

Dipartimento di Ingegneria e Scienza dell'Informazione

– KnowDive Group –

# Tourism And Waste Management in Trentino

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Document Data:

October 30, 2024

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Trento, Italy

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# Revision History:

Revision	Date	Author	Description of Changes
0.1	October 30, 2024	Maria Amalia Pelle	Document created

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# 1 Purpose Definition

The initial phase of our Knowledge Graph project focuses on clearly defining the purpose, establishing the domain of interest, and identifying personas and scenarios. These elements inform the formulation of competency questions, which address the needs and goals of the identified personas and scenarios: the competency questions will later be answered by querying the completed knowledge graph. This phase also includes the completion of the Purpose Definition Sheet, where all relevant entities and their associated properties are outlined, and the Entity-Relationship (ER) Modeling.

## 1.1 Informal Purpose

The purpose of our project is to offer comprehensive data regarding waste management and its relationship with tourism in the Province of Trento. The final Knowledge Graph (KG) will serve as a valuable tool for various stakeholders, including tourists, facility owners, and waste management authorities, by providing accessible information on waste disposal locations, recycling options, and the environmental impact of tourism on local waste management systems. Additionally, the KG will support researchers and experts by enabling in-depth analysis of the interactions between tourism activities and waste generation, promoting evidence-based decision-making in administration and policy development.

## 1.2 Domain of Interest (DoI)

The focus of this project is on waste production data and tourist infrastructure in the Province of Trento (Trento coordinates are 46°04'00"N, 11°07'00"E). The waste production data, which pertains to individual cities, covers a yearly timeline from 2010 to 2022.

## 1.3 Scenarios definition

- S1 General waste disposal: It's a sunny winter morning at Monte Bondone, a popular skiing destination in Trentino. As visitors enjoy their skiing activities, they generate waste such as snack wrappers and drink containers, which need to be properly disposed of to maintain the area's natural beauty.
- S2 Following policies guidance: Facility owners in Trentino must enforce regulations related to waste disposal to comply with local environmental laws. To achieve this, they should regularly review the waste management guidelines provided by the municipality and stay updated on any changes in legislation.

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- S3 Analysis on tourism waste impact: Trentino requires a thorough analysis of the impact of tourism on waste management to propose new regulations. In response to growing concerns about the increasing waste generated by tourist activities, a comprehensive study is needed to examine current waste management practices in popular tourist areas.
- S4 Time Series Analysis: During the COVID-19 pandemic, Trentino faced an unprecedented tourist season with marked fluctuations in visitor numbers due to shifting travel restrictions and health protocols. These changes might have impacted waste production at popular tourist destinations.
- S5 Special waste disposal: Sport tourism in Trentino attracts various travelers who bring along sporting equipment such as bicycles, climbing harnesses, and skis. However, accidents can happen even on vacation, leading to damaged gear. Unfortunately, this type of waste cannot always be disposed of easily and often requires transportation to specialized facilities for proper handling.
- S6 Waste management practices: The waste management provider aims to conduct a detailed comparative analysis of waste production levels across various municipalities within the region. The primary objective is to identify and understand the most effective waste management practices employed by cities with consistently lower waste outputs.

## 1.4 Personas

- P1 Maximilian is a 35-year-old Austrian citizen living in Innsbruck. An outdoor enthusiast, he enjoys winter sports, particularly skiing, and frequently travels to Trentino during the winter season. Passionate about environmental sustainability, Maximilian actively seeks ways to reduce his ecological footprint wherever he goes.
- P2 Luciana is a 45-year-old facility owner in Trento, operating a charming bed-and-breakfast that attracts tourists year-round. She actively seeks information on current waste management regulations and best practices to ensure her establishment complies with legal requirements and promotes eco-friendly tourism.
- P3 Diego is a 52-year-old policy maker in Trentino Province. Among his responsibilities, he reviews existing waste management policies to evaluate their effectiveness, identifies gaps, and proposes improvements. Diego collaborates with various stakeholders, including facility owners and environmental organizations, to ensure that the regulations he advocates are practical and beneficial for both the community and the environment.
- P4 Chiara is a 28-year-old researcher at FBK, currently participating in a collaborative research project. The goal of her study is to assess how tourism in various cities of Trentino con-

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tributes to waste production. She is particularly interested in comparing fluctuations in waste generation during the COVID-19 pandemic. Chiara is passionate about sustainable tourism and aims to identify strategies for reducing waste in the region.

P5 Filippo is a 24-year-old sports enthusiast living in Verona. He thrives on outdoor activities and finds it hard to relax, even on vacation. For this reason, he has chosen Caldonazzo for a weekend getaway with his girlfriend, Giulia. Eager for adventure, he has brought along his own canoe and is excited to make the most of their time together. However, upon arriving at their destination, he realizes that he has broken his paddle during the journey and is unsure of where to dispose of it properly.

P6 Giovanni is a 41-year-old waste management analyst working for Dolomiti Ambiente. With a background in environmental science, he is passionate about finding innovative solutions to improve waste management practices. Giovanni currently aims to compare waste production across various cities in Trentino to identify successful strategies employed by those with lower waste outputs.

## 1.5 Competency Questions

CQ-1 (P3-S3, P4-S4, P6-S6): As a policy maker/researcher evaluating waste management, what is the estimated total waste generated in specific tourist areas during peak seasons, and how is this waste categorized (e.g., plastic, organic)?

CQ-2 (P1-S1, P5-S5): While enjoying winter sports, where can I find the nearest recycling bins, and what types of waste can I dispose of in these bins?

CQ-3 (P2-S2): As a facility owner, what waste disposal options are available to me in Trentino, and which types of waste do these facilities accept?

CQ-4 (P2-S2): In order to maintain compliance with local regulations, what are the waste disposal requirements specific to my bed-and-breakfast? What are the acceptable disposal methods for different waste types?

CQ-5 (P3-S3, P6-S6): What types of waste are generated by various tourism activities in Trentino, and how do these types impact overall waste management practices?

CQ-6 (P3-S3, P5-S5, P6-S6): What special waste disposal facilities are available in Trentino, including their locations, capacities, and the types of waste they manage?

CQ-7 (P3-S3, P4-S4, P6-S6): Which areas in Trentino generate the most waste from tourism activities?

CQ-8 (P3-S3, P4-S4, P6-S6): During the COVID-19 pandemic, how did visitor fluctuations impact waste production at popular tourist destinations in Trentino? Can we analyze the yearly waste production trends for specific municipalities using the available data?

## 1.6 Concepts identification

The table below lists the entities - along with their respective properties - related to the competency questions, taking into consideration both the purpose (knowledge layer) and the available data sources (data layer).

Scenarios	Personas	Competency Questions	Entities	Properties	Focus
S3, S4, S6	P3, P4, P6	CQ-1, CQ-7, CQ-8	Municipality	Municipality_ID (PK) Name Location_ID Coordinates Population_size	Common
-	P1, P2, P3, P4, P5, P6	-	Person	Person_ID (PK) Role Name Surname Date_of_birth Country Is_a_Tourist Location_ID	Common
S1, S2, S3, S4, S5, S6	P1, P2, P3, P4, P5, P6	CQ-1, CQ-2, CQ-3, CQ-4, CQ-5, CQ-6, CQ-7, CQ-8	Waste Type	Waste_Type_ID (PK) Category Recyclability Disposal_Method	Core
S1, S4	P1, P3, P4, P5, P6	CQ-1, CQ-2, CQ-5, CQ-7	Location	Location_ID (PK) Name Category Latitude Longitude Municipality_ID (FK)	Core

S2	P2	CQ-4	Tourist Facility	Facility_ID (PK) Name Type Location_ID (FK)	Core
S1, S3	P1, P3	CQ-1, CQ-5	Tourist Activity	Activity_ID (PK) Type Seasonality Location_ID (FK)	Core
S1, S2, S3, S5	P1, P2, P3, P5	CQ-2, CQ-3, CQ-6	Waste Management Facility	Waste_Facility_ID (PK) Name Location_ID (FK)	Contextual
S2, S3	P2, P3	CQ-2, CQ-4	Waste Regulations	Policy_ID (PK) Name Effective_Date Municipality_ID (FK)	Contextual
S3, S4, S6	P3, P4, P6	CQ-1, CQ-5, CQ-7, CQ-8	Waste Production	Waste_Production_ID Quantity Waste_Type_ID Municipality_ID	Contextual

## 1.7 ER model definition

The ER model in Figure 1 (below) was designed using the previously considered concepts of entities and properties. It represents the initial graphical version of the final structure of the Knowledge Graph.

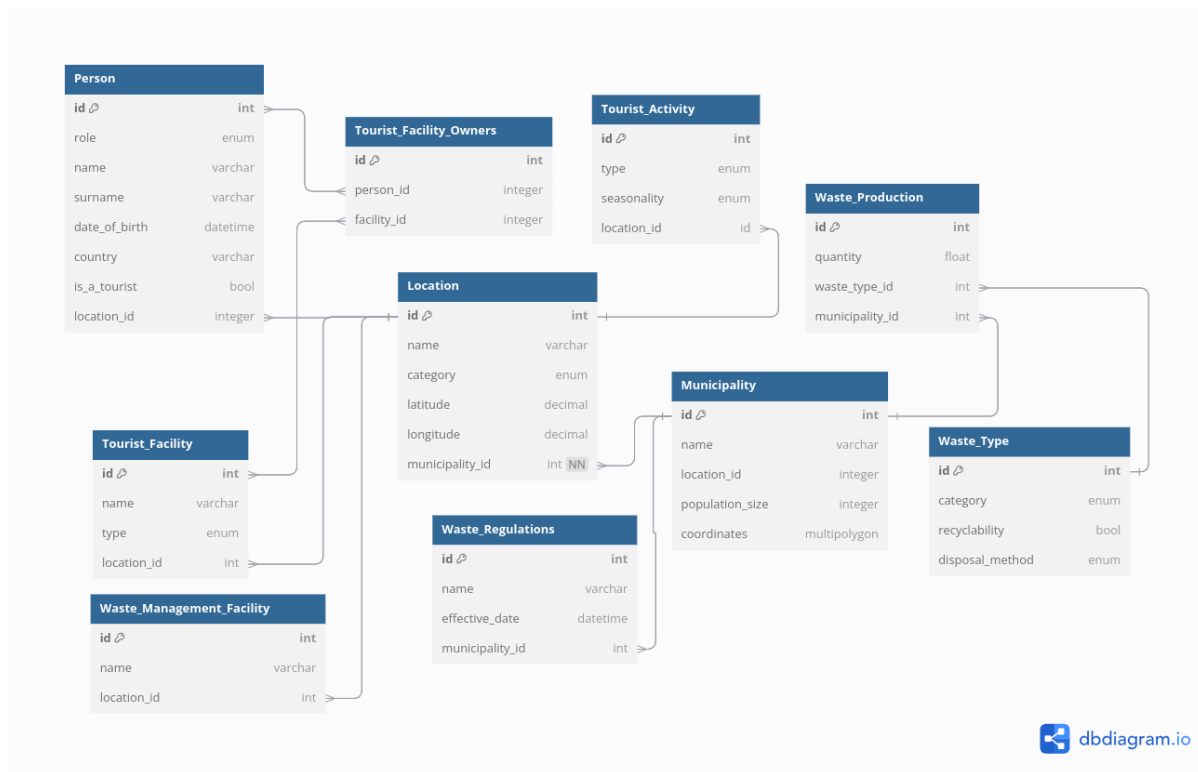


Figure 1: ER Diagram



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## 1.8 Overview of the first iTelos phase

In the initial phase of this project, our focus was to clearly define the project's purpose and identify key personas and scenarios likely to interact with the Knowledge Graph (KG). These personas include tourists visiting Trentino for leisure, analysts from the Province of Trento, and researchers from external institutions (such as FBK) who may use the KG to access information related to waste management and its connection to tourism. Guided by the competency questions, we then identified common, core, and contextual entities - along with their relevant properties - to structure the KG. This preliminary framework remains flexible, allowing us to adjust it based on data availability and ensuring the project's feasibility throughout later stages.

In this phase, we adopted the so-called Middle-out approach, considering both the knowledge layer and the data layer to facilitate easy data adaptation and knowledge modeling.

As a preliminary step, we collaboratively reviewed the data resources provided by our instructor:

- A comprehensive Knowledge Graph on tourism data
- The ISPRA website, which provided aggregated data on waste production per municipality and the locations of facilities for handling specific types of waste (e.g., special waste). Waste production data spans from 2010 to 2022, adding a valuable temporal dimension which helped to frame our Domain of Interest.

After analyzing these sources, we brainstormed additional datasets that could strengthen the KG's depth and utility. Key suggestions included

- Data on local waste disposal policies: Useful for managers of tourist facilities who require up-to-date disposal guidelines (Proposed by Gaudenzia).
- Data on public waste bin locations: Important for tourists who may need guidance on waste disposal options in unfamiliar areas (Proposed by Amalia).
- Real-time, geolocated data on tourist presence: Valuable for facility managers to optimize waste bin placement and collection logistics (Proposed by Yishak).

However, acquiring this additional data may present challenges. No centralized collection of waste disposal policies exists, so manual entry may be necessary. For public waste bin data, official sources are unavailable, so we considered relying on crowdsourced platforms like Overpass Turbo.

After gaining a general understanding of the available data sources, we shifted our focus to envisioning the final product and identifying potential personas and scenarios, as well as competency questions. For personas development, we leveraged our local experience and knowledge of the area, including our understanding of the types of tourists who frequent Trentino—primarily

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outdoor sports enthusiasts. We considered their possible needs and the types of waste-related information that would interest them, concluding that their primary concern would likely be access to disposal facilities. This approach also applied to tourist facility owners, who share similar concerns around waste disposal options for their guests. On the other hand, data such as annual waste production by municipality and ISPRA's other aggregated metrics, which are less relevant to the general public, are highly useful for policymakers, waste management authorities, and city administrators interested in broader environmental management. Lastly, we recognized that researchers could also benefit significantly from the KG, particularly given the temporal data dimensions, which support more in-depth analysis. While developing the Purpose Formalization Sheet and the Entity-Relationship Model, we took into consideration several reference context schemas, and particularly Schema.org.

Throughout this phase, each team member contributed to defining the project's purpose and domain of interest, as well as discussing the available data sources. Amalia and Gaudenzia identified personas, scenarios, and competency questions, creating the concept identification table. Gaudenzia and Yishak developed the Entity-Relationship (ER) schema using the IDEF1X notation, as recommended. Yishak managed all layout and formatting in LaTeX, while Amalia updated the repository on GitHub.