buildingSMART Deutschland

Whitepaper

of the buildingSMART specialist group open BIM in water management

January 2023

This white paper was written by an authorship team from the buildingSMART Germany community in 2023.

A group of water utility players from the international community have now approached buildingSMART International and wish to propose a program of activities to address the development of openBIM solutions for the sector.

This international working group have reviewed this white paper and find that it already gives a good introduction and oversight of the intention of the proposed program.

Therefore, this white paper is being used as an explanatory document for the buildingSMART International ‘Call for Participation’.

The intention is to attract more water utility players to the group and enable a program of works to be established.

Please enjoy reading this paper, with our grateful thanks to buildingSMART Germany.

buildingSMART International.

bSD Whitepaper_002_January 2023 bSD Publisher

About buildingSMART Germany

buildingSMART Germany is the competence network for the digital design, construction and operation of buildings. As part of the international buildingSMART community, we are interdisciplinary, user- and practice-orientated. More than 700 companies, research and higher education institutions, public authorities and institutions as well as private individuals from all areas of the construction and property industry are members of buildingSMART Germany. They are united by the desire to help shape digitalisation successfully. To this end, buildingSMART members work on a voluntary basis to develop open and manufacturer-neutral standards for digital methods and tools and bring this work to a global level via buildingSMART International. At regional level, buildingSMART members are organised in regional groups and use local and regional networks to promote the broad exchange of knowledge and experience. In this way, buildingSMART is actively involved globally, nationally and regionally in creating reliable and user-friendly framework conditions and standards for the successful digitalisation of the construction and real estate industry in Germany.
Germany.

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Contents

1 Introduction

Water management deals with the management of surface and underground waters, the extraction and treatment of drinking and process water, the management of wastewater and the drainage of areas with high precipitation or irrigation of areas with low precipitation. (see Figure 1).

The water industry is therefore an essential part of the basic supply of water to the population. The majority of technical facilities and water management networks fall within the scope of the "Ordinance on the Determination of Critical Infrastructures under the BSI Act (BSI Critis Ordinance - BSIKritisV)".

In Germany, the operation of water management facilities is largely carried out by public authorities and, in particular, by municipal or co-operative supply and disposal companies.

Digitalisation measures, which are necessary for the sustainable and future-oriented operation of the entire German infrastructure, do not stop at the water industry. By implementing the openBIM© methodology across the entire project life cycle, a step is being taken in the right direction to better manage future tasks.

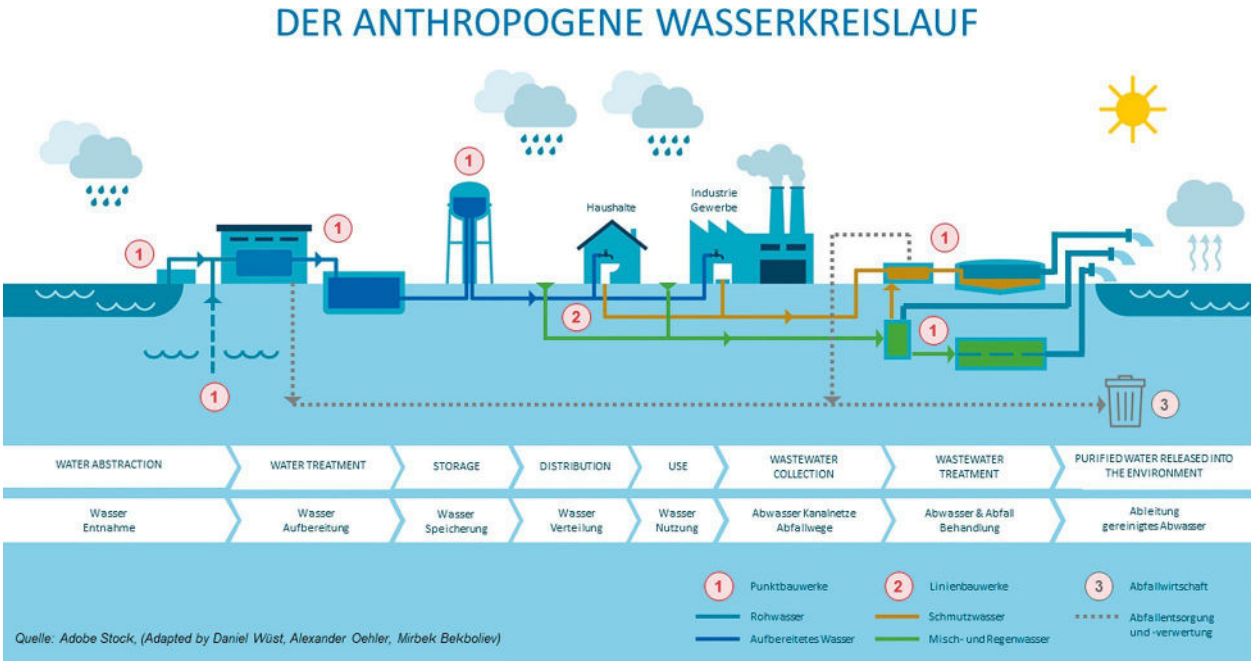

Figure 1Overview of water management structures (Source: Oehler, D. Wüst & M. Bekboliev)

2 Problem definition

Water management facilities and networks that are planned, built and operated for water supply, wastewater disposal and flood protection are often characterised by their complexity and mechanisation. Operating times of well over 50 years are not uncommon, but the rule.

Specific regulations and processes have been developed for the planning and execution of projects and the operation of water management facilities. The digital tools, formats and interfaces introduced in the process (e.g. ISYBAU, DWA M-150, DWA-M 803) are now an integral part of planning, construction and operation.

The "openBIM in the water industry" specialist group of buildingSMART Germany (bSD) would like to support the necessary use of openBIM standards and methodology. For a successful introduction of the BIM methodology, the consideration of all relevant structures and regulations is essential.

To ensure this, the members of this expert group are in close dialogue with the working groups of the German Association for Water, Wastewater and Waste (DWA), the DVGW German Technical and Scientific Association for Gas and Water and others, which are working on the creation of the DWA data sheet series 860 on the topic of "BIM in the water industry".

The needs of all stakeholders involved in the project cycle are taken into account in the "Water Management" specialist group. This requires that members from all areas of water management are represented in the expert group. This is the only way to ensure that everyone's interests are taken into account.

3 BIM in theory and practice

OpenBIM offers the opportunity to extend the benefits of BIM (Building Information Modelling) by improving the accessibility, usability, management and sustainability of digital data in the construction industry. At its core, a collaborative process that is manufacturer-independent plays an important role. The processes can be defined as shareable project information that supports seamless collaboration for all project participants. It also facilitates interoperability for the benefit of projects and systems throughout the entire life cycle. [4] openBIM ensures this:

- Interoperability is the key to digital change in the construction industry.
- Open and neutral standards should be developed to facilitate interoperability.
- Reliable data exchange depends on independent quality standards.
- Workflows for collaboration are improved through open and agile data formats.
- Flexibility in the choice of technology creates more value for everyone involved.
- Sustainability is guaranteed by long-term interoperable data standards.

Current analyses by the BMVI [6] show that there is an immense need for action, especially in the area of education and training, in order to be able to work with

digitalized planning methods. In addition, a lack of use cases, especially in the application of openBIM standards, are also obstacles to advancing some specialist areas with regard to BIM and interoperability. A common consensus and necessary extensions in the relevant domains are therefore required.

The open digital standards and services from buildingSMART also play an important role here, which should also be made possible in the water industry.

4 Terms and explanations

The terms used in connection with BIM are defined and described in VDI 2552 Sheet [1] [5] and VDI 2552 Sheet 2 [1]. In addition to the definition of the terms, the explanations of the "BIM Glossary" [7], published by bSD Verlag of buildingSMART Germany, are used below.

4.1 BIM documents and standardised formats

Client information requirements (AIA)
"Describe the requirements for digital information to be supplied by the contractor to the client in the course of providing the service." [VDI 2552 Sheet 1]. "The AIA define the project-related BIM requirements of the client (for the purposes of the definition, this also includes project participants who are themselves contractors and make requirements of subcontractors). The objectives and applications relevant to the client as well as the services and data required by the contractor are taken into account." [7]

AIA
(Client information requirements)

BIM execution plan (BAP)
Describes, among other things, the modelling rules and cooperation in the project [VDI 2552 sheets 1 and 2]. "The BAP is a document describing the implementation of the BIM method in accordance with the AIA." [7]

BAP
(BIM processing plan)

Industry Foundation Classes (IFC)
The DIN EN ISO 16739 series of standards is a standardised, digital description of the built environment, currently ISO for buildings. The extension for infrastructure (road, rail, ports/waterways) is currently undergoing the standardisation process at ISO1 (see Figure 2). IFC is an open, international standard that is manufacturer-neutral and can be used for numerous BIM use cases via a variety of hardware devices, software platforms and interfaces.

IFC
(Industry Foundation Classes)

[1] See IFC 4.3 Infra Extension -> https://standards.buildingsmart.org/IFC/DEV/IFC4_3/RC4-voting/HTML/

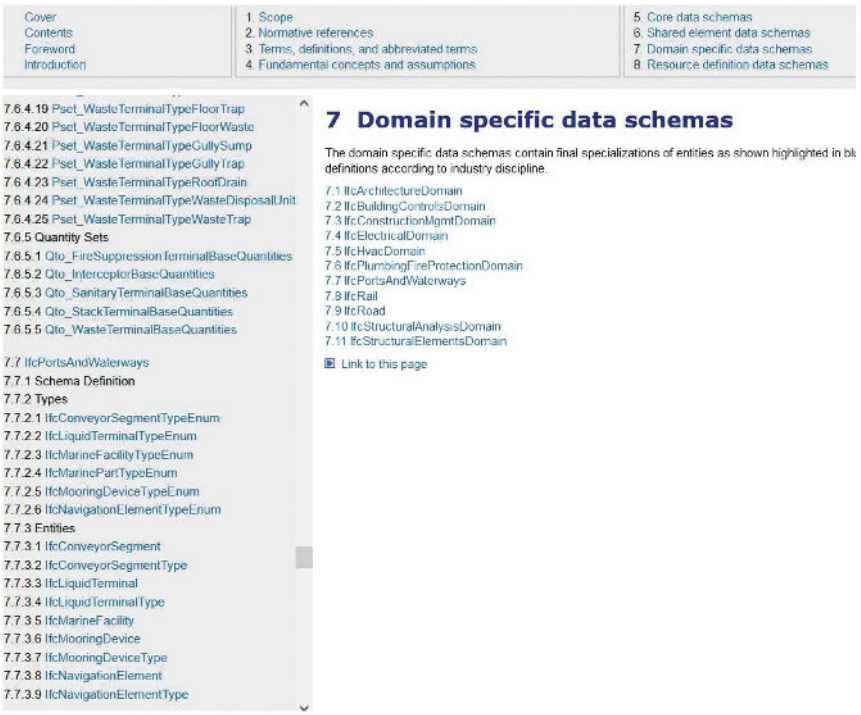

Figure 2: Domain Domain of IFC4.3 schema (Source: https://standards.buildingsmart.org/IFC/DEV/IFC4_3/RC4-voting/HTML/)

BIM Collaboration Format (BCF) BCF (BIM collaboration format)

BCF is a data format for the exchange of coordination messages [VDI 2552 Sheet 2]. "BCF is a manufacturer-neutral data format standardised by buildingSMART, which is used for communication between the various participants and BIM software products." [7]

The following classic or model-based information can be exchanged as examples:

- Screenshot of the problem from the 3D model;
- corresponding camera position in the 3D model;
- Textual description of the problem (optional);
- Textual or graphical solution proposal (optional);
- Responsibility (optional);
- Status "recognised, assigned, ignored, resolved, closed, etc." (optional).

4.2 BIM terms

BIM use cases (AwF)

"The project-specific BIM use cases to be implemented are derived from the overarching BIM objectives." [7] The general applications of BIM can be specified depending on the specialised trades. For the water management trade, this could be an inventory or maintenance, for example.

AwF
(BIM use cases)

The use cases represent the target for the leading BIM user, e.g. the coordination of the specialist trades (merging all specialist models into an overall model including the use of BCF collaboration).

BIM requirements

"The BIM requirements result from the BIM applications." [7]. BIM requirements specify the information required to implement the BIM method. Information milestones are defined (delivery date, originator, file formats, content and level of detail of the information, etc.).

BIM requirements

BIM methods

Describe the tools and working methods for realising the objectives. One example of this is the quality control and assurance of BIM models (automated collision check between parts of the merged specialised models). This can be carried out using software products known as model checkers (IFC viewers with additional functions).

BIM methods

Common Data Environment (CDE)

Is a shared data environment [VDI 2552 Sheet 1]. "Digital platform used for shared data storage and simplified data exchange" [7].

Data drops (DD)

Data exchange scenarios are a documented process in which the agreed data is exchanged between the parties involved at a defined point in time. "A data drop can contain one or more exchange requests. It is also called a data drop because it defines the data transfer." [7] Data transfer point (data drops) [VDI 2552 Sheet 1]. An example of this is the transfer of planning documents from the planner to the client.

CDE
(Common Data Environment)

DD
(Data Drops)

Exchange Requirements (ER)
Describes the requirements for the information content to be exchanged, which is required at the respective data transfer point (DD) [VDI 2552 Sheet 1 and DIN EN ISO 29481-2].
"Definition of objects and object structures with the associated levels of detail for a specific BIM use case." [7]

ER
(Exchange Requirements)

Information Delivery Manual (IDM)
Documentation (manual) that describes the operational processes and detailed specifications regarding the information that a participant must provide according to their role at a certain point in a project. Non-technical description of the information to be exchanged. [DIN EN ISO 29481-1]

IDM
(Information Delivery Manual)

Model View Definition (MVD)
Machine-interpretable, technical definition of an information exchange requirement that is linked to one or more defined standard information schemas [DIN EN ISO 29481-1]. "A model view definition (MVD) is a vendor-neutral computer-interpretable definition of an exchange requirement." "MVD was developed so that when data is exchanged between BIM software
applications, not the entire IFC data model (classes, feature sets, etc.) is exchanged, but only the subset that is actually required in the process in which the data exchange takes place." [7]

MVD
(Model View Definition)

4.3 BIM roles

Information author (BIM author)
"The BIM authors are specialist planners, among others. BIM authors are project members who edit the data model over the entire life cycle of a building in coordination with the BIM coordinators. They independently add information from the various specialist disciplines to the data model for the (partial) model in accordance with the contractually agreed quality and taking into account BIM standards as part of the BIM processes." [VDI 2552 sheets 1 and 7]

BIM author
(information author)

Information coordinator (BIM coordinator)
Project member who is responsible for the operational realisation of the BIM objectives over the entire life cycle of a building as part of the value creation process [VDI 2552 Parts 1 and 2]. The information coordinator is usually responsible for a specific trade.

BIM coordinator
(information coordinators)

Overall BIM coordinator

Overall BIM coordinator

The overall BIM coordinator is responsible for overall coordination. "The overall BIM coordinator is a project participant in large-scale projects who brings together all specialist or partial models of a construction project for coordination purposes. He checks the model in different dependencies." [7]

Information Manager (BIM Manager)

BIM Manager (Information Manager)

Project member who draws up the client information requirements and defines BIM objectives and applications as part of the project management process. [VDI 2552 sheets 1 and 2]

Information user (BIM user)

BIM user (Information user)

Information users only draw information from a building model [VDI 2552 sheets 1 and 2].

Information users can be, for example, estimators in planning, foremen in construction or personnel in plant operation.

5 Background

5.1 Reference to relevant work and services of buildingSMART

As the work and development of the openBIM standards are at the centre of buildingSMART, this working group is also pursuing this path.

openBIM uses open standards to achieve maximum interoperability between software from different manufacturers for the benefit of projects and buildings throughout their entire life cycle when working collaboratively with BIM. This includes digital workflows and the software-independent exchange of information on the basis of open standards, such as those developed by buildingSMART, which have been incorporated into international standardization in many cases.

The specialist group refers, among other things, to

- the standards IFC[2], IDM[3], MVD[4], IDF[5] and

[2] Industry Foundation Classes - DIN EN ISO 16739

[3] Information Delivery Manual - DIN EN ISO 29481-1

[4] Model View Definition

[5] International Framework for Dictionaries - ISO 12006-3

- the services UCM[6], bSDD[7], bSD Verlag and
- Formats such as BCF, COBie, CityGML, gbXML.

5.2 Links to working groups (WG), specialised groups (FG) and roundtables (RT) of bSD

Contact is maintained with

- FG Fire Protection,
- FG BIM in landscape architecture,
- FG BIM-Transport routes,
- RT TGA associations,
- FG Structural Design,
- FG Law,
- FG Facility Management,
- FG Construction 1,
- FG Construction 2,
- FG Cost determination,
- FG Rule-based quality control and quality assurance of BIM models,
- FG Steel construction,
- FG Factory Planning,
- RT BIM-GIS integration,
- FG (in Gr.) Energy industry,
- PG Digitisation of the model building regulations.

5.3 International connection

The international connection is made via

- buildingSMART International (bSI) Infra Room,
- buildingSMART International IDM/IFC Georeferencing.

[6] UCM - Use Case Management from buildingSMART International

[7] buildingSMART Data Dictionary to develop specific entities and their characteristics that are not contained in the IFC4.3 schema
and to publish them in the bSDD

The aim is to network and coordinate the future working group with these national and international initiatives.

5.4 GIS integration

The expert group takes into account the technical report BIM and GIS Integration Paper as a result of the MoU
(Memorandum of Understanding) between bSI and Open
Geospatial Consortium. [3]

5.5 Reference to other standards and regulations

Reference is made to the following regulations:

- DWA/DVGW (> 930 current standards and guidelines);
- Construction guidelines for wastewater (Federal Ministry of Housing, Urban Development and Building), including ISYBAU; • DIN, CEN, ISO;
- VDI.

5.6 Integration of organisations

The involvement of the following organisations is currently planned:

- Authorising authorities.

6 Scope and objectives of the specialist group

6.1 Area of application

A distinction is made between the following asset types:

- Line constructions:
  - Water supply networks (supra-regional and municipal drinking water networks),
  - Wastewater drainage networks (wastewater, rainwater, combined water networks, pressure pipes);
- Spatially delimited assets:
  - Structures on standing and flowing waters (e.g. transverse structures),
  - Drinking and process water extraction points/pumping (pumping stations),
  - Drinking and process water treatment (waterworks),
  - Drinking and process water storage tanks (water tanks, water towers),
  - Provision of extinguishing water (extinguishing water storage tanks and pressure boosting systems),
  - Wastewater pumping and storage (pumping stations, lift stations),
  - Wastewater treatment (sewage treatment plants, rainwater and process water treatment plants, sewage sludge valorisation),
  - Discharge points for treated wastewater (usually discharged into receiving waters).

6.2 Application phases

By networking and linking process, planning and operational data, the entire technical and organisational process/value chain of a water and wastewater infrastructure system can be mapped in digital models of structures and facilities. As water management facilities are always maintained, expanded and (partially) dismantled during operation, these phases are assigned to operation in Figure 3 [2].

Figure 3 shows the application phases of openBIM in water management:

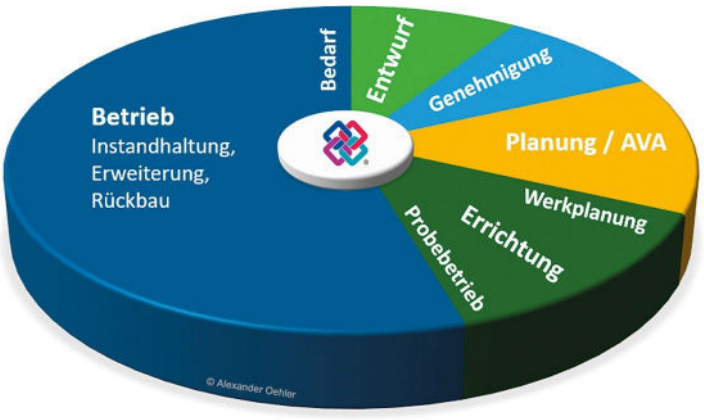

Figure 3 Application phases of openBIM
(Source: Alexander Oehler)

6.3 Use cases

Proposals for use cases were compiled during the 1st roundtable. These are to be detailed with a view to the framework conditions of water management planning, authorization and operation:

- Georeferencing:
  - Linking BIM and GIS (geoinformation system),
  - Surveying;
- Inventory;
- Coordination of specialized models

  Example interface sludge pipe = linear structure to aeration tank = point structure (coordinates, invert height, medium, material ...);
- Quantity and cost calculation;
- Scheduling;
- Visualization;
- Planning process (BAP - BIM processing plan and data transfer);
- Functional locations, room book (harmonisation of identification systems);
- Handover of the model to the owner;
- Operation:
  - (bidirectional) connection to ERP systems,
  - Asset Management,
  - Operational control systems/maintenance,

- Energy management/monitoring,
- Simulations (e.g. CFD (Computational Fluid Dynamics) network calculation, hydraulic calculations for sewer networks, etc.);

- Remediation;
- Fire and explosion protection;
- Occupational safety;
- Energy supply;
- Rescheduling and change management;
- Data exchange with external service providers
- Standing and flowing waters;
- Maintenance of natural and artificial ground and surface waters;
- Watercourse condition, water abstraction volumes, flood management.

6.4 Goals

The aim is to provide an openBIM data interface such as IFC and BCF for all line and point projects in the water industry in order to enable a large part of the information exchange required in the life cycle of a project or technical facility across almost all use cases.

A large proportion of the entities required in water management and their characteristics are already classified in the new IFC schemas. This can be seen very clearly in Figure 4 in the exemplary mapping for the topic of "water supply". In water management, the focus is often on systemic networks and process plants. One focus of the working group's work is therefore on the use of open exchange formats for existing working methods in the planning, construction and operation of water management networks and plants. As can be seen in the illustration, the aim is to examine whether the highlighted concepts can be extended to include specific IFC entities (classes) and their associated properties can be extended. For example, an "IfcProcess" could be suitable for the classification or mapping of water management processes. This should be done as part of the work on the taxonomy and the further definition of the exchange requirements.

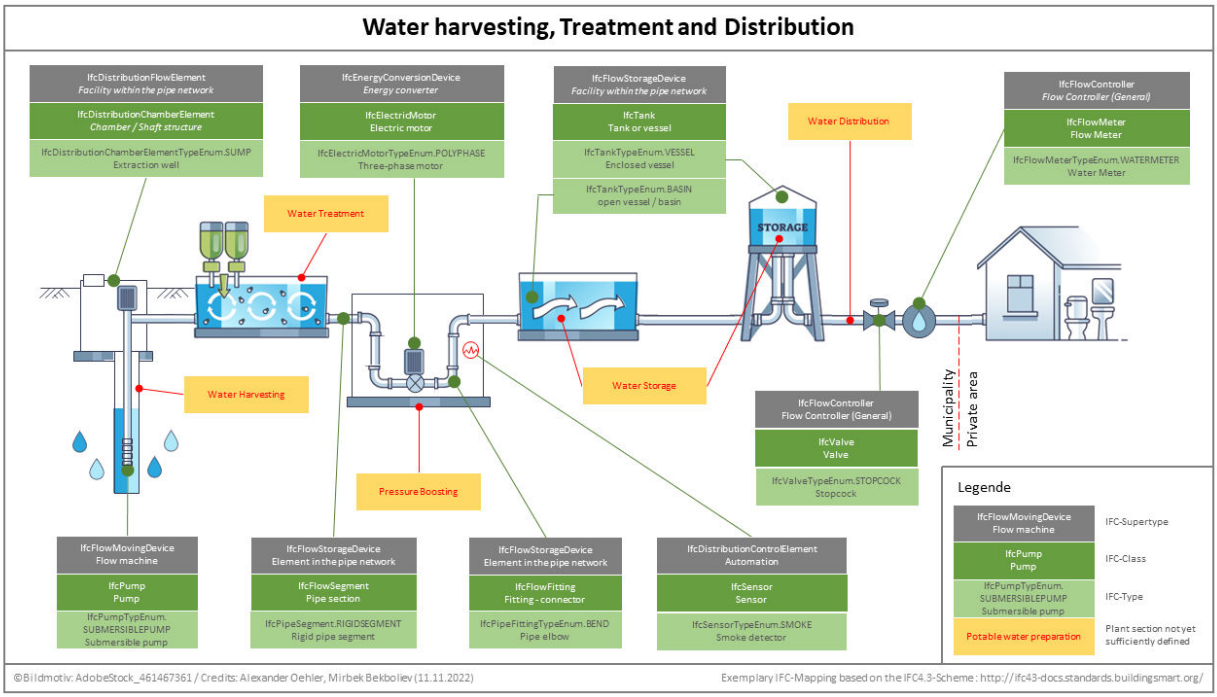

Figure 4 Exemplary IFC nomenclature based on the IFC 4.3 scheme: http://ifc43-docs.standards.buildingsmart.org (Source: ©Image motif: Adobe-Stock_461467361 / Diagram: Alexander Oehler, Mirbek Bekboliev (14.10.2022))

6.5 Procedure

The following procedure is planned:

- The group establishes a continuous and binding form of cooperation to achieve the overarching goals and strives for joint results and publications;
- Intended co-operation between DWA/DVGW and buildingSMART;
- Establishment of the necessary IDM (Information Delivery Manual) with necessary information exchange requirements (4.) and process maps (2.) of the water industry;
- Creation of BIM use cases and their BIM processes (BPMN 2.0);
- Definition of LOIN (Level of Information Need - formerly LoD);
- Creation of "modelling guidelines";
- Taxonomy;
- Exchange Requirements (IAA - Information Exchange Requirements) with IFC4.3 mapping (see Figure 4 for example IFC4.3 mapping);
- Creation of MVD (Model View Definition).

6.6 The challenges

The following challenges are seen:

- Variety of topics;
- Coordination of the numerous stakeholders and professional associations;
- Define and coordinate interfaces and areas of responsibility;
- The consideration of data structures such as DWAM 145-x or ISYBAU.

6.7 Opportunities and requirements of the industry

- Coordination of the regulations of the DWA (German Association for Water, Wastewater and Waste) and the DVGW (German Technical and Scientific Association for Gas and Water) (together around 930 standards and regulations) with buildingSMART Deutschland e. V.;
- Opportunities for introducing German standards at an international level;
- Coordination with the approval authorities.

6.8 Skills and expertise (= knowhow)

The project requires the continuous cooperation of experts who are familiar with processes from the entire life cycle of structures, plants and technical systems in the water industry.

- *Expertise and BIM knowledge from specialists in various fields (Process engineering, mechanical engineering, sewer and pipeline construction, civil engineering, structural and civil engineering, steel construction, subsoil, hydrology, meteorology, structural engineering, building services engineering, electrical engineering, measurement and control engineering, fire protection, georeferencing, KRITIS, etc.).*

If necessary, the following expertise is required:

- *Inventory (surveying, 3D modelling ...);*
- *Fire protection, FFW requirements;*
- *Occupational safety (workplace, explosion protection, noise protection, accessibility ...);*
- *Structural design (statics, stability, shoring, greening ...);*
- *Technical building equipment;*
- *Building protection (thermal, moisture protection ...);*
- *Road, landscape and open space planning;*
- *Public development;*

- *Energy, energy certificates and sustainability ...;*
- *Building law;*
- *Environmental protection, EIA environmental compatibility, species protection, BImSchV (air purity, etc.);*
- *Public bodies (authorities, supply and disposal companies, archaeology, explosive ordnance, forestry ...);*
- *Public procurement law;*
- *Hazardous substances;*
- *Logistics.*

7 Results of the expert group

The expert group intends to come to the following conclusions:

1. Taxonomy -> Class catalogue;
2. IDM (Information Delivery Manual):
   a. Information exchange requirements (Exchange Requirements),
   b. Process maps (Process with BPMN 2.0) of the water industry;
3. BIM use cases/BIM use cases;
4. Definition of LOIN (Level of Information Need - formerly LoD);
5. Modelling guidelines;
6. MVD (Model View Definition).

7.1 Publications and other utilization of the specialist group

- Objective bSD Verlag: Publication of IDM and class catalogue
- bSI UCM: Publication of use cases and their BIM processes
- Other utilisation options: Modelling guidelines
- planned joint publications with DWA/ DVGW

8 Initiators of the specialist group

The following people supported the establishment of the specialised group and the project description (as at 21 December 2021):

- Ralf Janyga, Afry Germany
- Daniel Wüst, Björnsen Consulting Engineers GmbH
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- Rene Strempel, Personal Member
- Christian Ziemer and Stefan Jaud, Siemens AG
- Dr Heinrich Herbst, Christian Maus and Roland Prangenberg, Sweco GmbH
- and, on the basis of the co-operation agreement, representatives of the DWA - German Association for Water, Wastewater and Waste e. V. and the DVGW - German Technical and Scientific Association for Gas and Water e. V.

The specialist group is headed by the following spokespersons:

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- Gunther Deinl
- Alexander Oehler
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Anyone interested in joining the specialist group is cordially invited to do so under the umbrella of the buildingSMART Germany association.

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Imprint

Publisher: buildingSMART Deutschland e. V.

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Design: B&B Fachübersetzergesellschaft mbH Order number

006