

# Change toolkit for digital building permit

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# 1. Executive Summary

CHEK DBP project aims to establish an open environment for DBP process to ensure integration for the different components, facilitating the communication between tools and DBP platform. For that purpose, "Deliverable 4.4 Open API for CHEK platform and integration manual" is a critical component of this initiative, focusing on the creation of an Open API that serves as the backbone for integrating various system components.

This deliverable focuses on the development of the Open API for CHEK platform. The open API has been developed with the objective of promoting transparency and accessibility, ensuring the secure transfer of data between the DBP platform (<u>BIMserver.center</u>) and external software (checking software) while implementing standards for authentication and data protection.

Over the 24-month development period, the initial 12 months were used to release a functional version of the API, in which an internal data model was designed based on the initial DBP process map and the first version was established in agreement with other software developers. The first release was followed by an additional year of refinements, which included: development and improvement of API calls, tool integrations, and bug fixes.

The following document gives an overview of the functionalities, structure and the connection with DBP tools, along with details on its implementation, fundamentals like authentication and connection procedures for external software. This document is divided into three sections: API REST context and overview, API implementation, API connection with external tools. The full documentation of the Open API REST is publicly available on Swagger (https://apis.bimserver.center/swagger.html ).

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# 2. Introduction

The use of an Open API is instrumental in achieving interoperability between different systems and software, interoperability is a key factor during the Digital Building Permit process due to the need of using different tools during this process. The open API allows integration of various data sources, tools and services, allowing the creation of a cohesive ecosystem for DBP.

# 2.1 Relation with other tasks

This task and deliverable are interconnected with several parts of the CHEK project as Open API is one of the main workflow enablers, contributing significantly to the creation of an integrated DBP platform. The task and deliverables, which are closely associated with "D4.4 Open API for CHEK platform and integration manual" include:

- Task 1.1. DBP Process Map: provides the foundation for understanding the DBP workflow.
- Task 4.1. User requirements and user experience: provides requirements and user experience insights.
- Task 4.2. Development, planning and optimization: Verifies the availability of required information within the process, ensuring that the functional prototypes developed for the API are tested and validated.
- Task 4.3. CHEK process management platform: As the API is a central component for integrating tools into the CHEK platform; this task supports the wider technological development of the process management platform integration.
- Task 4.5 and Task 4.6: these tasks are instrumental in ensuring that the Open API integrates with critical tools for urban planning and model validation.

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Figure 1: Relation with other tasks and outputs





# 3. Open API context and overview

# 3.1 DBP context

The CHEK Open API ensures integration and interactions between diverse tools and stakeholders involved in the workflow. Within the CHEK project, the API allows designers, municipalities, and developers to collaborate effectively in a unified digital environment that integrates tools related to both Geographical Information Systems (GIS) and Building Information Modeling (BIM) under the umbrella of exchanging open standards-compliant data, such as Verify3D, VCMap Chek plugin, and CYPEURBAN.



Figure 2: DBP workflow process in BIMserver.center

# 3.2 BIMserver.center overview

BIMserver.center platform serves as core structure and backbone for CHEK DBP process platform. BIMserver.center is CYPE's Common Data Environment for projects in an Open BIM workflow, offering features like 3D project visualization, project management and access to a repository of BIM tools. The platform currently has 229.977 registered users worldwide (136.000 in Europe) and more than 753.334 contributions.

During the CHEK project the platform has been further developed and improved adding new features and functionalities to its core structure to enable the DBP process. Among them, the development of a specific section for validation of validation projects for Municipalities (BIMserver.center Validation) and one of its main improvements which has been the development of the Open API REST to allow connection with external software tools and improve workflow management of the platform and specifically for the DBP workflow.

The Open API allows access communication with BIMserver.center platform functionalities such as: projects, contributions, documents, users, entities, applications, issues, conversations and notifications (see 4.1.2 section).

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# 4. API REST implementations

At the most basic level, an API is a mechanism that allows one application or service to access a resource within another application or service. REST API is an ideal choice for the CHEK DBP (BIMserver.center platform) due to its scalability, interoperability, and simplicity. As a stateless protocol, REST ensures high performance by efficiently handling multiple requests, which is crucial for a platform involving designers, municipalities, and other stakeholders. Its compatibility with various data formats and widespread industry adoption also makes it flexible and easy to integrate with existing systems, ensuring communication across diverse tools. BIMserver.center API REST was released on 26/05/2023 and has since been updated in an iterative way adding new calls when needed.

# 4.1 First steps

Below, a description of the first steps and important components and terminology that must be clear for any software developer that wants to connect to the platform through the API is shown. BIMserver.center API REST is publicly available at <a href="https://apis.bimserver.center/swagger/swagger.html">https://apis.bimserver.center/swagger/swagger/swagger/swagger.html</a>. The BIMserver.center API REST can be used to access and manage data, projects and contributions among other important functionalities for members of the platform.

# 4.1.1 Register on BIMserver.center Developers

BIMserver.center Developers is the platform's section that allows external software developers to connect their applications to the platform via the API. Any software developer willing to connect to the platform will have to create an account from the following link: <u>https://bimserver.center/en/teams</u>. The main functionalities of these accounts are the following:

- Obtain a BIMserver.center ID: allows obtaining an ID and secret ID to authenticate applications in the API.
- Add and manage applications: allows adding information of the applications and publishing applications in the BIMserver.center Store to make them publicly available from the platform to users.
- Access BIMserver.center documentation: documentation of the API and Swagger is available in a section in the developer's account as well as corporate identity and other documentation.
- **Trusted provider for municipalities:** allows indicating trusted applications for municipalities. Trusted applications can interact with municipality accounts (Validation accounts) allowing specific software to communicate and export information to these accounts.

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8	BIMserver.center P 🔋	
Hor	he > Applications > Edit application data	
	CYPEURBAN Client ID: 5686156F1-483B-4FCC-4949-5E0C42670D7C D Secret ID: ●	
	General description Graphical int	Information Version Other links
	Application data	
	Name*	
	CYPEURBAN	
	× II II = II = II II	Description
	Name in each language	Definition and verification of the urban parameters of the building.
	CYPEURBAN	

Figure 3: BIMserver.center Developer's account application management interface

### 4.1.2 Components and terminology

The BIMserver.center platform has a non-hierarchical component structure. The platform is composed by the necessary elements to develop and manage BIM projects. The components relevant for the DBP process are the following:

- **Projects:** Group of contributions.
- **Contributions:** A contribution is a collection of documents.
- **Documents:** Are the basic components of a contribution. The platform allows any type of file to be input as a document. However, to ensure an Open BIM workflow, it is recommended to use open standard files.
- Users. Resource contains information about user accounts.
- Entities. Entities correspond to accounts in the different sections of the platform. For the case of DBP
- **Applications (Store):** The BIMserver.center platform has an applications section (Store) where developers can include their tools through BIMserver.center Developers.
- Issues: Allow communication of issues between stakeholders, uses BCF format structure.
- Conversations: Allow users of the platform to communicate and have conversations.
- Notifications: Allow sending and receiving notifications.

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Figure 4: Main components of BIMserver.center platform and API





# 4.2 Fundamentals

## 4.2.1 Authentication

The BIMserver.center API REST allows access to a large amount of information. An authentication and authorization process must be carried out to ensure the security and privacy of the data associated with the platform users.

Access to the different resources of the API REST is carried out through the HTTP authentication scheme "Bearer authentication" (<u>https://developer.mozilla.org/en-US/docs/Web/HTTP/Authentication</u>) which uses security tokens when requests are made to the protected resources. The software developer must send this token in the Authorization header when making requests to the protected resources. The process to obtain these tokens is described below in the "connection process" section.

Table 1: Header of the request to the protected resources example.

Header of the request to the protected resources	
Authorization: Bearer <session_id></session_id>	

### **Connection process**

#### **Step 1**: Request temporary token.

Create a request to obtain a temporary session token via the POST /v1/BIMSERVER/LOGIN request. To do this, the application data (client\_id, client\_secret), available on BIMserver.center Developers, must be sent, along with the scope (scope).

- Step 2: Redirect to authorization URL.

The JSON body of the response to the POST /v1/BIMSERVER/LOGIN request from step 1 includes the URL field. This is the address of the authorization website generated by BIMserver.center. The user must be directed to this website in order to authorize the application to use the data stored in BIMserver.center.

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The well above CPURDARON to do the bolinear <b>User data</b> Access your access of the software Access of the software of the software of the software Access of the software of the software of the software Access of the software of the software of the software Access of the software of the softwa
Access your account data. User projects Costa, models you database projects of your access. User documents More rough your database, combinations of your access.
User documents Access por combinations. Convair, anady and devise contributions of your account.

Figure 5: User authorization for access to data, projects and documents.

### - Step 3: Obtain session token.

Once the user has granted authorization, a session token can be requested to allow the application to make use of API requests. To do this, the security\_id and session\_temp fields returned in the JSON body of the response to the POST /v1/BIMSERVER/LOGIN (link) request in step 1 are used. These are input parameters of the GET /v1/BIMSERVER/LOGIN/{session-temp} (link) request which, if correct, will return a session token (session\_id).





#### Table 2: Main parameters for authentication process

Parameter	Description
client id	Unique identifier (GUID) of the application. Can be found on BIMserver.center
crienc_id	Developers.
client secret	Unique identifier (GUID) of the developer. Can be found on the BIMserver.center
crient_secree	Developers.
scope	Scope of application (see Scope).
url	Authorization URL. From this web page generated by BIMserver.center the user
ull	can accept or decline the application's connection request.
security_id	Security token.
Session_temp	Temporary session token.
Session id	Session token that the application will use to make API requests on behalf of a
	user.

## Scope

Scopes allow setting granular access for applications, so they only have the necessary permissions.

#### Table 3: Scope and associated methods

Scope	Description	Associated methods
ocope	Description	
	Access the user account	GET /v1/BIMSERVER/SESSION
DATA_03ER_READ	data.	DELETE /v1/BIMSERVER/SESSION
DATA USER WRITE	Modify the user account	No associated methods at the moment
Brand_GOER_Mare	data.	No associated methods at the moment
PROJECTS_USER_READ	Access the projects.	GET /v1/BIMSERVER/PROJECTS
	Create new projects.	
PROJECTS_USER_WRITE	Modify and delete the	POST /v1/BIMSERVER/PROJECTS
	user's projects.	
	Access the contributions	GET
CONTRIBUTIONS_USER_READ	Access the contributions.	/v1/BIMSERVER/CONTRIBUTIONS
	Create new	
	contributions. Modify and	POST
CONTRIBUTIONS_USER_WRITE	delete the user's	/v1/BIMSERVER/CONTRIBUTIONS
	contributions	

# **Authentication - API Reference Index**

- POST /v1/BIMSERVER/LOGIN Gets the temporary session token, secure id and authorization url.

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#### Swagger UI

https://apis.bimserver.center/swagger/swagger.html#/authentication/postAuthenti
cation

GET /v1/BIMSERVER/LOGIN/{session-temp} Gets the session token.

#### Swagger UI

https://apis.bimserver.center/swagger/swagger.html#/authentication/getAuthentic ation

#### 4.2.2 Error codes and responses

#### Structure of a response

When a request has been completed successfully, it is indicated with an HTTP 200 code and a JSON is returned in the response body. In addition, the status field with the value "OK" must be found within the JSON file. The requested data will be returned in the record (object) or records (array) fields.

#### Table 4: Example of a successful request response structure.

```
Example of a successful request response structure.
{
    "status": "OK",
    "record": {
        ...
     }
```

#### Structure of an error response

When an error occurs in a request, a JSON is returned in the response body with the error object. In addition, within this JSON file there must be a status field with the value "error". The error object contains a code (code) and a descriptive text of the error (message).

Table 5: Example of an error response structure.

```
Example of an error response structure.
```

```
status": "error",
   "error": {
        "message": <string>,
        "code": <integer>
    }
}
```

### 4.2.3 Versioning

The BIMserver.center API versioning is represented by the version number declared in the request path: https://apis.bimserver.center/v1. When making a change to the BIMserver.center API we differentiate between disruptive and non-disruptive changes:

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- Disruptive changes: These changes require developers to adapt their application code and consequently imply a change in the version number.
  - Introduction of a new mandatory parameter
  - Deletion of an existing request
  - Deletion of a field from the response
  - o Deletion of an existing query parameter
  - o Change of the type of an input or response parameter
  - Change of the name of a field
  - Change of the name of a resource
  - Change of the authorization scopes
- **Non-disruptive changes:** These changes do not require developers to adapt their application code and consequently do not imply a change in the version number.
  - o Introduction of a new request
  - Introduction of a new optional parameter
  - Introduction of a new field in the response
  - o Introduction of new authorization scopes

For CYPE, ensuring API stability is of extreme importance, as its widespread adoption depends on maintaining high reliability. Therefore, a strong commitment has been made to design structured and well-thought calls, which are preserved as much as possible. The API follows a versioning system, and since its first publication in May 2023, the first version 1.0.0 has been maintained. All updates introduced so far have been non-disruptive, and no version increment has been required.

# 4.2.4 Pagination

It is important to use pagination when fetching large amounts of data through API endpoints to prevent the query from placing an excessive load that triggers a request timeout. In general, pagination is recommended for all services that return large numbers of records. To perform pagination, offset and limit fields will be used in the query parameters. The offset field indicates the number of records to skip at the beginning of the query, while the limit field indicates the maximum number of records to return in the response. In this way, a subset of the requested data can be fetched in a controlled manner, which helps improve API performance and efficiency.



#### Table 6: Example of a request with pagination parameters.



# 4.2.5 Expansion

In the responses to API requests about a resource, fields that refer to different resources may be found. For example, when requesting data for a project, a field will be included in the response to indicate the owner; this field will be an object corresponding to the user's resource.

By default, only the ID of the element in these fields will be returned in the response. With expansions, it is possible to expand the objects associated with the resources referenced in the request responses. This way, the complete object will be returned instead of the ID. To indicate in the request that a field should be expanded in the response, the expand query parameter is used.

Table 7: Example of a request with expansion parameters.

```
Example of request with expansion parameters
https://apis.bimserver.center/v1/BIMSERVER/contributions?expand=entity&expand=owner
```

It is important to note that expanding fields increases the time it takes the server to process the request. Therefore, it is advisable to use the expand field only when necessary.

- 4.2.6 Process for uploading a contribution
- **Step 1**: Create a container.

Create a request to obtain a container of the contribution through the POST /v1/BIMSERVER/CONTRIBUTIONS request. To do this, the contribution data such as the project (project\_id), the name (name) and the list of documents (documents) that make it up must be sent.

- Step 2: Upload files.

The JSON body of the response to the POST /v1/BIMSERVER/CONTRIBUTIONS request from step 1 includes the url field. This is the address of the contribution container hosted on the BIMserver.center cache server. This address is used to upload each of the documents indicated in the documents field of the request. The URL parameter document\_index indicates the index of the file to be uploaded according to its position in the documents field.

- + url&document\_index=0
- + url&document\_index=1
- + url&document\_index=2
- + url&document\_index=...
- Step 3: Close container

o url&endpoint=true

Once the upload is complete, the container must be closed with the URL parameter endpoint=true.





#### 4.2.7 Rate limits

In order to control possible fraudulent uses of the BIMserver.center platform and ensure its stability, limits have been set on some requests.

Resources	Associated methods	Limitations	
All	All	Maximum number of requests	100 / min
POST	Maximum contribution size (Professional projects)	15 Gb	
	POST /v1/BIMSERVER/CONTRIBUTIONS	Maximum contribution size (Non- professional projects)	5 Gb
Contributions		Maximum number of new contributions in one day	300
		Maximum size of new contributions in one day	100 Gb

#### Table 8: Rate Limits and Restrictions for API Requests

### 4.2.8 Validation calls

Within the API, there are specific calls for correct functioning of the DBP process. These calls are related to accessing and managing projects from BIMserver.center Validation accounts and also managing users and permits from these same accounts.

validation Requests related to the BIMserver.center validation	Find out more: https://developers.bimserver.center/
GET /{validation_entity_id}/validation_projects Get validation projects.	∨ 🅯
GET /{validation_entity_id}/validation_projects/{id} Get a validation project.	v 🇎
GET /{validation_entity_id}/validation_projects/{id}/validators Get the validators of a validation project.	v 🇎
PUT /{validation_entity_id}/validation_projects/{id}/validators Update validation project.	v 🗎
GET /{validation_entity_id}/validation_projects/{id}/tags Get the tags of a validation project.	✓ 🅯

Figure 7: Swagger UI - API REST Validation calls.

### 4.2.9 Sample specification of the validation JSON.

To communicate results of checking to BIMserver.center platform, a JSON protocol was set at the beginning of the project. The results of checking must be always communicated under *bsc\_validation.json* file name which has the following sample specification.

This proposed protocol was set at the beginning of the project, before the appearance of IDS. Currently, other protocols are being studied for future implementations and long-term sustainability of the project. CYPE will continue working after the finalization of this task and project to fulfil requirements from municipalities in terms of standardized exchange of information between tools.

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Table 9: Example	of JSON	Structure	for	Validation	Rules
------------------	---------	-----------	-----	------------	-------



# 4.3 Resources: integration manual

All the resources for connecting with the Open API are available on the home page of BIMserver.center Developers account. They consist of a public version of the AI REST documentation and link to Swagger UI. Any new resource that CYPE considers necessary will be accessible from this page.

<b>BIM</b> server o	center P				🕞 cre: e 🕶 🖩 🗢 🛦 👌
cype	CYPE Developent account View public profile (2)		ALL   COMPLEMENTS   OTHERREQUIRCES   MANUALS	8	
	Documents	>	Swagger UI The Swagger UI is an open source project to visually render	Corporate identity Contains several resources for applying the BiMserver.center	
	Applications	>	documentation for an API defined with the OpenAPI (Swagger) Specification. Swagger UI lets you visualize and interact with the ADFr nerviriar software basicon and of the involvementation basic	brand correctly in all its expressions, and its aim is to serve as a tool to help all those responsible for interpreting, rememunization and anotherm is answer for difference domains. An	
	A Marketing	Σ	Page -		
	10. Retail	>	API REST Documentation		
	📸 Users	>	The BIMserver.center API can be used to access and manage the data, projects and contributions of the platform's users, as well as to generate new contributions. BiMserver.center is a enlishmentar work electrons extended to the architecture		

Figure 8: Screenshot BIMserver.center Developers - Access to API resources.

# 4.3.1 Swagger

During the project development, Swagger UI was selected to present the full documentation of the API REST to the partners and to the general public. Swagger UI is an open-source project for visually presenting the documentation of

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an API defined with the OpenAPI specification (Swagger). Swagger UI allows developers to view and interact with API resources without having to install the implementation logic. This facilitates implementation in the back-end and consumption on the client side.

Because the BIMserver.center API has an OpenAPI specification, it is possible to view it through Swagger UI at the following link: <u>https://apis.bimserver.center/swagger/swagger.html</u>

Swagger.	bscrestapi_openapi yaml	Explore	
BIMServer.center terretary.center API can be used to acco contented to the construction field, open to softw Some useful links: • Elikserver.center.platform • Elikserver.center.platform Terms of service Contact the developer	RESTAPI <sup>1000</sup> (ASS) ess and manage the data, projects and contributions of the members of the platform, as well as to generate new contr are developers. This guide shows and explains the different tools available in the API and how to use them.	ibutions. BIMserver.center is a collaborative work platform,	
Servers https://apis.bimserver.center/v1/BIMSERV	ER - BIMserver.center REST API server 🗸	Authorize 🔒	
authentication Requests for auth	nentication	Find out more: https://developers.bimserver.center/	
POST /login Create a temporary ses	ssion.	$\checkmark$	
GET /login/{session_temp}	Get the session id.	$\checkmark$	
Session Requests related to the active	e session	Find out more: https://developers.bimserver.center/	
GET /session Get session data.		V 🗎	
DELETE /session Clear session.		× 🋍	
projects Requests related to the user	s projects	Find out more: https://developers.bimserver.center/	

Figure 9: Screenshot of Swagger UI - API REST Full Documentation

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# 5. Connection with external tools

The following section serves as a development proof of concept and portrays the connections of the tools CYPEURBAN (CYPE), VC Map CHEK (Virtual City Systems) and Verify 3D (Xinaps) as well as the connection with RDF Viewer (RDF) with BIMserver.center platform using the Open API.

As described above, any tool that connects to the platform with the Open API will need to go through the authentication process; during this process the user will explicitly allow the tool to access information in BIMserver.center.

# 5.1 CYPEURBAN

CYPEURBAN is a BIM desktop tool for validation of urbanistic rules and its parameters. Through the Open API, CYPEURBAN integrates directly into DBP workflow as a pre-checking/pre-validation tool, allowing designers to have access to building and city models for checking.

## 5.1.1 Connection to BIMserver.center and download information.

Any time a designer creates a new project in CYPEURBAN, it can be linked to BIMserver.center to download and upload information. Designers have to follow the steps described below to connect to the platform with the Open API:

1. A new job must be created in CYPEURBAN.

Job name	
	Browse
File name new	.urb
Description	1

Figure 10: Creating a new job in CYPEURBAN

2. The user must log-in into BIMserver.center to access the corresponding project.

	Project selection X		
	Link to a BitMserver.center project		
	<b>BIM</b> server.center		
	lt's what you do		
	Without connection 2 Select project Select project Select project Select an outpup project from the Biblicever.conter platform.		
	Configuration     Create new project     Create a new project     Create a new project on the BMserve.conter.		
	www.bimserver.center Project: -		
	Accest		
Figu	re 11: Logging into a BIMserver.center ac	count	
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3. Authentication must be carried out in the browser. CYPEURBAN must be granted access to user data, projects, and documents. Once authorisation is granted, the API returns a confirmation message if the process is successful.

BIMserver.center	BIMserver.center
CYPEURBAN wants to access your BMserver.center account ans.ferreiro.sistiga@gmail.com Charge to another account Charge to another account Database 3 3	Operation carried out correctly. The authorisation process can be continued from the application.
This will allow CYPEURBAN to do the following: User data Access your account data.	
User projects Access your projects. Create, modify and delete projects of your account.	
User documents Access your contributions. Create, modify and delete contributions of your account.	
By clicking on 'Allow', you auchorize this application and BiMserver, center to use you' information in accordance with that established in their respective terms of service and privacy policies.	

Figure 12: Granting authorisation to CYPEURBAN in the browser.

4. Authentication must also be accepted within the program to complete the login.



Figure 13: Accepting authentication in the program.

5. Once logged into BIMserver.center, the option to select a project becomes available. This step links the new CYPEURBAN job with an existing BIMserver.center project.

	Project selection X	
	Link to a BIMserver.center project	
	😵 BIM server.center	
	It's what you do	
	Ane Ferreiro Sistiaga and rerio Sistiaga@gmail.com	
	Create new project Create a new project Create a new project on the BiMarever center.	
	www.bimserver.center Project: -	
	Accept Cancel	
Fig	ure 14: Selecting a project from BIMserver.cer	iter.
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6. The list of available projects associated with the BIMserver.center account is displayed (6). The desired project can be selected. Additional project details, including contributions and direct links to the project and user profiles in the BIMserver.center browser version, can be accessed via the magnifying glass icon (7).

View only my projects						
Project name	Owner ^	Last change	Type of project	View options	Manag	
Crownhall - Mies Van Der Rohe	BIMserver.center	2022-05-20 01:34:52	••• Generic (not professional)	Visible to all users	Closed	9
Proyecto Oficinas	BIMserver.center	2023-05-25 12:25:09	••• Generic (not professional)	Not visible	Closed	9
Proyecto de edificio de viviendas	BIMserver.center	2023-05-04 16:39:30	••• Generic (not professional)	Visible to all users	Closed	Q
VCS_Lisbon	CHEK Designer	2024-09-24 15:20:56	Professional	Visible to all users	Open	Q
VCS_Gaia 6	CHEK Designer	2024-09-24 14:36:41	Professional	Visible to all users	Open	Q
AscoliPiceno Demo VCS-TUD	CHEK Designer	2024-10-02 15:16:02	Professional	Visible to all users	Open	9
Lisbon ZWEI	CHEK Designer	2024-09-17 14:43:58	Professional	Visible to all users	Open	9
Lisbon Demo	CHEK Designer	2024-09-02 13:38:08	L Evaluation	Not visible	Closed	9
VCS_AscoliPiceno	CHEK Designer	2024-09-17 14:20:33	Professional	Visible to all users	Open	9
VCS_Prague	CHEK Designer	2024-09-05 15:04:11	Professional	Visible to all users	Open	9
SIA-Gaia-FromScratch	CHEK Designer	2024-09-05 11:14:12	Professional	Not visible	Closed	9
TEMPLATE COURSE BIM_001	CYPE Academy	2023-10-30 08:45:42	🞓 Educational	Visible to all users	Closed	9
Unifamiliar aislada - Climatizació	CYPE Academy	2024-02-02 13:48:23	🞓 Educational	Visible to all users	Closed	9
Uniones de la estructura de sopo	CYPE Education	2023-05-29 13:55:01	🞓 Educational	Visible to all users	Closed	9
Edificio residencial - Planificación	CYPE Education	2024-05-02 13:55:43	🞓 Educational	Visible to all users	Closed	9
Hostal de montaña - CTE DB SI_0	CYPE Education	2023-05-10 11:31:25	🞓 Educational	Visible to all users	Closed	9
Hostal de montaña - CTE DB SI_0	CYPE Education	2023-05-10 09:09:25	🞓 Educational	Visible to all users	Closed	9
Cube House_004	CYPE Education	2023-05-09 17:56:22	🞓 Educational	Visible to all users	Closed	9
Vivienda unifamiliar - Justificació	CYPE Education	2023-03-09 09:14:20	🞓 Educational	Visible to all users	Closed	9
Edificio de viviendas - Diseño arq	CYPE Education	2023-03-08 18:04:49	Educational	Visible to all users	Closed	9
Metallic Hotel UK	CYPE Sales	2022-12-02 17:23:18	••• Generic (not professional)	Not visible	Closed	9
Arena UK	CYPE Sales	2022-12-15 12:46:45	••• Generic (not professional)	Not visible	Closed	9
BIM TOWER by CYPE	CYPE Sales	2024-07-10 15:13:19	Professional	Visible to all users	Open	9

Figure 15: Viewing the list of available projects.

The magnifying glass icon gives access to the project metadata, including links to profiles on the BIMserver.center browser version.

😵 BIMserver.center					
	It's what you do				
	Project name	VCS_Lisbon Access browser			
	Owner	CHEK Designer			
	Type of project	Professional			
	View options	Visible to all users			
	Management of collaboration requests	Open			
6.0	Description	VCS Test Project for Lisbon Pilot in EU Project "CHEK"			
	Last change	Tue 24 Sep 2024 15:20			
	Status	Active			
Q Contributions		www.bimserver.cent			

Figure 16: Accessing project metadata and browser links.

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Additionally, a list of contributions and their associated files may be accessed from there.

	Contribution	Size	Last change	No			Contribu	tion Dem	o_Lisbon_v1
1	Pilot test Lisboa 01	85.83 KB	2024-03-19 11:28:25	4			Last char	nge Tue	4 Jun 2024 23:24
2	NeighbourObjects_Min	1.62 MB	2024-05-24 10:34:08	5			Descripti	ion Desi	n V1 by ZWEI
3	NeighbourObjects_Max	2.19 MB	2024-05-24 10:44:48	5			Tans		
4	240524	1015.78 KB	2024-05-24 12:46:51	5			ings		
5	240524_536cf4	1015.78 KB	2024-05-24 12:47:40	5					
6	buildings_demolished	31.44 KB	2024-05-24 18:36:29	5		•			
7	Demo_Lisbon_v1	52.88 MB	2024-06-04 23:24:33	4		File	Туре	Size	Last change
8	CityModel Subset	4.83 MB	2024-06-05 14:54:31	7	1	Demo_Lisbon_v1	bscollab	1.08 KB	2024-06-04 23:24:3
9	Demo_Lisbon_v1_geor	31.55 MB	2024-08-04 14:50:39	3	2	Demo_Lisbon_v1	bsplcmnt	3.50 KB	2024-06-04 23:24:3
10	Test Brecia	15.73 MB	2024-08-29 21:32:47	11	3	Demo_Lisbon_v1	gltf	41.25 MB	2024-06-04 23:24:3
11	Lisbon Dataset for Bre	3.00 MB	2024-09-05 12:23:33	3	4	Demo_Lisbon_v1	ifc	11.62 MB	2024-06-04 23:24:3
12	Lisbon Dataset for Bre	7.16 MB	2024-09-05 16:02:03	9					
13	Site example	10.65 KB	2024-09-06 12:31:03	3					
14	Test export	72.66 KB	2024-09-06 14:30:11	5					
15	vcs_Demo_Lisbon_v1	20.09 KB	2024-09-24 15:20:49	5					

Figure 17: Viewing contributions and associated files.

 Once the project is selected, a list of contributions (9) can be chosen for download within the program. Information on the geographical location and reference system of the contributions is also available.

	Select the	files you want to include	9	
	Import	Contribution	Description	Last change
		Demo_Lisbon_v1	Design V1 by ZWEI	2024-06-04 23:24:33
		240524		2024-05-24 12:46:51
		240524_536cf4		2024-05-24 12:47:40
		buildings_demolished		2024-05-24 18:36:29
		CityModel Subset		2024-06-05 14:54:31
		Demo_Lisbon_v1_georeferenced	the georeferenced version of the Demo_Lisbon_v1 for visualisatio	2024-08-04 14:50:39
		Lisbon Dataset for Brescia		2024-09-05 12:23:33
		Lisbon Dataset for Brescia_8d4a1f		2024-09-05 16:02:03
			Geographic loc	ation and reference system
	Accept	] 10		Cancel
		Figure 18: S	electing contributions to import.	
API for CHEK platforn	n and ii	ntegration manual		
or CHEK platform	n and ii	Figure 18: S	electing contributions to import.	



		Geograph	nic location and refer	ence system		×
Reference system selecti	Applicatio Project Site Model	n IFC Uploader Demo_Lisbon_v1 Site 1 Model 1				
Angular g	eographic coord	dinates	6	Local referen		())
Latitude			42.414722 *	Хо	0.000	) m
Longitude			-71.258056	Yo	0.000	) m
Altitude			31.50 m	Zo	0.000	) m
North			0	Angle	0.00	
North			0.00			
Postal add	iress			Visual editi	ing of the local reference system of the r	nodel
Address	Rua de Santa M	Vlarta 41-41B		Link to the	local reference system of the model	
Town	Lisbon					
Region	CâmaraMunic	ipal de Lisboa(		Recover th	e local reference system of the model	
Post code						
Country	Portugal					
Reference sys	stem of the site					
Хо			-8.687 m			
Yo			-6.950 m			
Zo			0.000 m			
Angle			10.62 *			
Accept					c	ancel

Figure 19: Viewing the geographic location and reference system.

8. After confirming the selection, the project is loaded in CYPEURBAN. The active connection to the platform is shown in the top right corner of the application.



# 5.1.2 Update and share information with BIMserver.center platform.

In CYPEURBAN it is possible to update the information from the models as well as exporting the information of the checked model to BIMserver.center. To do so, users may find the update and share buttons on the top right part of the program's interface.



Figure 21: Updating and sharing information with BIMserver.center.

# 5.2 VC Map

VC Map is an Open-Source JavaScript framework and API for building dynamic and interactive maps on the web. It can display 2D data, oblique imagery and massive 3D data including terrain data, vector data, mesh models, and point clouds making it easy for users to explore and interact with the data in an integrated and high-performance map application. The VC Map framework offers ready-to-use map tools and plugins that can be flexibly combined in a VC Map app to meet the needs and demands of end-users to carry out a variety of analyses and simulations.

As part of the CHEK project, Virtual City Systems (VCS) has developed a VC Map CHEK plugin for compliance checking of urban regulations (documented in D4.8). The CHEK plugin utilized the OPEN API developed by CYPE software to connect and interact with DBP projects from VC Map and exchange associated data in the following way:

# 5.2.1 Connect to the DBP platform

In a web browser, go to <u>https://chek.virtualcitymap.de</u> and open the CHEK plugin that is integrated into the header of the map. It will open a login window that redirects to the login dialogue of the DBP platform using the authentication and session endpoints provided by the Open API (see also 4.2.1). After successful login, the user will be recognized as authorized user by VC Map and redirected to the next step:

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## 5.2.2 Query user entities and associated DBP projects

Once the user is logged in using her/his BIMserver.center credentials, it is possible to select an associated user entity that he/she is assigned to, to explore projects of that account that the user has access to. For this the BIMserver.center entities and project endpoint are being used:



Figure 23: VC Map CHEK Plugin: Explore projects associated with a selected user entity

This is equivalent to navigating user entities and its projects on the DBP platform (Figure 24), but directly from the VC Map user interface.





CMEX Designer       Tay output Myraditudins       Funder       Tay output Myraditudins       Funder	
CHERNON CONCEPTION       Image: Chernol Conception       Image: Cherno	
<sup>1</sup> Projects <sup>1</sup> DODA, Mar25, SAA <sup>1</sup> Color Age <th></th>	
<sup>2</sup> / <sub>1</sub> Leers <sup>2</sup> / <sub>1</sub> Devs <sup></sup>	
Image: The test       DBANC, OFF, GAA       Image: Context test       Image: Context <t< td=""><td></td></t<>	
□       0640-0.07E_L300A       ▲       ○	1
Add collaborator IFC entities Pending to be managed	
Same and Sa Same and Same and Sa Same and Same	in Gaia in March

Figure 24: Comparison of selecting user entities and projects in BIMserver.center

# 5.2.1 Associating DBP projects with map data modules

As the user selects from the list of available projects, it will automatically open the map data module associated with this project in the map view. This provides the possibility to explore available map data relevant for the selected DBP project and location. This automation has been established using a configuration option in the CHEK plugin of VC Map to associate tags that can be assigned to projects in BIMserver.center to specific data modules in VC Map. These tags are queried from the metadata of a project by calling its tags via the Open API:



Figure 25: VC Map CHEK Plugin: Associating tags and specific map modules in the configuration of the plugin

This concept could either be used to serve multiple municipalities/geodata providers with one application, or to fulfill varying data requirement of the checks for different types of DBP projects (e.g. residential, industrial projects) by organizing data in modules according to its use cases.

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# 5.2.2 Upload city data exports to the DBP project

Additional to the CHEK plugin, VC Map offers a plugin for exporting data from the 3D City Model by specifying a user defined export extent in the map. In its original version, queried data is sent to the user's email address. To support a higher degree of automation working with a processing chain of multiple software solutions in the DBP context, this plugin was adapted to directly export data from the 3D city map to the currently active DBP project of the CHEK plugin while connected to BIMserver.center using the data upload process on DBP projects provided by the Open API (see 4.2.6):



😢 BIMserver center 👂 🔳			Contribution	
Home > DEMO_Mar25_APC	Contributions Issues	v	Map data export Last change: 04/16/2025 8:09:15 PM	
Traditions of a	Search Name -	Filter + Description =	Included files	3D. Download
	AscoliPiceno_07032025_results Map data export	Submitted Resu	export.gtf	
	Ruleset vcs_v2_1 Renov Scenario	Defines a set of Converted semi	plot,son	
	vcs_AscoliPiceno_07032025 v2_1 Renov Scenario_georeferenced v2_1 Renov Scenario	the georeference	>	
Add collaborator (FC entities) Pending to be managed	AscoliPicena_07032025_georeferenced	the georeferent		
1 Issue Demonstration Project for Consortium Meeting in Gala in March 2025				

Figure 26: VC Map CHEK Plugin: Automated upload of map data exports to the DBP project

The result can then be fed into the GIS-to-BIM converter (D3.1) and used to provide geospatial context to the design process.





# 5.2.3 Store and query data of a DBP project

Once the designer uploads a building proposal, it will show up in the list of contributions of the DBP project. Contained data of a project is queried using the projects endpoint of the Open API. The CHEK plugin of VC Map only shows a selection of contributions the map can interact with (filtered by file type) and summarizes associated contributions (e.g. converted models by BIM-to-Geo converter or visualization model converter) as actions on the original contribution (e.g. to show/hide visualization and semantic model LoDs).





### 5.2.4 Upload checking results to a DBP project for validation

After the designer checked compliance to urbanistic rules on a building proposal with reference to its geospatial context, successful checking results can be reported to the municipality using the send report button in the checklist displayed via the CHEK plugin. This action sends a BIMserver.center compliant JSON file (as specified in 4.2.9) to transfer the checking results to the DBP platform using the Open API:

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2D 3D 😂 👌 🖏	* 📀			<b>C</b> HEK	Ascoli Piceno		
Compliance Checks Puleset URL* https://files2.himsenver.center/CYAL	× CODO ison		〕 ∴ ~ ++	0 P	# P. ~ Q ~	◆ · ∐ ·	iri
Compliance checking						THE REAL	
✓ HEIGHT							11
(REC-Art.13) Building Height: Max	: 7-		/ /				
✓ BUILDABILITY INDEX	6			$\langle \rangle$		A P	
R [NTA-Art.n/a] Territorial Buildability Index: Max	:			Run II.	-	- tr	
[NTA-Art.n/a] Gross Area Index: Max	: 1	- Barton (					
V DISTANCE		1 1/5	K				
[REC-Art.13p] Building-Boundaries Distance: Min	:	TH				All to	
P. [REC-Art.13q] Building-Road Distance: Min	: 322	and the second					
BACK RUN CHECKLIST	it the Test Results	3.5				A S	
🔞 BIMserver.center 👂 🔋					CHEK Municipality	Validation V	₽▲ 💽
Home > DEMO_Mar25_APC							
DEMO_Mar25_APC	Contributions Issu	es History	Review				
Professional	5 Number of checks 5 Valid	0 Not applicable					
	Code Description			Unit	Project	Code	Status
	APC-01 Building Hel	ght: Max		m	19.29	15	
Land Land	APC-08 Buildability	ndex: Max		m	5.715	3	
	APC-14 Buildability	ndex: Max		m	2.194	3	
	APC-23 Building-Bo	undaries Distance: Min		m	3.16	5	
3D.0	APC-24 Building-Ro.	d Distance: Min		m	4.82	5	

Figure 28: VC Map CHEK Plugin: Sending results of geospatial compliance checks to the DBP platform from VC Map

# 5.2.5 Validate DBP projects

Switching to the perspective of the municipality, the municipality gets access to review the project once the validation report is submitted. The validation endpoint (see 4.2.8) of the Open API is used to query and interact with validation projects in an equivalent way to design projects to conduct the review of the checking results interactively in VC Map. The VC Map UI further integrates actions to accept or reject projects directly from the CHEK plugin, transferring the selected validation status to the DBP status. Also, if assigned reviewers prefer the tabular view of BIMserver.validation, the validation status is synced and is always present on the project's metadata.

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Figure 29: VC Map CHEK Plugin: Review and validate DBP project from the VC Map user interface

In summary, the Open API of BIMserver.center made it possible to seamlessly integrate our application VC Map into the DBP workflow and to enable authorized data access, retrieval and exchange of relevant data, thereby creating an interoperable solution based on specialized software products. This option merges capabilities of BIM- and GIS-based software into a joint solution for the management and validation of DBP projects.

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# 5.3 Verify3D

# 5.3.1 Add a project from the DBP platform

1. In a Web-Browser, the user can navigate to chek.verifi3d.com and login with their Verifi3D credentials

Verifi3D by Xinaps	
Username	
Password 🏽 🗞	
LOG IN FORGOT PASSWORD?	
LOG IN WITH 🗸	
REQUEST A TRIAL	

Figure 30: Verifi3D - Login Dialog

a. (single sign-on can be set up for AutoDesk and Microsoft accounts, but is not implemented for BIMserver.center / the CHEK platform)



#### Figure 31: Verifi3D - Single Sign-On (SSO) choices

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2. After login, the user is redirected to the welcome Screen. Here the "Go To Projects" button can be used to go to the "Projects" page.



Figure 32: Verifi3D - Welcome Page





3. With the "Add Project From" the user can open the CDE connection wizard.

← → ♂ 🗳 chek.verifi3d	l.com/main/projects				☆ 📭 🌢 🖆 🚫 🗄
$\widehat{\mathbf{w}}$					4º 🕸 🖓 🖇
<b>(</b>			Projects		
ORGANIZE			TE NEW VERIFIED PROJECT + ADD PR	roject from $\sim$	
Search	Q				
Vuutuure	J_Mar25_APC 20 C	DEMO_Mar25_GAIA	OEMO_Mar25_IPR Xinaps - christian.chek	80 DEMO_Mar25_LIS Xinaps - christian.chek	Prague Building Rule Librar Xinaps - christian.chek

Figure 33: Verifi3D - Projects Page

4. The first step in the CDE connection wizard is to choose a CDE provider, e.g. BIMserver.center





5. The second step in the CDE connection wizard is to choose an user account. If no account is known for the chosen CDE provider, the user can continue by clicking "Add another account".

Add a project	from BIMserve	r.center	
Select a provider	Select an account	3 Sele	ct a project
😵 BIMserver.center			C
Choose an account			
Please choose an account to use for selecting projects	O christian@	)xinaps.com	Î
Please note that you will have access only to the projects own or shared to the account.	+ Add another account		
			NEXT

Figure 35: Verifi3D - CDE connection wizard, user account selection

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6. In the new browser tab that opens, the user can log in to BIMserver.center with their BIMserver.center credentials.

Login	
E-mail	
E-mail	
Password	
Password	

Figure 36: Verifi3D - CDE connection wizard, BIMserver.center login dialog

- 7. The BIMserver.center browser tab can be closed now.
- 8. Next, the user can choose a BIMserver.center project from a BIMserver.center team available to them.

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Add a project from BIMserver.center					
	Select a provider	Select an account	3 Select a project		
		🛞 christian@xinaps.com	C		
	Search		$\bullet$		
	🔻 😢 CHEK Designer				
	DEMO_CYPE_ASCOLI				
	😵 DEMO_CYPE_GAIA				
	2 DEMO_CYPE_LISBOA				
	2 DEMO_CYPE_PRAGUE				
	😢 DEMO_Mar25_APC				
	😢 DEMO_Mar25_GAIA				
	😢 DEMO_Mar25_IPR				
	😢 DEMO_Mar25_LIS				
	N m concernent in		U		
			CANCEL PREVIOUS ADD		

Figure 37: Verifi3D - CDE connection wizard, Team and Project selection

9. The project is now permanently added to the user's Projects page in Verifi3D



Figure 38: Verifi3D - Projects Page with added BIMserver.center project





10. The user can open the Project and go to "Models"



Figure 39: Verifi3D - Project Page





11. The Model Browser shows the contributions in the BIMserver.center project. By clicking the cube icons, the user can add contributions, models and even specific model versions to the Model Set Builder.



Figure 40: Verifi3D - Model selection and loading

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12. As long as the "LOAD" toggle is switched on, the models will convert and load immediately.



Figure 41: Verifi3D - Loading models

13. It is possible to save the collection of models in the Model Set builder to "Saved Model Sets". A saved model set remembers the choice of models and model versions from BIMserver.center. It is even possible to set the version to "always latest", so the latest version of that model will be loaded when the Saved model Set is opened.

	Model Set Builder $\times$	
	Model Set [unsaved]	
	3 Models, 0 Model Sets	
	+ CREATE FOLDER	
	Search	
	▼ PRHAHA_GOA_V5.3	
	🛞 413_AR_AP_510. 🖤 💿 🔟	
	🛞 413_AR_AP_510. 🖤 💿 🔟	
	🛞 413_AR_AP_510_ 🖤 💿 🔟	
	Welcome to your Moc Version 1 D	ate Added: 1/1/1970
	Builder! Here, you can Always Lat	est
	Add models from the Model <del>prowser</del>	
	Toggle Load Models on to view them in	
	Figure 42: Verifi3D - choosing mod	el versions, automatically
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30/04/2025		



# 5.4 RDF – IFC and CityGML Viewer

The Web Assembly IFC and CityGML Viewer has been developed and adjusted to access BIMserver.center projects. The integration as well as execution is following the Web Assembly (WASM) capabilities and executes fully in the Web browser on the client. This means all interaction with BIMserver.center as well as processing both IFC as well as CityGML content into a rendered mesh is fully executed on the client within the Web browser.



Figure 43: IFC and CityGML Viewer – a single IFC file

Several IFC and CityGML models can be visualized within one scene.







Figure 44: IFC and CityGML Viewer – two CityGML files in one view







Figure 46: IFC and CityGML Viewer - converted CityGML files and IFC files in one view (from a single contribution)

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# 6. Conclusion

The development of the Open API REST for BIMserver.center has been a key component in enabling interoperability and integration across the different tools and services involved in the CHEK Digital Building Permit (DBP) workflow. This deliverable provides a thorough description of the API structure, its main functionalities, and detailed integration guidance.

Throughout the project, several external tools—CYPEURBAN, VC Map, Verify3D, and RDF Viewer—have been successfully integrated using this Open API, proving its capacity to support a connected and automated DBP environment. Key aspects such as authentication, versioning, error handling, validation communication, and resource management have been thoroughly addressed to ensure a secure and scalable implementation.

By offering a publicly documented and structured API, BIMserver.center and the CHEK platform promote a transparent, open, and interoperable ecosystem that benefits all stakeholders involved in digital building permitting—from designers to municipalities. This structure allows flexibility and modularity in the composition of the set of tools used by each municipality to support the different workflow steps. In fact, more software can be easily connected to the platform by following the same procedure and reusing the same Open API definition. The resulting architecture can therefore be tailored to the specific requirements of diverse municipalities, facilitating scalability and adoption of digital urban planning and permitting process in Europe.

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