SCOREwater

Smart City Observatories implement REsilient Water Management

DELIVERABLE D3.4

INTEGRATION OF SMART WATER DATA MODELS (COMPLIANT WITH FIWARE-MODELS), SMART ALGORITHMS AND DATA-DRIVEN MODELS IN THE SCOREWATER PLATFORM

Dissemination level	Public
Type	Demonstrator
Issued by	Civity
Contributing project partners	Hydrologic, Eurecat, IVL
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Keywords	Smart water data model, FIWARE, SCOREwater platform
Number of pages	20
Number of annexes	1
Date:	2021-08-30
Version:	V 2
Deliverable number	D3.4
Work Package number:	WP 3
Status:	Delivered
Approved by coordinator (IVL)	2021-08-30

This project hase recieved funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement no 820751

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REVISION HISTORY

Version	Reason for changes	Name	Date
1	Original release to EU	Bas Vanmeulebrouk	2020-11-18
2	Minor modifications following the review comments in PR1 (Feb 2021). Complete the information of different data models during the extended time of delivery. Explanation of the relation between Smart data models, Smart algorithms and Data driven models.	Bas Vanmeulebrouk	2021-08-30

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ABBREVIATIONS

Abbreviation	Definition
API	Application Programming Interface
CKAN	Comprehensive Kerbal Archive Network
FIWARE	Future Internet WARE
JSON	JavaScript Object Notation
ICT	Information and Communications Technology
IoT	Internet of Things
NGSI	Next Generation Service Interface
SDG	Sustainable Development Goals
SME	Small and Medium-sized Enterprise

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PROJECT ABSTRACT

SCOREwater focuses on enhancing the resilience of cities against climate change and urbanization by enabling a water smart society that fulfils SDGs 3, 6, 11, 12 and 13 and secures future ecosystem services. We introduce digital services to improve management of wastewater, stormwater and flooding events. These services are provided by an adaptive digital platform, developed and verified by relevant stakeholders (communities, municipalities, businesses, and civil society) in iterative collaboration with developers, thus tailoring to stakeholders' needs. Existing technical platforms and services (e.g. FIWARE, CKAN) are extended to the water domain by integrating relevant standards, ontologies and vocabularies, and provide an interoperable open-source platform for smart water management. Emerging digital technologies such as IoT, Artificial Intelligence, and Big Data is used to provide accurate real-time predictions and refined information.

We implement three large-scale, cross-cutting innovation demonstrators and enable transfer and upscale by providing harmonized data and services. We initiate a new domain "sewage sociology" mining biomarkers of community-wide lifestyle habits from sewage. We develop new water monitoring techniques and data-adaptive storm water treatment and apply to water resource protection and legal compliance for construction projects. We enhance resilience against flooding by sensing and hydrological modelling coupled to urban water engineering. We will identify best practices for developing and using the digital services, thus addressing water stakeholders beyond the project partners. The project will also develop technologies to increase public engagement in water management.

Moreover, SCOREwater will deliver an innovation ecosystem driven by the financial savings in both maintenance and operation of water systems that are offered using the SCOREwater digital services, providing new business opportunities for water and ICT SMEs.

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EXECUTIVE SUMMARY

This deliverable builds upon the information provided in D3.1 (in which the set-up of the SCOREwater platform is described) and in D3.2 and D3.3 (in which the initial implementation is described). This document describes the progress on the standard data models and protocols, proposed by Task 1.1 (specification of the SCOREwater platform), that have been implemented in and adapted for the SCOREwater platform in the three cities (Amersfoort, Barcelona and Gothenburg).

The application of these standard models is strongly related to the ingestion of data from all sensors and the publication of Open API´s. Since the SCOREwater project started, the FIWARE foundation launched an initiative to develop standard data models and protocols. The SCOREwater project is involved in this process and has chosen to use these models. If the models are not suitable for our project, the SCOREwater project will provide input and feedback to further improve these standard models.

It can be concluded that from a content point of view the FIWARE data models are applicable to the datasets in the SCOREwater project. Missing are metadata on the dataset and individual data points. Metadata on the dataset can be incorporated into CKAN, which is also part of the SCOREwater platform, however there is no placeholder for metadata on individual data points (for instance a quality stamp). Furthermore, it is not possible to include raw information.

The current situation for this deliverable is that initial implementations of the standard data models have been realized. Validation and testing of the models has started. The focus until now has been on collecting, processing and harmonizing data from different sensors. In this phase it was possible to check the completeness, provide feedback, extend the number of data models and participate in the initiative of the FIWARE foundation to create a library of standard data models. During the next project phase, the focus will shift towards the Data Market (usage, documentation, business models). Those results will be reported in D3.6 Implementation of the SCOREwater Data Market to support new business models for suppliers and providers, planned for release in August 2022.

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1. INTRODUCTION

This deliverable describes how smart algorithms and data driven models rely on Smart Data Models and protocols used in the SCOREwater Platform.

The demonstrator is an important part of the development of the SCOREwater Platform, since it focuses on standard data models. These models are a prerequisite reuse of data sources and the development of algorithms, data driven models, applications, dashboards and new solutions.

Paragraph 2 describes some generic characteristics of the SCOREwater Platform and the link between smart algorithms, data-driven models and Smart Data Models. More details can be found in Deliverable 3.1, 3.2 and 3.3. Paragraph 3describes the implementation of the different data models.

2. SMART ALGORITHMS, DATA-DRIVEN MODELS AND SMART DATA MODELS

The SCOREwater Platform is based on the FIWARE-architecture. It uses open source software components from the FIWARE catalogue, and follows the open data models and open API's. These three aspects (software, data models and API's) are strongly related.

Figure 1 depicts how data from different sensor data sources flows through the platform to be used in smart algorithms, data driven models, apps and dashboards. The SCOREwater platform provides different methods for ingesting data into the time series database (1). Sensor information comes into the platform using a proprietary format. It is stored in a time series database (2) and published using different API's to fit the specific needs of data consumers (3). Applications, models and dashboards connect to those API's to obtain access to the data in the time series data (4).

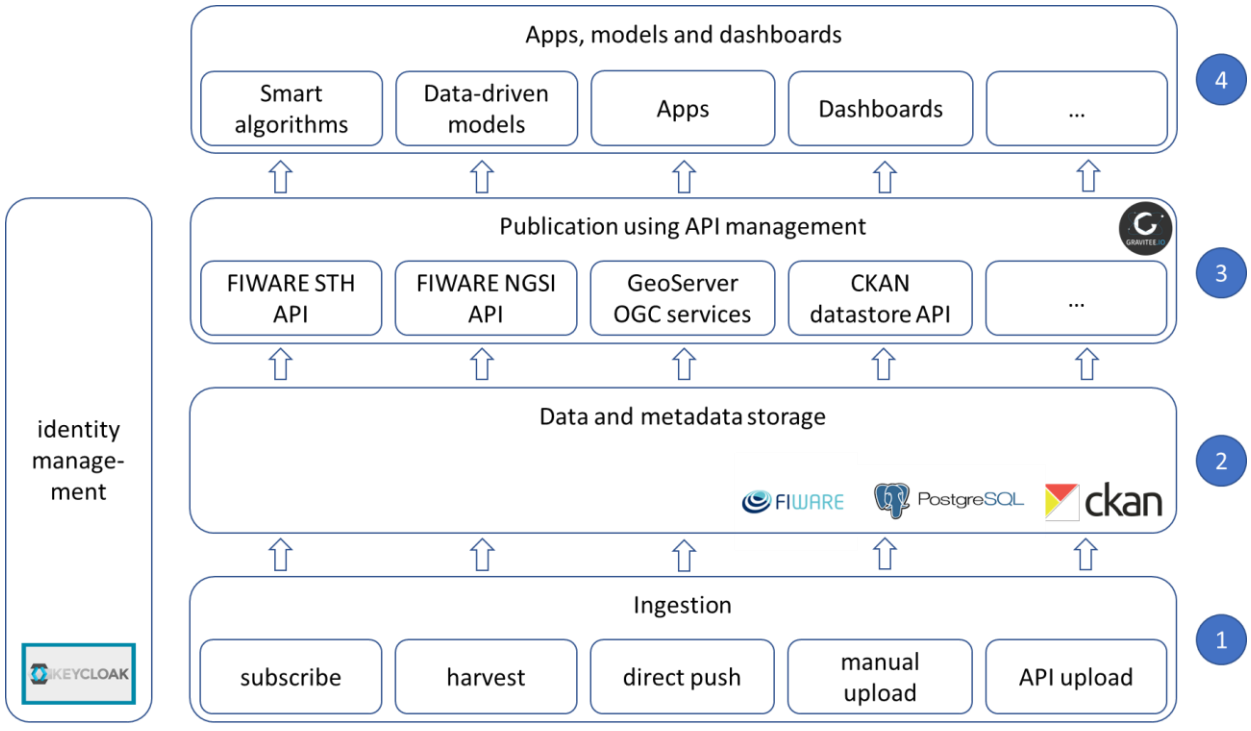

Figure 1 The SCOREwater Platform with different options to ingest, process and publish data.

The API's publish the data in the harmonized data model. The SCOREwater project relies on the FIWARE Smart Data Models for this purpose (FIWARE, 2020). Smart algorithms and data-driven models can rely on these harmonized data models for reading data. This facilitates re-using the same smart algorithms and data-driven models with different data sources without having to adapt them to different proprietary data models.

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The first smart algorithm for which this principle is applied is the IVL Time Series Constrictor Python program. This program can be used to detect outliers in time series measurements. When connected to the Short Term History API present in the SCOREwater platform, the same code can be applied to detect outliers in different data sources.

Where smart algorithms and data-driven models using data from the SCOREwater are being run is flexible. First of all, users can run their smart algorithms and data-driven models on their own computers, either on their desktop or in a public or private cloud. Secondly, third parties can create a processing service on a server in a public or private cloud on which smart algorithms and data-driven models are being run using data from the SCOREwater platform. Users can request running the smart algorithms or data-driven models via for instance an API call. A similar set-up could be created on the SCOREwater platform. In all cases, the smart algorithms and data-driven models can be included in the marketplace to facilitate discovery by interested parties. And output can be fed back to the platform in the form of a dataset.

The Smart Data Models are so to speak the linking pin between the sensor data and the smart algorithms and data-driven models. The next section of this deliverable discusses the different Smart Data Models applied within the frame of SCOREwater.

3. SMART DATA MODELS

In parallel with the SCOREwater project the FIWARE Foundation launched an initiative to develop “smart data models” (FIWARE, 2020). It is an open initiative for agile data model standardization. This initiative creates a list of standardized terms and data models. All the data models are available in Github and free to use, with an open licence allowing its modification. The models provide examples in several formats, including JSON and CSV. This allows users to select the format which suits their needs. Additionally, there are JSON-schemas which help to check the validity of the json. All these data models work on the FIWARE platform.

An important part of this process is a governance model, allowing to submit new data models or give feedback on existing models. The SCOREwater project collaborates with this smart data models initiative from FIWARE and exchanges experiences from the project to help improve and extend the smart data models.

Within the SCOREwater project the first steps have been taken to implement these smart data models. Deliverable 3.1, 3.2 and 3.3 provide additional information. This deliverable provides an overview of the progress made on the different data models.

3.1. WEATHER OBSERVED

The Measure your City data (the citizen science project “Meet je Stad”) is ingested in the SCOREwater platform and harmonized according to the FIWARE data model “Weather observed” (FIWARE, 2020) Variables collected are temperature (degrees Celsius), relative humidity (percentage) and, depending on the type of sensor, illuminance (Lux).

Similarly, data from two weather stations in Göteborg is sent to the SCOREwater Platform and harmonized according to the same FIWARE data model. The data from these weather stations shows the rainfall per day (precipitation). The challenge is that it is a cumulative precipitation, while the FIWARE data model currently only includes one timestamp. There is no option to include a from/to timestamp, or a unit. To work around this, the from timestamp is published. How to derive the to timestamp from the from timestamp is explained in the metadata.

Figure 2 contains an overview of the WeatherObserved FIWARE data model. It indicates how the different datasets are mapped using this data model.

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			Amersfoort		Gothenburg	
			Meet je stad	Teneo	Vatten I Goteborg	SMHI
id	Mandatory	Unique identifier.	From station metadata	From station metadata	From station metadata	From station metadata
type	Mandatory	Entity type. It must be eq	Dataset constant	Dataset constant	Dataset constant	Dataset constant
dataProvider	Optional	Specifies the URL to infor	Dataset constant	Dataset constant	Dataset constant	Dataset constant
dateModified	Mandatory	Last update timestamp o	From measurement	From measurement	From measurement	From measurement
dateCreated	Mandatory	Entity's creation timestar	From station metadata	From station metadata	From station metadata	From station metadata
name	Optional	Name given to the weath	From station metadata	From station metadata	From station metadata	From station metadata
location	or address	Location of the weather	From station metadata	From station metadata	From station metadata	-
address	or location	Civic address of the weat	-	-	-	From station metadata
dateObserved	Mandatory	The date and time of this	From measurement	From measurement	From measurement	From measurement
source	Optional	A sequence of characters	Dataset constant	Dataset constant	Dataset constant	Dataset constant
refDevice	Optional	A reference to the device	-	-	-	-
refPointOfInterest	Optional	A reference to a point of	From station metadata	From station metadata	From station metadata	From station metadata
weatherType	Optional	Observed weather type. I	-	-	-	-
dewPoint	Optional	Dew point encoded as a r	-	-	-	From measurement
visibility	Optional	Visibility reported.	-	-	-	-
temperature	Optional	Air's temperature observe	From measurement	From measurement	-	From measurement
relativeHumidity	Optional	Air's relative humidity ob	From measurement	From measurement	-	From measurement
precipitation	Optional	Precipitation level observ	-	From measurement	From measurement (2)	From measurement (3)
windDirection	Optional	Wind direction expressed	-		-	From measurement
windSpeed	Optional	Observed wind speed in r	-	-	-	From measurement
atmosphericPressu	Optional	Atmospheric pressure ob	-	-	-	From measurement
pressureTendency	Optional	Is the pressure rising or fa	-	-	-	-
solarRadiation	Optional	Solar radiation observed	-	-	-	-
illuminance	Optional	Illumninance observed m	From measurement (1)	-	-	-
streamGauge	Optional	Water level surface eleva	-	-	-	-
snowHeight	Optional	Snow height observed by	-	-	-	-
			(1) not for all sensors		(2) per day	(3) per hour
In line with FIWARE model		Either a mandatory or optional field which is present or a missing optional field				
Not in line with FIWARE model		Missing mandatory field				
Not in FIWARE model		Not in FIWARE model, present in SCOREwater data, useful to add				

Figure 2 Mapping to WeatherObserved data model

3.2. GREENSPACERECORD

The data from the soil moisture sensor network (D4.17) in the City of Amersfoort is mapped to the "GreenspaceRecord" FIWARE data model (FIWARE, 2020). This model contains a harmonized description of the conditions recorded on a particular area or point inside a greenspace (flower bed, garden, etc.), like soil temperature or soil moisture. Similarly, data from the Meetjestad soil moisture sensors is mapped to this model. Since the Meetjestad sensors measure soil moisture at different depths for the same location, it would be useful to include this information in the data model as well. Now this information is included in the identifier of the sensor.

Furthermore, comparing data from the Teneo sensors with the Meetjestad sensors is not that simple: the Teneo sensor measures soil moisture using a percentage of particles whereas Meetjestad uses conductivity. Converting one unit to the other is not a trivial task.

See Figure 3 for the mapping from soil moisture data to the GreenSpaceRecord data model.

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			Amersfoort		
			Teneo	Meetjestad	
id	Mandatory	Unique identifier.	From station metadata	From station metadata	
type	Mandatory	Entity type. It must be eq	Dataset constant	Dataset constant	
dataProvider	Optional	Specifies the URL to infor	Dataset constant	Dataset constant	
dateModified	Mandatory	Last update timestamp o	From measurement	From measurement	
dateCreated	Mandatory	Entity's creation timestar	From station metadata	From station metadata	
source	Optional	A sequence of characters	Dataset constant	Dataset constant	
location	Mandatory	Location of the area con	From station metadata	From station metadata	
dateObserved	Mandatory	Date and time of this obs	From measurement	From measurement	
soilTemperature	Optional	Observed soil temperatur	-	-	
soilMoistureVwc	Optional	Observed soil moisture m	From measurement	-	
soilMoistureEc	Optional	Observed soild moisture	-	From measurement	
refGreenspace	Optional	Garden or flower bed to	From station metadata	From station metadata	
refDevice	Optional	Device or devices used to	From station metadata	From station metadata	
depth	Additional	Depth at which soil moist	-	From station metadata	
In line with FIWARE model		Either a mandatory or optional field which is present or a missing optional field			
Not in line with FIWARE model		Missing mandatory field			
Not in FIWARE model		Not in FIWARE model, present in SCOREwater data, useful to add			

Figure 3 Mapping to GreenSpaceRecord data model

3.3. WATER QUALITY

Sensors from s::can in Barcelona upload data to the SCOREwater platform about water quality. This data is harmonized to the FIWARE data model "WaterQualityObserved" (FIWARE, 2020). Similar data from Talkpool and Swedish Hydro Solutions sensors in Göteborg is ingested in the SCOREwater platform and transformed to the same FIWARE data model. The SCOREwater sensors provide additional information which might be useful to be included in the data model. The s::can sensor measures chemical oxygen demand and the s::can and Swedish Hydro Solutions provide information regarding the amount of water (flow rate and/or volume).

Figure 4 depicts the mapping from the data off the water quality sensors to the WaterQualityObserved data model. For the s::can sensors, both location and address are missing since the exact location cannot be disclosed in order to prevent vandalism. At least one of those fields should be present though. To work around this, the address is included at a high level, it is indicated in which neighborhood in Barcelona the sensors have been installed which should be sufficient for using the data.

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			Gothenburg		Barcelona
			Talkpool	Swedish Hydro Solu	s::can
id	Mandatory	Unique identifier.	From station metadata	From station metadata	From station metadata
type	Mandatory	Entity type. It must be eq	Dataset constant	Dataset constant	Dataset constant
dataProvider	Optional	Specifies the URL to infor	Dataset constant	Dataset constant	Dataset constant
dateModified	Mandatory	Last update timestamp of	From measurement	From measurement	From measurement
dateCreated	Mandatory	Entity's creation timestar	From station metadata	From station metadata	From station metadata
location	or address	Location where measure	From station metadata	From station metadata	-
address	or location	Civic address where the V	-	-	-
refPointOfInterest	Optional	A reference to a point of	-	-	-
dateObserved	Mandatory	The date and time of this	From measurement	From measurement	From measurement
source	Optional	A sequence of characters	Dataset constant	Dataset constant	Dataset constant
temperature	Optional	Temperature.	From measurement	-	From measurement
conductivity	Optional	Electrical Conductivity.	From measurement	From measurement	From measurement
conductance	Optional	Specific Conductance.	-	-	-
tss	Optional	Total suspended solids.	-	-	From measurement
tds	Optional	Total dissolved solids.	-	-	-
turbidity	Optional	Amount of light scattered	From measurement (1)	From measurement	-
salinity	Optional	Amount of salts dissolved	-	-	From measurement
pH	Optional	Acidity or basicity of an a	From measurement	From measurement	From measurement
orp	Optional	Oxidation-Reduction pote	-	-	-
Concentrations of chemical agents	Optional		-	-	NH3, NH4, NO3, HS
codeq	Additional	Chemical oxygen demand	-	-	From measurement
flow	Additional	Flow rate	-	From measurement	From measurement
volum,e	Additional	Volume	-	From measurement	-
			(1) indicative		
In line with FIWARE model		Either a mandatory or optional field which is present or a missing optional field			
Not in line with FIWARE model		Missing mandatory field			
Not in FIWARE model		Not in FIWARE model, present in SCOREwater data, useful to add			

Figure 4 Mapping to WaterQualityObserved data model

3.4. ALERT

Within the frame of the Amersfoort case, a Flood Early Warning system has been developed. Warnings from this system are being published using the Alert FIWARE data model. The same data model may be used for alerts when other thresholds are being exceeded.

See Figure 5 for the mapping from warnings to the Alert data model.

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			Amersfoort			
			Flood early warning			
id	Mandatory	Unique identifier.	From station metadata			
type	Mandatory	Entity type. It must be eq	Dataset constant			
dataProvider	Optional	Specifies the URL to infor	Dataset constant			
dateModified	Mandatory	Last update timestamp o	From measurement			
dateCreated	Mandatory	Entity's creation timestar	From station metadata			
name	Optional	Name given to the weath	From station metadata			
location	or address	Location of the weather	From station metadata			
address	or location	Civic address of the weat	From station metadata			
dateObserved	Mandatory	The date and time of this	From measurement			
source	Optional	A sequence of characters	Dataset constant			
refDevice	Optional	A reference to the device	-			
refPointOfInterest	Optional	A reference to a point of	From station metadata			
category	Mandatory	Category of the Alert.	From measurement			
subCategory	Optional	Subcategory of the Alert.	From measurement			
dateIssued	Optional	The date and time the ite	From measurement			
validFrom	Optional	The start of the validity p	From measurement			
validTo	Optional	The end of the validity pe	From measurement			
description	Optional	A description of this item	From measurement			
alertSource	Mandatory	Source of the alert	From measurement			
data	Optional	Payload containing the da	From measurement			
severity	Optional	Severity of the Alarm	From measurement			
In line with FIWARE model		Either a mandatory or optional field which is present or a missing optional field				
Not in line with FIWARE model		Missing mandatory field				
Not in FIWARE model		Not in FIWARE model, present in SCOREwater data, useful to add				

Figure 5 Mapping to Alert data model

3.5. SEWER DATA MODELS

Currently there is no generic, international data model for sewer systems. The data model used within the City Of Amersfoort (Rioned, 2020) is focused on The Netherlands.

Within the FIWARE Smart Data Models initiative a data model “Water Network Management” (Github, 2020) is under development. This model and its entities are primarily derived from the EPANET platform (EPA United States Environmental Protection Agency, 2021). Whether it is useful for the SCOREwater demonstration projects needs to be investigated and tested. In a similar fashion SAREF4WATER (ETSI, 2020) will be investigated.

4. LESSONS LEARNED

Based on the first results, some feedback on the data models is provided in Table 1 (this is also described in D3.3). This feedback is collected from developers at Civity working on the SCOREwater platform and input from SCOREwater partners connecting their sensors and data to the platform.

In general, it can be concluded that from a point of view of the contents of datasets FIWARE data models can be applied to the SCOREwater datasets. However, they do not accommodate for metadata, both on dataset level and on data level. Metadata on dataset level can be included in the CKAN metadata repository which is also part of the SCOREwater platform. Metadata on individual data points (for example a quality stamp) however cannot be included in a harmonized way. Furthermore, the data models do not accommodate for raw data. When investigating remarkable patterns in the harmonized data it might be useful to look up the underlying raw data.

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Table 1 Feedback on FIWARE data models

Data model	Observations
WaterQualityObserved	Data collected can be incorporated into FIWARE model without a lot of effort. SCOREwater datasets contain information which are useful to be included in the FIWARE data model.
WeatherObserved	Some weather stations provide more information, not everything can be included in the standard FIWARE data model.
“sewer information”	Missing models and information systems. A first draft of a FIWARE Model has been published. Whether it fits within the SCOREwater project needs to be investigated.
Alerting	Data collected can be incorporated into FIWARE model without a lot of effort.
GreenspaceRecord	Data collected can be incorporated into FIWARE model without a lot of effort. It would be useful to add a field for depth at which soil moisture has been measured.

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5. REFERENCES

CKAN. (2020, 05 01). *CKAN, the world's leading Open Source data portal platform*. Opgehaald van https://ckan.org/

EPA United States Environmental Protection Agency. (2021, 07 16). *EPANET Application for Modeling Drinking Water Distribution Systems*. Opgehaald van EPA: https://www.epa.gov/water-research/epanet

ETSI. (2020, 11 13). *SAREF extension for water*. Opgehaald van ETSI: https://saref.etsi.org/saref4watr/v1.1.1/

FIWARE. (2020, 05 04). *Air quality observed*. Opgehaald van FIWARE-datamodels: https://fiware-datamodels.readthedocs.io/en/latest/Environment/AirQualityObserved/doc/spec/index.html

FIWARE. (2020, 05 04). *Alert data model*. Opgehaald van FIWARE-datamodels: https://fiware-datamodels.readthedocs.io/en/latest/Alert/doc/spec/index.html

FIWARE. (2020, 10 10). *GreenSpaceRecord*. Opgehaald van FIWARE data models: https://fiware-datamodels.readthedocs.io/en/latest/ParksAndGardens/GreenspaceRecord/doc/spec/index.html

FIWARE. (2020). *Smart Data Models*. Opgehaald van Smart Data Models: https://smartdatamodels.org/

FIWARE. (2020, 05 04). *Water quality*. Opgehaald van FIWARE-datamodels: https://fiware-datamodels.readthedocs.io/en/latest/Environment/WaterQualityObserved/doc/spec/index.html

FIWARE. (2020, 05 04). *Weather observed*. Opgehaald van FIWARE-datamodels: https://fiware-datamodels.readthedocs.io/en/latest/Weather/WeatherObserved/doc/spec/index.html

Github. (2020, 11 13). *smart-data-models*. Opgehaald van Github: https://github.com/smart-data-models/dataModel.WaterNetworkManagement

Rioned. (2020). *Gegevenswoordenboek Stedelijk Water*. Opgehaald van https://data.gwsw.nl/

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ANNEX 1 – STOCKTAKING

A final Annex of stocktaking was included in all Deliverables of SCOREwater produced after the first half-year of the project. It provides an easy follow-up of how the work leading up to the Deliverable has addressed and contributed to four important project aspects:

1. Strategic Objectives
2. Project KPI
3. Ethical aspects
4. Risk management

STRATEGIC OBJECTIVES

Table 2 lists those strategic objectives of SCOREwater that are relevant for this Deliverable and gives a brief explanation on the specific contribution of this Deliverable.

Table 2. Stocktaking on Deliverable's contribution to reaching the SCOREwater strategic objectives.

Project goal	Contribution by this Deliverable
SO1: Deploy and demonstrate a smart water management approach, which is people-centred, inclusive, interoperable, flexible and safe.	The deliverable uses open-source software and open standards which are not controlled by Big Tech to deliver water related information to both professionals and the general public.
SO2: Harmonize and improve interoperability opportunities in the water sector by enhancing and adopting water/ICT open standards, ecosystems, vocabularies and ontologies.	The deliverable uses open standards and open data models and applies those to water related information thus investigating what does work and identifying potential issues.
SO5: Identify and mitigate key barriers to implementation of smart, resilient water management	The deliverable delivers water related information to both professionals and the general public.
The SCOREwater platform will be based on existing open source software components, standards and data models.	This deliverable describes the data models used in the SCOREwater platform.
Identify existing systems and applications, and provide a functional and technical analysis of these systems and applications, including relevant standards, connections and data.	Deliverable 3.1, 3.2 and 3.3 describe software solutions for the SCOREwater platform. This deliverable describes the data models used in the SCOREwater Platform.
A prerequisite of the project is to base the SCOREwater platform on FIWARE	The implementation of data models is based upon the FIWARE Smart Data Models initiative.

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PROJECT KPI

Table 3 lists the project KPI that are relevant for this Deliverable and gives a brief explanation on the specific contribution of this Deliverable[1].

Table 3. Stocktaking on Deliverable's contribution to SCOREwater project KPI's.

Project KPI	Contribution by this deliverable
KPI2: Number of input data-sources connected and consumed	14 (data sources connected)
KPI7: Number of experiences related to ICT standardization and testbed standardized	5 (FIWARE Smart data models)
KPI9: Number of Open Data Catalogues in the Data Market	3 (one for each case)
KPI21: Cross-domain integration with other Open Data Catalogues	2 (SMHI and Vatten i Goteborg)
Open source software by default	This deliverable uses FIWARE open source components, models and standards for connecting and integrating sensor data in the SCOREwater platform (when available). The availability of these standardized data streams (open API´s) contributes to KPI's 7 (Number of experiences related to ICT standardization and testbed standardized), 9 (Number of Open Data Catalogues in the Data Market), 21 (Cross-domain integration with other Open Data Catalogues), 10 (Standardization barriers identified and mitigation options demonstrated) and 12 (Technological barriers identified and mitigation options demonstrated).
FIWARE as prerequisite	This deliverable uses selected FIWARE data models for standardizing and harmonization of data in the SCOREwater platform.

[1] D3.2, D3.3 and D3.4 are tightly linked. The reported KPI numbers are the cumulative effort of all three deliverables. Thus the same values are reported in all three deliverables' annexes.

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ETHICAL ASPECTS

Table 4 lists the project's Ethical aspects and gives a brief explanation on the specific treatment in the work leading up to this Deliverable. Ethical aspects are not relevant for all Deliverables. Table 4 indicates "N/A" for aspects that are irrelevant for this Deliverable.

Table 4. Stocktaking on Deliverable's treatment of Ethical aspects.

Ethical aspect	Treatment in the work on this Deliverable
Justification of ethics data used in project	N/A
Procedures and criteria for identifying research participants	N/A
Informed consent procedures	N/A
Informed consent procedure in case of legal guardians	N/A
Filing of ethics committee's opinions/approval	N/A
Technical and organizational measures taken to safeguard data subjects' rights and freedoms	In accordance with D9.2 where applicable
Implemented security measures to prevent unauthorized access to ethics data	In accordance with D9.2 where applicable
Describe anonymization techniques	In accordance with D9.2 where applicable
Interaction with the SCOREwater Ethics Advisor	N/A

RISK MANAGEMENT

Table 5 lists the risks, from the project's risk log, that have been identified as relevant for the work on this Deliverable and gives a brief explanation on the specific treatment in the work leading up to this Deliverable.

Table 5. Stocktaking on Deliverable's treatment of Risks.

Associated risk	Treatment in the work on this Deliverable
Technical immaturity of FIWARE components	Standardization of data models is ongoing and in some cases in its early phases. Close collaboration with other EU-funded projects and the FIWARE-foundation limits this risk and helps to exchange knowledge and develop an open library of data models.
Missing of incomplete standards and data models	Collaboration with other EU-funded projects, FIWARE-foundation and other standardization bodies to develop open standards and data models.

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