Efficient Ways to Visualize and Analyze Data in BIM360 Project with Power BI

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Principal Developer Advocate

Joined Autodesk in 2007 as a developer advocate. Starting with desktop products’ APIs, Xiaodong is now engaging in Autodesk Forge and AEC solutions, including BIM360 and Revit etc. He is one of the contributors of Forge blog and ADN DevBlog, researching integrations by Forge and web & cloud technology. Xiaodong is based in China, yet mingling with the global community of Autodesk and programming. He is also the ambassador of Intel IoT technology.
Agenda

• About BIM 360 and Power BI
• Power BI Templates for Construction
• Power BI Partner Card
• BIM 360 Forge API & Data Extraction
• Power BI Visual of Forge Viewer
• Power BI Embedded in Web App with Forge Viewer
About BIM 360 and Power BI
Unified platform connecting your project teams and data in real-time, from design through construction, supporting informed decision-making and leading to more predictable and profitable outcomes.
Account Management

- Projects
- Companies
- Users
- Roles
- Apps
- etc

Documents Management

- Folder
- Version
- Model Visualization
- 3D model/2D drawing
- Phases, rooms, levels...
- PDF, markup, hyperlink
- Review
- etc

Design Collaboration

- Real-time Revit cloud worksharing and collaboration workflows for Civil 3D and Plant 3D
- Connect design teams to improve project outcomes
- Improve productivity, reduce rework, and accelerate project delivery
Field Management

• Issue
  • General data, assignee, status, type, sub-type, due-date, documents, pushpin...

• Checklist
  • sections, item, fields, answers..

Project Management

• RFI
  • General data, transitions, assignee, status, due-date, documents, pushpin...

• Submittals

• Meetings

Asset Management

• General data
• Categories
• Details, linked Issues, Checklists...
• Status
Model Coordination

- Coordination Space
- Model Collections
- Clash Results
  - Matrix View, Breakdown View
- Clash Issue

Cost Management

- Budget
- Change Order
- supplier contracts
- Budget impacts
- RCO, OCO, SCO etc.
Insights

• Unified project-level data, analytics, and predictive insights.
• Review project data by intelligent cards
• Overview of metrics related to the current high-risk issues in project.
• Overview of metrics related to design review and model coordination processes.
• Overview of metrics related to the issues, RFIs, and submittals associated with project.
• Overview of cost and budget trends, such as the original vs projected budget for different aspects of the project.
• Overview of metrics related to the quality of the project.
• Support custom cards
Power BI

- Data analysis intelligently
- Rich types of visuals: general dashboards types, and huge number of custom visuals in AppSource
- Data modeling directly and interactively
- Generating, refreshing, data associating, data sorting, data mining automatically.
- Data searching and classifying efficiently
- Desktop version and web version
- Import data by file, database, data stream (IoT), scripts, custom data etc..
- Support custom visual
- Nice web services, embedded container, easy integration.
Key is Data
Power BI Templates for Construction
Data Connector

• Extract the account-level data
• Admin data
  - Activated services, Business units, Companies, Projects, Users, Roles
• Project data
  - Checklists, Cost, Daily logs, Issues, Locations, Submittals, RFIs
• Provide some Power BI reports templates
  - Admin dashboard
  - Project dashboard
  - RFI dashboard
Possible Data Sources for Report without Coding

**EXPORT BY BIM360 DATA CONNECTOR**
- Most admin data and field management data
- Some data might not be available

**DOCUMENT LOGS**
- General data of documents
- Documents in one folder and subfolder only

**ISSUE/RFI/CHECKLIST REPORT**
- Easy to dump data of these entities
- Data of one project only
- Some data might not be available

**REVIT DATABASE LINK**
- Depend on Revit
- One model metadata only
- In mdb format
Power BI Partner Card
Partner Card

- iFrame configuration
- URL provided by the partner company when you subscribe or purchase the application
- Or, URL can be accessed by 3rd party
  - Power BI, Domo, AOMS, Clarity…
Power BI Card
Embed with BIM 360 Insights

Secure embed code
Here's a link you can use to embed this content.
https://app.powerbi.com/reportEmbed?reportId=781492ef-74d8-4249-9776-3b749c994659

Customize Dashboard
Organize the order and add new cards to your dashboard.
DEMO

Power BI Templates for Construction
Power BI Partner Card
BIM 360 Forge API & Data Extraction
## Basic Steps to Start

### STEP 1
**CREATE FORGE APP**
- Register Forge account
- Create Forge app
- Client ID
- Client Secret
- Callback URL

### STEP 2
**INTEGRATE APP WITH BIM360**
- Approve the app to access BIM360 data (Admin/Docs)
- Or invite the app to access

### STEP 3
**CALL BIM360 WEB SERVICES**
- Follow web service help to build the calling (by code or by tool)
- Input authentication token (2-legged) or authorization token (3 legged token)
- Set necessary scopes: data:read, or account:read
- Input query parameters

### STEP 4
**USE RESPONSE DATA**
- Json format
- Key-value pair or array
- Inject to web app or analysis
BIM 360 Forge API is RESTful

Quoted from wikipedia: Representational state transfer (REST) is a software architectural style that defines a set of constraints to be used for creating Web services.

Resource (web service endpoint)
https://developer.api.autodesk.com/hq/v1/accounts/:account_id/projects

1. specify required or optional headers such as token
2. BIM 360 Projects Data
3. one page
4. pagination
5. specify required or optional parameters such as filter project by name
Extract Data by RESTful Tool

Get data without coding or with a little coding

- Easy for test endpoints
- Support 2 legged token and 3 legged token workflow
- Support post and pre scripts
- Support batch running
- Limitations:
  - Some manual interferences are required
  - Loop for dumping all records with coding
  - Default response format is Json. Need to convert to flat format separately
  - No way to auto-export all records to local file
DEMO

Extract BIM360 Data by Postman
Extract Data by Script

Less coding with R Scripts - Sam

• Import BIM360 admin, or document data to Power BI report
• Import BIM 360 feature data to Power BI report
• Easy to use (copy paste the demo code)
• One time execution, hard to debug and troubleshooting
• Tricky to work with 3 legged token
• Not suitable to dump pagination

Less coding with Node.js utility - Xiaodong

• Support export BIM360 admin data to excel without coding
• Support export BIM360 document data to excel without coding
• Support export BIM360 feature data to excel without coding
• Extensible to add more custom exporting by less coding
• Support both 2legged token and 3legged token workflow
• Easy to handle pagination
• Easy to debug and troubleshooting
DEMO

Extract BIM360 Data by Node.js Tool
Power BI Visual of Forge Viewer
Visuals

FORGE VIEWER
- A browser based container that can load and render 3D model or 2d drawing
- No plugin, no installer, browser only
- Complete model/drawing data
- Plentiful built-in extensions
- Rich API (JavaScript) for app integration

POWER BI CUSTOM VISUAL
- Visualize data by your own way
- Rich library of fully-customizable, open-source data visualizations
- HTML5, TypeScripted, easy to integrate with known JavaScripts libraries.
- Package into redistributable visual across products or in AppSource.
Load Forge Viewer Dynamically

```javascript
private async loadForgeViewerScriptAndStyle(): Promise<void> {
    return new Promise<void>((resolve, reject) => {
        let forgeviewerjs = document.createElement('script');
        forgeviewerjs.src = 'https://developer.api.autodesk.com/modelderivative/v2/viewers/viewer3D.js';
        forgeviewerjs.id = 'forgeviewerjs';
        document.body.appendChild(forgeviewerjs);

        forgeviewerjs.onload = () => {
            console.info('Viewer scripts loaded');
            let link = document.createElement('link');
            link.rel = 'stylesheet';
            link.href = 'https://developer.api.autodesk.com/modelderivative/v2/viewers/style.min.css';
            link.type = 'text/css';
            link.id = 'forgeviewercss';
            document.body.appendChild(link);
            console.info('Viewer CSS loaded');
            resolve();
        };

        forgeviewerjs.onerror = (err) => {
            console.info('Viewer scripts error!: ' + err );
            reject(err);
        };
    });
```
DEMO

Embed Forge Viewer inside Power BI Report
Power BI Embedded in Web App with Forge Viewer
DEMO

Analyze Clash Data by Power BI Component + Forge Viewer
Register and Create Power BI App

Create Data Source by **Push Data Format**

```json
{ "name": "dataset_name", "tables": [ { "name": "column_name1", "data_type": "data_type" }, { "name": "column_name2", "data_type": "data_type" }, ... ] }
```

Make a Report with Dummy Data
(Bubble Chart and Table View)
Power BI Embedded Playground
DEMO

Embed Power BI in Web App
Push Data as source for Power BI

- No refresh limit: update data and report any time
- Use Power BI Restful API to create data source and push data

Model Coordination API

- Clash API:
  - Get clash instances collection: dblds, documents etc
- Index Property API:
  - Get properties of clashed elements on backend
Enable non-login access of Power BI

- Get OpenId token without authorization workflow
- Assign admin role with the user
- Grant admin consent

Selection Events of Power BI with Forge Viewer

- Table view
- Bubble chart
  - Get summarized data (by cluster) firstly, and find corresponding table rows with cluster data, and finally get those clashes.
Summary

- No programming
  - Data Connector
  - Partner Card
  - Extract/Export functionalities

- A little programming
  - Call BIM 360 API by Restful tool such as Postman, exporting data in Json format
  - Use R scripts/templates to execute the extracting

- More programming
  - By more advanced programming such as Node.js. customized based on BIM 360 Export Tool

- Comprehensive programming
  - Embed Forge Viewer inside Power BI report
  - Embed Power BI report inside a Forge app
Get Started with Forge

BIM360 API Documentation

Get Access to a BIM 360 Account

A Forge app needs to be connected to a specific BIM 360 account before you can ensure that your app has been granted permission to access that account. As an Admin in BIM 360. This section outlines how to get access to a BIM 360 account.

Before You Begin

Make sure that you have registered a Forge app and have your client ID available.

Step 1: Provisioning a BIM 360 Account

Development Account

During the development phase, we strongly recommend that you use a separate

- Create a trial account and convert it to a developer account, by following:
  - Browse to the Try BIM 360 for Free page, and click the Try Docs Free and BIM 360 Account Admin for 30 days. (The Try Docs for 30 Days控)
  - Click the Try Docs Free button at the top right corner of the screen, and click Submit.
  - Enter an email address in the Email field. The Sign in screen appears account name for BIM 360 Docs and BIM 360 Account Admin.
  - If the email address is already associated with an Autodesk account, otherwise, click Create Account, and follow instructions to create a Management screen appears.

LearnForge Tutorial

View BIM 360 & Fusion models

This tutorial will guide you creating webapp with the following UI on the left a list of Hubs, Projects, Folders, Items (files) and respective Versions, on the right a 3D viewer to view them.

To view your model, you need the following steps:

1. Create a server: 
   - First-time developer? You should start here
2. Authorize
3. List hubs & projects
4. User information
5. Show on Viewer
Get Help

forge.help@autodesk.com

Thank you!