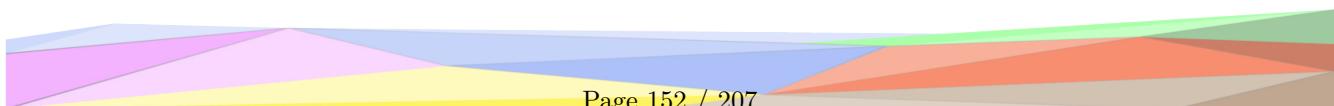
24	Person, Grade, Building, Establish- ment, Time, Date, Price, Payment, Work, Income, Occu- pation, Location	Daughter, School, College, Day, Cheap, Expensive	Ticket, Price, Time Table, Stop	Bus, Train, Electric Scooter, Bicycle, Taxi, Ca- ble Car	Ticket	Subscrip- tion Card
25	Work, Oc- cupation, Estab- lishment, Building, Feeling, Is- sue, Illness, Habit, Transport, Vehicle, Compli- cation, Pain, Date, Event, Body, Per- son, Time, Distance, Path, Decision	Home, Re- lax, Quiet, Migraine, Stress, Day, Noise, Chaos, Head, Commuter, Travel, Public Transport, Private Transport	Time Table, Stop	Bicycle, Electric Scooter, Bus, Taxi, Train	Preference, Delay	Sound- proofed, Strike

26	Appointment, Public Transport, Private Service, Extra-urban, Urban, Day, Village, Engine, Large, Heavy, Bulky, Blockage, Car, Truck, Driver, Police, Station, Station, Help, Repair, Unknown, Private Service	Time Table, Stop	Bus Stop	Location, Accident	Double Bus, Departure	
27	Person, Date, Time, Estab-lishment, Road, Event, Inconve-nience, Payment, Location, Plan, Period, Building, Vehicle, Knowl-edge, Path, Price, Ticket, Place	Day, Hus-band, Square, Stand, Mother, Closure, Free, Pay, Crowded, City Cen-ter, Sub-urbs, Morning, Afternoon, House, Public Transport, Private Transport, Avail-ability, Threshold, Family	Time Table, Stop	Car, Bus Stop	City, Dis-tance, Cost	Market, Parking

28	Person, Vehicle, Feeling, Sensation, Service, Building Establishment	Comfortable, Easy, Sharing, Station, Friend, Slots, Availability	Stop	Bike, Bike Station	Location	Nearest, Free Slots, Occupied Slots, Total Slots
29	Person, Establishment, Building, Location, Place, Date, Time, Sensation, Feeling, Health, Weather, City, Season, Transport, Equipment	Husband, Day, Public Transport, Mountain, Altitude, Village, Resort, Mobility, Special Needs	Time Table	Train, Train Station		Railway, Station, Hot, Summer, Weelchair, Air Conditioner, Platform
30	Person, Event, City, Vehicle, Service, Price	Daughter, Markets, Public Trans- ports, Shar- ing, Gift, Square	Stop	Car, Car-sharing	Location	Coupon Code, Nearest
31	Person, Establishment, Building, Location, Place, Time, Date, Issues, Equipment	Day, Hus- band, Public Transport, Home, Spe- cial Needs, Mobility, Shop	Stop, Time Table	Bus		Current Position, wheelchair, Platform

#### 4.1.2 Attributed Competency Questions

According to our classified Competency Questions and the collected datasets, we can conclude the essential Etype(s), and their object properties as well as data properties based on the hierarchical principle. The confirmation of Etype(s) definition and the construction of different Etype(s) relationship lay the primary foundation for the ER model. The explicit table of attributed CQs with respect to different classification (common, core, contextual) is



displayed as follows:

Etype	Object Property		Data Property	
	Object Property	Object type	Data Property	Data Type
TransportEnum			value	string
DirectionEnum			value	string
SupportedEnum			value	string
ParkingStopEnum			value	string
ExceptionEnum			value	string
CurrencyEnum			value	string
PaymentEnum			value	string
FareEnum			value	string
Agency			name email phone url	string string string string
Location			name latitude longitude	string float float
PublicTransportStop	location zone type wheelchair	Location Location TransportEnum SupportedEnum		
ParkingStop	location type	Location ParkingStopEnum	address totalSlots	string int
BikeSharingStop	location	Location	address totalSlots freeSlots bikes	string int int int
Route	agency transport	Agency TransportEnum	shortName longName	string string
Trip	route calendar direction wheelchair bike	Route Calendar DirectionEnum SupportedEnum SupportedEnum	name	string
Calendar			startDate endDate monday tuesday wednesday thursday friday saturday sunday	Date Date bool bool bool bool bool bool bool bool
CalendarException	calendar exception	Calendar ExceptionEnum	date	Date
StopTime	trip stop	Trip PublicTransportStop	arrival departure sequence	Time Time int

Fare	currency FareType payment	CurrencyEnum FareEnum PaymentEnum	price duration	float int
FareRule	fare origin destination	Fare Location Location		

#### 4.1.3 Classified Competency Questions and Attributed Competency Questions Metadata

Graph:

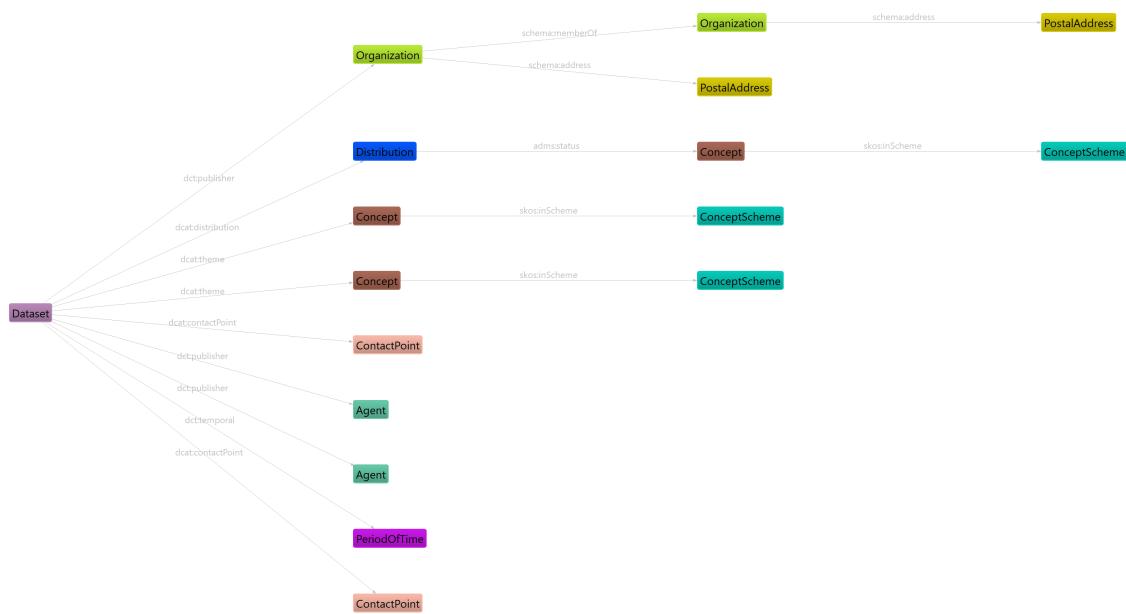


Figure 4.1: *Classified Competency Questions and Attributed Competency Questions* metadata graph

#### RDF Metadata:

```

1 @prefix : <https://www.epos-eu.org/epos-dcat-ap#> .
2 @prefix schema: <http://schema.org/> .
3 @prefix spdx: <http://spdx.org/rdf/terms#> .
4 @prefix owl: <http://www.w3.org/2002/07/owl#> .
5 @prefix gsp: <http://www.opengis.net/ont/geosparql#> .
6 @prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
7 @prefix skos: <http://www.w3.org/2004/02/skos/core#> .
8 @prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
9 @prefix hydra: <http://www.w3.org/ns/hydra/core#> .
10 @prefix geo: <http://www.w3.org/2003/01/geo/wgs84_pos#> .
11 @prefix oa: <http://www.w3.org/ns/oa#> .
12 @prefix dct: <http://purl.org/dc/terms/> .
13 @prefix sh: <http://www.w3.org/ns/shacl#> .
14 @prefix dcat: <http://www.w3.org/ns/dcat#> .
15 @prefix locn: <http://www.w3.org/ns/locn#> .
16 @prefix foaf: <http://xmlns.com/foaf/0.1/> .
17 @prefix epos: <https://www.epos-eu.org/epos-dcat-ap#> .

```

```

18 @prefix adms: <http://www.w3.org/ns/adms#> .
19 @prefix org: <http://www.w3.org/ns/org#> .
20 @prefix cnt: <http://www.w3.org/2011/content#> .
21 @prefix vcard: <http://www.w3.org/2006/vcard/ns#> .
22 @prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
23 @prefix http: <http://www.w3.org/2006/http#> .
24 @prefix dash: <http://datashapes.org/dash#> .
25 @prefix dc: <http://purl.org/dc/elements/1.1/> .

26
27 <https://www.epos-eu.org/epos-dcat-ap#Organization/2dad489f-4ce3-4e0d-9122-b70df55b8ef2>
28     rdf:type schema:Organization ;
29     schema:address <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/b0bb325d-f408-4dac-80e0-2389d8efb97f> ;
30     schema:email "knowdive@disi.unitn.it" ;
31     schema:identifier "http://knowdive.disi.unitn.it"^^xsd:anyURI ;
32     schema:legalName "Knowdive" ;
33     schema:leiCode "http://knowdive.disi.unitn.it" ;
34     schema:logo "http://knowdive.disi.unitn.it/wp-content/uploads/knowdive-new-logo.png"^^xsd:anyURI ;
35     schema:memberOf <https://www.epos-eu.org/epos-dcat-ap#Organization/78574deb-e40e-4c05-a5c6-40beeff01aa0> ;
36     schema:url "http://knowdive.disi.unitn.it"^^xsd:anyURI .

37
38 <https://www.epos-eu.org/epos-dcat-ap#Organization/78574deb-e40e-4c05-a5c6-40beeff01aa0>
39     rdf:type schema:Organization ;
40     schema:address <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/cd879ddb-55b6-4620-a0e4-c85a2df9f483> ;
41     schema:email "ateneo@unitn.it" , "ateneo@pec.unitn.it" ;
42     schema:identifier "www.unitn.it"^^xsd:anyURI ;
43     schema:legalName "Università degli Studi di Trento" ;
44     schema:leiCode "00340520220" ;
45     schema:logo "https://static-cdn.unitn.it/sites/www.unitn.it/themes/unitn_theme/images/newlogo_unitn_en.png"
46         ^^xsd:anyURI ;
47     schema:telephone "0461281111" ;
48     schema:url "www.unitn.it"^^xsd:anyURI .

49 <https://www.epos-eu.org/epos-dcat-ap#PeriodOfTime/84efa52e-3879-4d09-b0b9-36362e915866>
50     rdf:type dct:PeriodOfTime ;
51     schema:endDate "2022-01-25T00:00:00Z"^^xsd:dateTime ;
52     schema:startDate "2021-09-13T00:00:00Z"^^xsd:dateTime .

53
54 <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/b0bb325d-f408-4dac-80e0-2389d8efb97f>
55     rdf:type schema:PostalAddress ;
56     schema:addressCountry "IT" ;
57     schema:addressLocality "Povo (TN)" ;
58     schema:postalCode "I-38123" ;
59     schema:streetAddress "Via Sommarive 9" .

60
61 <https://www.epos-eu.org/epos-dcat-ap#Concept/4040fa1c-755a-4706-9fcf-b2e9d6fb755>
62     rdf:type skos:Concept ;
63     skos:definition "Land transport is the transport or movement of people, animals or goods from one location
64         to another location on land." ;
65     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/f913bd20-8e7b-4d82-9688-ca745a432f24> ;
66     skos:prefLabel "Land Transport" .

67 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/f913bd20-8e7b-4d82-9688-ca745a432f24>
68     rdf:type skos:ConceptScheme ;
69     dct:description "The movement of people or goods from one place to another." ;
70     dct:title "Transport" .

71
72 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ca07b831-220f-4c49-bc3b-6e8215eb3238>
73     rdf:type schema:ContactPoint ;
74     schema:availableLanguage "en-US" , "it-IT" ;
75     schema:contactType "Member" ;
76     schema:email "carlo.corradini@studenti.unitn.it" ;
77     schema:name "Carlo Corradini" .

78
79 <https://www.epos-eu.org/epos-dcat-ap#Concept/520bf2b3-6fcc-45ad-971a-b17df5fe98f0>

```

```

80    rdf:type skos:Concept ;
81    skos:definition "Inception is the second iTelos phase:\r\nInputs:\r\n * Classified Competency Questions (CQ
82      )\r\n * Datasets\r\n * Reference teleologies\r\nOutputs:\r\n * ER Model\r\n * Selected Datasets\r\nIn
83      order to understand and properly execute the Informal Modeling activities, we need to be familiar with
84      the notion of Ontology and, most important, we need to define what is a Teleology and why it is used
85      in iTelos.\r\nIt is not possible to produce a global schema with the objective to integrate all the
86      data available (can you model the world ?). For this reason the Datasets Selection activity plays a
87      crucial role in the identification of those datasets containing ALL and ONLY the information required
88      to satisfy the Purpose.\r\nWe've four foundational relational constructs in our foundational teleology
89      :\r\n * hasFunction: relates objects to functions and illustrates the fact that - objects can have one
90      or more admissible functions\r\n * hasFunctionAction: relates functions to actions and illustrates
91      the fact that - functions can be realized via one or more admissible functions\r\n * hasObjectAction:
92      relates objects to actions and illustrates the fact that - objects can have one or more admissible
93      functions\r\n * ObjectToObjectRelation models the diverse array of semantic relations existing between
94      different objects\r\nInformal Modeling phase:\r\n * Classified CQ (= each concept in Analysed CQ
95      further classified as Objects, Functions and Actions)\r\n * Attributed CQ (= each concept in
96      Classified CQ enriched with required object properties and data properties )\r\nThe Purpose
97      formalization Process is data driven.\r\nThe CQs, as well as the kernel concepts and ETypes and
98      Properties, are produced following the five-steps formalization process which always considers the
99      information available on the datasets collected. We cannot consider a kernel concept extracted from a
100     CQ that cannot be covered by any data collected.\r\nThe ETypes with their data and object properties
101     will be used to create the ER model, that will be in turn modeled on data." ;
102
103    skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/5edb028b-96af-4035-8d62-c253acd5a3c5> ;
104    skos:prefLabel "Informal Modeling Phase" .
105
106 <https://www.epos-eu.org/epos-dcat-ap#Distribution/2d8e5529-0e68-4e0d-af09-49a96f1c6c25>
107    rdf:type dcat:Distribution ;
108    dct:conformsTo "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W6.L11.M4.T11.2.1.
109      EvaluationTheory.pdf" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W6.
110      L10.M4.T11.1.3.ETypes&PropsExtraction.pdf" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/
111      material/slides/W2.L2.M2.T4.1.iTelosPrinciples.pdf" , "https://unitn-kdi-2021.github.io/
112      unitn-kdi-2021-website/material/slides/W6.L10.M4.T11.1.4.ERModel.pdf" , "https://unitn-kdi-2021.github
113      .io/unitn-kdi-2021-website/material/slides/W2.L3.M2.T4.2.iTelosStructure.pdf" , "https://
114      unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W6.L11.M4.T11.2.2.EvaluationP1-2.pdf"
115      ;
116
117    dct:description "Modeling Sheet is in xlsx format. See https://wikipedia.org/wiki/Microsoft\_Excel for more
118      information." , "Modeling Sheet template is available at https://unitn-kdi-2021.github.io/
120      unitn-kdi-2021-website/material/templates/ModelingSheet.xlsx" , "Modeling Sheet Metadata regarding
121      Trentino Transportation." ;
122
123    dct:format "https://en.wikipedia.org/wiki/Microsoft_Excel"^^xsd:anyURI ;
124
125    dct:identifier "https://github.com/carloccorradini/Trentino-Transportation/tree/main/Teleologies/Informal%20
126      Modeling"^^xsd:anyURI ;
127
128    dct:issued "2021-12-10T00:00:00Z"^^xsd:dateTime ;
129
130    dct:language "English" ;
131
132    dct:license "https://opensource.org/licenses/MIT"^^xsd:anyURI ;
133
134    dct:modified "2021-12-10T00:00:00Z"^^xsd:dateTime ;
135
136    dct:rights "https://opensource.org/licenses/MIT" ;
137
138    dct:title "Modeling Sheet" , "Trentino Transportation" ;
139
140    dct:type "Collection"^^xsd:anyURI ;
141
142    spdx:checksum "md5 a0a4af8d2a8ba66e0e5b490ced32d8a2" ;
143
144    adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/b9645f82-9500-414c-a51d-255ff657c69e> ;
145
146    dcat:accessURL "https://drive.google.com/drive/folders/177nmXMqyy0tTm-a8-c8EsFviFBoBB3HX?usp=sharing"^^xsd:
147      anyURI , "https://github.com/carloccorradini/Trentino-Transportation/tree/main/Teleologies/Informal%20
148      Modeling"^^xsd:anyURI ;
149
150    dcat:byteSize "45981.0"^^xsd:double ;
151
152    dcat:downloadURL "https://github.com/carloccorradini/Trentino-Transportation/raw/main/Teleologies/Informal
153      %20Modeling/ModelingSheet.xlsx"^^xsd:anyURI ;
154
155    dcat:mediaType "application/vnd.openxmlformats-officedocument.spreadsheetml.sheet" ;
156
157    foaf:page "https://github.com/carloccorradini/Trentino-Transportation" .
158
159
160 <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/cd879ddb-55b6-4620-a0e4-c85a2df9f483>
161
162    rdf:type schema:PostalAddress ;
163
164    schema:addressCountry "IT" ;
165
166    schema:addressLocality "Trento" ;

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110     schema:postalCode "38122" ;
111     schema:streetAddress "Via Calepina 14" .
112
113 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/a21146bd-a38c-49fe-a02f-f8575d1d73e2>
114     rdf:type skos:ConceptScheme ;
115     dct:description "The position or rank of someone or something when compared to others in a society,
116     organization, group, etc." ;
117     dct:title "Status" .
118
119 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/5edb028b-96af-4035-8d62-c253acd5a3c5>
120     rdf:type skos:ConceptScheme ;
121     dct:description "The DI Purpose, expressed by the final user as a natural language sentence, define the
122     main goal for the whole data integration. It represent what the final user should be able to do
123     exploiting the DI final outcome (KG). Due to that, the Purpose leads the whole integration process and
124     makes iTelos be a Purpose driven DI methodology.\r\nDomain of Interest (DoI): The portion of the
125     world that involves all the information elements used to satisfy a specific purpose.\r\nIn order to
126     identify the level of reusability of the resources collected and handled along the methodology.\r\n
127     iTelos Data Life Cycle:\r\n * Data Collection & Preparation (DTA-1): align the different sources data
128     formats, and data standards, representing the information carried through a single data format. The
129     aligned data can be then collected within the methodologies Input Repository\r\n * Syntactic Alignment
130     (DTA-2.1): align the data value formats by adopting the same data standards for similar data types\r\n
131     * Semantic Alignment (DTA-2.2): align the semantic of the data (entity schema representation and word
132     sense disambiguation)\r\n * Entity Matching (DTA-2.3): align modeled entities with already existing
133     representations of the same entities\r\n * Application Alignment (DTA-3): the last transformation (
134     considered as out of scope for the DI methodology) aims to align the integrated data in order to let
135     them suitable to be used by a specific application\r\nTeleology is the study of ends and goals, things
136     whose existence or occurrence is purposive. Concretely, in our context, teleologies are ontologies
137     but with the proviso that teleologies focus on function and on how a chosen representation fits a
138     certain purpose. In other words, the teleologies are the way adopted in the DI methodology (iTelos) to
139     model (design, represent) the information that needs to be exploited by final users.\r\nA KG, as
140     result of a DI process, is composed by knowledge (teleologies) and data (datasets) resources combined
141     together in the best way possible in order to achieve the users Purpose. There are three different
142     approaches to build such kind of KGs:\r\n * Knowledge centric: The data schema design comes first and
143     then the data are aligned to it.\r\n * Data centric: The data schema is mainly (some adaptation are
144     always required) extracted from the data to be integrated.\r\n * Middle-out approach: The data schema
     (teleology) is designed considering already existing knowledge resources AND the data. While the
     datasets are adapted to the schema designed." ;
145     dct:title "iTelos Principles" .
146
147 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/3a8a3044-3e7a-463d-94d9-15c4f4822938>
148     rdf:type schema>ContactPoint ;
149     schema:availableLanguage "zh-CN" , "en-US" ;
150     schema:contactType "Member" ;
151     schema:email "xuanli.li@studenti.unitn.it" ;
152     schema:name "Xuanli Li" .
153
154 <https://www.epos-eu.org/epos-dcat-ap#Concept/b9645f82-9500-414c-a51d-255ff657c69e>
155     rdf:type skos:Concept ;
156     skos:definition "Containing all the necessary parts, answers, or information." ;
157     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/a21146bd-a38c-49fe-a02f-f8575d1d73e2> ;
158     skos:prefLabel "Completed" .
159
160 <https://www.epos-eu.org/epos-dcat-ap#Agent/828bf6b9-9f4b-4355-bcd0-d68b188811cb>
161     rdf:type foaf:Agent ;
162     foaf:name "Carlo Corradini" .
163
164 <https://www.epos-eu.org/epos-dcat-ap#Dataset/3a2e0c02-aeba-44d1-b688-a5e21d81d088>
165     rdf:type dcat:Dataset ;
166     dct:accessRights "Public" ;
167     dct:accrualPeriodicity "Once"^^xsd:anyURI ;
168     dct:conformsTo "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W6.L10.M4.T11.1.3.
169     ETypes&PropsExtraction.pdf" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/
     /W6.L11.M4.T11.2.2.EvaluationP1-2.pdf" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/
     material/slides/W6.L10.M4.T11.1.4.ERModel.pdf" , "iTelos" , "https://unitn-kdi-2021.github.io/

```

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unitn-kdi-2021-website/material/slides/W6.L10.M4.T11.1.1-2.FoundationalTeleology.pdf" , "https://
unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W6.L11.M4.T11.2.1.EvaluationTheory.pdf
" ;
145   dct:created "2021-09-13T00:00:00Z"^^xsd:dateTime ;
146   dct:description "For more information see the following websites: https://unitn-kdi-2021.github.io/
      unitn-kdi-2021-website https://drive.google.com/drive/folders/12p27IFsmy9Us4AD2lw_0fEvl1k7BaIMk?usp=
      sharing https://github.com/carlocorradini/Trentino-Transportation" , "The project is related to the
      Knowledge and Data integration (KDI) course held in the academic year 2021/2022 at the University of
      Trento (UNITN)." , "Carlo Corradini (https://github.com/carlocorradini) and Xuanli Li(https://github.com/xuanli666) are the members assigned to the realization and finalization." , "With the development
      of big data technology and cloud storage technology, we are in an era of the rapid increase in
      information, with countless data or knowledge. How to manage these data and achieve more efficient
      sharing and utilization is an area that many researchers are exploring, that is, to fulfill the
      integration of knowledge and data in specific, rather than leaving information be unorganized. This
      report focuses on integrating all the public transportation as well as sharing vehicles information
      within Trentino so that a more complete transport information system could help people make a better
      decision and save time or money as much as possible. Specifically, we pay attention to the application
      of vehicles that GTFS has not covered, such as sharing bikes, sharing cars, and so on so forth, which
      is added to the system, and then residents have more choices when determining paths." , "Inception
      Sheet Metadata regarding Trentino Transportation." , "This project aims to comprehensively consider
      the transportation situations under the specific Trentino region, not only involving the public
      transportation services but also the personal tracks. Collecting the latest temporal and spatial
      information and integrating the data and knowledge from diverse sources. Public transportation
      services, vehicles, bus stations, train stations, railways, highways, simple streets, public
      transportation service timelines, and trip schedules are the main important elements that will be
      mainly paid attention, besides, the mixed using of some vehicles and the parking path will be
      exploring." ;
147   dct:identifier "https://github.com/carlocorradini/Trentino-Transportation/tree/main/Teleologies/Informal%20Modeling"^^xsd:anyURI ;
148   dct:issued "2021-12-10T00:00:00Z"^^xsd:dateTime ;
149   dct:language "English" ;
150   dct:modified "2021-12-10T00:00:00Z"^^xsd:dateTime ;
151   dct:publisher <https://www.epos-eu.org/epos-dcat-ap#Organization/2dad489f-4ce3-4e0d-9122-b70df55b8ef2> , <
      https://www.epos-eu.org/epos-dcat-ap#Agent/828bf6b9-9f4b-4355-bcd0-d68b188811cbhttps://www.epos-eu.org/epos-dcat-ap#Agent/f9cfb89e-3bb9-41ba-b263-e0386fce30ed> ;
152   dct:temporal <https://www.epos-eu.org/epos-dcat-ap#PeriodOfTime/84efa52e-3879-4d09-b0b9-36362e915866> ;
153   dct:title "Modeling Sheet Metadata" ;
154   dct:type "Collection"^^xsd:anyURI ;
155   dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/3a8a3044-3e7a-463d-94d9-15c4f4822938>
      , <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ca07b831-220f-4c49-bc3b-6e8215eb3238> ;
156   dcat:distribution <https://www.epos-eu.org/epos-dcat-ap#Distribution/2d8e5529-0e68-4e0d-af09-49a96f1c6c25>
      ;
157   dcat:keyword "Fausto Giunchiglia" , "Xuanli Li" , "fare" , "bike" , "Knowledge and Data integration" , "bus
      " , "Simone Bocca" , "extra-urban transport" , "trentino trasporti" , "car sharing" , "KDI" , "iTilos"
      , "public transport" , "UniTN" , "cash" , "taxi" , "cable car" , "Carlo Corradini" , "train" , "
      University of Trento" , "trento" , "bike sharing" , "transport" , "price" , "trentino" , "mobile" , "
      trip" , "parking" , "ticket" , "route" , "cartascalare" , "bike parking" , "urban transport" ;
158   dcat:landingPage "https://github.com/carlocorradini/Trentino-Transportation" ;
159   dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/4040fa1c-755a-4706-9fcfd-b2e9d6fbb755> , <https://www.epos-eu.org/epos-dcat-ap#Concept/520bf2b3-6fcc-45ad-971a-b17df5fe98f0> ;
160   foaf:page "https://github.com/carlocorradini/Trentino-Transportation" .
161
162 <https://www.epos-eu.org/epos-dcat-ap#Agent/f9cfb89e-3bb9-41ba-b263-e0386fce30ed>
163   rdf:type foaf:Agent ;
164   foaf:name "Xuanli Li" .

```

---

## 4.2 ER Model

In line with the attributed CQs table, the 3 components, Etypes, object properties, and the data properties in the domain of transportation can be assembled into the ER model, which is the extensive version of the schema since it clearly shows the functions and actions between the Etypes except objects.

Besides, the Etypes' classes are clarified. From our ER model graph 4.2, it clearly manifests that Location, Fare, Trip, Agency, Route are the common Etypes and FareRule, LocationType, ParkingStop, BikesharingStop, PublicTransportStop, Stoptime, CalendarExpectation, and Calendar are the core Etypes. Moreover, we created the class Enumeration to list all the subclass of some Etypes. Furthermore, the data type of date and time are utilized only from the logic view since KOS doesn't support date and time only but a full datetime. Therefore, it is a forced procedure done to align the unsupported data type in KOS. The all Enums for different objects are considered as contextual concepts in our the ER model. And the table below explains it in detail:

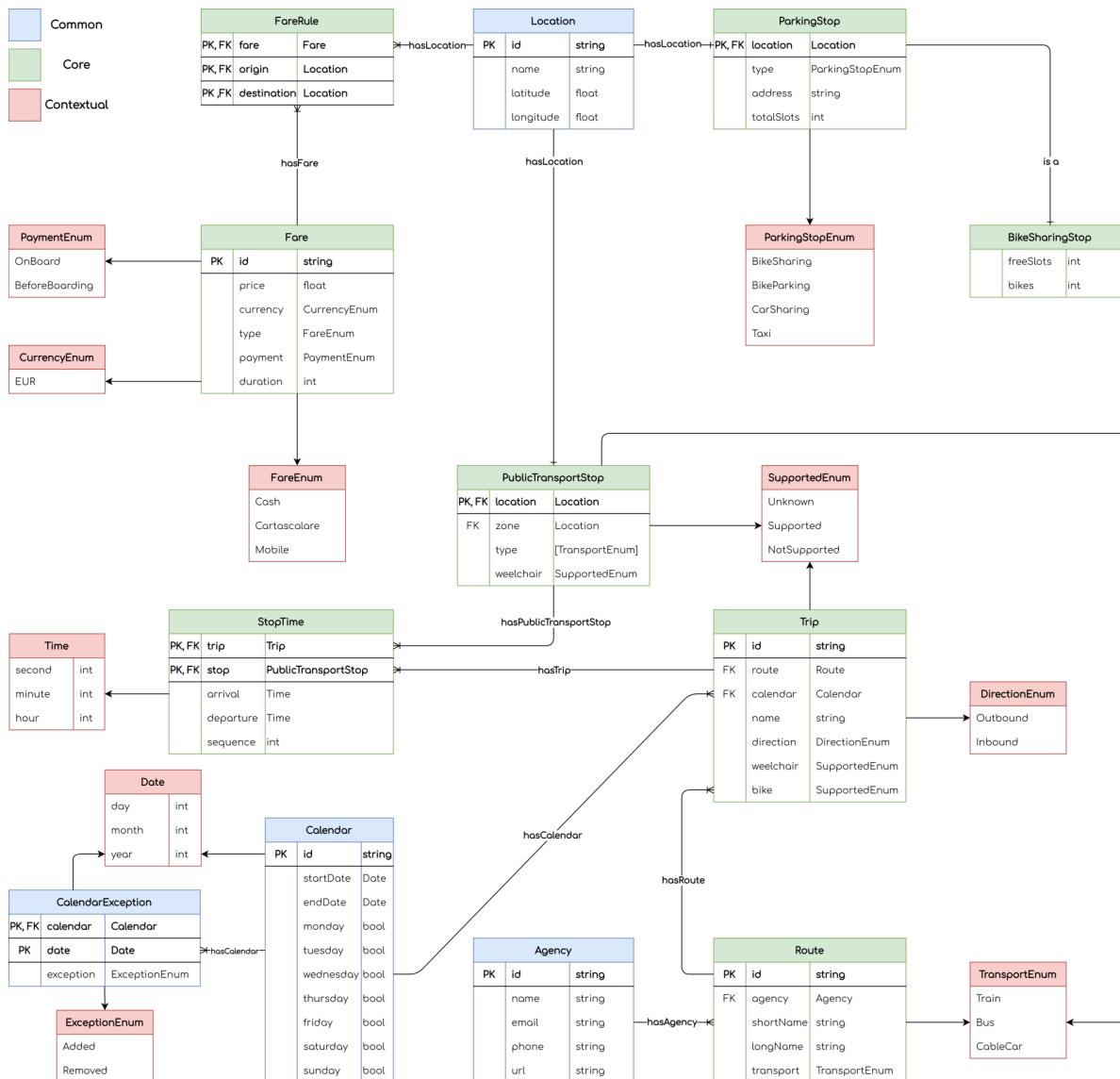
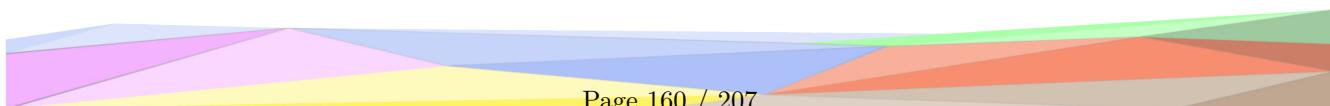


Figure 4.2: ER model of Trentino Transportation

Types	Objects	Description	hasFunction
Common	Location	A generic location with name, latitude, longitude.	
	Agency	Specify the name and contact ways of the agency.	
	Calendar	Check some days from the perspective of which day in a week.	
	CalendarException	Specify the date of a calendar and if there is an exception in respect with the agenda.	<ul style="list-style-type: none"> <li>• has_Calendar</li> <li>• has_ExceptionEnum</li> </ul>
Core	Route	Specify the name, the relevant agency and the modes of the transport of the route.	<ul style="list-style-type: none"> <li>• has_Agency</li> <li>• has_TransportEnum</li> </ul>
	Trip	Specify the name, direction, routes, calendar of the trip and if the trip supports taking wheelchairs and bikes.	<ul style="list-style-type: none"> <li>• has_Calendar</li> <li>• has_Route</li> <li>• has_DirectionEnum</li> <li>• has_SupportedEnum</li> </ul>
	ParkingStop	Specify the address, location, and total number of available slots of various paring area.	<ul style="list-style-type: none"> <li>• has_Location</li> <li>• has_Park- ingStopEnum</li> </ul>
	BikeShaingStop	Specify additional information for bike sharing stops except the common attributes of parkingStop.	
	PublicTransportStop	Specify the zone, and clear location of each public transport stop and make sure if it supports wheelchair.	<ul style="list-style-type: none"> <li>• has_Location</li> <li>• has_TransportEnum</li> <li>• has_SupportedEnum</li> </ul>
	StopTime	Specify the arrival, departure time, and the stopping sequence after clarifying trip and public transport stop.	<ul style="list-style-type: none"> <li>• has_Trip</li> <li>• has_PublicTransport- Stop</li> </ul>
	Fare	Specify the some rules about the cost of trips, that is, price, currency, the way to pay, and when to pay and the effective period.	<ul style="list-style-type: none"> <li>• has_CurrencyEnum</li> <li>• has_FareEnum</li> <li>• has_PaymenEnum</li> </ul>



	FareRule	Offer the primary keys to ensure the fare.	<ul style="list-style-type: none"> <li>• has_Fare</li> <li>• has_Location</li> </ul>
<b>Contextual</b>	ParkingStopEnum	Specify the specific type of stop. There is the list of stop types: <ul style="list-style-type: none"> <li>• BikeSharingStop</li> <li>• BikeParkingStop</li> <li>• CarSharingStop</li> <li>• Taxi</li> </ul>	
	TransportEum	List three kinds of public vehicles can be used for people in Trentino: <ul style="list-style-type: none"> <li>• Train</li> <li>• Bus</li> <li>• CableBus</li> </ul>	
	PaymentEnum	Offer 2-time choices for payment: <ul style="list-style-type: none"> <li>• OnBoard</li> <li>• BeforeBoarding</li> </ul>	
	CurrencyEnum	Aims to choose the currency type and necessary way to pay the cost by EUR in Trentino.	
	FareEnum	Specify the payment way of the fare. Three ways are listed here: <ul style="list-style-type: none"> <li>• Cash</li> <li>• Cartascalare</li> <li>• Mobile</li> </ul>	
	SupportedEnum	Specify if the public vehicles can take wheelchairs or bikes. <ul style="list-style-type: none"> <li>• Unknown</li> <li>• Supported</li> <li>• NotSupported</li> </ul>	
	DirectionEnum	2 directions for the trip. <ul style="list-style-type: none"> <li>• Outbound</li> <li>• Inbound</li> </ul>	

	ExceptionEnum	Ensure that if the trip has been added or removed: <ul style="list-style-type: none"><li>• Added</li><li>• Removed</li></ul>
--	---------------	--

Table 4.3: ER model description

#### 4.2.1 ER Model Metadata

Graph:

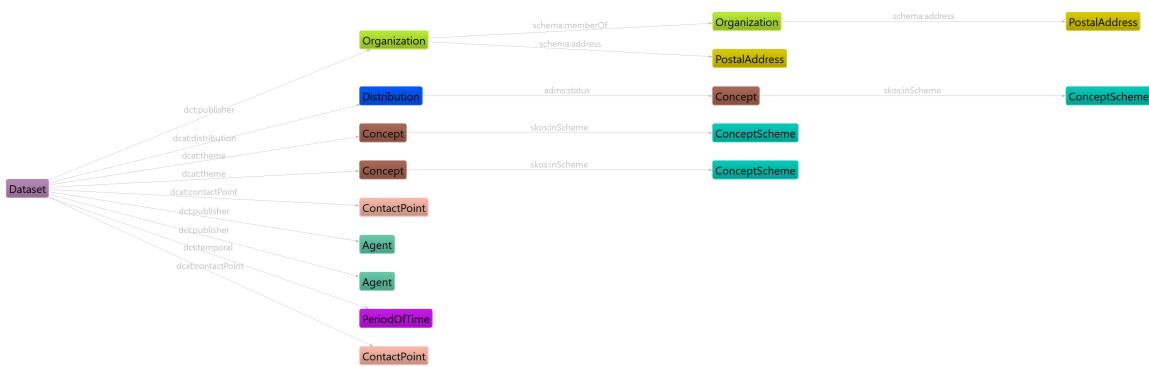


Figure 4.3: Entity Relational Model metadata graph

#### RDF Metadata:

```

1 @prefix : <https://www.epos-eu.org/epos-dcat-ap#> .
2 @prefix schema: <http://schema.org/> .
3 @prefix spdx: <http://spdx.org/rdf/terms#> .
4 @prefix owl: <http://www.w3.org/2002/07/owl#> .
5 @prefix gsp: <http://www.opengis.net/ont/geosparql#> .
6 @prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
7 @prefix skos: <http://www.w3.org/2004/02/skos/core#> .
8 @prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
9 @prefix hydra: <http://www.w3.org/ns/hydra/core#> .
10 @prefix geo: <http://www.w3.org/2003/01/geo/wgs84_pos#> .
11 @prefix oa: <http://www.w3.org/ns/oa#> .
12 @prefix dct: <http://purl.org/dc/terms/> .
13 @prefix sh: <http://www.w3.org/ns/shacl#> .
14 @prefix dcat: <http://www.w3.org/ns/dcat#> .
15 @prefix locn: <http://www.w3.org/ns/locn#> .
16 @prefix foaf: <http://xmlns.com/foaf/0.1/> .
17 @prefix epos: <https://www.epos-eu.org/epos-dcat-ap#> .
18 @prefix adms: <http://www.w3.org/ns/adms#> .
19 @prefix org: <http://www.w3.org/ns/org#> .
20 @prefix cnt: <http://www.w3.org/2011/content#> .
21 @prefix vcard: <http://www.w3.org/2006/vcard/ns#> .
22 @prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
23 @prefix http: <http://www.w3.org/2006/http#> .
24 @prefix dash: <http://datashapes.org/dash#> .
25 @prefix dc: <http://purl.org/dc/elements/1.1/> .
26
27 <https://www.epos-eu.org/epos-dcat-ap#Organization/2dad489f-4ce3-4e0d-9122-b70df55b8ef2>
  
```

```

28   rdf:type schema:Organization ;
29   schema:address <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/b0bb325d-f408-4dac-80e0-2389d8efb97f> ;
30   schema:email "knowdive@disi.unitn.it" ;
31   schema:identifier "http://knowdive.disi.unitn.it"^^xsd:anyURI ;
32   schema:legalName "Knowdive" ;
33   schema:leiCode "http://knowdive.disi.unitn.it" ;
34   schema:logo "http://knowdive.disi.unitn.it/wp-content/uploads/knowdive-new-logo.png"^^xsd:anyURI ;
35   schema:memberOf <https://www.epos-eu.org/epos-dcat-ap#Organization/78574deb-e40e-4c05-a5c6-40beef01aa0> ;
36   schema:url "http://knowdive.disi.unitn.it"^^xsd:anyURI .
37
38 <https://www.epos-eu.org/epos-dcat-ap#Organization/78574deb-e40e-4c05-a5c6-40beef01aa0>
39   rdf:type schema:Organization ;
40   schema:address <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/cd879ddb-55b6-4620-a0e4-c85a2df9f483> ;
41   schema:email "ateneo@unitn.it" , "ateneo@pec.unitn.it" ;
42   schema:identifier "www.unitn.it"^^xsd:anyURI ;
43   schema:legalName "Università degli Studi di Trento" ;
44   schema:leiCode "00340520220" ;
45   schema:logo "https://static-cdn.unitn.it/sites/www.unitn.it/themes/unitn_theme/images/newlogo_unitn_en.png"
46   ^^^xsd:anyURI ;
46   schema:telephone "0461281111" ;
47   schema:url "www.unitn.it"^^xsd:anyURI .
48
49 <https://www.epos-eu.org/epos-dcat-ap#PeriodOfTime/84efa52e-3879-4d09-b0b9-36362e915866>
50   rdf:type dct:PeriodOfTime ;
51   schema:endDate "2022-01-25T00:00:00Z"^^xsd:dateTime ;
52   schema:startDate "2021-09-13T00:00:00Z"^^xsd:dateTime .
53
54 <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/b0bb325d-f408-4dac-80e0-2389d8efb97f>
55   rdf:type schema:PostalAddress ;
56   schema:addressCountry "IT" ;
57   schema:addressLocality "Povo (TN)" ;
58   schema:postalCode "I-38123" ;
59   schema:streetAddress "Via Sommarive 9" .
60
61 <https://www.epos-eu.org/epos-dcat-ap#Concept/4040fa1c-755a-4706-9fcd-b2e9d6fbb755>
62   rdf:type skos:Concept ;
63   skos:definition "Land transport is the transport or movement of people, animals or goods from one location
64   to another location on land." ;
65   skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/f913bd20-8e7b-4d82-9688-ca745a432f24> ;
66   skos:prefLabel "Land Transport" .
67
67 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/f913bd20-8e7b-4d82-9688-ca745a432f24>
68   rdf:type skos:ConceptScheme ;
69   dct:description "The movement of people or goods from one place to another." ;
70   dct:title "Transport" .
71
72 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ca07b831-220f-4c49-bc3b-6e8215eb3238>
73   rdf:type schema>ContactPoint ;
74   schema:availableLanguage "en-US" , "it-IT" ;
75   schema:contactType "Member" ;
76   schema:email "carlo.corradini@studenti.unitn.it" ;
77   schema:name "Carlo Corradini" .
78
79 <https://www.epos-eu.org/epos-dcat-ap#Concept/520bf2b3-6fcc-45ad-971a-b17df5fe98f0>
80   rdf:type skos:Concept ;
81   skos:definition "Inception is the second iTelos phase:\r\nInputs:\r\n * Classified Competency Questions (CQ
82   )\r\n * Datasets\r\n * Reference teleologies\r\nOutputs:\r\n * ER Model\r\n * Selected Datasets\r\nIn
83   order to understand and properly execute the Informal Modeling activities, we need to be familiar with
84   the notion of Ontology and, most important, we need to define what is a Teleology and why it is used
85   in iTelos.\r\nIt is not possible to produce a global schema with the objective to integrate all the
86   data available (can you model the world ?). For this reason the Datasets Selection activity plays a
87   crucial role in the identification of those datasets containing ALL and ONLY the information required
88   to satisfy the Purpose.\r\nWe have four foundational relational constructs in our foundational teleology
89   :\r\n * hasFunction: relates objects to functions and illustrates the fact that - objects can have one

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or more admissible functions\r\n \* hasFunctionAction: relates functions to actions and illustrates the fact that - functions can be realized via one or more admissible functions\r\n \* hasObjectAction: relates objects to actions and illustrates the fact that - objects can have one or more admissible functions\r\n \* ObjectToObjectRelation models the diverse array of semantic relations existing between different objects\r\n \* Informal Modeling phase:\r\n \* Classified CQ (= each concept in Analysed CQ further classified as Objects, Functions and Actions)\r\n \* Attributed CQ (= each concept in Classified CQ enriched with required object properties and data properties )\r\n The Purpose formalization Process is data driven.\r\n The CQs, as well as the kernel concepts and ETypes and Properties, are produced following the five-steps formalization process which always considers the information available on the datasets collected. We cannot consider a kernel concept extracted from a CQ that cannot be covered by any data collected.\r\n The ETypes with their data and object properties will be used to create the ER model, that will be in turn modeled on data.\r\n The general methodology for modelling the purpose specific ER comprise the following (flexible) steps:\r\n \* Specify the reference context, viz. Thing, in the context of our Purpose\r\n \* Instantiate the Object Partonomy with respect to Thing\r\n \* Relate each object to its (proper) function(s)\r\n \* Relate each function to its (admissible) action(s)\r\n \* Relate each object to its (admissible) action(s)\r\n Some general observations regarding the methodology for modelling of the ER are as follows:\r\n \* iTelos is completely flexible in terms of the various combination of concepts (amongst objects, functions and actions) required for modelling a particular scenario w.r.t a reference context\r\n \* The flexibility is achieved via the usage of customized teleological patterns for specific modelling requirements. Examples being Object hierarchies, Object-Function patterns, Object-Action patterns etc\r\n \* For instance, in geospatial domain, we can collapse all the concepts in an object hierarchy (as functions and actions might be irrelevant to model)\r\n \* Similarly, in process modelling, representing actions are of utmost importance" ;

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82 skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/5edb028b-96af-4035-8d62-c253acd5a3c5> ;
83 skos:prefLabel "Informal Modeling Phase" .
84
85 <https://www.epos-eu.org/epos-dcat-ap#Distribution/2d8e5529-0e68-4e0d-af09-49a96f1c6c25>
86 rdf:type dcat:Distribution ;
87 dct:conformsTo "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W6.L10.M4.T11.1.3.ETypes&PropsExtraction.pdf" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W2.L2.M2.T4.1.iTelosPrinciples.pdf" , "https://en.wikipedia.org/wiki/Portable\_Network\_Graphics" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W6.L10.M4.T11.1.4.ERModel.pdf" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W2.L3.M2.T4.2.iTelosStructure.pdf" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W6.L11.M4.T11.2.2.EvaluationP1-2.pdf" ;
88 dct:description "Entity Relational Model regarding Trentino Transportation." , "Entity Relational Model in PNG format. See https://en.wikipedia.org/wiki/Portable\_Network\_Graphics for more information." ;
89 dct:format "https://en.wikipedia.org/wiki/Microsoft\_Excel"^^xsd:anyURI ;
90 dct:identifier "https://github.com/carloccorradini/Trentino-Transportation/tree/main/Teleologies/Informal%20Modeling"^^xsd:anyURI ;
91 dct:issued "2021-12-10T00:00:00Z"^^xsd:dateTime ;
92 dct:language "English" ;
93 dct:license "https://opensource.org/licenses/MIT"^^xsd:anyURI ;
94 dct:modified "2021-12-10T00:00:00Z"^^xsd:dateTime ;
95 dct:rights "https://opensource.org/licenses/MIT" ;
96 dct:title "Entity Relational Model" , "Trentino Transportation" ;
97 dct:type "Collection"^^xsd:anyURI ;
98 spdx:checksum "md5 019b40f33fada85590f6642047f9a01b" ;
99 adms:status <https://www.epos-eu.org/epos-dcat-ap#Concept/b9645f82-9500-414c-a51d-255ff657c69e> ;
100 dcat:accessURL "https://drive.google.com/drive/folders/177nmXMqyy0tTm-a8-c8EsFviFBoBB3HX?usp=sharing"^^xsd:anyURI , "https://github.com/carloccorradini/Trentino-Transportation/tree/main/Teleologies/Informal%20Modeling"^^xsd:anyURI ;
101 dcat:byteSize "1678120.0"^^xsd:double ;
102 dcat:downloadURL "https://github.com/carloccorradini/Trentino-Transportation/raw/main/Teleologies/Informal%20Modeling/er.png"^^xsd:anyURI ;
103 dcat:mediaType "image/png" ;
104 foaf:page "https://github.com/carloccorradini/Trentino-Transportation" .
105
106 <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/cd879ddb-55b6-4620-a0e4-c85a2df9f483>
107 rdf:type schema:PostalAddress ;
108 schema:addressCountry "IT" ;
109 schema:addressLocality "Trento" ;
  
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110     schema:postalCode "38122" ;
111     schema:streetAddress "Via Calepina 14" .
112
113 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/3a8a3044-3e7a-463d-94d9-15c4f4822938>
114     rdf:type schema:ContactPoint ;
115     schema:availableLanguage "zh-CN" , "en-US" ;
116     schema:contactType "Member" ;
117     schema:email "xuanli.li@studenti.unitn.it" ;
118     schema:name "Xuanli Li" .
119
120 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/5edb028b-96af-4035-8d62-c253acd5a3c5>
121     rdf:type skos:ConceptScheme ;
122     dct:description "The DI Purpose, expressed by the final user as a natural language sentence, define the
main goal for the whole data integration. It represent what the final user should be able to do
exploiting the DI final outcome (KG). Due to that, the Purpose leads the whole integration process and
makes iTelos be a Purpose driven DI methodology.\r\nDomain of Interest (DoI): The portion of the
world that involves all the information elements used to satisfy a specific purpose.\r\nIn order to
identify the level of reusability of the resources collected and handled along the methodology.\r\n
iTilos Data Life Cycle:\r\n * Data Collection & Preparation (DTA-1): align the different sources data
formats, and data standards, representing the information carried through a single data format. The
aligned data can be then collected within the methodologies Input Repository\r\n * Syntactic Alignment
(DTA-2.1): align the data value formats by adopting the same data standards for similar data types\r\n
* Semantic Alignment (DTA-2.2): align the semantic of the data (entity schema representation and word
sense disambiguation)\r\n * Entity Matching (DTA-2.3): align modeled entities with already existing
representations of the same entities\r\n * Application Alignment (DTA-3): the last transformation (
considered as out of scope for the DI methodology) aims to align the integrated data in order to let
them suitable to be used by a specific application\r\nTeleology is the study of ends and goals, things
whose existence or occurrence is purposive. Concretely, in our context, teleologies are ontologies
but with the proviso that teleologies focus on function and on how a chosen representation fits a
certain purpose. In other words, the teleologies are the way adopted in the DI methodology (iTilos) to
model (design, represent) the information that needs to be exploited by final users.\r\nA KG, as
result of a DI process, is composed by knowledge (teleologies) and data (datasets) resources combined
together in the best way possible in order to achieve the users Purpose. There are three different
approaches to build such kind of KGs:\r\n * Knowledge centric: The data schema design comes first and
then the data are aligned to it.\r\n * Data centric: The data schema is mainly (some adaptation are
always required) extracted from the data to be integrated.\r\n * Middle-out approach: The data schema
(teleology) is designed considering already existing knowledge resources AND the data. While the
datasets are adapted to the schema designed." ;
123     dct:title "iTilos Principles" .
124
125 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/a21146bd-a38c-49fe-a02f-f8575d1d73e2>
126     rdf:type skos:ConceptScheme ;
127     dct:description "The position or rank of someone or something when compared to others in a society,
organization, group, etc." ;
128     dct:title "Status" .
129
130 <https://www.epos-eu.org/epos-dcat-ap#Concept/b9645f82-9500-414c-a51d-255ff657c69e>
131     rdf:type skos:Concept ;
132     skos:definition "Containing all the necessary parts, answers, or information." ;
133     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/a21146bd-a38c-49fe-a02f-f8575d1d73e2> ;
134     skos:prefLabel "Completed" .
135
136 <https://www.epos-eu.org/epos-dcat-ap#Agent/828bf6b9-9f4b-4355-bcd0-d68b188811cb>
137     rdf:type foaf:Agent ;
138     foaf:name "Carlo Corradini" .
139
140 <https://www.epos-eu.org/epos-dcat-ap#Dataset/3a2e0c02-aeba-44d1-b688-a5e21d81d088>
141     rdf:type dcat:Dataset ;
142     dct:accessRights "Public" ;
143     dct:accrualPeriodicity "Once"^^xsd:anyURI ;
144     dct:conformsTo "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W6.L10.M4.T11.1.3.
ETypes&PropsExtraction.pdf" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/
/W6.L11.M4.T11.2.2.EvaluationP1-2.pdf" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/
material/slides/W6.L10.M4.T11.1.4.ERModel.pdf" , "iTilos" , "https://unitn-kdi-2021.github.io/

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unitn-kdi-2021-website/material/slides/W6.L10.M4.T11.1.1-2.FoundationalTeleology.pdf" , "https://
unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W6.L11.M4.T11.2.1.EvaluationTheory.pdf
" ;
145   dct:created "2021-09-13T00:00:00Z"^^xsd:dateTime ;
146   dct:description "For more information see the following websites: https://unitn-kdi-2021.github.io/
      unitn-kdi-2021-website https://drive.google.com/drive/folders/12p27IFsmy9Us4AD2lw_0fEvl1k7BaIMk?usp=
      sharing https://github.com/carlocorradini/Trentino-Transportation" , "The project is related to the
      Knowledge and Data integration (KDI) course held in the academic year 2021/2022 at the University of
      Trento (UNITN)." , "Carlo Corradini (https://github.com/carlocorradini) and Xuanli Li(https://github.com/xuanli666) are the members assigned to the realization and finalization." , "With the development
      of big data technology and cloud storage technology, we are in an era of the rapid increase in
      information, with countless data or knowledge. How to manage these data and achieve more efficient
      sharing and utilization is an area that many researchers are exploring, that is, to fulfill the
      integration of knowledge and data in specific, rather than leaving information be unorganized. This
      report focuses on integrating all the public transportation as well as sharing vehicles information
      within Trentino so that a more complete transport information system could help people make a better
      decision and save time or money as much as possible. Specifically, we pay attention to the application
      of vehicles that GTFS has not covered, such as sharing bikes, sharing cars, and so on so forth, which
      is added to the system, and then residents have more choices when determining paths." , "Inception
      Sheet Metadata regarding Trentino Transportation." , "This project aims to comprehensively consider
      the transportation situations under the specific Trentino region, not only involving the public
      transportation services but also the personal tracks. Collecting the latest temporal and spatial
      information and integrating the data and knowledge from diverse sources. Public transportation
      services, vehicles, bus stations, train stations, railways, highways, simple streets, public
      transportation service timelines, and trip schedules are the main important elements that will be
      mainly paid attention, besides, the mixed using of some vehicles and the parking path will be
      exploring." ;
147   dct:identifier "https://github.com/carlocorradini/Trentino-Transportation/tree/main/Teleologies/Informal%20Modeling"^^xsd:anyURI ;
148   dct:issued "2021-12-10T00:00:00Z"^^xsd:dateTime ;
149   dct:language "English" ;
150   dct:modified "2021-12-10T00:00:00Z"^^xsd:dateTime ;
151   dct:publisher <https://www.epos-eu.org/epos-dcat-ap#Organization/2dad489f-4ce3-4e0d-9122-b70df55b8ef2> , <
      https://www.epos-eu.org/epos-dcat-ap#Agent/828bf6b9-9f4b-4355-bcd0-d68b188811cbhttps://www.epos-eu.org/epos-dcat-ap#Agent/f9cfb89e-3bb9-41ba-b263-e0386fce30ed> ;
152   dct:temporal <https://www.epos-eu.org/epos-dcat-ap#PeriodOfTime/84efa52e-3879-4d09-b0b9-36362e915866> ;
153   dct:title "Entity Relational Model Metadata" ;
154   dct:type "Collection"^^xsd:anyURI ;
155   dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/3a8a3044-3e7a-463d-94d9-15c4f4822938>
      , <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ca07b831-220f-4c49-bc3b-6e8215eb3238> ;
156   dcat:distribution <https://www.epos-eu.org/epos-dcat-ap#Distribution/2d8e5529-0e68-4e0d-af09-49a96f1c6c25>
      ;
157   dcat:keyword "Fausto Giunchiglia" , "Xuanli Li" , "fare" , "bike" , "Knowledge and Data integration" , "bus
      " , "Simone Bocca" , "extra-urban transport" , "trentino trasporti" , "car sharing" , "KDI" , "iTilos"
      , "public transport" , "UniTN" , "cash" , "taxi" , "cable car" , "Carlo Corradini" , "train" , "
      University of Trento" , "trento" , "bike sharing" , "transport" , "price" , "trentino" , "mobile" , "
      trip" , "parking" , "ticket" , "route" , "cartascalare" , "bike parking" , "urban transport" ;
158   dcat:landingPage "https://github.com/carlocorradini/Trentino-Transportation" ;
159   dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/4040fa1c-755a-4706-9fcfd-b2e9d6fbb755> , <https://www.epos-eu.org/epos-dcat-ap#Concept/520bf2b3-6fcc-45ad-971a-b17df5fe98f0> ;
160   foaf:page "https://github.com/carlocorradini/Trentino-Transportation" .
161
162 <https://www.epos-eu.org/epos-dcat-ap#Agent/f9cfb89e-3bb9-41ba-b263-e0386fce30ed>
163   rdf:type foaf:Agent ;
164   foaf:name "Xuanli Li" .

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### 4.3 Evaluation

In informal modeling phase, we still from the schema and data level to make evaluations.

In the schema level, we compare our ER model and a set of CQs. If the informal ER model covers CQs, we compute Coverage. Similarly, if the proposed informal ER model properly extends CQs, we leverage the metric Extensiveness. In this case, there is just a small part of overlap between our ER and CQs, hence we calculate both Coverage and Extensiveness. Our CQs comprises 22 classes and 67 properties while our ER model includes 12 Etypes and 58 properties.

After comparison, we can find that they have 5 common Etypes and 14 common properties. Accordingly, the Etype Coverage is  $Cov(CQ_c) = 0.2273$  and the Properties Coverage is  $Cov(CQ_p) = 0.2090$ . And the Etype Extensiveness is  $Ext(CQ_c) = 0.2414$  and the Property Extensiveness is  $Ext(CQ_p) = 0.3964$ .

For the data level, our datasets have 16 classes and 102 properties. And same as above, our ER model comprises 12 Etypes and 58 properties, among them 8 common Etypes and 31 common properties shared with datasets. We tend to apply Coverage and Sparsity.

Therefore the Etype Coverage is  $Cov(CQ_c) = 0.5$  and the Properties Coverage is  $Cov(CQ_p) = 0.3039$ . In addition, the Etype Sparsity is  $Spr(CQ_c) = 0.6$  and the Properties Coverage is  $Spr(CQ_p) = 0.5504$

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# 5 Formal Modeling

Formal Modeling is the third iTelos phase, and the aims in this stage are to generate the ETG model and syntactically align the datasets for knowledge and data level respectively based on the ER model, selected datasets, and reference ontologies.

Hence, this chapter focuses on the description of the following activities:

- ETG generation
- Data management (syntactic heterogeneity)
- Formal Modeling evaluation

## 5.1 ETG generation

In this stage, we attempt to generate the ETG as shareable as possible reusing the reference ontologies. There are 3 essential sub activities, ontology selection, language alignment, and schema building, consist of the ETG generation activity.

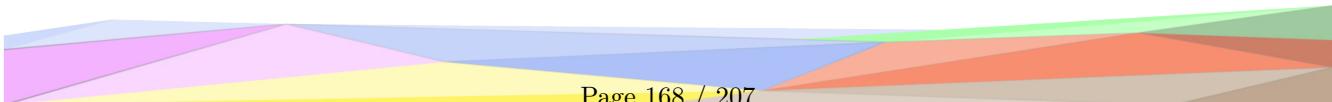
### 5.1.1 Ontology Selection

The purpose of ontology selection is to find out the appropriate ontologies for reference which includes appropriate concepts which can be reused to model the ER. To be more specifically, ontology Selection, as the first step of ETG generation activity, is focused on reusing ontology elements (classes, object properties, data properties) from state-of-the-art ontologies which are semantically synonymous with concepts which model the ER model. The crucial part is to find the concepts of the existed ontologies can be related and aligned as the objects, functions, and actions in our ER model. In compliance with the previous reference ontology, since our research domain is associated with transport and space, GTFS is one of the most common reference standard format and it can be regarded as a useful schema for our ER model. In addition, one of our dataset, Trentino Trasporti, illustrates Trentino public transport in the format of GTFS. Furthermore, we found another helpful reference schema from Schema.org, called ParkingFacility, which offers us some concepts adopted in our ER model, like location, address, name, etc.

Besides, we pay attention to choose the concepts in accordance with the order of classification, common, core, and contextual. Firstly, we consider the potential concepts (objects, functions, actions, data properties, object properties) in the common category from existing ontologies such as Location, agency in our ER model. Secondly, we consider the concepts from the core category, like Trip and Route. Finally, we think about the concepts from the contextual category, for instance, FareEnum.

### 5.1.2 Language Alignment

In terms of the ER model, it just can be considered as the intermediate model of ETG since it still has the issue of conceptual diversity (L1) and language diversity (L2) concerning the language aspect. Conceptual diversity means



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the concepts are not unique in the model. Language diversity indicates that different languages describe the same concepts. UKC is the specialized tool to addresses these issues. UKC is a developing platform offers numerous of language and concepts for using in the field of the knowledge integration. Moreover, one significant point is that we can get one unique identifier (GID) for each of our concepts according to similarity and KOS provides a simpler API of UKC to query and fetch. In addition, when the desired words can be found in UKC Concept Core (CC), we can create the new one to extend the range of UKC lexicon.

In our project, most of our concepts can be found in UKC CC and the corresponding global identifiers were matched. However the other part of concepts that don't exist in UKC needs to be defined first and then create them to get the new GID. As far as the definitions of these concepts are concerned, we first chose to check them in Schema.org and then if we still did not find the accurate definition, we defined them by ourselves.

### 5.1.3 Schema Alignment

On this stage, we devote to the final alignment, schema alignment. The ontology at present can not be regarded as the ETG model since there is a gap between the model and the foundational teleology. Schema alignment involves aligning the objects, functions, actions, and relations in the ETG model to their semantically corresponding foundational primitives via intermediate concepts.

In our project, the necessary foundational primitives are provided in the initial file from the professor. We can see the existing class with their GID. It's explicit to see the objects (Living and Non-Living), functions (Producers and Consumers), actions, space, and time (a priori). Combining with our previous ER model, we aligned our objects in the ER model to a non-living object due to all the objects of our ER model with life. Then we continued to align the functions in the ER model to the producer and consumer respectively. And since there is not action in our ER model, so no actions are aligned. The last step, we tried to align the ER model to the foundational relations.

### 5.1.4 ETG model

After ensuing the necessary materials, we applied another essential tool, Protégé, which is a free, open source ontology editor and framework for building intelligent systems. Protégé practically achieves schema alignment activity, which allows us to construct the classes (Etype(s) in our project), object, and data properties in different pages as well as the final visualization of ontologies. The following graphs and tables show some information of our final ETG classes. The output of Protégé is in the form of an OWL RDF/XML file, which can be checked in our GitHub repository.

#### 5.1.4.1 Classes

Classes are the core components of the project and the ontology. Each class has been assigned with a Global Identifier (GID) that uniquely identifies the concept expressed.

Classes provide an abstraction mechanism for grouping resources with similar characteristics. Like RDF classes, every OWL class is associated with a set of individuals, called the class extension. The individuals in the class extension are called the instances of the class. A class has an intensional meaning (the underlying concept) which is related but not equal to its class extension. Thus, two classes may have the same class extension, but still be different classes[5]. The classes in ETG model are manifested in Figure 5.1 and the following table, which explains it as well.

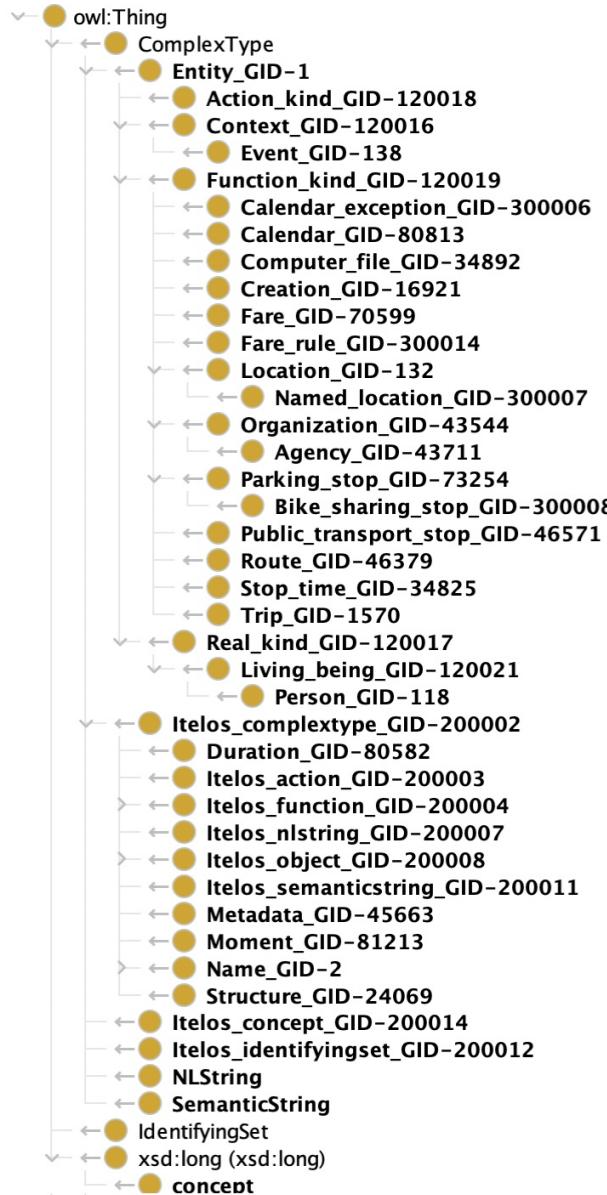


Figure 5.1: *Protégé* Classes

Class	GID	UKC
Calendar_exception	300006	✗
Calendar	80813	✓
Fare	70599	✓
Fare_rule	300014	✗
Named_location	300007	✗
Agency	43711	✓
Parking_stop	73254	✓
Bike_sharing_stop	300008	✗
Public_transport_stop	46571	✓
Route	46379	✓
Stop_time	34825	✓
Trip	1570	✓

#### 5.1.4.2 Enums

A class description of the "enumeration" kind is defined with the `owl:oneOf` property. The value of this built-in OWL property must be a list of individuals that are the instances of the class. This enables a class to be described by exhaustively enumerating its instances. The class extension of a class described with `owl:oneOf` contains exactly the enumerated individuals, no more, no less. The list of individuals is typically represented with the help of the RDF construct `rdf:type="Collection"`, which provides a convenient shorthand for writing down a set of list elements[6].

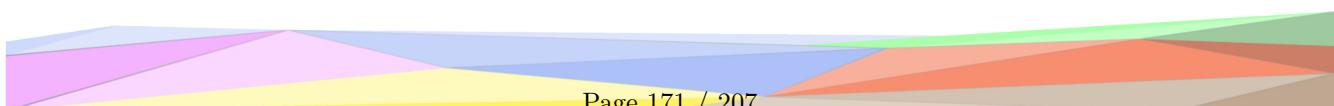
In the previous phases we have used the enumeration kind as a utility construct to map a fixed set of possible values for a Data Property. e.g In the ER Model we have used the `ExceptionEnum` in the `CalendarException` Etype. The only possible value of the Data Property `exception` is *Added* or *Removed*. No other values are accepted. This is logical and values constraints that ensure the correctness and execution accuracy on the overall data. The Enum data type is commonly supported for the majority of the ontology editors and management systems (such as Protégé). However, the KOS platform has a strict data types restrictions and the Enum data type is currently not supported<sup>1</sup>.

To solve this issue we have taken two major design and architectural decisions:

1. In the Attributed Competency Questions section we decided to map all the Enums as Etype(s) to show to the reader that there are some Object Properties in non-Enums Etype(s) that are linked to them. Each Enum Etype has no Object Properties and only a single Data Property called `value` of type `string`. Therefore, forcing a logical single value property that looks like a real Enum data type.
2. Thanks to the Data Alignment phase and the usage of a strict type and compiled programming language that naturally support the Enum data type, the resulting *aligned* datasets to ensure the correctness and uniqueness of an Enum value. Note that for completeness in the *aligned* datasets all Enum(s) are transformed into a JSON string array even if they are not used in Karmalinker.

Thanks to the decisions taken above, in the ETG generation all Enum(s), both as data type and Etype, have been omitted. The result is that each Enum value used in an Etype is simply mapped as a `string` Data Property that will be *linked* to the datasets via Karmalinker ensuring correctness.

<sup>1</sup>For more information regarding Protégé guidelines in the KOS platform see the following PDF available at <https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/templates/Protégé-guidelines.pdf>



#### 5.1.4.3 Object Properties

Object Properties link individuals to individuals[7].

An Object Property is defined as an instance of the built-in OWL class `owl:ObjectProperty` which is a subclass of the RDF class `rdf:Property`.

##### Domain:

For an Object Property one can define (multiple) `rdfs:domain` axioms. Syntactically, `rdfs:domain` is a built-in property that links a property (some instance of the class `rdf:Property`) to a class description. An `rdfs:domain` axiom asserts that the subjects of such property statements must belong to the class extension of the indicated class description.

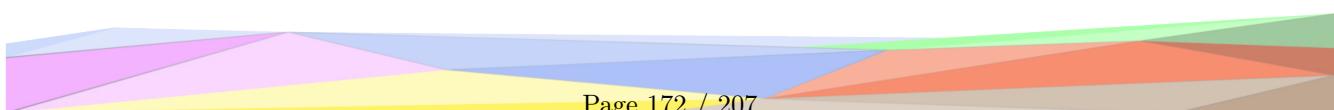
Multiple `rdfs:domain` axioms are allowed and should be interpreted as a conjunction: these restrict the domain of the property to those individuals that belong to the intersection of the class descriptions.

##### Range:

For an Object Property property one can define (multiple) `rdfs:range` axioms. Syntactically, `rdfs:range` is a built-in property that links a property (some instance of the class `rdf:Property`) to either a class description or a data range. A `rdfs:range` axiom asserts that the values of this property must belong to the class extension of the class description or to data values in the specified data range. The Object properties in our ETG model are shown in the following table and Figure 5.2 below.



Figure 5.2: *Protégé* Object Properties



Object Property	GID	Domain	Range	UKC
has_agency_GID-111742_Type-46379	111742	Route_GID-46379	Agency_GID-43711	✓
has_calendar_exception_calendar_GID-80813_Type-300006	80813	Calendar_exception_GID-300006	Calendar_GID-80813	✓
has_destination_GID-46122_Type-300014	46122	Fare_rule_GID-300014	Named_location_GID-300007	✓
has_fare_GID-70599_Type-300014	70599	Fare_rule_GID-300014	Fare_GID-70599	✓
has_origin_GID-45883_Type-300014	45883	Fare_rule_GID-300014	Named_location_GID-300007	✓
has_parking_stop_location_GID-779_Type-73254	779	Parking_stop_GID-73254	Named_location_GID-300007	✓
has_public_transport_stop_location_GID-779_Type-46571	779	Public_transport_stop_GID-46571	Named_location_GID-300007	✓
has_route_GID-22592_Type-1570	22592	Trip_GID-1570	Route_GID-46379	✓
has_stop_GID-46571_Type-34825	46571	Stop_time_GID-34825	Public_transport_stop_GID-46571	✓
has_trip_calendar_GID-80813_Type-1570	80813	Trip_GID-1570	Calendar_GID-80813	✓
has_trip_GID-1570_Type-34825	1570	Stop_time_GID-34825	Trip_GID-1570	✓
has_zone_GID-45993_Type-46571	45993	Public_transport_stop_GID-46571	Named_location_GID-300007	✓

#### 5.1.4.4 Data Properties

Data properties link individuals to data values[7]. A data property is defined as an instance of the built-in OWL class `owl:DatatypeProperty` which is a subclass of the RDF class `rdf:Property`.

##### Domain:

For a Data Property one can define (multiple) `rdfs:domain` axioms. Syntactically, `rdfs:domain` is a built-in property that links a property (some instance of the class `rdf:Property`) to a class description. An `rdfs:domain` axiom asserts that the subjects of such property statements must belong to the class extension of the indicated class description.

Multiple `rdfs:domain` axioms are allowed and should be interpreted as a conjunction: these restrict the domain of the property to those individuals that belong to the intersection of the class descriptions.

##### Range:

For a Data Property property one can define (multiple) `rdfs:range` axioms. Syntactically, `rdfs:range` is a built-in property that links a property (some instance of the class `rdf:Property`) to either a class description or a data range. An `rdfs:range` axiom asserts that the values of this property must belong to the class extension of the class description or to data values in the specified data range. The ETG data properties can be checked in the Figure 5.3 and table below.



Figure 5.3: *Protégé* Data Properties

Data Property	GID	Domain	Range	UKC
has_latitude_GID-46263_Type-132	46263	Location_GID-132	float	✓
has_longitude_GID-46270_Type-132	46270	Location_GID-132	float	✓
has_address_GID-45803_Type-73254	45803	Parking_stop_GID-73254	string	✓
has_agency_id_GID-39085_Type-43711	39085	Agency_GID-43711	string	✓
has_agency_name_GID-2_Type-43711	2	Agency_GID-43711	string	✓
has_arrival_GID-300016_Type-34825	300016	Stop_time_GID-34825	dateTime	✗
has_bike_GID-300013_Type-1570	300013	Trip_GID-1570	string	✗
has_bikes_GID-300018_Type-300008	300018	Bike_sharing_stop_GID-300008	int	✗
has_calendar_id_GID-39085_Type-80813	39085	Calendar_GID-80813	string	✓

has_currency_GID-71038_Type-70599	71038	Fare_GID-70599	string	✓
has_date_GID-80736_Type-300006	80736	Calendar_exception_GID-300006	dateTime	✓
has_departure_GID-300017_Type-34825	300017	Stop_time_GID-34825	dateTime	✗
has_direction_GID-73503_Type-1570	73503	Trip_GID-1570	string	✓
has_duration_GID-80582_Type-70599	80582	Fare_GID-70599	int	✓
has_email_GID-300003_Type-43711	300003	Agency_GID-43711	string	✗
has_end_date_GID-300004_Type-80813	300004	Calendar_GID-80813	dateTime	✗
has_exception_GID-31741_Type-300006	31741	Calendar_exception_GID-300006	string	✓
has_fare_id_GID-39085_Type-70599	39085	Fare_GID-70599	string	✓
has_fare_type_GID-300015_Type-70599	300015	Fare_GID-70599	string	✗
has_free_slots_GID-300001_Type-300008	300001	Bike_sharing_stop_GID-300008	int	✗
has_friday_GID-80762_Type-80813	80762	Calendar_GID-80813	boolean	✓
has_location_name_GID-2_Type-300007	2	Named_location_GID-300007	string	✓
has_long_name_GID-300003_Type-46379	300000	Route_GID-46379	string	✗
has_monday_GID-80758_Type-80813	80758	Calendar_GID-80813	boolean	✓
has_named_location_id_GID-39085_Type-300007	39085	Named_location_GID-300007	string	✓
has_parking_stop_type_GID-300005_Type-73254	300005	Parking_stop_GID-73254	string	✗
has_payment_GID-70421_Type-70599	70421	Fare_GID-70599	string	✓
has_phone_GID-34494_Type-43711	34494	Agency_GID-43711	string	✓
has_price_GID-70571_Type-70599	70571	Fare_GID-70599	float	✓
has_public_transport_stop_type_GID-300012_Type-56571	300012	Public_transport_stop_GID-46571	string	✗
has_public_transport_stop_wheelchair_GID-300019_Type-46571	300019	Public_transport_stop_GID-46571	string	✗
has_route_id_GID-39085_Type-46379	39085	Public_transport_stop_GID-46379	string	✓
has_saturday_GID-80763_Type-80813	80763	Calendar_GID-80813	boolean	✓
has_sequence_GID-27840_Type-34825	27840	Stop_time_GID-34825	int	✓
has_short_name_GID-1842_Type-46379	1842	Route_GID-46379	string	✓
has_start_date_GID-300002_Type-80813	300002	Calendar_GID-80813	dateTime	✗
has_sunday_GID-80757_Type-80813	80757	Calendar_GID-80813	boolean	✓
has_thursday_GID-80761_Type-80813	80761	Calendar_GID-80813	boolean	✓
has_total_slots_GID-300010_Type-73254	300010	Parking_stop_GID-73254	int	✗
has_transport_GID-16756_Type-46379	16756	Route_GID-46379	string	✓
has_trip_id_GID-39085_Type-1570	39085	Trip_GID-1570	string	✓
has_trip_name_GID-2_Type-1570	2	Trip_GID-1570	string	✓
has_trip_wheelchair_GID-300011_Type-1570	300011	Trip_GID-1570	string	✗
has_tuesday_GID-80759_Type-80813	80759	Calendar_GID-80813	boolean	✓
has_url_GID-34123_Type-43711	34123	Agency_GID-43711	string	✓
has_wednesday_GID-80760_Type-80813	80760	Calendar_GID-80813	boolean	✓

### 5.1.5 ETG Metadata

This section is devoted to displaying the metadata graph and table of the ETG model.

**Graph:**

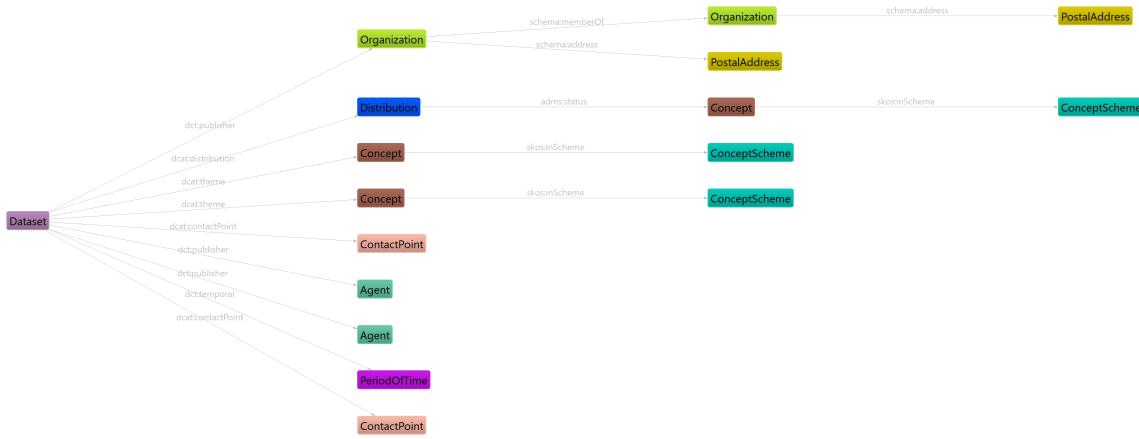


Figure 5.4: *Entity Type Graph* metadata graph

**RDF Metadata:**

```

1 @prefix : <https://www.epos-eu.org/epos-dcat-ap#> .
2 @prefix schema: <http://schema.org/> .
3 @prefix spdx: <http://spdx.org/rdf/terms#> .
4 @prefix owl: <http://www.w3.org/2002/07/owl#> .
5 @prefix gsp: <http://www.opengis.net/ont/geosparql#> .
6 @prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
7 @prefix skos: <http://www.w3.org/2004/02/skos/core#> .
8 @prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
9 @prefix hydra: <http://www.w3.org/ns/hydra/core#> .
10 @prefix geo: <http://www.w3.org/2003/01/geo/wgs84_pos#> .
11 @prefix oa: <http://www.w3.org/ns/oa#> .
12 @prefix dct: <http://purl.org/dc/terms/> .
13 @prefix sh: <http://www.w3.org/ns/shacl#> .
14 @prefix dcat: <http://www.w3.org/ns/dcat#> .
15 @prefix locn: <http://www.w3.org/ns/locn#> .
16 @prefix foaf: <http://xmlns.com/foaf/0.1/> .
17 @prefix epos: <https://www.epos-eu.org/epos-dcat-ap#> .
18 @prefix adms: <http://www.w3.org/ns/adms#> .
19 @prefix org: <http://www.w3.org/ns/org#> .
20 @prefix cnt: <http://www.w3.org/2011/content#> .
21 @prefix vcard: <http://www.w3.org/2006/vcard/ns#> .
22 @prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
23 @prefix http: <http://www.w3.org/2006/http#> .
24 @prefix dash: <http://datashapes.org/dash#> .
25 @prefix dc: <http://purl.org/dc/elements/1.1/> .

26
27 <https://www.epos-eu.org/epos-dcat-ap#Organization/2dad489f-4ce3-4e0d-9122-b70df55b8ef2>
28     rdf:type schema:Organization ;
29     schema:address <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/b0bb325d-f408-4dac-80e0-2389d8efb97f> ;
30     schema:email "knowdive@disi.unitn.it" ;
31     schema:identifier "http://knowdive.disi.unitn.it"^^xsd:anyURI ;
32     schema:legalName "Knowdive" ;
33     schema:leiCode "http://knowdive.disi.unitn.it" ;
34     schema:logo "http://knowdive.disi.unitn.it/wp-content/uploads/knowdive-new-logo.png"^^xsd:anyURI ;
  
```

```

35     schema:memberOf <https://www.epos-eu.org/epos-dcat-ap#Organization/78574deb-e40e-4c05-a5c6-40beef01aa0> ;
36     schema:url "http://knowdive.disi.unitn.it"^^xsd:anyURI .
37
38 <https://www.epos-eu.org/epos-dcat-ap#Organization/78574deb-e40e-4c05-a5c6-40beef01aa0>
39     rdf:type schema:Organization ;
40     schema:address <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/cd879ddb-55b6-4620-a0e4-c85a2df9f483> ;
41     schema:email "ateneo@unitn.it" , "ateneo@pec.unitn.it" ;
42     schema:identifier "www.unitn.it"^^xsd:anyURI ;
43     schema:legalName "Università degli Studi di Trento" ;
44     schema:leiCode "00340520220" ;
45     schema:logo "https://static-cdn.unitn.it/sites/www.unitn.it/themes/unitn_theme/images/newlogo_unitn_en.png"
46         ^^xsd:anyURI ;
47     schema:telephone "0461281111" ;
48     schema:url "www.unitn.it"^^xsd:anyURI .
49
50 <https://www.epos-eu.org/epos-dcat-ap#PeriodOfTime/84efa52e-3879-4d09-b0b9-36362e915866>
51     rdf:type dct:PeriodOfTime ;
52     schema:endDate "2022-01-25T00:00:00Z"^^xsd:dateTime ;
53     schema:startDate "2021-09-13T00:00:00Z"^^xsd:dateTime .
54
55 <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/b0bb325d-f408-4dac-80e0-2389d8efb97f>
56     rdf:type schema:PostalAddress ;
57     schema:addressCountry "IT" ;
58     schema:addressLocality "Povo (TN)" ;
59     schema:postalCode "I-38123" ;
60     schema:streetAddress "Via Sommarive 9" .
61
62 <https://www.epos-eu.org/epos-dcat-ap#Concept/4040fa1c-755a-4706-9fcf-b2e9d6fb755>
63     rdf:type skos:Concept ;
64     skos:definition "Land transport is the transport or movement of people, animals or goods from one location
65         to another location on land." ;
66     skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/f913bd20-8e7b-4d82-9688-ca745a432f24> ;
67     skos:prefLabel "Land Transport" .
68
69 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/f913bd20-8e7b-4d82-9688-ca745a432f24>
70     rdf:type skos:ConceptScheme ;
71     dct:description "The movement of people or goods from one place to another." ;
72     dct:title "Transport" .
73
74 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ca07b831-220f-4c49-bc3b-6e8215eb3238>
75     rdf:type schema>ContactPoint ;
76     schema:availableLanguage "en-US" , "it-IT" ;
77     schema:contactType "Member" ;
78     schema:email "carlo.corradini@studenti.unitn.it" ;
79     schema:name "Carlo Corradini" .
80
81 <https://www.epos-eu.org/epos-dcat-ap#Concept/520bf2b3-6fcc-45ad-971a-b17df5fe98f0>
82     rdf:type skos:Concept ;
83     skos:definition "Formal Modeling is the third iTelos phase:\r\nInputs:\r\n * ER Model\r\n * Selected
84         Datasets\r\n * Reference ontologies\r\nOutputs:\r\n * ETG\r\n * Dataset syntactically aligned\r\nThe
85         ETG Generation activity is internally defined by three sub activities:\r\n * Ontology Selection:
86         selection of those ontologies which includes appropriate concepts which can be reused to model the ER\r
87         * Language Alignment: identification, and import in Knowledge Base of concepts and terms to be
88         used to\r\nbuild the ETG.\r\nSchema Building: composition of the ER schema designed with the
89         foundational teleology Language Alignment transforms the informal concepts of the ETG Model to formal
90         concepts with the key support of the UKC. Three main objectives:\r\n * Representing each informal
91         concept in the ETG Model with the unique identifier (GID) from UKC, thus, rendering each concept
92         formal and absorbing L1 diversity\r\n * The ETG Model vocabulary has both already existing concepts in
93         the UKC CC, and, new concepts absent in the UKC CC. We align the existing concepts with their
94         equivalents in the UKC CC and extend the UKC CC by adding (only) the new concepts (with new GIDs),
95         thus, absorbing L1 as well as L2 diversity\r\n * Due to the LC, each concept can also be rendered
96         multilingually, thus opening up the possibility to adapt the ETG in any language or culture.\r\nThe
97         general methodology for language alignment, as semi-automatically performed via KOS application, is as
98         follows;\r\n * Each term (concept) is selected from amongst the classes, relations and attributes (
```

all terms from all these hierarchies are considered; one at a time)\r\n \* The term is (semantically) searched in the UKC Knowledge Base (UKC KB) via the KOS (iTilos) application, and the step will result in one of the following two scenarios:\r\n \* Scenario 1 (S1): Synonymous Match between the ETG concept and a synonymous concept found in the UKC KB\r\n \* Scenario 2 (S2): No Existing Semantic Match between the ETG concept and any concept in the UKC KB\r\n The schema alignment activity aims to exactly close the gap between the ETG model and the foundational teleology. It formally grounds the ETG model in the foundational teleology, thus producing the final, fully formal ETG ready for the next phase - data integration. Schema alignment involves aligning the objects, functions, actions and relations in the ETG model to their semantically corresponding foundational primitives via intermediate concepts. The ETG created following the above process is (i) shareable as it is grounded in the foundational teleology, and (ii) reusable as a consequence of the domain compositionality principle of iTilos\r\n Data types misalignment: The data types misalignment appears when the same information is represented using different data types.\r\n Data value format misalignment: The data value format misalignment appears when different formats of the same data type are adopted for same information in different datasets.\r\n Data language misalignment: The data language misalignment appears when different natural languages are adopted for same information in different datasets.\r\n Data and Knowledge layers alignment: Also in the Formal Modelling phase, iTilos maintains the synchronisation between knowledge and data layer." ;

82 skos:inScheme <<https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/5edb028b-96af-4035-8d62-c253acd5a3c5>> ;

83 skos:prefLabel "Formal Modeling Phase" .

84

85 <<https://www.epos-eu.org/epos-dcat-ap#Distribution/2d8e5529-0e68-4e0d-af09-49a96f1c6c25>>

86 rdf:type dcat:Distribution ;

87 dct:conformsTo "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W8.L14.M5.T13.2. SyntacticHeterogeneity.pdf" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W7.L13.M5.T13.1.1.OntologySelection.pdf" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W8.L15.M5.T13.3.EvaluationP3-4.pdf" , "https://www.w3.org/OWL/" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W7.L13.M5.T13.1.3-4.SchemaAlignment.pdf" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W7.L13.M5.T13.1.2.LanguageAlignment.pdf" ;

88 dct:description "Entity Type Graph in OWL format. See https://www.w3.org/OWL/. " , "Entity Type Model regarding Trentino Transportation." ;

89 dct:format "https://www.w3.org/OWL/"^^xsd:anyURI ;

90 dct:identifier "https://github.com/carloccorradini/Trentino-Transportation/tree/main/Teleologies/Formal%20Modeling"^^xsd:anyURI ;

91 dct:issued "2021-12-11T00:00:00Z"^^xsd:dateTime ;

92 dct:language "English" ;

93 dct:license "https://opensource.org/licenses/MIT"^^xsd:anyURI ;

94 dct:modified "2021-12-11T00:00:00Z"^^xsd:dateTime ;

95 dct:rights "https://opensource.org/licenses/MIT" ;

96 dct:title "Entity Type Graph" , "Trentino Transportation" ;

97 dct:type "Collection"^^xsd:anyURI ;

98 spdx:checksum "md5 c38154a8d7fe919a774c324e19e53f17" ;

99 adms:status <<https://www.epos-eu.org/epos-dcat-ap#Concept/b9645f82-9500-414c-a51d-255ff657c69e>> ;

100 dcat:accessURL "https://drive.google.com/drive/folders/1-8ZkqbEZx3lub4H8jUNB-c5bIZ8ptkNe?usp=sharing"^^xsd:anyURI , "https://github.com/carloccorradini/Trentino-Transportation/tree/main/Teleologies/Formal%20Modeling"^^xsd:anyURI ;

101 dcat:byteSize "98389.0"^^xsd:double ;

102 dcat:downloadURL "https://github.com/carloccorradini/Trentino-Transportation/raw/main/Teleologies/Formal%20Modeling/ETG.owl"^^xsd:anyURI ;

103 dcat:mediaType "application/rdf+xml" ;

104 foaf:page "https://github.com/carloccorradini/Trentino-Transportation" .

105

106 <<https://www.epos-eu.org/epos-dcat-ap#PostalAddress/cd879ddb-55b6-4620-a0e4-c85a2df9f483>>

107 rdf:type schema:PostalAddress ;

108 schema:addressCountry "IT" ;

109 schema:addressLocality "Trento" ;

110 schema:postalCode "38122" ;

111 schema:streetAddress "Via Calepina 14" .

112

113 <<https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/5edb028b-96af-4035-8d62-c253acd5a3c5>>

114 rdf:type skos:ConceptScheme ;

115 dct:description "The DI Purpose, expressed by the final user as a natural language sentence, define the main goal for the whole data integration. It represent what the final user should be able to do

exploiting the DI final outcome (KG). Due to that, the Purpose leads the whole integration process and makes iTelos be a Purpose driven DI methodology.\r\nDomain of Interest (DoI): The portion of the world that involves all the information elements used to satisfy a specific purpose.\r\nIn order to identify the level of reusability of the resources collected and handled along the methodology.\r\niTilos Data Life Cycle:\r\n \* Data Collection & Preparation (DTA-1): align the different sources data formats, and data standards, representing the information carried through a single data format. The aligned data can be then collected within the methodologies Input Repository\r\n \* Syntactic Alignment (DTA-2.1): align the data value formats by adopting the same data standards for similar data types\r\n \* Semantic Alignment (DTA-2.2): align the semantic of the data (entity schema representation and word sense disambiguation)\r\n \* Entity Matching (DTA-2.3): align modeled entities with already existing representations of the same entities\r\n \* Application Alignment (DTA-3): the last transformation (considered as out of scope for the DI methodology) aims to align the integrated data in order to let them suitable to be used by a specific application\r\nTeleology is the study of ends and goals, things whose existence or occurrence is purposive. Concretely, in our context, teleologies are ontologies but with the proviso that teleologies focus on function and on how a chosen representation fits a certain purpose. In other words, the teleologies are the way adopted in the DI methodology (iTilos) to model (design, represent) the information that needs to be exploited by final users.\r\nA KG, as result of a DI process, is composed by knowledge (teleologies) and data (datasets) resources combined together in the best way possible in order to achieve the users Purpose. There are three different approaches to build such kind of KGs:\r\n \* Knowledge centric: The data schema design comes first and then the data are aligned to it.\r\n \* Data centric: The data schema is mainly (some adaptation are always required) extracted from the data to be integrated.\r\n \* Middle-out approach: The data schema (teleology) is designed considering already existing knowledge resources AND the data. While the datasets are adapted to the schema designed." ;

```

116   dct:title "iTilos Principles" .
117
118 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/a21146bd-a38c-49fe-a02f-f8575d1d73e2>
119   rdf:type skos:ConceptScheme ;
120   dct:description "The position or rank of someone or something when compared to others in a society, organization, group, etc." ;
121   dct:title "Status" .
122
123 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/3a8a3044-3e7a-463d-94d9-15c4f4822938>
124   rdf:type schema>ContactPoint ;
125   schema:availableLanguage "zh-CN" , "en-US" ;
126   schema:contactType "Member" ;
127   schema:email "xuanli.li@studenti.unitn.it" ;
128   schema:name "Xuanli Li" .
129
130 <https://www.epos-eu.org/epos-dcat-ap#Concept/b9645f82-9500-414c-a51d-255ff657c69e>
131   rdf:type skos:Concept ;
132   skos:definition "Containing all the necessary parts, answers, or information." ;
133   skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/a21146bd-a38c-49fe-a02f-f8575d1d73e2> ;
134   skos:prefLabel "Completed" .
135
136 <https://www.epos-eu.org/epos-dcat-ap#Agent/828bf6b9-9f4b-4355-bcd0-d68b188811cb>
137   rdf:type foaf:Agent ;
138   foaf:name "Carlo Corradini" .
139
140 <https://www.epos-eu.org/epos-dcat-ap#Dataset/3a2e0c02-aebe-44d1-b688-abe21d81d088>
141   rdf:type dcat:Dataset ;
142   dct:accessRights "Public" ;
143   dct:accrualPeriodicity "Once"^^xsd:anyURI ;
144   dct:conformsTo "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W7.L13.M5.T13.1.3-4 .SchemaAlignment.pdf" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W8.L14.M5.T13.2.SyntacticHeterogeneity.pdf" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W7.L13.M5.T13.1.2.LanguageAlignment.pdf" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W8.L15.M5.T13.3.EvaluationP3-4.pdf" , "iTilos" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W7.L13.M5.T13.1.1.OntologySelection.pdf" ;
145   dct:created "2021-09-13T00:00:00Z"^^xsd:dateTime ;
146   dct:description "For more information see the following websites: https://unitn-kdi-2021.github.io/unitn-kdi-2021-website https://drive.google.com/drive/folders/12p27IFsmy9Us4AD2lw_0fEv1k7BaIMk?usp=sharing https://github.com/carlocorradini/Trentino-Transportation" , "The project is related to the
  
```

Knowledge and Data integration (KDI) course held in the academic year 2021/2022 at the University of Trento (Unitn).", "Carlo Corradini (<https://github.com/carlocorradini>) and Xuanli Li(<https://github.com/xuanli666>) are the members assigned to the realization and finalization.", "Entity Type Graph Metadata regarding Trentino Transportation.", "With the development of big data technology and cloud storage technology, we are in an era of the rapid increase in information, with countless data or knowledge. How to manage these data and achieve more efficient sharing and utilization is an area that many researchers are exploring, that is, to fulfill the integration of knowledge and data in specific, rather than leaving information be unorganized. This report focuses on integrating all the public transportation as well as sharing vehicles information within Trentino so that a more complete transport information system could help people make a better decision and save time or money as much as possible. Specifically, we pay attention to the application of vehicles that GTFS has not covered, such as sharing bikes, sharing cars, and so on so forth, which is added to the system, and then residents have more choices when determining paths.", "This project aims to comprehensively consider the transportation situations under the specific Trentino region, not only involving the public transportation services but also the personal tracks. Collecting the latest temporal and spatial information and integrating the data and knowledge from diverse sources. Public transportation services, vehicles, bus stations, train stations, railways, highways, simple streets, public transportation service timelines, and trip schedules are the main important elements that will be mainly paid attention, besides, the mixed using of some vehicles and the parking path will be exploring.";

```

147  dct:identifier "https://github.com/carlocorradini/Trentino-Transportation/tree/main/Teleologies/Formal%20Modeling"^^xsd:anyURI ;
148  dct:issued "2021-12-11T00:00:00Z"^^xsd:dateTime ;
149  dct:language "English" ;
150  dct:modified "2021-12-11T00:00:00Z"^^xsd:dateTime ;
151  dct:publisher <https://www.epos-eu.org/epos-dcat-ap#Organization/2dad489f-4ce3-4e0d-9122-b70df55b8ef2> , <https://www.epos-eu.org/epos-dcat-ap#Agent/828bf6b9-9f4b-4355-bcd0-d68b188811cb> , <https://www.epos-eu.org/epos-dcat-ap#Agent/f9cfb89e-3bb9-41ba-b263-e0386fce30ed> ;
152  dct:temporal <https://www.epos-eu.org/epos-dcat-ap#PeriodOfTime/84efa52e-3879-4d09-b0b9-36362e915866> ;
153  dct:title "Entity Type Graph Metadata" ;
154  dct:type "Collection"^^xsd:anyURI ;
155  dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/3a8a3044-3e7a-463d-94d9-15c4f4822938> , <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ca07b831-220f-4c49-bc3b-6e8215eb3238> ;
156  dcat:distribution <https://www.epos-eu.org/epos-dcat-ap#Distribution/2d8e5529-0e68-4e0d-af09-49a96f1c6c25> ;
157  dcat:keyword "Fausto Giunchiglia" , "Xuanli Li" , "fare" , "bike" , "Knowledge and Data integration" , "bus" , "Simone Bocca" , "extra-urban transport" , "trentino trasporti" , "car sharing" , "KDI" , "iTilos" , "public transport" , "Unitn" , "cash" , "taxi" , "cable car" , "Carlo Corradini" , "train" , "University of Trento" , "trento" , "bike sharing" , "transport" , "price" , "trentino" , "mobile" , "trip" , "parking" , "ticket" , "route" , "cartascalare" , "bike parking" , "urban transport" ;
158  dcat:landingPage "https://github.com/carlocorradini/Trentino-Transportation" ;
159  dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/4040fa1c-755a-4706-9fcf-b2e9d6fb755> , <https://www.epos-eu.org/epos-dcat-ap#Concept/520bf2b3-6fcc-45ad-971a-b17df5fe98f0> ;
160  foaf:page "https://github.com/carlocorradini/Trentino-Transportation" .
161
162 <https://www.epos-eu.org/epos-dcat-ap#Agent/f9cfb89e-3bb9-41ba-b263-e0386fce30ed>
163  rdf:type foaf:Agent ;
164  foaf:name "Xuanli Li" .
```

## 5.2 Data Management

At the previous stage, we preliminarily filtered the unnecessary data and remained the useful six datasets. On this stage we focus on solving the Syntactic Heterogeneity. First, we using the programming to transform all the datasets to be presented in format of json. Based on these explicitly readable files, we checked if the value formats in different datasets are in line with our ETG model and if the same properties belonged to same entity among different datasets have same values. Then, the language representation inspection were executed since some place names using the Italian alphabets which are not acceptable in some applications like KarmaLinker. We translated

the Italian alphabets or vocabulary into English.

### 5.3 Evaluation

The evaluation in this formal modeling phase is still important and another metric is introduced, called Cue validity. Cue is a set of metrics to measure the quality of the Etype/ETG. The formulas of Cue for Etype and ETG are respectively shown in Equation 5.1 and 5.2 :

$$Cue_e(e) = \sum_{i=1}^{|prop(e)|} Cue_p(p_i, e) \in [0, |prop(e)|] \quad (5.1)$$

$$Cue_k(K) = \sum_{i=1}^{|E_K|} Cue_e(e_i) \in [0, |prop(K)|] \quad (5.2)$$

During Formal modeling phase, we evaluate the on schema level. Based on the formal ETG and several reference ontologies. If the formal ETG and its Etypes are properly defined by their properties, Cuek (ETG) and Cuee(Etype) should be used. If the proposed ETG is different from the reference ontologies, applying metric Sparsity.

Until now, we have acquired the proposed ETG model rather than the final formal model. We are supposed to compute the Sparsity. After comparison, we can find that they have 6 common Etypes and 37 common properties between the reference ontology and our proposed ETG when the ETG has 12 Etypes, 58 properties, and reference ontology has 17 Etypes and 137 properties. Accordingly, the Etype Sparsity is  $Spr(ETG_c) = 0.7392$  and the Properties Sparsity is  $Spr(CQ_p) = 0.7658$ . Moreover, we wanted to perceive other metrics as well, the all results are revealed in the following table:

Table 5.4: Caption

	Sparsity	Coverage	Extensiveness
Etypes	0.7392	0.5	0.4782
Properties	0.7658	0.6379	0.6329

---

# 6 Data Integration

This section is dedicated to the description of the Data Integration phase. Like in the previous section, the current one aims to describe the different sub activities performed by all the team members, as well as the phase outcomes produced.

More in details, this section provides a description of the following activities:

- Data management (semantic heterogeneity)
- Entity matching
- Data integration phase evaluation

The Data Integration phase aims to build the final EG, populating the ETG previously produced with the datasets entities. Specifically, the input of this phase are the ETG and Dataset syntactically aligned and the output are supposed to be corresponding EG, metadata and the project documentation.

## 6.1 Data management

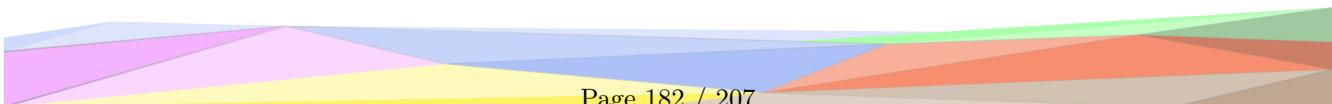
Firstly, we should realize the presence of multiple representation of the same real world entity, which is called **Semantic Heterogeneity**. This section dedicates to addressing the issue of semantic heterogeneity so that we can align the data to ETG accurately. Executing the two separate activities, entity alignment and entity matching together to achieve the solution of the semantic misalignment within the datasets. Entity alignment means mapping multiple entity representation (between different datasets) to the single, purpose-specific schema (ETG). In other words, entity alignment conducts the mapping from entities and entity properties to Etypes and Etype properties correctly between distinct datasets.



In this phase, we focus on the data alignment. During the previous stage, we have transformed all the initial datasets from diverse formats (kml, zip) to json files. The coding part mainly adopted the programming language **Rust**. After the processing of formatting and eliminating syntactic heterogeneity, we extracted all the useful data and conducted alignment according the Etypes and the class Enums from the present datasets (the number more than initial ones). Finally, we acquired 20 files in json format. During the alignment, the most important library of Rust is **Serde**, which is a framework for serializing and deserializing Rust data structures efficiently and generically. The specific sub datasets formats before and after processing as well as the adopted dependencies are demonstrated in the table below.

The Rust sources regarding the alignment program used in the data alignment is available at the following repository: <https://github.com/carloccorradini/kdi-alignment>

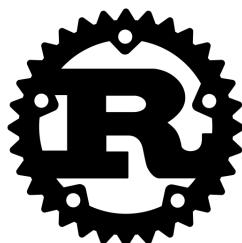
Note that the `README.md` file is enriched with useful information on how to install the Rust compiler and how to build and run the program.



Sub Datasets before Processing	Alignment Libraries	Sub Datasets after Alignment
bikesharing_lavis.json bikesharing_mezzocorona.json bikesharing_mezzolombardo.json bikesharing_rovereto.json bikesharing_sanmichelealladige.json bikesharing_trento.json car_sharing.kml centro_in_bici.kml extraurban.zip extraurban_fare.zip parcheggio_protetto_biciclette.kml taxi.kml urban.zip urban_fare.zip	gtfs-structures = "0.29" serde = "1.0" serde_json = "1.0" serde_repr = "0.1" chrono = "0.4" strum = "0.23" strum_macros = "0.23" zip = "0.5" csv = "1.1" serde-xml-rs = "0.5" log = "0.4" env_logger = "0.9"	agencies.json bike_sharing_stops.json calendar_exceptions.json calendars.json currency_enum.json direction_enum.json exception_enum.json fare_enum.json fare_rules.json fares.json locations.json parking_stop_enum.json parking_stops.json payment_enum.json public_transport_stops.json routes.json stop_times.json supported_enum.json transport_enum.json trips.json

### 6.1.1 The Rust programming language

Rust official site: <https://www.rust-lang.org>

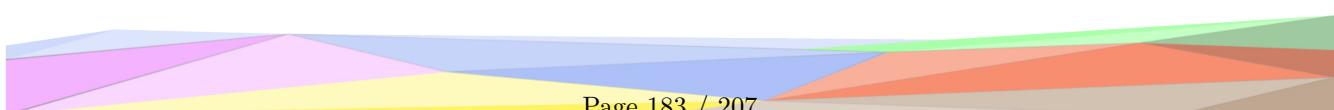


Rust is a multi-paradigm, general-purpose programming language designed for performance and safety, especially safe concurrency. Rust is syntactically similar to C++, but can guarantee memory safety by using a borrow checker to validate references. Rust achieves memory safety without garbage collection, and reference counting is optional. Rust has been called a systems programming language and in addition to high-level features such as functional programming it also offers mechanisms for low-level memory management.

Rust was originally designed by Graydon Hoare at Mozilla Research, with contributions from Dave Herman, Brendan Eich, and others. The designers refined the language while writing the Servo experimental browser engine, and the Rust compiler. It has gained increasing use in industry, and Microsoft has been experimenting with the language for secure and safety-critical software components. Rust has been voted the "most loved programming language" in the Stack Overflow Developer Survey every year since 2016.

## 6.2 Entity matching

The final method of Itelos needs to be leveraged is the entity matching, which aim to identify if different entities in the datasets can represent the same real world entity, and as a consequence, should be merged within the final EG. The key step of the entity matching is ensuing **Identifying Set**, which is a set of Etypes properties. We should uniquely identify an entity through the values associated to them since identifiers are not always existed in the



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datasets.

This procedure was conducted in a crucial platform, KarmaLinker. KarmaLinker allows us to well match the datasets to the predefined Ontology and meanwhile setting URI for every Etypes is convenient so that we can solve the semantic heterogeneity totally. In the end, KarmaLinker can create the model file for each Etpe and it can be used next time directly. The combined representation of the graph and table explicitly manifest the main Etypes with URIs, the object properties with URIs and the data properties. Some detailed instances in our project are shown in Figure 6.1:



Figure 6.1: Data Integration in Karmalinker

After ensuring the same entities, there are often some conflicts during merging the values within the dataset or different representation of the same entity. In this case, a specific kind of metadata associated to the datasets and/or directly to the entities within the datasets can help decide the final choices. Provenance is one of the good tools, which is a metadata indicating the origin of the dataset/entity/value thus it's not tough to select appropriate values to associate to the Etype property.

### 6.3 EG Metadata

This section is devoted to displaying the metadata graph and table of the EG model.

**Graph:**



Figure 6.2: *Entity Graph* metadata graph

**RDF Metadata:**

```

1 @prefix : <https://www.epos-eu.org/epos-dcat-ap#> .
2 @prefix schema: <http://schema.org/> .
3 @prefix spdx: <http://spdx.org/rdf/terms#> .
4 @prefix owl: <http://www.w3.org/2002/07/owl#> .
5 @prefix gsp: <http://www.opengis.net/ont/geosparql#> .
6 @prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
7 @prefix skos: <http://www.w3.org/2004/02/skos/core#> .
8 @prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
9 @prefix hydra: <http://www.w3.org/ns/hydra/core#> .
10 @prefix geo: <http://www.w3.org/2003/01/geo/wgs84_pos#> .
11 @prefix oa: <http://www.w3.org/ns/oa#> .
12 @prefix dct: <http://purl.org/dc/terms/> .
13 @prefix sh: <http://www.w3.org/ns/shacl#> .
14 @prefix dcat: <http://www.w3.org/ns/dcat#> .
15 @prefix locn: <http://www.w3.org/ns/locn#> .
16 @prefix foaf: <http://xmlns.com/foaf/0.1/> .
17 @prefix epos: <https://www.epos-eu.org/epos-dcat-ap#> .
18 @prefix adms: <http://www.w3.org/ns/adms#> .
19 @prefix org: <http://www.w3.org/ns/org#> .
20 @prefix cnt: <http://www.w3.org/2011/content#> .
21 @prefix vcard: <http://www.w3.org/2006/vcard/ns#> .
22 @prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
23 @prefix http: <http://www.w3.org/2006/http#> .
24 @prefix dash: <http://datashapes.org/dash#> .
  
```

```

25 @prefix dc: <http://purl.org/dc/elements/1.1/> .
26
27 <https://www.epos-eu.org/epos-dcat-ap#Organization/2dad489f-4ce3-4e0d-9122-b70df55b8ef2>
28   rdf:type schema:Organization ;
29   schema:address <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/b0bb325d-f408-4dac-80e0-2389d8efb97f> ;
30   schema:email "knowdive@disi.unitn.it" ;
31   schema:identifier "http://knowdive.disi.unitn.it"^^xsd:anyURI ;
32   schema:legalName "Knowdive" ;
33   schema:leiCode "http://knowdive.disi.unitn.it" ;
34   schema:logo "http://knowdive.disi.unitn.it/wp-content/uploads/knowdive-new-logo.png"^^xsd:anyURI ;
35   schema:memberOf <https://www.epos-eu.org/epos-dcat-ap#Organization/78574deb-e40e-4c05-a5c6-40beeff01aa0> ;
36   schema:url "http://knowdive.disi.unitn.it"^^xsd:anyURI .
37
38 <https://www.epos-eu.org/epos-dcat-ap#Organization/78574deb-e40e-4c05-a5c6-40beeff01aa0>
39   rdf:type schema:Organization ;
40   schema:address <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/cd879ddb-55b6-4620-a0e4-c85a2df9f483> ;
41   schema:email "ateneo@unitn.it" , "ateneo@pec.unitn.it" ;
42   schema:identifier "www.unitn.it"^^xsd:anyURI ;
43   schema:legalName "Università degli Studi di Trento" ;
44   schema:leiCode "00340520220" ;
45   schema:logo "https://static-cdn.unitn.it/sites/www.unitn.it/themes/unitn\_theme/images/newlogo\_unitn\_en.png"^xsd:anyURI ;
46   schema:telephone "0461281111" ;
47   schema:url "www.unitn.it"^^xsd:anyURI .
48
49 <https://www.epos-eu.org/epos-dcat-ap#PeriodOfTime/84efa52e-3879-4d09-b0b9-36362e915866>
50   rdf:type dct:PeriodOfTime ;
51   schema:endDate "2022-01-25T00:00:00Z"^^xsd:dateTime ;
52   schema:startDate "2021-09-13T00:00:00Z"^^xsd:dateTime .
53
54 <https://www.epos-eu.org/epos-dcat-ap#PostalAddress/b0bb325d-f408-4dac-80e0-2389d8efb97f>
55   rdf:type schema:PostalAddress ;
56   schema:addressCountry "IT" ;
57   schema:addressLocality "Povo (TN)" ;
58   schema:postalCode "I-38123" ;
59   schema:streetAddress "Via Sommarive 9" .
60
61 <https://www.epos-eu.org/epos-dcat-ap#Concept/4040fa1c-755a-4706-9fcd-b2e9d6fbb755>
62   rdf:type skos:Concept ;
63   skos:definition "Land transport is the transport or movement of people, animals or goods from one location to another location on land." ;
64   skos:inScheme <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/f913bd20-8e7b-4d82-9688-ca745a432f24> ;
65   skos:prefLabel "Land Transport" .
66
67 <https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/f913bd20-8e7b-4d82-9688-ca745a432f24>
68   rdf:type skos:ConceptScheme ;
69   dct:description "The movement of people or goods from one place to another." ;
70   dct:title "Transport" .
71
72 <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ca07b831-220f-4c49-bc3b-6e8215eb3238>
73   rdf:type schema>ContactPoint ;
74   schema:availableLanguage "en-US" , "it-IT" ;
75   schema:contactType "Member" ;
76   schema:email "carlo.corradini@studenti.unitn.it" ;
77   schema:name "Carlo Corradini" .
78
79 <https://www.epos-eu.org/epos-dcat-ap#Concept/520bf2b3-6fcc-45ad-971a-b17df5fe98f0>
80   rdf:type skos:Concept ;
81   skos:definition "Data Integration is the fourth iTelos phase:\r\nInputs:\r\n * ETG\r\n * Dataset syntactically aligned\r\nOutputs:\r\n * EG\r\n * Metadata\r\n * Project Documentation\r\nThe Data Integration phase aims to build the final EG, populating the ETG previously produced with the datasets entities. In this phase the knowledge and data layer are, in the end, merged together and the data semantic heterogeneity is handled.\r\nIt has to deal with Semantic Heterogeneity:\r\n * Entity alignment (DTA - 2.2): which aims to map multiple entity representation (between different datasets)
```

to the single, purpose-specific schema (ETG).  
 \* Entity matching (DTA - 2.3): which aims to identify if different entities in the datasets can represent the same real world entity, and as a consequence, should be merged together within the final EG.  
 82 skos:inScheme <<https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/5edb028b-96af-4035-8d62-c253acd5a3c5>> ;  
 83 skos:prefLabel "Data Integration Phase" .  
 84  
 85 <<https://www.epos-eu.org/epos-dcat-ap#Distribution/2d8e5529-0e68-4e0d-af09-49a96f1c6c25>>  
 86 rdf:type dcat:Distribution ;  
 87 dct:conformsTo "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/videos/karmalinker-demo-kdi2021.mp4" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W10.L19.M6.T16.1-2.SemanticHeterogeneity.pdf" ;  
 88 dct:description "Entity Graph in RDF format." , "Entity Model regarding Trentino Transportation." ;  
 89 dct:format "https://www.w3.org/RDF/"^^xsd:anyURI ;  
 90 dct:identifier "https://github.com/carlocorradini/Trentino\_Transportation/tree/main/Teleologies/Data%20Integration"^^xsd:anyURI ;  
 91 dct:issued "2021-12-15T00:00:00Z"^^xsd:dateTime ;  
 92 dct:language "English" ;  
 93 dct:license "https://opensource.org/licenses/MIT"^^xsd:anyURI ;  
 94 dct:modified "2021-12-15T00:00:00Z"^^xsd:dateTime ;  
 95 dct:rights "https://opensource.org/licenses/MIT" ;  
 96 dct:title "Trentino Transportation" , "Entity Graph" ;  
 97 dct:type "Collection"^^xsd:anyURI ;  
 98 spdx:checksum "md5 7186eb1d18efc95e479e746085b5b034" ;  
 99 adms:status <<https://www.epos-eu.org/epos-dcat-ap#Concept/b9645f82-9500-414c-a51d-255ff657c69e>> ;  
 100 dcat:accessURL "https://github.com/carlocorradini/Trentino\_Transportation/tree/main/Teleologies/Data%20Integration"^^xsd:anyURI , "https://drive.google.com/drive/folders/1d7QPcG3uI9aHw\_UXUsKuiDtCz0wapA-f?usp=sharing"^^xsd:anyURI ;  
 101 dcat:byteSize 3.9048358E7 ;  
 102 dcat:downloadURL "https://github.com/carlocorradini/Trentino\_Transportation/tree/main/Datasets/Data%20Integration"^^xsd:anyURI ;  
 103 dcat:mediaType "application/rdf+xml" ;  
 104 foaf:page "https://github.com/carlocorradini/Trentino-Transportation" .  
 105  
 106 <<https://www.epos-eu.org/epos-dcat-ap#PostalAddress/cd879ddb-55b6-4620-a0e4-c85a2df9f483>>  
 107 rdf:type schema:PostalAddress ;  
 108 schema:addressCountry "IT" ;  
 109 schema:addressLocality "Trento" ;  
 110 schema:postalCode "38122" ;  
 111 schema:streetAddress "Via Calepina 14" .  
 112  
 113 <<https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/5edb028b-96af-4035-8d62-c253acd5a3c5>>  
 114 rdf:type skos:ConceptScheme ;  
 115 dct:description "The DI Purpose, expressed by the final user as a natural language sentence, define the main goal for the whole data integration. It represent what the final user should be able to do exploiting the DI final outcome (KG). Due to that, the Purpose leads the whole integration process and makes iTelos be a Purpose driven DI methodology.  
 \* Domain of Interest (DoI): The portion of the world that involves all the information elements used to satisfy a specific purpose.  
 \* In order to identify the level of reusability of the resources collected and handled along the methodology.  
 \* iTelos Data Life Cycle:  
 \* Data Collection & Preparation (DTA-1): align the different sources data formats, and data standards, representing the information carried through a single data format. The aligned data can be then collected within the methodologies Input Repository  
 \* Syntactic Alignment (DTA-2.1): align the data value formats by adopting the same data standards for similar data types  
 \* Semantic Alignment (DTA-2.2): align the semantic of the data (entity schema representation and word sense disambiguation)  
 \* Entity Matching (DTA-2.3): align modeled entities with already existing representations of the same entities  
 \* Application Alignment (DTA-3): the last transformation (considered as out of scope for the DI methodology) aims to align the integrated data in order to let them suitable to be used by a specific application  
 \* Teleology is the study of ends and goals, things whose existence or occurrence is purposive. Concretely, in our context, teleologies are ontologies but with the proviso that teleologies focus on function and on how a chosen representation fits a certain purpose. In other words, the teleologies are the way adopted in the DI methodology (iTilos) to model (design, represent) the information that needs to be exploited by final users.  
 \* A KG, as result of a DI process, is composed by knowledge (teleologies) and data (datasets) resources combined together in the best way possible in order to achieve the users Purpose. There are three different approaches to build such kind of KGs:  
 \* Knowledge centric: The data schema design comes first and

---

then the data are aligned to it.\r\n \* Data centric: The data schema is mainly (some adaptation are always required) extracted from the data to be integrated.\r\n \* Middle-out approach: The data schema (teleology) is designed considering already existing knowledge resources AND the data. While the datasets are adapted to the schema designed." ;  
 116     dct:title "iTilos Principles" .  
 117  
 118 <<https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/a21146bd-a38c-49fe-a02f-f8575d1d73e2>>  
 119     rdf:type skos:ConceptScheme ;  
 120     dct:description "The position or rank of someone or something when compared to others in a society, organization, group, etc." ;  
 121     dct:title "Status" .  
 122  
 123 <<https://www.epos-eu.org/epos-dcat-ap#ContactPoint/3a8a3044-3e7a-463d-94d9-15c4f4822938>>  
 124     rdf:type schema>ContactPoint ;  
 125     schema:availableLanguage "zh-CN" , "en-US" ;  
 126     schema:contactType "Member" ;  
 127     schema:email "xuanli.li@studenti.unitn.it" ;  
 128     schema:name "Xuanli Li" .  
 129  
 130 <<https://www.epos-eu.org/epos-dcat-ap#Concept/b9645f82-9500-414c-a51d-255ff657c69e>>  
 131     rdf:type skos:Concept ;  
 132     skos:definition "Containing all the necessary parts, answers, or information." ;  
 133     skos:inScheme <<https://www.epos-eu.org/epos-dcat-ap#ConceptScheme/a21146bd-a38c-49fe-a02f-f8575d1d73e2>> ;  
 134     skos:prefLabel "Completed" .  
 135  
 136 <<https://www.epos-eu.org/epos-dcat-ap#Agent/828bf6b9-9f4b-4355-bcd0-d68b188811cb>>  
 137     rdf:type foaf:Agent ;  
 138     foaf:name "Carlo Corradini" .  
 139  
 140 <<https://www.epos-eu.org/epos-dcat-ap#Dataset/3a2e0c02-aebe-44d1-b688-a5e21d81d088>>  
 141     rdf:type dcat:Dataset ;  
 142     dct:accessRights "Public" ;  
 143     dct:accrualPeriodicity "Once"^^xsd:anyURI ;  
 144     dct:conformsTo "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/videos/karmalinker-demo-kdi2021.mp4" , "https://unitn-kdi-2021.github.io/unitn-kdi-2021-website/material/slides/W10.L19.M6.T16.1-2.SemanticHeterogeneity.pdf" , "iTilos" ;  
 145     dct:created "2021-09-13T00:00:00Z"^^xsd:dateTime ;  
 146     dct:description "For more information see the following websites: https://unitn-kdi-2021.github.io/unitn-kdi-2021-website https://drive.google.com/drive/folders/12p27IFsmy9Us4AD2lw\_0fEvl1k7BaIMk?usp=sharing https://github.com/carlocorradini/Trentino-Transportation" , "The project is related to the Knowledge and Data integration (KDI) course held in the academic year 2021/2022 at the University of Trento (Unitn)." , "Carlo Corradini (<https://github.com/carlocorradini>) and Xuanli Li(<https://github.com/xuanli666>) are the members assigned to the realization and finalization." , "Entity Graph Metadata regarding Trentino Transportation." , "With the development of big data technology and cloud storage technology, we are in an era of the rapid increase in information, with countless data or knowledge. How to manage these data and achieve more efficient sharing and utilization is an area that many researchers are exploring, that is, to fulfill the integration of knowledge and data in specific, rather than leaving information be unorganized. This report focuses on integrating all the public transportation as well as sharing vehicles information within Trentino so that a more complete transport information system could help people make a better decision and save time or money as much as possible. Specifically, we pay attention to the application of vehicles that GTFS has not covered, such as sharing bikes, sharing cars, and so on so forth, which is added to the system, and then residents have more choices when determining paths." , "This project aims to comprehensively consider the transportation situations under the specific Trentino region, not only involving the public transportation services but also the personal tracks. Collecting the latest temporal and spatial information and integrating the data and knowledge from diverse sources. Public transportation services, vehicles, bus stations, train stations, railways, highways, simple streets, public transportation service timelines, and trip schedules are the main important elements that will be mainly paid attention, besides, the mixed using of some vehicles and the parking path will be exploring." ;  
 147     dct:identifier "<https://github.com/carlocorradini/Trentino-Transportation/tree/main/Teleologies/Data%20Integration>"^^xsd:anyURI ;  
 148     dct:issued "2021-12-15T00:00:00Z"^^xsd:dateTime ;  
 149     dct:language "English" ;

---

```

150    dct:modified "2021-12-11T00:00:00Z"^^xsd:dateTime ;
151    dct:publisher <https://www.epos-eu.org/epos-dcat-ap#Organization/2dad489f-4ce3-4e0d-9122-b70df55b8ef2> , <
152        https://www.epos-eu.org/epos-dcat-ap#Agent/828bf6b9-9f4b-4355-bcd0-d68b188811cb , <https://www.epos-eu.org/epos-dcat-ap#Agent/f9cfb89e-3bb9-41ba-b263-e0386fce30ed> ;
153    dct:temporal <https://www.epos-eu.org/epos-dcat-ap#PeriodOfTime/84efa52e-3879-4d09-b0b9-36362e915866> ;
154    dct:title "Entity Graph Metadata" ;
155    dct:type "Collection"^^xsd:anyURI ;
156    dcat:contactPoint <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/3a8a3044-3e7a-463d-94d9-15c4f4822938>
157        , <https://www.epos-eu.org/epos-dcat-ap#ContactPoint/ca07b831-220f-4c49-bc3b-6e8215eb3238> ;
158    dcat:distribution <https://www.epos-eu.org/epos-dcat-ap#Distribution/2d8e5529-0e68-4e0d-af09-49a96f1c6c25>
159        ;
160    dcat:keyword "Fausto Giunchiglia" , "Xuanli Li" , "fare" , "bike" , "Knowledge and Data integration" , "bus"
161        , "Simone Bocca" , "extra-urban transport" , "trentino trasporti" , "car sharing" , "KDI" , "iTilos"
162        , "public transport" , "UniTN" , "cash" , "taxi" , "cable car" , "Carlo Corradini" , "train" , "
163        University of Trento" , "trento" , "bike sharing" , "transport" , "price" , "trentino" , "mobile" , "
164        trip" , "parking" , "ticket" , "route" , "cartascalare" , "bike parking" , "urban transport" ;
165    dcat:landingPage "https://github.com/carlocorradini/Trentino-Transportation" ;
166    dcat:theme <https://www.epos-eu.org/epos-dcat-ap#Concept/4040fa1c-755a-4706-9fcd-b2e9d6fbb755> , <https://www.epos-eu.org/epos-dcat-ap#Concept/520bf2b3-6fcc-45ad-971a-b17df5fe98f0> ;
167    foaf:page "https://github.com/carlocorradini/Trentino-Transportation" .
168
169 <https://www.epos-eu.org/epos-dcat-ap#Agent/f9cfb89e-3bb9-41ba-b263-e0386fce30ed>
170    rdf:type foaf:Agent ;
171    foaf:name "Xuanli Li" .

```

---

## 6.4 Evaluation

The last phase evaluation is most important since it can directly reflect the quality (effectiveness and applicability) of our model.

There are two main evaluations. One is to solve the CQs during the inception phase based on practical applications, like SQL. Using the application of our model into the practical questions are executed in Outcome exploitation section.

Moreover, on the data level, we still can apply the metric 'Sparsity' to evaluate if our datasets are sufficiently aligned to ETG properties. After the comparison between the Formal ETG (ETG) and the Dataset Schema, we found there is total coincident that EG and DS both have 12 Etype(s) and 58 properties. Accordingly, the Etype Sparsity is  $Spr(ETG_e) = 1 - \frac{|DS_e \cap Ont_e|}{|DS_e \cup Ont_e|} = 0$  and the Properties Sparsity is  $Spr(CQ_p) = 1 - \frac{|DS_p \cap Ont_p|}{|DS_p \cup Ont_p|} = 0$ . The results demonstrate there is no sparsity between Formal ETG and our dataset Schema.

Besides, after the inspection, we didn't find the problem related to the three non-quantitative dimensions, Consistency, Accuracy, and Completeness.

---

# 7 Open Issues

This section aims to describe any issues/problems remained open along the DI process. The description of open issues has to provide a clear explanation about the problems, the approaches adopted while trying to solve them, and eventually, any proposed solution that has not been applied.

During the whole project, We have encountered many challenges associated with different aspects.

## 7.1 Data type issues

In terms of our datasets, some data are presented in date or time format while the Protégé just supports the 'datetime' format, thus we set both date and time format then aligned them together when it was deployed to the Karmalinker.

The other problem about the data type is that we set 'Enumerations' to be as the data types of some data properties, like public transport type and parking stop type. The fact is that the Enumeration data types can not be represented in the applications (Protégé, Karmalinker), hence we used the string or list to replace them.

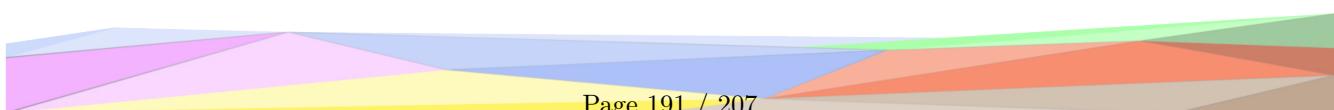
## 7.2 KOS issues

During the procedures applied in KOS, we also face some changes. There is no 'undo' or 'delete' button, which means we were supposed to upload all correct stuff since we just had one opportunity. Nevertheless, we found we did something wrong with our ETG model when we proceed with formal modeling phase. And the professor suggested we should redo all the procedures of KOS. There is no doubt that this a time and energy-consuming experience. Luckily, everything went smoothly when we did again.

## 7.3 Karmalinker issues

When we attempted to align our datasets to ontology, we found a dataset called 'fareRule' is too large to be handled by Karmalinker. One solution we adopted was splitting the big file into small chunks and repeating the same process on every chunk with a predefined model. We have to admit that this method works but this is inefficient.

Another problem occurred is that one Etype have more than one foreign keys and some of the foreign keys link to the same external Etype. Hence it produced some errors to mismatch the values to properties, for instance, the Etype, PublicTransportStop, has two object properties with URIs linked to Location however one Etype should only have one URI. The consequence was that when we put the model to application, there was a mismatch between location and zone.



---

The final method we utilized is to create different identifiers for the external Etype to link the different properties belonged to one Etype with multiple same object properties.

## 7.4 Electric Scooter

We are unable to answer the Competency Questions regarding the Electric Scooter caused by missing dataset(s). This is due to the fact that this type of transport is relatively new and all the available agencies are private without public data available.

To solve this issue we can exploit the knowledge that the majority of the Electric Scooter stops are located adjacent the available Bike Sharing stops. Therefore, when searching for an Electric Scooter stop the query must be translated to a search for a Bike Sharing stop. Note that the resulting stop(s) does not guarantee that there will be also an Electric Scooter stop.

Moreover, an Electric Scooter can be left wherever a user wants without the obligation to return it to a stop. This real-time data are crucial for a better Quality of Service but as wrote before due to the leakage of data this is not (currently) possible.

## 7.5 Trenitalia

Trenitalia is the primary train operator in Italy. A subsidiary of Ferrovie dello Stato Italiane, itself owned by the Italian government, the company was established in 2000.

The current status of the project includes only the regional train and/or scheduled a-priori trains. It doesn't include any interstate trains or non-scheduled trains. This is caused by the absence of any publicly available datasets regarding Trenitalia and/or trains in general.

Trenitalia offers some API to interact with their backend, however has been proved that the documentation and architecture of these APIs are really bad and not well engineered.

We suggest reading the article *+++TRENITALIA SHOCK+++ NON crederete MAI a queste API \*painful\**<sup>1</sup> on Medium where an Italian user tried to interact with these APIs and the overall experience was bad, painful, and shockingly complicated.

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<sup>1</sup><https://medium.com/@albigiu/trenitalia-shock-non-crederete-mai-a-queste-api-painful-14433096502c>

# 8 Outcome exploitation

The final section of the current document aims to provide a description of the data integration process outcome. First, we report the final Knowledge Graph (KB) information (like, number of Etypes and properties, the number of entities for each Etype(s), and so on). Moreover we present some application examples based on our model via SPARQL.

In the end of this section, some general conclusions are added comprising the consideration of this project and the thinking on further improvement.

## 8.1 KB information

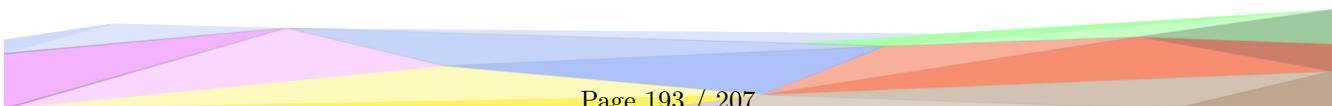
After the whole process of this project, we successfully created a Knowledge Graph regarding Trentino Transportation, which integrated the whole data of public and sharing vehicles within Trentino.

To be more specific to display the model, we calculated some total numbers of our final Knowledge Graph components including Etypes, properties, and the corresponding entities. The details are shown in the table below.

	Etype	Property	Entity
	Agency	5	1
	Bike_sharing_stop	2	121
	Calendar_exception	3	4193
	Calendar	10	121
	Fare_rule	3	969708
	Fare	6	127
	Named_location	4	4767
	Parking_stop	4	26
	Public_transport_stop	4	3915
	Route	5	166
	Stop_time	5	198611
	Trip	7	5948
Total	12	58	1187704

## 8.2 Model applications

The goal of this project is to integrate the information including the data and knowledge of Trentino transportation to knowledge graph so that the users can apply it to check the answers according to their queries. In line with the aim, we tried to apply our model to the practical questions using SPARQL in GraphDB. There are some instances deployed and the results prove our model performs well. The details of questions, SPARQLs, results, and visualization are shown as follows:



---

### 8.2.1 SPARQL

RDF is a directed, labeled graph data format for representing information in the Web. This specification defines the syntax and semantics of the SPARQL query language for RDF. SPARQL can be used to express queries across diverse data sources, whether the data is stored natively as RDF or viewed as RDF via middleware. SPARQL contains capabilities for querying required and optional graph patterns along with their conjunctions and disjunctions. SPARQL also supports extensible value testing and constraining queries by source RDF graph. The results of SPARQL queries can be result sets or RDF graphs[1].

Note that the following SPARQL queries have been made possible thanks to the help offered by the following tutorial: <https://www.stardog.com/tutorials/sparql>

---

## 8.2.2 Query 1

Return the **first** available departure time of **Bus 5/** from the stop **Piazza Dante**.

### 8.2.2.1 Source

---

```
1 PREFIX iri: <http://knowdive.disi.unitn.it/etype#>
2
3 SELECT ?departure
4 {
5   ?stopTime a iri:Stop_time_GID-34825 ;
6     iri:has_trip_GID-1570_Type-34825 ?trip ;
7     iri:has_stop_GID-46571_Type-34825 ?stop ;
8     iri:has_departure_GID-300017_Type-34825 ?departure ;
9     iri:has_sequence_GID-27840_Type-34825 ?sequence ;
10    FILTER (?sequence = 1) .
11
12  ?stop iri:has_public_transport_stop_location_GID-779_Type-46571 ?location ;
13    iri:has_public_transport_stop_type_GID-300012_Type-46571 ?Type ;
14    FILTER REGEX (?Type, "Bus") .
15
16  ?location iri:has_location_name_GID-2_Type-300007 ?lName ;
17    FILTER (?lName = "Piazza Dante \"Stazione Fs\"") .
18
19  ?trip iri:has_route_GID-22592_Type-1570 ?route .
20
21  ?route iri:has_short_name_GID-1842_Type-46379 ?shortName ;
22    FILTER (?shortName = "5/") .
23 }
24 ORDER BY ASC (?departure)
25 LIMIT 1
```

---

### 8.2.2.2 Execution

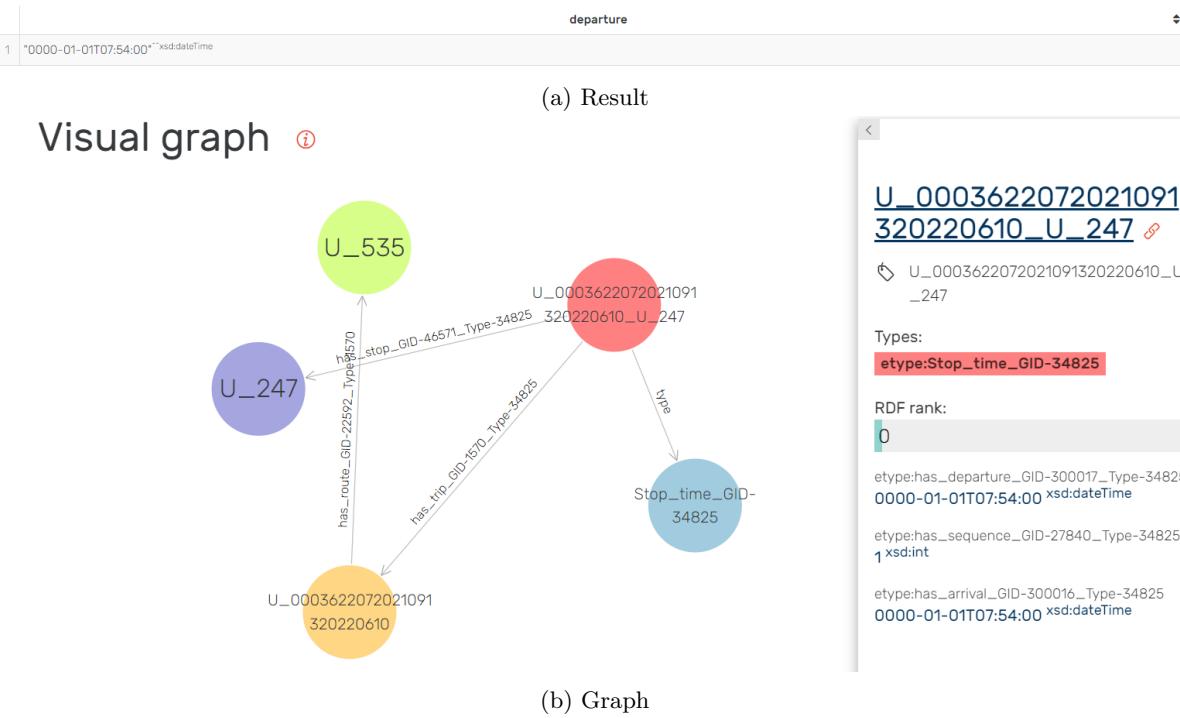


Figure 8.1: Query 1

---

### 8.2.3 Query 2

Return all the available **cost** for the trip from **Trento** to **Padergnone** and sort for the most cheaper (and ticket duration).

#### 8.2.3.1 Source

---

```
1 PREFIX iri: <http://knowdive.disi.unitn.it/etype#>
2
3 SELECT ?type ?price ?currency ?duration
4 {
5     ?fareRule a iri:Fare_rule_GID-300014 ;
6         iri:has_fare_GID-70599_Type-300014 ?fare ;
7         iri:has_origin_GID-45883_Type-300014 ?origin ;
8         iri:has_destination_GID-46122_Type-300014 ?destination .
9
10    ?origin iri:has_location_name_GID-2_Type-300007 ?oName ;
11        FILTER (?oName = "Trento") .
12
13    ?destination iri:has_location_name_GID-2_Type-300007 ?dName ;
14        FILTER (?dName = "Padergnone") .
15
16    ?fare iri:has_fare_type_GID-300015_Type-70599 ?type ;
17        iri:has_price_GID-70571_Type-70599 ?price ;
18        iri:has_currency_GID-71038_Type-70599 ?currency ;
19        iri:has_duration_GID-80582_Type-70599 ?duration .
20 }
21 ORDER BY ASC (?price) DESC(?duration)
```

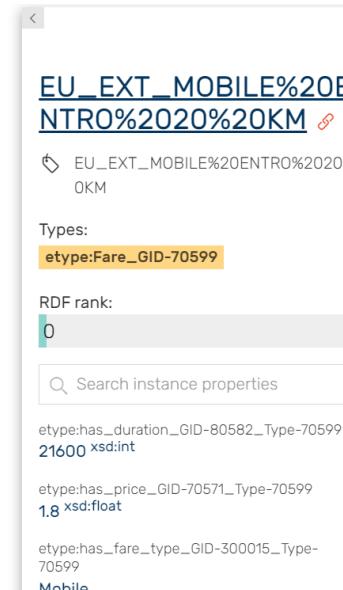
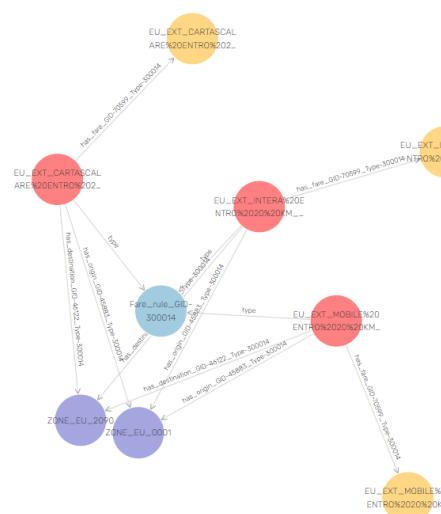
---

### 8.2.3.2 Execution

	type	price	currency	duration
1	"Mobile"	"1.8"^^xsd:float	"EUR"	"21600"^^xsd:int
2	"Cartascalare"	"2.0"^^xsd:float	"EUR"	"21600"^^xsd:int
3	"Cash"	"2.0"^^xsd:float	"EUR"	"21600"^^xsd:int

(a) Result

Visual graph ⓘ



(b) Graph

Figure 8.2: Query 2

---

## 8.2.4 Query 3

Return the **nearest train stop** from the "Department of Information Engineering and Computer Science @ University of Trento" within a **range of 1 Km**.

### 8.2.4.1 Source

---

```
1 PREFIX iri: <http://knowdive.disi.unitn.it/etype#>
2 PREFIX omgeo: <http://www.ontotext.com/owlim/geo#>
3
4 SELECT ?name ?latitude ?longitude ?distance
5 {
6     ?stop a iri:Public_transport_stop_GID-46571 ;
7         iri:has_public_transport_stop_location_GID-779_Type-46571 ?location ;
8         iri:has_public_transport_stop_type_GID-300012_Type-46571 ?type ;
9         FILTER REGEX (?type, "Train") .
10
11    ?location iri:has_latitude_GID-46263_Type-132 ?latitude ;
12        iri:has_longitude_GID-46270_Type-132 ?longitude ;
13        iri:has_location_name_GID-2_Type-300007 ?name ;
14        # Calculate distance from
15        # 'Department of Information Engineering and Computer Science @ University of Trento'
16        BIND (omgeo:distance(46.0677084, 11.1500311, ?latitude, ?longitude) AS ?distance)
17        # Maximum allowed distance in Km
18        FILTER (?distance < 1)
19 }
20 ORDER BY ASC (?distance)
```

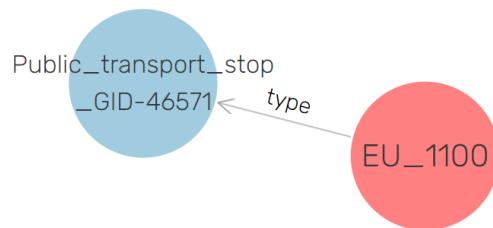
---

#### 8.2.4.2 Execution

	name	latitude	longitude	distance
1	"Povo-Mesiano"	"46.06612"^^xsd:float	"11.142769"^^xsd:float	"0.5874043474184484"^^xsd:float
2	"Povo-Mesiano"	"46.06612"^^xsd:float	"11.142769"^^xsd:float	"0.5874043474184484"^^xsd:float

(a) Result

Visual graph ⓘ



(b) Graph

EU\_1100 ⓘ

EU\_1100

Types:

- etype:Named\_location\_GID-300007
- etype:Public\_transport\_stop\_GID-46571

RDF rank: 0

Search instance properties

etype:has\_longitude\_GID-46270\_Type-132  
11.142769 xsd:float

etype:has\_location\_name\_GID-2\_Type-300007  
Povo-Mesiano

etype:has\_latitude\_GID-46263\_Type-132  
46.06612 xsd:float

etype:has\_public\_transport\_stop\_wheelchair\_GID-300019\_Type-46571  
Unknown

etype:has\_public\_transport\_stop\_type\_GID-300012\_Type-46571  
Bus,Train Show 1 more ▾

- Train, Bus

Figure 8.3: Query 3

## 8.2.5 Query 4

Return the first ten generic and specialized bike sharing stops within 5 Km from "Piazza Duomo @ Trento" and sort them by distance. For specialized only obtain also free slots and bikes.

### 8.2.5.1 Source

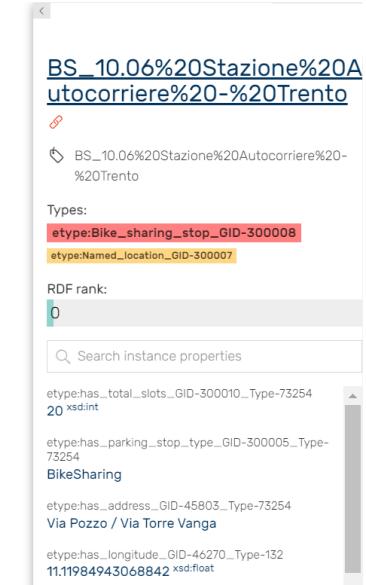
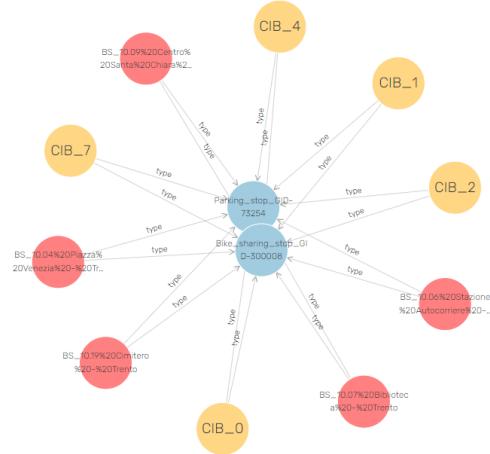
```
1 PREFIX iri: <http://knowdive.disi.unitn.it/etype#>
2 PREFIX omgeo: <http://www.ontotext.com/owlim/geo#>
3
4 SELECT ?name ?latitude ?longitude ?distance ?address ?totalSlots ?freeSlots ?bikes
5 {
6     # Combine generic & specialized 'BikeSharing'
7     { ?stop a iri:Parking_stop_GID-73254 }
8     UNION
9     { ?stop a iri:Bike_sharing_stop_GID-300008 }
10
11    ?stop iri:has_parking_stop_location_GID-779_Type-73254 ?location ;
12        iri:has_address_GID-45803_Type-73254 ?address ;
13        iri:has_total_slots_GID-300010_Type-73254 ?totalSlots ;
14        iri:has_parking_stop_type_GID-300005_Type-73254 ?type ;
15        FILTER (?type = "BikeSharing")
16
17    OPTIONAL {
18        # Specialized 'BikeSharing' predicates
19        ?stop iri:has_free_slots_GID-300001_Type-300008 ?freeSlots ;
20            iri:has_bikes_GID-300018_Type-300008 ?bikes ;
21            # Stop with at least one bike available
22            FILTER (?bikes > 0)
23    }
24
25    ?location iri:has_location_name_GID-2_Type-300007 ?name ;
26        iri:has_latitude_GID-46263_Type-132 ?latitude ;
27        iri:has_longitude_GID-46270_Type-132 ?longitude ;
28        # Calculate distance from
29        # 'Piazza Duomo @ Trento'
30        BIND (omgeo:distance(46.0671931, 11.1212042, ?latitude, ?longitude) AS ?distance)
31        # Maximum allowed distance in Km
32        FILTER (?distance < 5)
33    }
34 ORDER BY ASC (?distance) DESC (?bikes)
```

### 8.2.5.2 Execution

	name	latitude	longitude	distance	address	totalSlots	freeSlots	bikes
1	"10.06 Stazione Autocorriere"	"46.0702356381064"	"xsd:float	"11.1984943068842"	"xsd:float	"0.3542691299938874"	"xsd:float	"Via Pozzo / Via Torre Vanga"
2	"10.07 Biblioteca"	"46.07043395910254"	"xsd:float	"11.121399842327946"	"xsd:float	"0.5608640577508455"	"xsd:float	"Via Alfieri / Via Torre Vanga"
3	"PIAZZA DANTE: via Torre Vanga - stazione autocorriere"	"46.07037816415674"	"xsd:float	"11.19849738161901"	"xsd:float	"0.3699457804142002"	"xsd:float	"PIAZZA DANTE: via Torre Vanga - stazione autocorriere"
4	"10.19 Cimitero"	"46.063655353792"	"xsd:float	"11.19203014368616"	"xsd:float	"0.42284652002787765"	"xsd:float	"via Madruzzo / via Rosmini"
5	"10.04 Piazza Venezia"	"46.06763791402558"	"xsd:float	"11.12698715869156"	"xsd:float	"0.44782204037243417"	"xsd:float	"via Grazielo / piazza Venezia"
6	"PARCHEGGIO CANESTRINI"	"46.06874165011523"	"xsd:float	"11.156491348342165"	"xsd:float	"0.4588713753913557"	"xsd:float	"PARCHEGGIO CANESTRINI"
7	"10.09 Centro Santa Chiara"	"46.06345393738132"	"xsd:float	"11.12375366752849"	"xsd:float	"0.4598686604594884"	"xsd:float	"Via S. Croce 78"
8	"PARCHEGGIO DUOMO: via Sansovino"	"46.06722229094914"	"xsd:float	"11.15104618338075"	"xsd:float	"0.47332271012347395"	"xsd:float	"PARCHEGGIO DUOMO: via Sansovino"
9	"PIAZZA DANTE: via Alfieri - Palazzo della Regione"	"46.07147095275777"	"xsd:float	"11.12124281662683"	"xsd:float	"0.4759248991650507"	"xsd:float	"PIAZZA DANTE: via Alfieri - Palazzo della Regione"
10	"PIAZZA DANTE: stazione FFSS - capolinea autobus urbani"	"46.07194923564187"	"xsd:float	"11.119335888226276"	"xsd:float	"0.5482303825676421"	"xsd:float	"PIAZZA DANTE: stazione FFSS - capolinea autobus urbani"

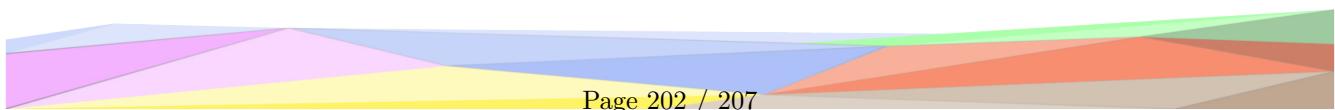
(a) Result

Visual graph ⓘ



(b) Graph

Figure 8.4: Query 4



## 8.2.6 Query 5

Return the first ten **departure time** and correlated **stop** location of **bus 5** with an **inbound direction** available after "11:30:00" on the "2021-12-15". Stop and trip must support "**wheelchair**". The stop must be withing a **500 m** radius from the "Department of Information Engineering and Computer Science @ University of Trento".

### 8.2.6.1 Source

```
1 PREFIX iri: <http://knowdive.disi.unitn.it/etype#>
2 PREFIX omgeo: <http://www.ontotext.com/owlim/geo#>
3
4 SELECT ?stopName ?latitude ?longitude ?departure ?distance
5 {
6     ?stopTime a iri:Stop_time_GID-34825 ;
7         iri:has_trip_GID-1570_Type-34825 ?trip ;
8         iri:has_departure_GID-300017_Type-34825 ?departure ;
9         iri:has_stop_GID-46571_Type-34825 ?stop ;
10        # 'Departure' must be after (inclusive) '11:30:00'
11        FILTER (STR(?departure) >= "0000-01-01T11:30:00")
12
13    ?trip iri:has_route_GID-22592_Type-1570 ?route ;
14        iri:has_trip_calendar_GID-80813_Type-1570 ?calendar ;
15        iri:has_trip_wheelchair_GID-300011_Type-1570 ?tripWheelchair ;
16        iri:has_direction_GID-73503_Type-1570 ?direction ;
17        # 'Wheelchair' boarding & 'Inbound' direction
18        FILTER (?tripWheelchair = "Supported" && ?direction = "Inbound")
19
20    ?stop iri:has_public_transport_stop_wheelchair_GID-300019_Type-46571 ?stopWheelchair ;
21        iri:has_public_transport_stop_location_GID-779_Type-46571 ?location ;
22        # 'Wheelchair' accessible
23        FILTER (?stopWheelchair = "Supported")
24
25    ?location iri:has_latitude_GID-46263_Type-132 ?latitude ;
26        iri:has_longitude_GID-46270_Type-132 ?longitude ;
27        iri:has_location_name_GID-2_Type-300007 ?stopName ;
28        # Calculate distance from
29        # 'Department of Information Engineering and Computer Science @ University of Trento'
30        BIND (omgeo:distance(46.0677084, 11.1500311, ?latitude, ?longitude) AS ?distance)
31        # Maximum allowed distance in Km
32        FILTER (?distance < 0.5)
33
34    ?route iri:has_short_name_GID-1842_Type-46379 ?shortName ;
35        iri:has_transport_GID-16756_Type-46379 ?transport ;
36        # 'Bus' number '5'
37        FILTER (?shortName = "5" && ?transport = "Bus")
38
39    ?calendar iri:has_wednesday_GID-80760_Type-80813 ?wednesday ;
40        iri:has_start_date_GID-300002_Type-80813 ?startDate ;
41        iri:has_end_date_GID-300004_Type-80813 ?endDate ;
42        # Supported date '2021-12-15' on a 'wednesday' day
43        FILTER (
44            ?wednesday
45            && ?startDate <= "2021-12-15T00:00:00"^^xsd:dateTime
```

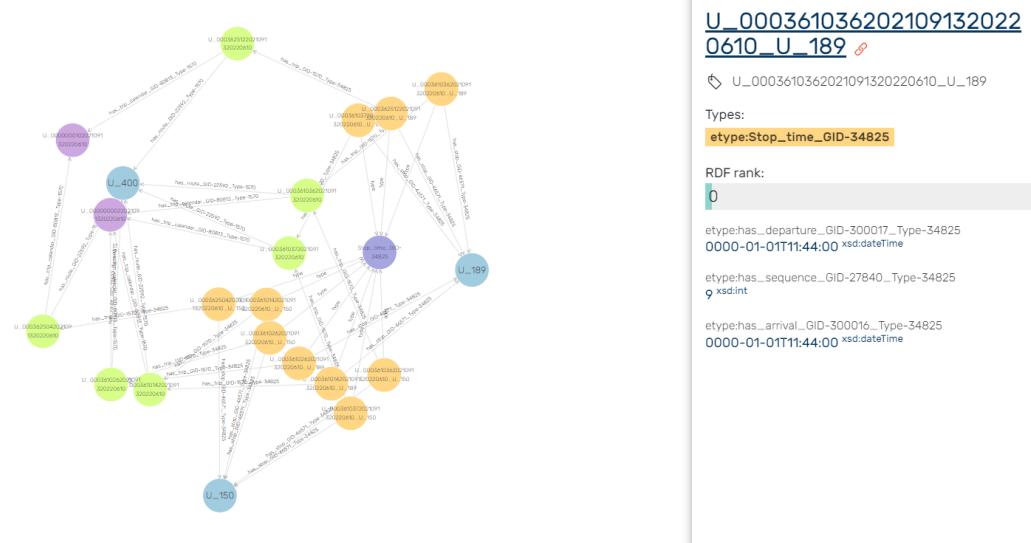
```
46          && ?endDate >= "2021-12-15T00:00:00"^^xsd:dateTime  
47      )  
48 }  
49 ORDER BY ASC (?departure) ASC (?distance)
```

### 8.2.6.2 Execution

	stopName	latitude	longitude	departure	distance
1	"Povo "Fac. Scienze"	"46.063316"	"11.150206"	"0000-01-01T11:44:00"	"0.48841103677195546"
2	"Povo Valoni"	"46.065747"	"11.146323"	"0000-01-01T11:45:00"	"0.35967491808089724"
3	"Povo "Fac. Scienze"	"46.063316"	"11.150206"	"0000-01-01T12:04:00"	"0.48841103677195546"
4	"Povo Valoni"	"46.065747"	"11.146323"	"0000-01-01T12:05:00"	"0.35967491808089724"
5	"Povo "Fac. Scienze"	"46.063316"	"11.150206"	"0000-01-01T12:24:00"	"0.48841103677195546"
6	"Povo Valoni"	"46.065747"	"11.146323"	"0000-01-01T12:25:00"	"0.35967491808089724"
7	"Povo Valoni"	"46.065747"	"11.146323"	"0000-01-01T12:34:00"	"0.35967491808089724"
8	"Povo "Fac. Scienze"	"46.063316"	"11.150206"	"0000-01-01T12:44:00"	"0.48841103677195546"
9	"Povo Valoni"	"46.065747"	"11.146323"	"0000-01-01T12:45:00"	"0.35967491808089724"
10	"Povo "Fac. Scienze"	"46.063316"	"11.150206"	"0000-01-01T12:49:00"	"0.48841103677195546"

(a) Result

Visual graph ⓘ



(b) Graph

Figure 8.5: Query 5

---

### 8.3 Project conclusion

In terms of the project results, we think we have successfully achieved the purpose to create a Knowledge Graph integrating the knowledge and data regarding Trentino Transportation. Our final project outcomes are useful and applicable for the reality. However, the whole process of fulfilling this project is full of challenges, especially just depending on two team members to execute all steps. Nevertheless, when we look back on the project, it's interesting and inspiring.

Furthermore, there is still some space for improvement even if this model can be used for the basic applications.

- The project mainly relates to the public transportation, bike, and car-sharing facilities. However other aspects like normal car parks, gas stations, and gas prices also might be considered.
- The project integrates the static information. On the other hand, constructing a real-time transportation KG is also a significant research direction.

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