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MANUSQUARE

MANUfacturing eco**S**ystem of **QUA**lified **R**esources **E**xchange

D3.4
Distributed data sharing

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List of Abbreviations

Acronym	Description
B2B	Business to Business
CPM	Corporate Performance Management
ERP	Enterprise Resource Planning
GWP	Global Warming Potential
IPR	Intellectual Property Rights
IT	Information Technology
MANU-SQUARE	MANUfacturing ecoSystem of QUAlified Resource Exchange
PPS	Production Planning System
RPC	Remote Procedure Call
SME	Small and Medium Enterprises
WEF	World Economic Forum
WP	Work Package
FOAF	Friend of a friend, machine-readable ontology describing persons, their activities and their relations to other people and objects.
ACRT	Agent Certification Ontology
EDM	Ecosystem Data Manager
CRUD	Create, Read, Update, Delate

1 EXECUTIVE SUMMARY

This report addresses the description of the MANU-SQUARE distributed data sharing management system, embodied in the Ecosystem Data Manager component.

Sharing data between entities is essential for supply chain collaboration, following the recent recommendations of the “Commission staff working document on Online Platforms”. According to this approach and following the design of the MANU-SQUARE platform, the main goal of this component is to give a persistency service on more repositories connected to the platform.

Starting from the architecture defined in Task 1.4 and from the extended data model analysed and created in Task 2.3, in Task 3.4, HOLONIX designed and developed the Ecosystem Data Manager.

The outcome of this report is a description of the design and the development of the Ecosystem Data Manager. The integration between this component and others in the MANU-SQUARE platform components, such as Blockchain, Semantic Infrastructure and the platform tools, will be reported in Deliverable *D4.6 Tested and integrated system*, expected in Month 26. This notwithstanding, the development of the Ecosystem Data Manager, here reported, has been carried out in close collaboration with the respective partners so that their requirements and expectations are fully met, making future integration as easy and smooth as possible.

The report consists of the following chapters:

- § 2 introduces the aim and scope of the Ecosystem Data Manager, the relationships with other tasks and the outline;
- § 3 describes the applied methodology which mainly consists of consortium partner meetings, analysis made on the architecture defined in Task 1.4 and reported in D1.4, and the analysis made on the data model extension reported in D2.3;
- § 4 represents the Ecosystem Data Manager: design, development, deployment and tests phases are described;
- § 5 concludes the report and presents the next steps.

2 INTRODUCTION

2.1 MANU-SQUARE in a nutshell

The MANU-SQUARE project creates an ecosystem that acts as a virtual marketplace bringing the available production capacity, as well as other virtual and physical assets, closer to the production demand to obtain the optimal matching (see Figure 1). This has two main advantages:

- the rapid and efficient creation of local distributed value networks for innovative providers of product services;
- the reintroduction and optimization in the loop of unused capacity and potential that would otherwise be lost.

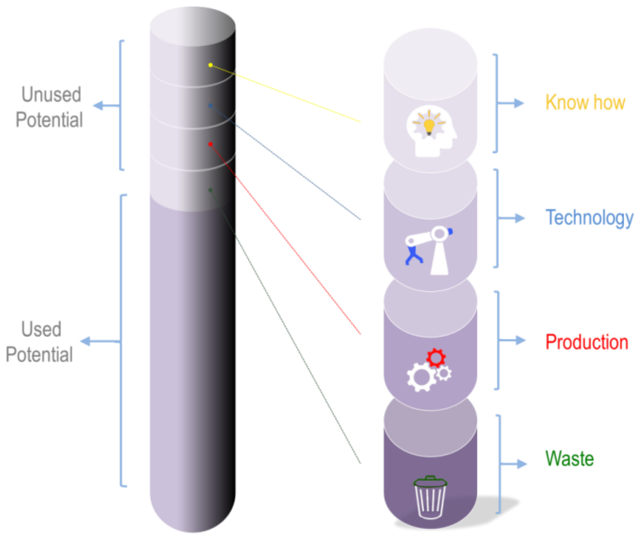

Figure 1 Composition of the unused potential

MANU-SQUARE establishes an ecosystem that is organized to match the needs of buyers with the availability of sellers in terms of know-how, technology, manufacturing capacity and waste. The associated MANU-SQUARE platform uses a Blockchain technology to ensure transparency and provide security, thereby fostering the building of trust amongst the different stakeholders of the platform. A manufacturer may have a role of a supplier (seller) or a customer (buyer). In the case of the latter, a manufacturer uses the platform to engage with the MANU-SQUARE ecosystem to fulfil a need, such as additional production capabilities. The platform performs the search for the optimal matching on a wide number of possible suppliers from the MANU-SQUARE ecosystem, using a sophisticated criterion that ensures high level of quality, reliability of suppliers, reduction of costs and short time to close the business transaction. The generated ecosystem allows optimal matches also for resources other than production hours or tangible assets with the aim to identify and exploit unexpected synergies between participants and to promote the mutual interaction of diverse industries, also within different value networks, for beneficial reuse of competences and flows.

The main objectives of the project are:

1. To make European unused manufacturing capacity emerge towards its reintegration in the loop and the creation of local efficient value networks.
2. To support innovative SMEs and start-ups in finding the optimal suppliers to transform their business ideas into new product-services.
3. To seamlessly involve actors all along the entire value network including consumers for cross-fertilization of product-service solutions and underlying technologies.
4. To coordinate the whole MANU-SQUARE ecosystem towards a better use of resources and a more sustainable European manufacturing.

2.2 Aim and scope of the Ecosystem Data Manager

The aim and scope of this document is to describe the design, development and deployment made to achieve the Ecosystem Data Manager, expected as a result of Task 3.4 in Month 24. This work has been done starting from the shared and validated architecture presented in Task 1.4 and in deliverable D1.4 and from the extended data model reported in Task 2.3 and in deliverable D2.3. The Ecosystem Data Manager is integrated in the MANU-SQUARE platform in Task 4.6. It interacts with the Blockchain, the Semantic Infrastructure and the platform tools developed in WP4.

2.3 Relationships of T3.4 with other tasks

Task 3.4 is connected with tasks in WP1, WP2, WP4 and WP6. It takes inputs from Task 1.4 and 2.3. Starting from the architecture (Task 1.4) and the data model extension (Task 2.3), it has been possible to define the role and the design of the Ecosystem Data Manager. Task 3.4 results are used as input for the WP4 tools and for WP6 Task 6.1 platform deployment and customisation. These relationships are shown in Figure 2.

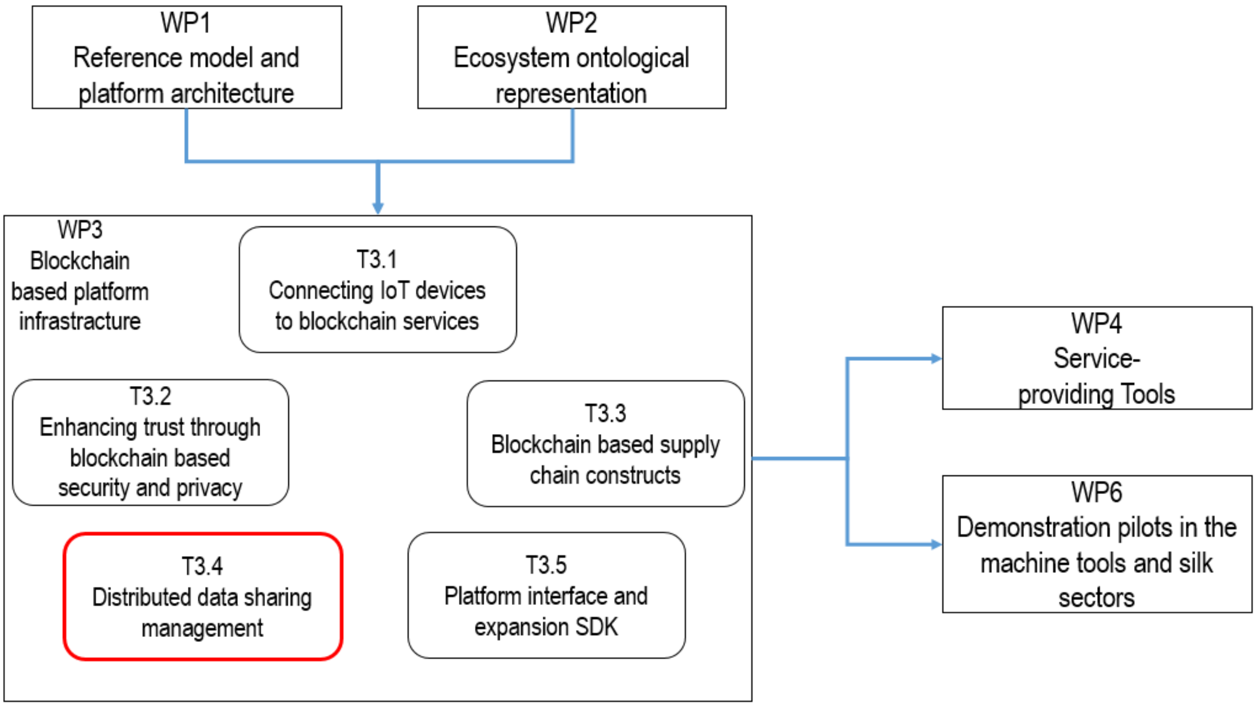

Figure 2 Relationship of Task 3.4 with other tasks

2.4 Outline

This report is organized into 5 chapters. The first chapter, § 1, is an executive summary. § 2 and § 3 provide introduction, explain the aim and scope of the report, its relationships and the applied methodology. § 4 presents the Ecosystem Data Manager design, development, deployment and test phases. The final chapter, § 5, concludes the report.

3 METHODOLOGY

The Ecosystem Data Manager definition and deployment has been possible starting from the architecture defined in Task 1.4 and the extended data model reported in Task 2.3. Meetings with partners gave the possibility to discuss this component of the architecture, in order to finalize the Ecosystem Data Manager's role, its relationships with other components and to define the best approach to develop it.

The applied methodology to define the MANU-SQUARE Ecosystem Data Manager is shown in Figure 3. It consists of analysis made on the MANU-SQUARE platform architecture, the extended version of the data model, the platform components and their relationships. The match with this analysis enabled discussion on the role of the Ecosystem Data Manager during physical and online meetings with partners from WP3 and WP4. Partners involved in this discussion have been: HOLONIX, IBM, SUPSI, INESC, SINTEF and INNOVA.

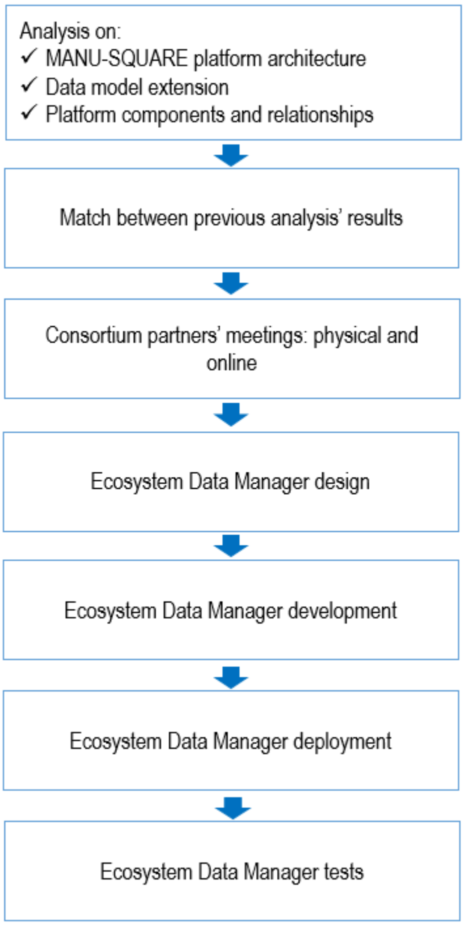

Figure 3 Ecosystem Data Manager definition methodology

3.1 The architecture defined in Task 1.4

The main goal of Task 1.4 is the definition of the MANU-SQUARE platform architecture. Figure 4 represents the validated architecture, where components are divided in four main layers. The Ecosystem Data Manager belongs to the Data Layer. It communicates both with all the tools belonging to the Tools layer and in the Data Layer with the Blockchain and the Semantic Infrastructure. For more details please refer to Deliverable D1.4. Moreover, all details related to the integration between platform components will be inserted in Deliverable D4.6 as results of activities of Task 4.6.

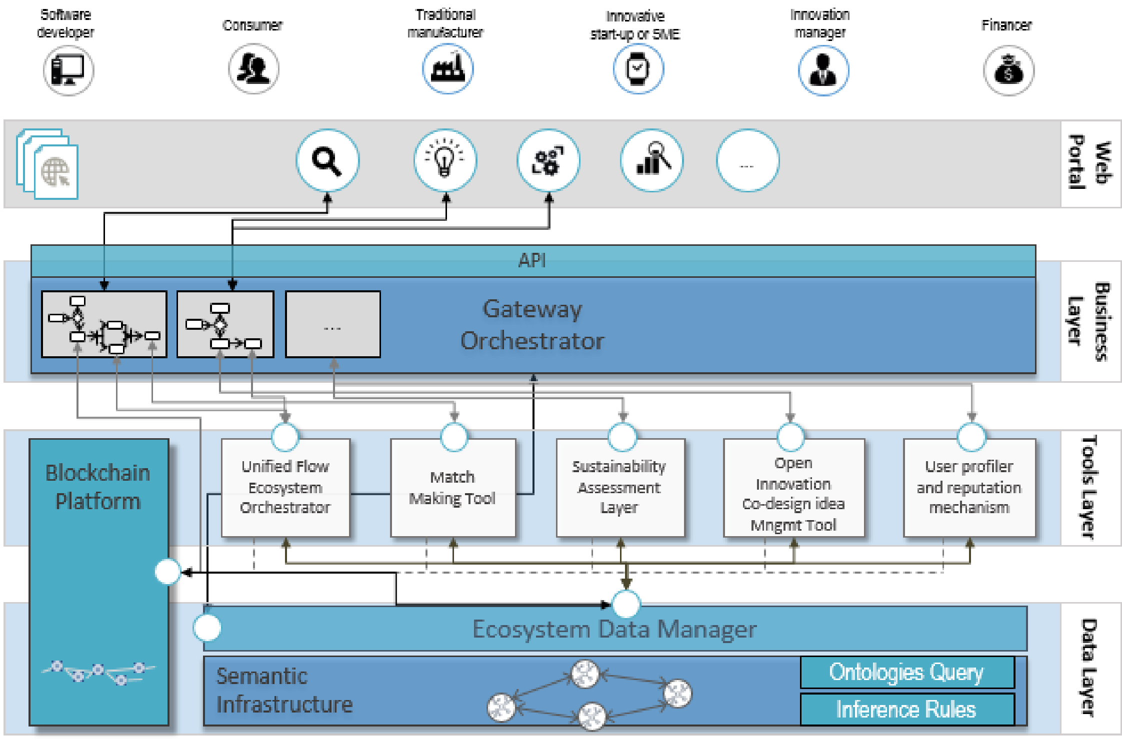

Figure 4 MANU-SQUARE architecture

3.2 Data model extension in Task 2.3

Starting from the data model elaborated in Task 1.4, in Task 2.3, an extension was needed and has been implemented. All partners worked at their tools' data models in order to define the entities to be added to the whole data model. Figure 5 represents the obtained extended data model. Only classes are here reported, for more details please refer to Deliverable D2.3. This analysis was necessary during the definition and development of the Ecosystem Data Manager in order to understand which entities had to rely on its persistency services and which one should better have persistency in the Semantic Infrastructure and which ones in the Blockchain. In Task 4.6, expected at Month 26, this topic will be further analysed to ensure the integration among components of the MANU-SQUARE platform.

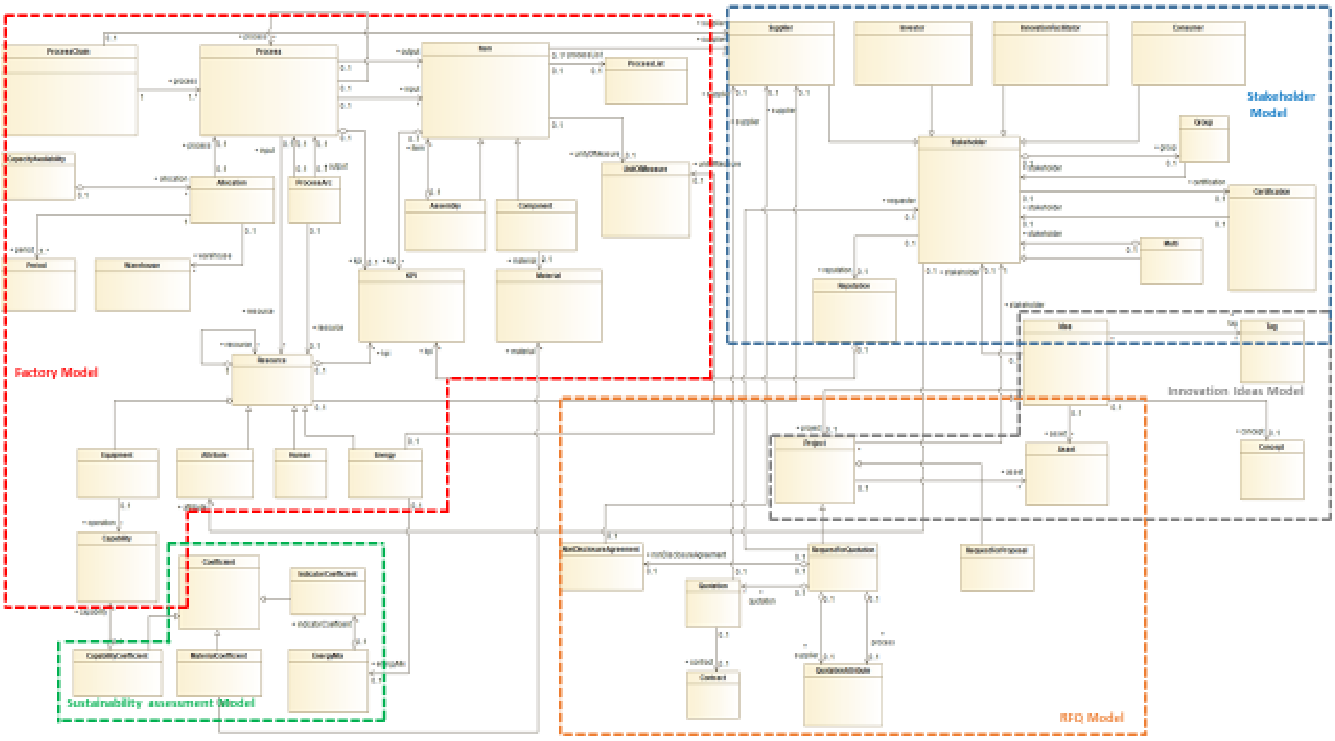

Figure 5 Data model extension

3.3 Consortium partners meetings

Meetings with consortium partners responsible for each component have been done both physically and online. The Main goal has been to define the role of the Ecosystem Data Manager, its main functionalities and the details.

Table 1 lists the physical meetings while Table 2 addresses the online ones.

Meetings	Topic	Partners involved
1st physical meeting 09th of January 2019 - Manno	WP4 Kick-off meeting, with Task 3.4 presentation	HOLONIX; IBM; INESC; INNOVA; SINTEF; SUPSI, CSEM
2nd physical meeting 31th of January 2019 – Meda	Ecosystem Data Manager discussion	HOLONIX, SUPSI
3rd physical meeting 20th of May 2019 – Milan	Third General Assembly. WP3 with Task 3.4 presentation and discussion	All partners
4th physical meeting 08th of July 2019 - Brussels	Mid-term review preparation: Task 3.4 status and next steps	All partners
5th physical meeting 19th of September 2019 - Meda	Task 3.4 updates	HOLONIX; SUPSI
6th online meeting 8th of October 2019 - Porto	Fourth General Assembly. WP3 with Task 3.4 presentation and discussion.	All partners
7th physical meeting 10th of December 2019 – Manno	MVP preparation, with Task 3.4 final status and partners' update	HOLONIX; INESC; INNOVA; SINTEF; SUPSI

Table 1 Recap of consortium partners physical meetings

Meetings	Topic	Partners involved
31th of January 2019	HOLONIX internal meeting to define Task 3.4 goals	HOLONIX
08th of February 2019	WP4 call with Task 3.4 discussion	HOLONIX, SUPSI, IBM, INESC, INNOVA; SINTEF
06th of March 2019	WP4 call with Task 3.4 discussion	HOLONIX, SUPSI, IBM, INESC, INNOVA; SINTEF

12th of Aprile 2019	WP4 call with Task 3.4 discussion	HOLONIX, SUPSI, IBM, INESC, INNOVA; SINTEF
16th of September 2019	HOLONIX internal meeting to define Task 3.4 status	HOLONIX
24th of October 2019	HOLONIX internal meeting to define Task 3.4 status	HOLONIX, SUPSI
30th of October 2019	WP3 Call	HOLONIX, SUPSI, IBM
14th of November 2019	WP4 call with Task 3.4 update	HOLONIX, IBM, INESC, INNOVA; SINTEF
27th of November 2019	WP4 call with Task 3.4 update	HOLONIX, IBM, INESC, INNOVA; SINTEF

Table 2 Recap of consortium partners online meetings

4 Ecosystem Data Manager report

This chapter reports all details and activities done to achieve the development of the Ecosystem Data Manager.

4.1 Design

The Ecosystem Data Manager enables the MANU-SQUARE platform to adopt multiple persistency layers. It configures and it uses them without having to know where each data model object will be managed. To carry out this activity, the Ecosystem Data Manager doesn't need integration rules or protocol details. The EDM is able to link WP4 Tools with the Gateway Orchestrator using always the same end points for the Semantic Infrastructure, the BlockChain and the Object Oriented Database. In the future it will be able to link also other additional persistency or brokering services like, for example, Kafka, in order to open data to other platforms.

Moreover the EDM is developed in order to be able to manage specific services of a given persistence layer. For example, when the Blockchain creates and selects services, the EDM guarantees that it is always possible to reach these services. Each time the service is called, developers could decide to store their entities not only in a default database but also in other persistency layers. This is possible without the need to refactor the EDM code. Tools, if necessary, could have also their private namespace meant to store their own runtime data.

Within EDM, HOLONIX implemented CRUD operations[1], which are the basic behaviours of persistent storage.

Figure 6 shows all the use cases functionalities of the EDM. They allow viewing, searching and modifying information through GUI forms and reports. Entities are read, created, updated and deleted through the EDM.

"Green" men represent the Gateway Orchestrator, developed by SUPSI at Month 24, and a generic Tool (e.g. the Matchmaking, the Idea Manager, etc.). "Blue" circles represent all the use cases the EDM has to manage. The EDM is able ("yellow circles"), to create, update, select, delete, customize, etc. Each time a user is created, it will be saved also in the EDM; each time a request for quotation is saved, it will be created by the EDM, etc.

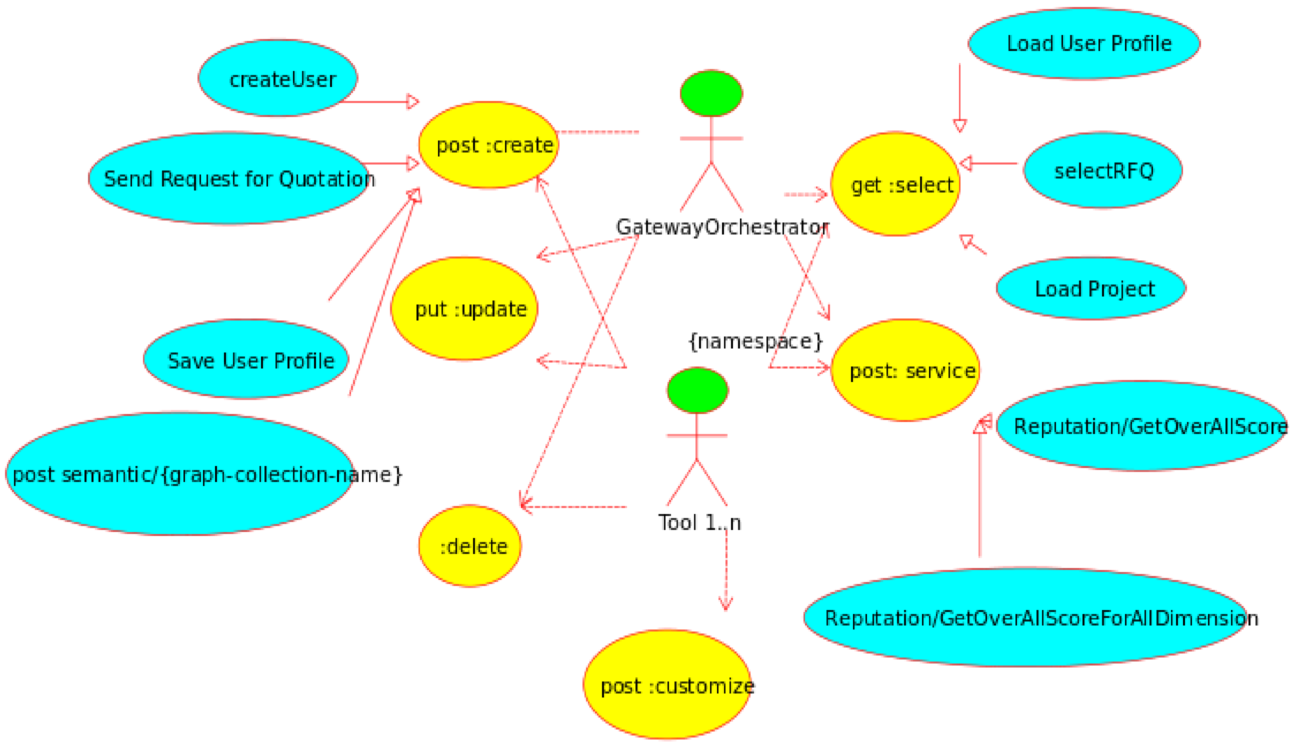

Figure 6 Ecosystem Data Manager use cases

[1] CRUD: create, read, update and delete operations for a specific object

4.2 Development

In the MANU-SQUARE project context, each Entity is saved within a specific data storage, so some metadata have been created in order to manage the CRUD mechanism. The entity "map" has been created to save the association between the Entity and the Data Source. As designed within the architecture, (§ 3.1) the main data storage sources are: Semantic Infrastructure, Blockchain and OODB.

EDM knows in which data storage each entity has to be stored (if nothing has been configured the default is an OODB) and it acts respecting the data storage rules.

In order to document EDM, HOLONIX used the tool Swagger. To have more details and to join it, please refer to this link: http://manusquare.holonix.biz:27070/?url=http://manusquare.holonix.biz:9090/v2/api-docs#/

There are 4 different endpoints.

Figure 7 Four endpoints

Mainly the APIs are divided in 4 groups:

- map-controller
- data-ctrl
- service-ctrl
- test-ctrl

The CRUD operations (as designed within the use case diagram) are implemented within EDM using the REST (HTTP) protocol.

In order to create, read, update and delete an object, the HTTP protocol provides a set of request methods to allow performing the desired action.

The following list reports the possible actions:

- Create: POST request method
- Read: GET request method
- Update: PUT request method
- Delete: DELETE request method

The first group is the map-controller:

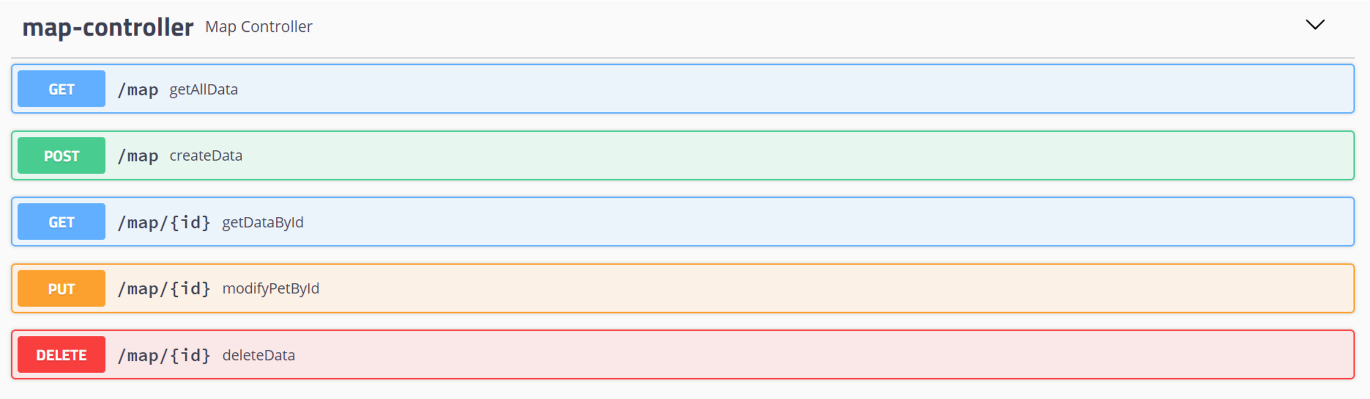

Figure 8 Map - controller

There is a map (Entity → Data Source) that it is defined within EDM in order to remember where to save each entity, so it is responsible to save the metadata.

Example:


```
{
    "pk": "cbc43b38-0053-4d11-9a10-6b4d8ad1ef39",
    "dataSource": "dataOntologySvcImpl",
    "entityName": "Supplier",
    "collectionName": "stakeholders",
    "readOnly": false
}
```


In the example above, the “Supplier” entity (defined within Deliverable 2.3) is saved within the Semantic Infrastructure (dataOntologySvcImpl). When the EDM receives a new object from Supplier entity, it knows that it has to save it within the Semantic Infrastructure.

EDM provides an endpoint in order to create, read, update and delete these maps.

The second group is data-ctrl:

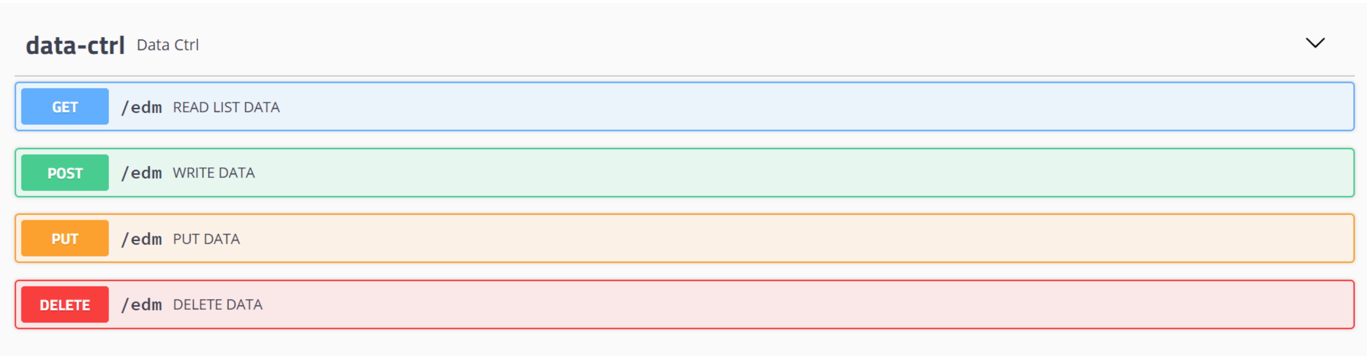

Figure 9 Data - ctrl

This is the main endpoint of EDM. Contrary to map-controller, that is implemented in order to manage the metadata, the data-ctrl APIs are implemented to manage all the modelled data contained in Deliverable 2.3. Data-ctrl is able to read a list of data, to write and put data as well as to delete data.

4.2.1 How do we read data?

The first API is dedicated to read data from the different repositories. In order to complete this operation some parameters are required (see Figure 10).

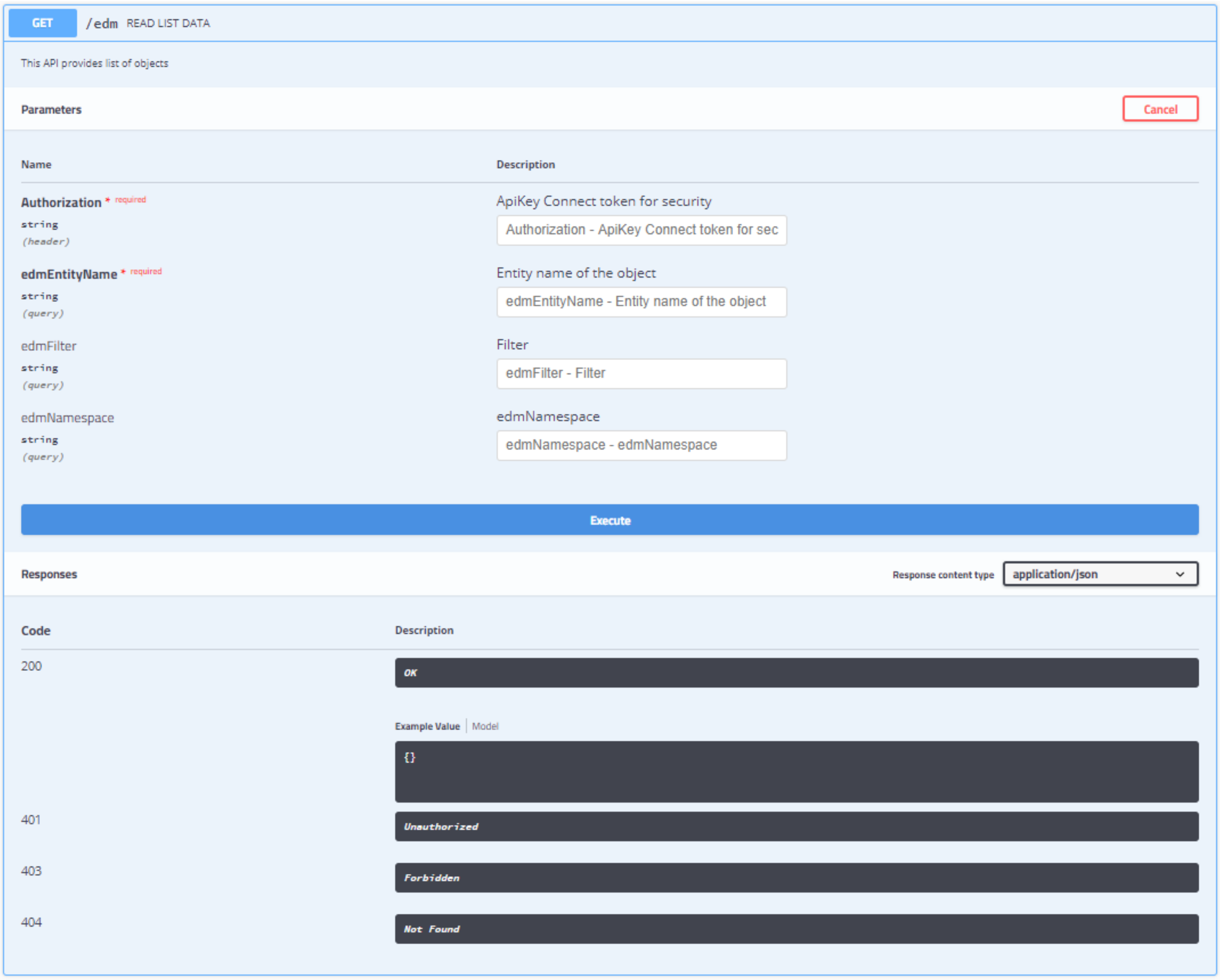

Figure 10 Read list data

4.2.2 How do we insert data?

The second API is dedicated to insert data to the different repositories. In order to complete this operation some parameters are required (see Figure 11).

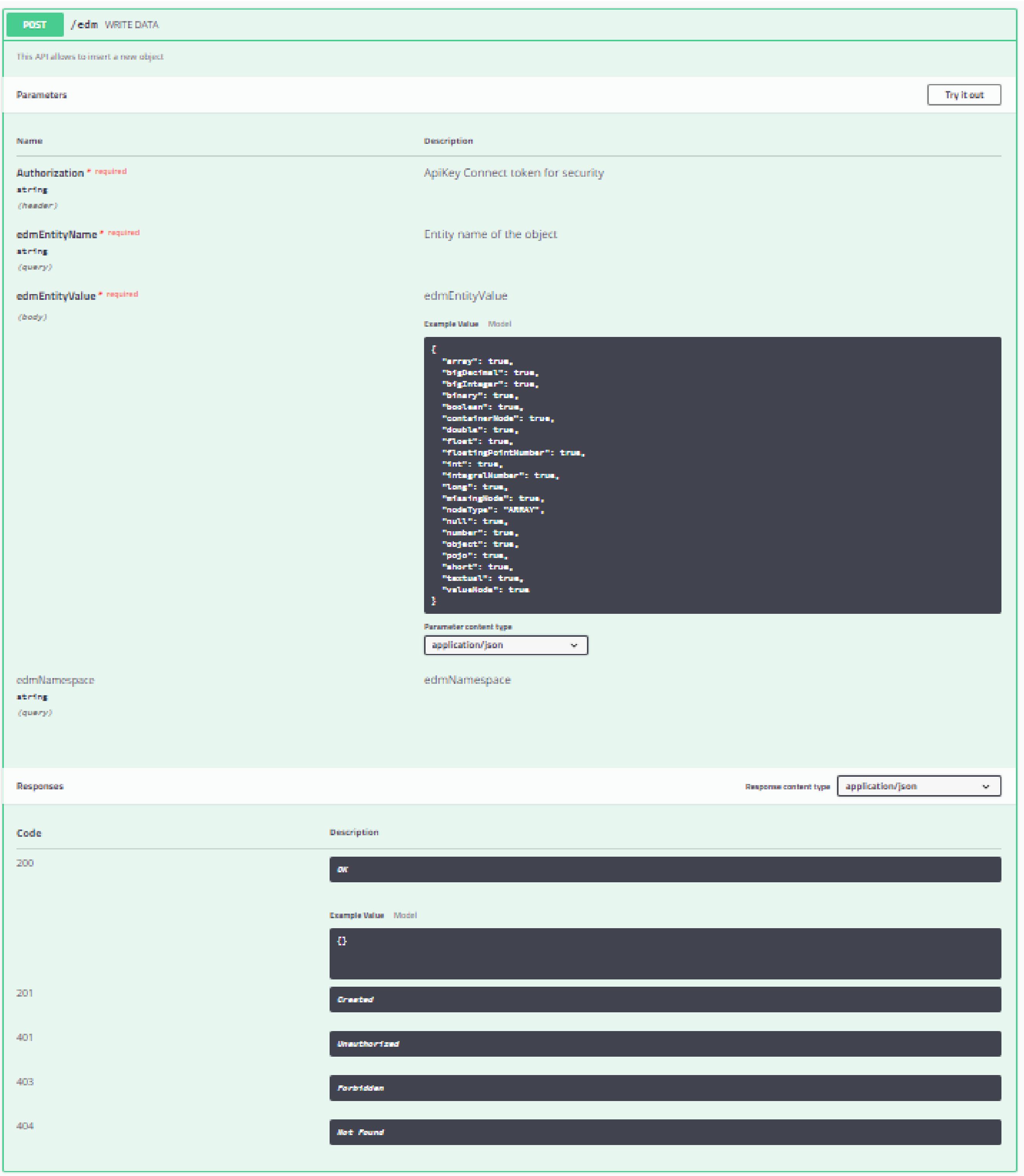

Figure 11 Write data

4.2.3 How do we update data?

The third API is dedicated to update the data already existing in the repositories. In order to complete this operation some parameters are required (see Figure 12).

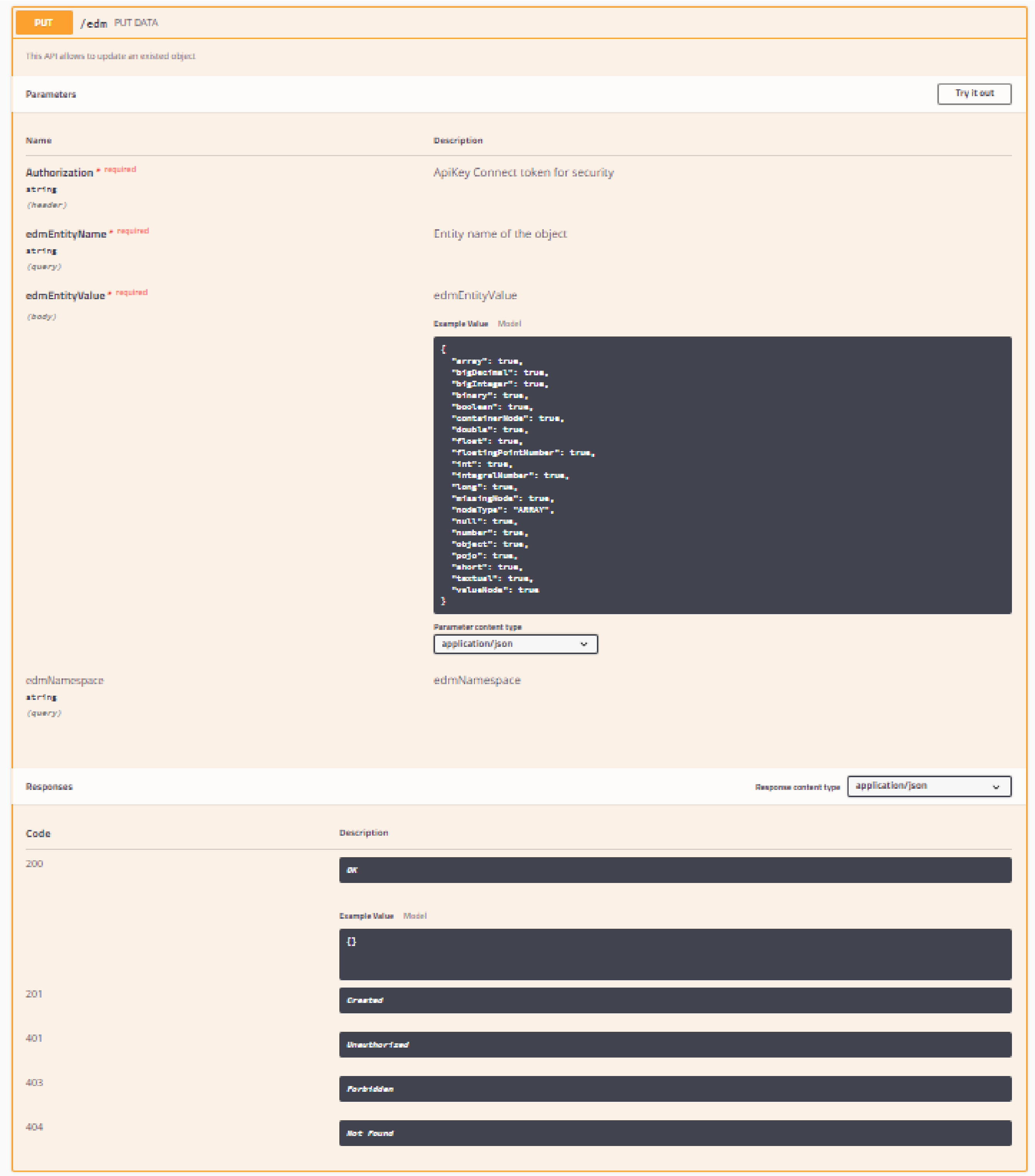

Figure 12 Put data

4.2.4 How do we delete data?

The fourth and last API is dedicated to delete the data already existing in the repositories. In order to complete this operation some parameters are required (see Figure 13).

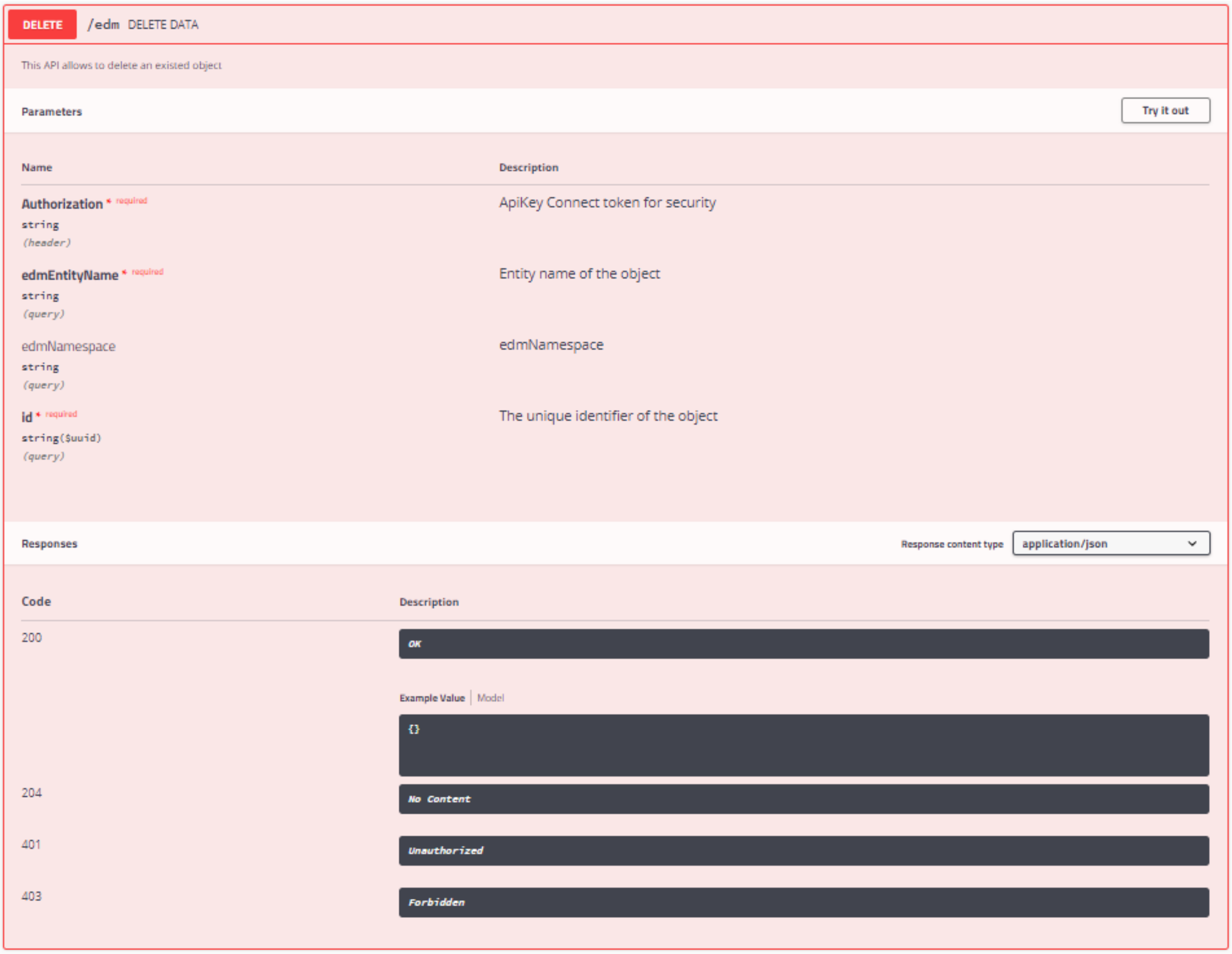

Figure 13 Delate data

4.2.5 Parameters on EDM endpoints

All used parameters on EDM endpoints reported in § 4.2.1 to § 4.2.4 are summed up in Table 3

HTTP parameter type	Name	Value type	Mandatory/Optional	Description
Header	Authorization	String	Mandatory	Here we need to insert the ApiKey. This token is for the security, it should be delivered by the EDM provider.
Query	edmEntityName	String	Mandatory	It is the Entity name of the object. Ex: Supplier
Query	edmFilter	String	Optional	It is a JSON, it contains the query that is applied to data. E.g. `{"currentUser.id": "user1"}` The output here is all the objects having "currentUser.id" equals to "user1".
Query	edmNamespace	String	Optional	This parameter is concatenated to the entity name parameter in this way: edmNamespace_edmEntityName. The aim is to allow having the same edmEntityName belonging to different edmNamespace.
Body	edmEntityValue	JSON	Mandatory	It is the entity value(object) that will be saved through EDM. The object should be a JSON.
Query	id	UUID	Mandatory	The unique identifier of the object that we need to manipulate.

Table 3 Parameters on EDM endpoints

4.3 Deployment

This chapter will be also part of Deliverable D6.1 and *Task 6.1 MANU-SQUARE platform customisation and deployment*, expected at Month 36.

EDM is released as a docker image within Gitlab repository. In this section, more information regarding the EDM releases are given. Needed steps in order to run the EDM component are reported.

EDM project repository is: https://gitlab.com/manusquare/edm

Each repository contains its own docker registry, so EDM docker images are pushed to https://gitlab.com/manusquare/edm/container_registry

The actual version of EDM image is: registry.gitlab.com/manusquare/edm:0.4

This image within the docker-compose is refereed: https://gitlab.com/manusquare/edm/blob/master/docker-compose.yml that is defined in order to run the EDM component.

4.3.1 How do we run EDM?

- Docker login to GitLab registry: docker login registry.gitlab.com
- Download the last version of the images: docker-compose pull
- Docker up: docker-compose up -d
- Access to the Swagger doc: http://localhost:27070/?url=http://localhost:8080/v2/api-docs
- Docker stop: docker-compose stop
- Docker restart: docker-compose start
- Docker stop and remove the containers: docker-compose down
- Docker stop, remove the containers and the volumes: docker-compose down –v

4.4 Tests

These tests have been done at the end of the EDM deployment:

- **Docker login to GitLab registry:** docker login registry.gitlab.com
- **Download the last version of the images:** docker-compose pull
- **Docker up:** docker-compose up -d
- **Run tests**: docker-compose -f docker-compose.tests.yml up --force-recreate --build -d

Figure 14 shows an example of carried out testing. First rows create a supplier without authorization, and the status code that the system retrieve is “400”. In the second test, a supplier creation having a json not correctly formed gives as result a status code “500”. If a project is correctly created, updated, read and deleted, the status result is “200”.

```
Starting Tests ...
Check if edm is up ...
The collection /etc/newman/1_ManuSquare EDM Tests.postman_collection.json is running ...
newman

ManuSquare EDM Tests

- Create Supplier without authorization
  POST edm:9090/edm?edmEntityName=Project [400 Bad Request, 338B, 122ms]
  ✓  Status code is 400

- Create Supplier having json mal formed
  POST edm:9090/edm?edmEntityName=Project [500 Internal Server Error, 390B, 24ms]
  ✓  Status code is 500

- Create a new Project
  POST edm:9090/edm?edmEntityName=Project [200 OK, 1.66KB, 16ms]
  ✓  Status code is 200

- Update the Project
  PUT edm:9090/edm?edmEntityName=Project [200 OK, 1.67KB, 13ms]
  ✓  Status code is 200

- Read Project using Filter
  GET edm:9090/edm?edmEntityName=Project&edmFilter={ "id": "5a407946-945d-4869-ab9d-3a4a616b7c97"} [200 OK, 1.67KB, 13ms]
  ✓  Status code is 200

- Delete the Project
  DELETE edm:9090/edm?edmEntityName=Project&id=5a407946-945d-4869-ab9d-3a4a616b7c97 [200 OK, 75B, 11ms]
  ✓  Status code is 200

┌-------------------------┬-------------------┬-------------------┐
|                         |          executed |            failed |
├-------------------------┼-------------------┼-------------------┤
|              iterations |                 1 |                 0 |
├-------------------------┼-------------------┼-------------------┤
|                requests |                 6 |                 0 |
├-------------------------┼-------------------┼-------------------┤
|            test-scripts |                12 |                 0 |
├-------------------------┼-------------------┼-------------------┤
|      prerequest-scripts |                 8 |                 0 |
├-------------------------┼-------------------┼-------------------┤
|              assertions |                 6 |                 0 |
├-------------------------┴-------------------┴-------------------┤
| total run duration: 522ms                                       |
├-----------------------------------------------------------------┤
| total data received: 5.01KB (approx)                            |
├-----------------------------------------------------------------┤
| average response time: 33ms [min: 11ms, max: 122ms, s.d.: 39ms] |
└-----------------------------------------------------------------┘
```

Figure 14 EDM Tests

5 CONCLUSION

The main goal of this deliverable is to provide an exhaustive description of the Ecosystem Data Manager component, its relations with the other MANU-SQUARE software components and the choices that have been taken in order to build the platform integration around this critical component. The EDM, resulting from the activities of Task 3.4, provides persistency services in collaboration with the other components of the MANU-SQUARE platform, such as the Semantic Infrastructure and the Blockchain.

All phases, including design, development, deployment and testing have been described. Starting from the high-level architectural description, it has been shown how to access, update and manage data while also providing instructions on how to run the EDM.

The availability of the EDM is at the basis of the integration with other MANU-SQUARE platform components that is currently ongoing and that will be reported in Deliverable D4.6 after achievement of Task 4.6 objective. The final goal is to achieve an integrated platform that, leveraging the data management and persistency services offered by the EDM, offers the functionalities, such as matchmaking, reputation, sustainability and others, that the external tools developed in WP4 concurrently provide.