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How to handle hundreds of projects in BIM 360 and integrate into ERP

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Learning Objectives

- Discover how to use BIM 360 for numerous projects.
- Discover how Forge can replicate your existing project data to BIM 360.
- Understand how easy an integration can be.
- Understand what an integration brings you.

Description

Building hundreds of single-family homes is a challenge impossible to tackle without the help of a well-integrated IT infrastructure. Therefore, we took BIM 360 software into the heart of our Enterprise Resource Planning (Microsoft Dynamics NAV) and helped our different departments thrive in accomplishing their tasks. Out of our fully integrated construction chain, we will show the window procurement, installation, and repair procedure as an example of how to interact with the BIM 360 model in our ERP, and how to exchange data instantly between the ERP and BIM 360. As the access permissions settings were defined already in our ERP, Forge gave us the possibility to sync the security settings for hundreds of projects and stakeholders instantly.

Speakers

Joël Schons is the owner and the CEO of Stugalux Construction S.A.. He started his career as an IT consultant in London, then came back to Luxembourg to integrate the Stugalux group in 2002.

A technology enthusiast, he's always seeking the real-world application for the last innovation, believing that technology will help the workers, and not replace them.

Johann Cantryn works as a technical specialist for Datech, a value-added distributor for the Autodesk solutions.

After his first encounter with Revit, sixteen years ago, he was fully convinced of the added value of BIM and started helping companies in the BeNeLux implement BIM workflows. Today he is mainly focused on BIM 360 workflows and integrations. Technology is changing the world, technology is changing the AEC industry. He is happy to be a part of it.

Table of contents

| | |
|---|-----------|
| HOW TO HANDLE HUNDREDS OF PROJECTS IN BIM 360 AND INTEGRATE INTO ERP | 1 |
| TABLE OF CONTENTS..... | 2 |
| PART 1 – PROJECT LEVEL INTEGRATION | 3 |
| FREQUENT CHALLENGES ENCOUNTERED | 3 |
| STANDARD SOLUTION: AUTODESK BIM 360..... | 4 |
| TAILOR-MADE SOLUTION: AUTODESK BIM 360 INTEGRATED WITH MICROSOFT DYNAMICS NAV | 4 |
| <i>Stage 1: get necessary data.....</i> | <i>4</i> |
| <i>Stage 2: ERP configuration</i> | <i>4</i> |
| <i>Stage 3: Generate BIM 360 project</i> | <i>8</i> |
| PART 2: OBJECT LEVEL INTEGRATION..... | 11 |
| FREQUENT CHALLENGES ENCOUNTERED | 11 |
| INTEGRATION FRAMEWORK | 11 |
| <i>BIM viewer in Microsoft Dynamics NAV</i> | <i>11</i> |
| <i>Create link between ERP and BIM objects</i> | <i>13</i> |
| <i>Adding additional information to the BIM objects</i> | <i>14</i> |
| <i>View the status in the viewer.....</i> | <i>15</i> |
| WHAT DOES THIS MEAN? | 16 |
| <i>Ordering phase: Computer Aided Ordering</i> | <i>16</i> |
| <i>Ordering phase: change management</i> | <i>18</i> |
| <i>Construction phase: where to install products?</i> | <i>19</i> |
| <i>Maintenance phase: get the actual information of building components</i> | <i>21</i> |
| <i>From ERP to Revit model</i> | <i>22</i> |
| CONCLUSION | 25 |
| ANNEXES | 26 |
| A1: FORGE API METHODS CALL..... | 26 |
| A2: CURL INTERPRETATION IN MICROSOFT DYNAMICS NAV..... | 26 |
| A3: PUBLICATION PROCESS..... | 27 |

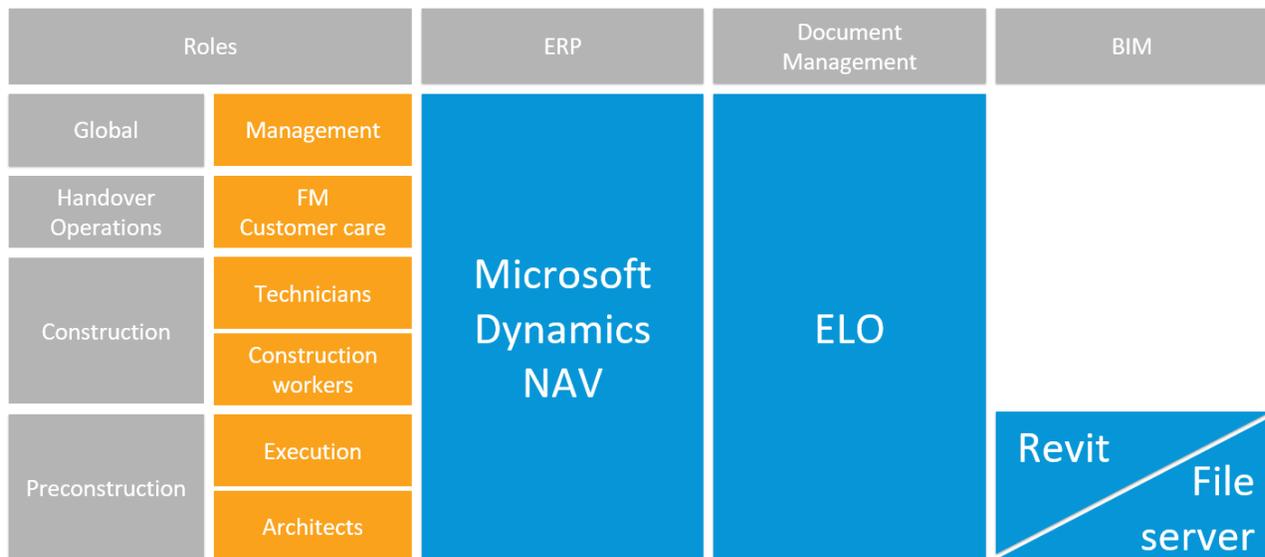
Part 1 – Project Level integration

Frequent challenges encountered

Within Stugalux, in the overall process of a project, 3 platforms were used: Microsoft Dynamics NAV (ERP), ELO (Document management) and a file server (File management).

Exchanging plans between the different departments was done using PDF files. These were created from Revit, saved on the file server and then put in the document management system 'ELO' via the ERP system 'Microsoft Dynamics NAV'. This procedure was repeated for each new version of the Revit project.

At the end of a project, a multitude of PDF files for the different versions of the same project could be found in different environments. This could lead to communication errors during the project process and the use of the wrong versions of the plans by the technicians of the various departments.



INFORMATION PLATFORMS

Standard solution: Autodesk BIM 360

To overcome these problems, we wanted to implement a ‘one source of truth’ system for document versions: for each team member it had to be easy to find the latest version of the plans in just one place. BIM 360 Docs was a perfect solution to achieve this!

In addition, the standard BIM 360 communication tools (like mark-ups and document issues) as well as the BIM 360 Build functionality for field management improved the general project process and the flow between the different departments.

But because we have between 150 and 200 ongoing projects a year, we still had a lot of challenges to manage all these projects:

- A lot of time needed to be spent on managing user permissions and creating the folder structure for each project.
- There was a lot of human errors during the project creation process.
- The structure of the project folders was not consistent
- ...

Tailor-made solution: Autodesk BIM 360 integrated with Microsoft Dynamics NAV

To establish an optimized process for creating projects, we went through 3 stages using Autodesk Forge.

Details about how to create a new project in BIM 360 by using Autodesk Forge are presented in annex A1.

Stage 1: get necessary data

First, we wanted to gather information from the BIM 360 environment so that it can be used for:

- Import user roles in our ERP system.
- Merge information:
 - From ERP users and BIM 360 users.
 - From existing ERP projects and projects created manually in BIM 360.

Stage 2: ERP configuration

Template for folder structure

To standardize the folder structure on all platforms (file server and BIM 360) and ensure the consistency, we’ve created a template project definition in Microsoft Dynamics.

The folder creation is a process completely ERP-driven; the same hierarchy is used for the creation of the folders on the file server and on the BIM 360 platform.

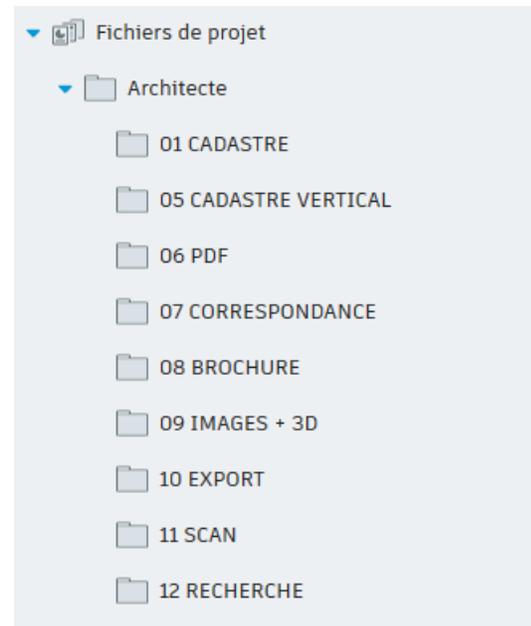
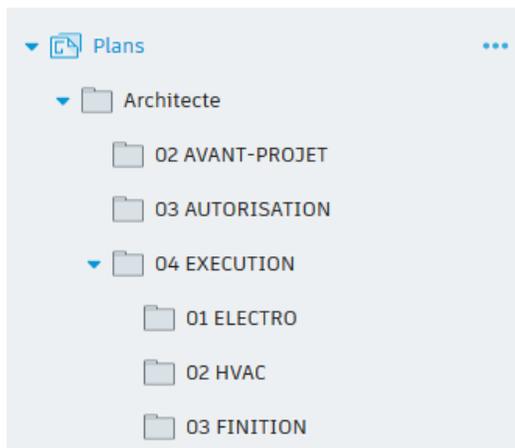
Folder Structure ▾

| Code | Name | Order | Prefix Files | Main Folder | Linked Docume... | Have Web... |
|--------------|-------------------|-------|--------------|---------------|-------------------------------------|-------------------------------------|
| ▲ ARCHI | Architecte | 0 | | All | <input type="checkbox"/> | <input type="checkbox"/> |
| ARC-CAD | CADASTRE | 1 | | Files project | <input type="checkbox"/> | <input type="checkbox"/> |
| ARC-AP | AVANT-PROJET | 2 | AP | Plans | <input type="checkbox"/> | <input type="checkbox"/> |
| ARC-AUTO | AUTORISATION | 3 | DA | Plans | <input type="checkbox"/> | <input type="checkbox"/> |
| ▲ ARC-EXE | EXECUTION | 4 | EX | Plans | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| EXE-ELECTRO | ELECTRO | 1 | EX | Plans | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| EXE-HVAC | HVAC | 2 | EX | Plans | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| EXE-FINITION | FINITION | 3 | EX | Plans | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| ARC-CADV | CADASTRE VERTICAL | 5 | | Files project | <input type="checkbox"/> | <input type="checkbox"/> |
| ARC-PDF | PDF | 6 | | Files project | <input type="checkbox"/> | <input type="checkbox"/> |
| ARC-CORRESP | CORRESPONDANCE | 7 | | Files project | <input type="checkbox"/> | <input type="checkbox"/> |
| ARC-BROCH | BROCHURE | 8 | | Files project | <input type="checkbox"/> | <input type="checkbox"/> |
| ARC-IMG3D | IMAGES + 3D | 9 | | Files project | <input type="checkbox"/> | <input type="checkbox"/> |
| ARC-EXP | EXPORT | 10 | | Files project | <input type="checkbox"/> | <input type="checkbox"/> |
| ARC-SCAN | SCAN | 11 | | Files project | <input type="checkbox"/> | <input type="checkbox"/> |
| ARC-RECH | RECHERCHE | 12 | | Files project | <input type="checkbox"/> | <input type="checkbox"/> |

ERP SIDE: TEMPLATE DEFINITION

| Nom | Modifié le | Type | Taille |
|----------------------|------------------|---------------------|--------|
| 01 CADASTRE | 27/09/2018 09:15 | Dossier de fichiers | |
| 02 AVANT-PROJET | 27/09/2018 09:15 | Dossier de fichiers | |
| 03 AUTORISATION | 27/09/2018 09:15 | Dossier de fichiers | |
| 04 EXECUTION | 15/10/2018 12:20 | Dossier de fichiers | |
| 05 CADASTRE VERTICAL | 27/09/2018 09:15 | Dossier de fichiers | |
| 06 PDF | 27/09/2018 09:15 | Dossier de fichiers | |
| 07 CORRESPONDANCE | 27/09/2018 09:15 | Dossier de fichiers | |
| 08 BROCHURE | 27/09/2018 09:15 | Dossier de fichiers | |
| 09 IMAGES + 3D | 01/10/2018 08:10 | Dossier de fichiers | |
| 10 EXPORT | 27/09/2018 09:15 | Dossier de fichiers | |
| 11 SCAN | 27/09/2018 09:15 | Dossier de fichiers | |
| 12 RECHERCHE | 27/09/2018 09:15 | Dossier de fichiers | |

FILE SERVER: RESULTING FOLDER STRUCTURE AFTER USE OF TEMPLATE



BIM 360 DOCUMENT MANAGEMENT: RESULTING FOLDER STRUCTURE

User setting

Each user from the ERP was given one of the roles which were previously imported from BIM 360, and was linked to a BIM 360 account.

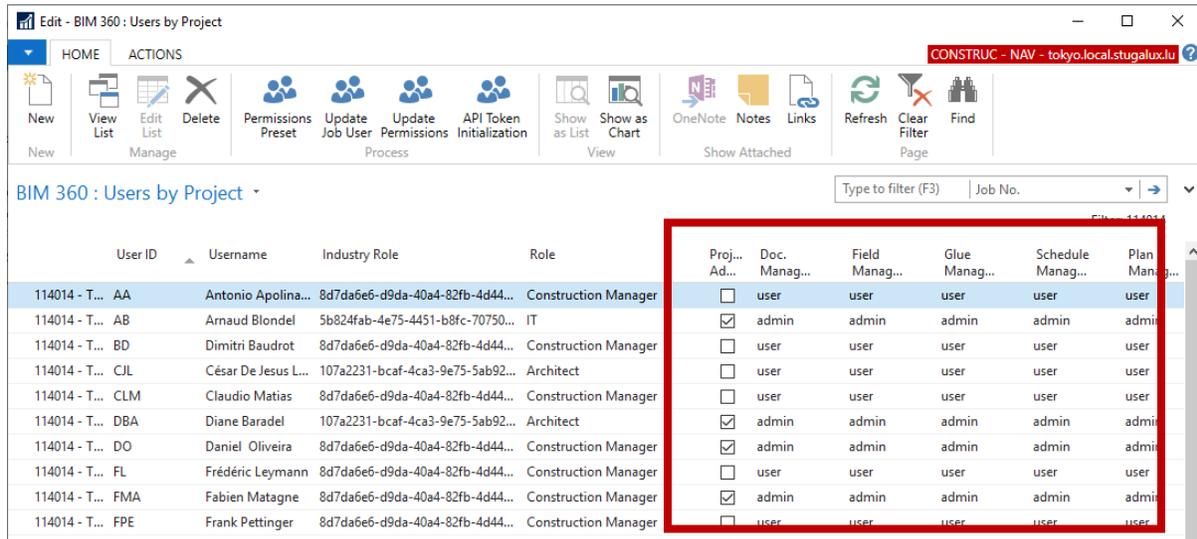
| Code | Name | E-Mail | B360 - User ID | Role Name |
|------|----------------------|------------|----------------|----------------------|
| AA | Antonio Apolinario | [redacted] | [redacted] | Construction Manager |
| AB | Arnaud Blondel | [redacted] | [redacted] | IT |
| BA | Alexander Blasius | [redacted] | [redacted] | Project Manager |
| BD | Dimitri Baudrot | [redacted] | [redacted] | Construction Manager |
| BP | Bernhard Paul | [redacted] | [redacted] | Construction Manager |
| CG | Claude Gebhard | [redacted] | [redacted] | Project Manager |
| CJL | César De Jesus Lopes | [redacted] | [redacted] | Architect |
| CLM | Claudio Matias | [redacted] | [redacted] | Construction Manager |
| DBA | Diane Baradel | [redacted] | [redacted] | Project Manager |
| DL | Dirk Lehnig | [redacted] | [redacted] | Construction Manager |
| DO | Daniel Oliveira | [redacted] | [redacted] | Project Manager |
| FDC | Fabio Da Cruz | [redacted] | [redacted] | Project Manager |
| FL | Frédéric Leymann | [redacted] | [redacted] | Construction Manager |
| FMA | Fabien Matagne | [redacted] | [redacted] | Project Manager |

USER LIST IN THE ERP MICROSOFT DYNAMICS NAV

Users selection

The users are assigned project by project and split in rights groups:

- Management
- Project manager
- Technicians from each department
- ...



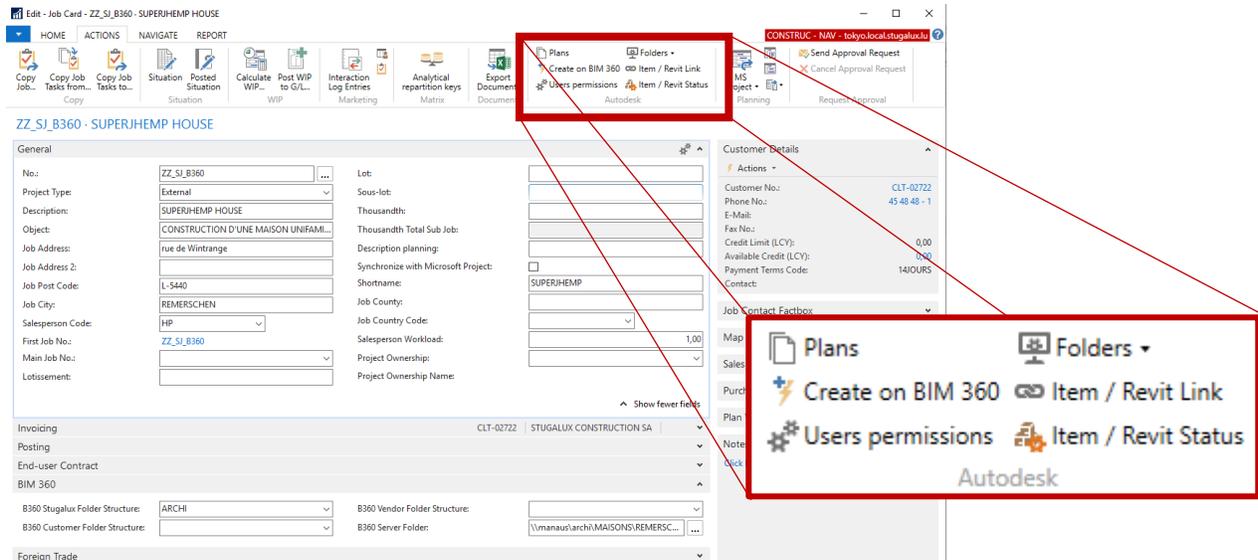
| User ID | Username | Industry Role | Role | Proj... Ad... | Doc. Manag... | Field Manag... | Glue Manag... | Schedule Manag... | Plan Manag... |
|-------------------|---------------------|----------------------------------|----------------------|-------------------------------------|---------------|----------------|---------------|-------------------|---------------|
| 114014 - T... AA | Antonio Apolina... | 8d7da6e6-d9da-40a4-82fb-4d44... | Construction Manager | <input type="checkbox"/> | user | user | user | user | user |
| 114014 - T... AB | Arnaud Blondel | 5b824fab-4e75-4451-b8fc-70750... | IT | <input checked="" type="checkbox"/> | admin | admin | admin | admin | admin |
| 114014 - T... BD | Dimitri Baudrot | 8d7da6e6-d9da-40a4-82fb-4d44... | Construction Manager | <input type="checkbox"/> | user | user | user | user | user |
| 114014 - T... CJL | César De Jesus L... | 107a2231-bcaf-4ca3-9e75-5ab92... | Architect | <input type="checkbox"/> | user | user | user | user | user |
| 114014 - T... CLM | Claudio Matias | 8d7da6e6-d9da-40a4-82fb-4d44... | Construction Manager | <input type="checkbox"/> | user | user | user | user | user |
| 114014 - T... DBA | Diane Baradel | 107a2231-bcaf-4ca3-9e75-5ab92... | Architect | <input checked="" type="checkbox"/> | admin | admin | admin | admin | admin |
| 114014 - T... DO | Daniel Oliveira | 8d7da6e6-d9da-40a4-82fb-4d44... | Construction Manager | <input checked="" type="checkbox"/> | admin | admin | admin | admin | admin |
| 114014 - T... FL | Frédéric Leymann | 8d7da6e6-d9da-40a4-82fb-4d44... | Construction Manager | <input type="checkbox"/> | user | user | user | user | user |
| 114014 - T... FMA | Fabien Matagne | 8d7da6e6-d9da-40a4-82fb-4d44... | Construction Manager | <input checked="" type="checkbox"/> | admin | admin | admin | admin | admin |
| 114014 - T... FPE | Frank Pettinger | 8d7da6e6-d9da-40a4-82fb-4d44... | Construction Manager | <input type="checkbox"/> | user | user | user | user | user |

ERP: USERS AFFECTATION BY PROJECT

The access level for each user is also set for the different BIM 360 services (Document management, Field Management and so on).

Stage 3: Generate BIM 360 project

To control the interactions between the ERP and BIM 360, several tools were made available in the ERP user interface.



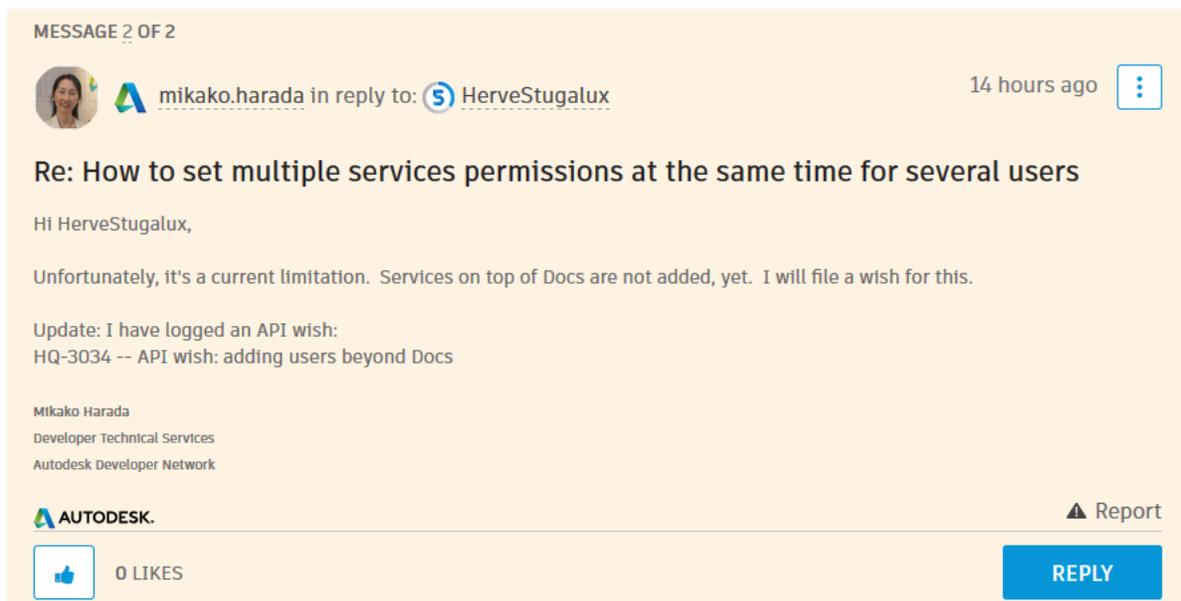
ERP USER INTERFACE: CREATION OF THE NEW PROJECT ON BIM 360

To create the new BIM 360 project, the steps are as follows (details in annex A3):

1. Configure users (see 'Stage 2: ERP Configuration')
2. Generate new project on BIM 360
3. Generate folder structure within new BIM 360 project
4. Configure member's access level for the different BIM 360 services using BIM 360 Project administration
5. Add Field management checklists using standard user interface.

Managing member's access level for BIM 360 services

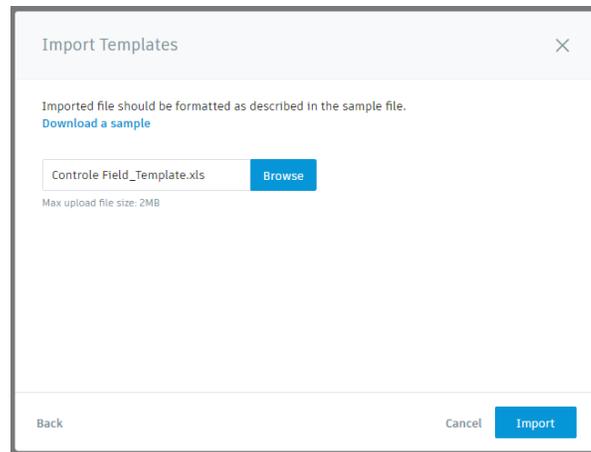
Now, there are still some limitations to what can be done through the APIs. For example, for the configuration of the service access levels when using Autodesk Forge to add new users in the new project. Although you can add new users AND change their access level for the document management service using the Autodesk Forge statement '[POST projects/:project_id/users/import](#)', this seems still to be impossible for the other services like 'Field Management'.



API ONLY ALLOWS TO SET THE PERMISSIONS ON DOCS ; OTHER PERMISSIONS MUST BE SET MANUALLY

Adding checklists to Field Management

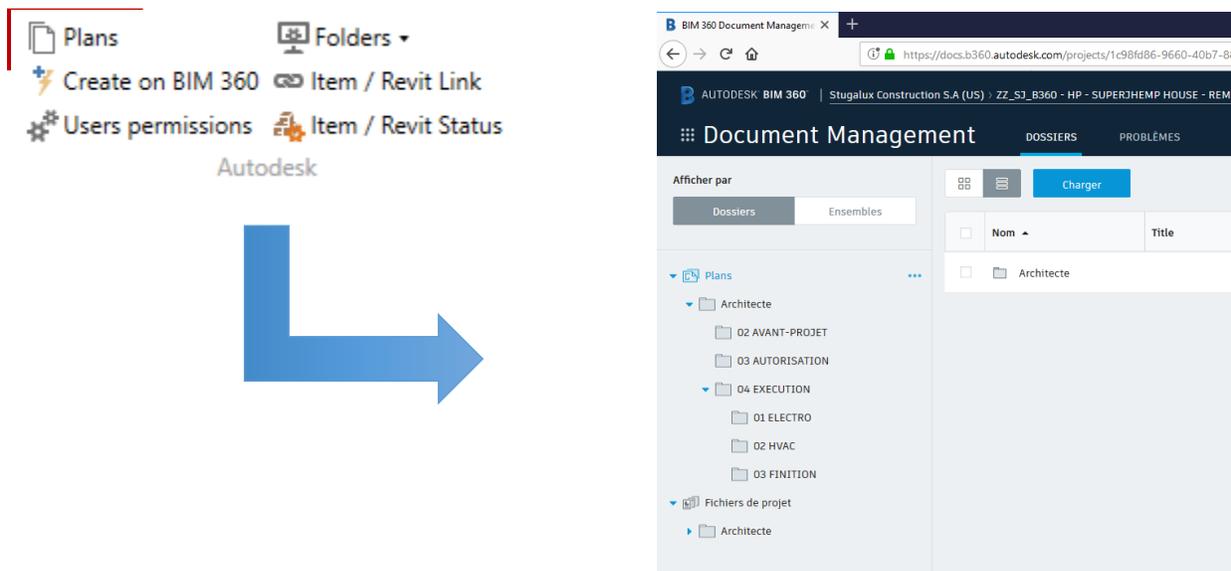
At the moment, the standard user interface is the only way to add quality control checklist to the project. This functionality is expected to be made available in the future.



IMPORT OF CHECKLIST TEMPLATES INTO FIELD MANAGEMENT

Immediate access to documents from Microsoft Dynamics

The users have access to the plans directly from the user interface of the ERP. With a single click on one of the buttons that have been added to the ribbon, they are presented with the interface of BIM 360 Docs on the specific project they were working on.



FROM ERP INTERFACE TO BIM 360 DOCUMENT MANAGEMENT

Part 2: Object level integration

Frequent challenges encountered

Once that the user experience has been unified on a project level, challenges rose up on an object level. Information about the components came from 2 sources:

1. BIM model: with the positional, sizing and general object information.
2. ERP system: with the product, manufacturer and order information.

In every phase of the construction process, users need information about the components from BOTH data sources, meaning that they have to work with two different environments which is time-consuming and leads to errors. To reduce these risks, it was necessary to create a seamless user experience with an immediate access to all the information at once.

Users also need down-to-earth pragmatic information about the components:

- Is it ordered?
- Is it installed?
- Does it have to be replaced?

This information is crucial to better support the ordering-, construction- and maintenance phases and must be available to all team members regardless of the data source they're using. This information should be visible when working in the ERP system, when looking at the models and plans in BIM 360 and also in the As-Built Revit BIM model.

Integration framework

To make the combined component data (ERP + BIM) available to users, and in order to create new workflows for the support of the employees, the following steps were taken.

BIM viewer in Microsoft Dynamics NAV

First step in the integration process was to make the BIM data viewable when a user is working in the ERP environment, so that there is only one access point to all the data.

Autodesk Forge Viewer was integrated into the Microsoft Dynamics NAV user interface. With the Autodesk Forge viewer, a user can view 3D models and 2D plans on-line without the need to install software. It is also easy to use and accessible for any team member.

Microsoft Dynamics NAV

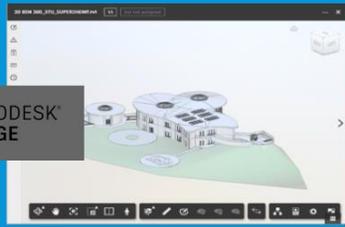
| Windows | | |
|---------|----|----------|
| Type | ID | Revit ID |
| ABC-001 | 01 | 65123589 |
| ABC-001 | 02 | 96214523 |
| DEF-003 | 03 | 01287412 |

Forge viewer



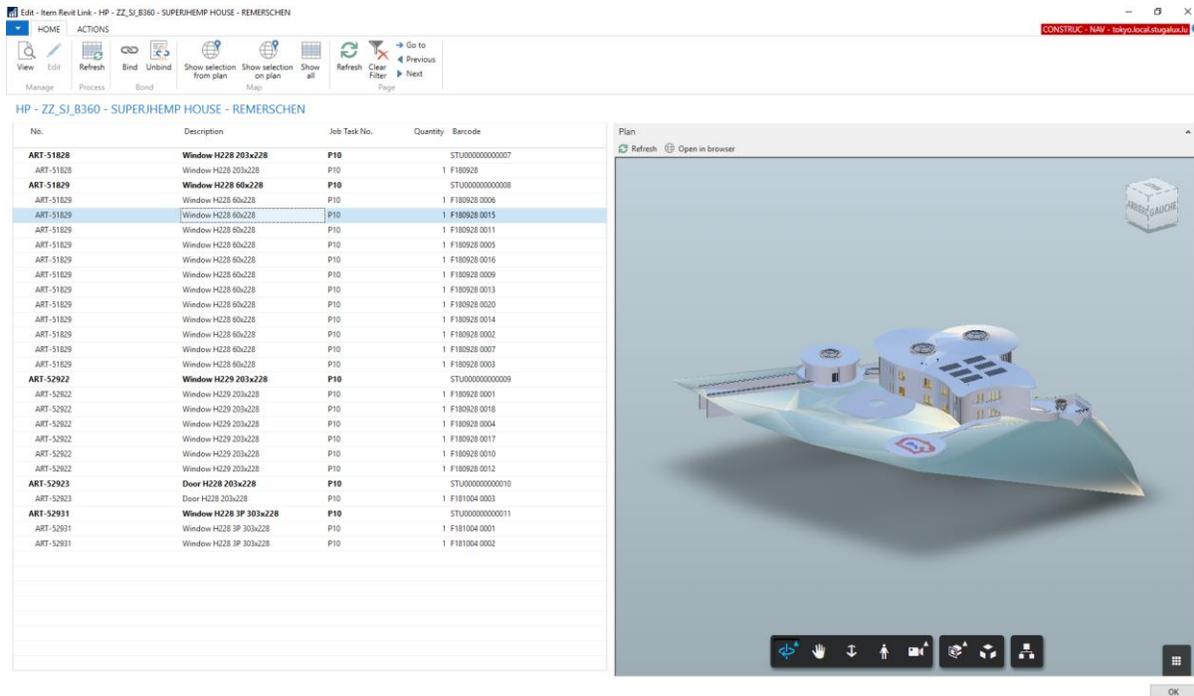
FORGE VIEWER SHOWING IN MICROSOFT DYNAMICS NAV APPLICATION

In this solution Geo-IT programmed the Autodesk Forge viewer in such a way that it automatically searches in BIM 360 for the right BIM model of the active Dynamics project.

| ERP | Document Management | | | | | | | | | | | | | | | |
|---|---------------------|-------------|--|-----|-----|-------------|---------|----|--------|---------|----|--------|---------|----|--------|--|
| <p>Microsoft Dynamics NAV</p> <table border="1"> <thead> <tr> <th colspan="3">Windows</th> </tr> <tr> <th>No.</th> <th>Qty</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>ABC-001</td> <td>01</td> <td>Window</td> </tr> <tr> <td>ABC-001</td> <td>02</td> <td>Window</td> </tr> <tr> <td>DEF-003</td> <td>03</td> <td>Window</td> </tr> </tbody> </table> <p>FORGE Viewer</p>  | Windows | | | No. | Qty | Description | ABC-001 | 01 | Window | ABC-001 | 02 | Window | DEF-003 | 03 | Window | <p>BIM 360</p>  |
| Windows | | | | | | | | | | | | | | | | |
| No. | Qty | Description | | | | | | | | | | | | | | |
| ABC-001 | 01 | Window | | | | | | | | | | | | | | |
| ABC-001 | 02 | Window | | | | | | | | | | | | | | |
| DEF-003 | 03 | Window | | | | | | | | | | | | | | |

LINK BETWEEN ERP DATA AND BIM 360 MODEL

The result is that if a user is working in Dynamics he has an immediate view on both the ERP data and the BIM model which gives him all the input to make better decisions.

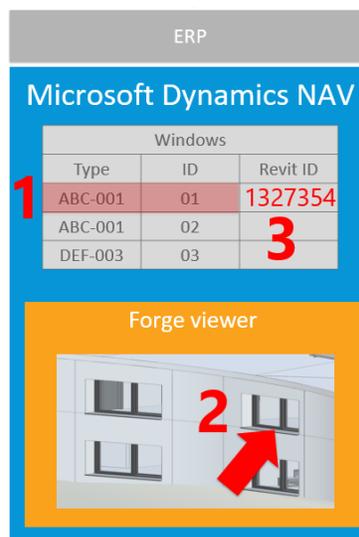


FORGE VIEWER INTEGRATED IN THE MICROSOFT DYNAMICS NAV USER INTERFACE

Create link between ERP and BIM objects

The following step in the integration process was to create a synergy between the BIM data source and the ERP data source on object level.

The basic idea was to link ERP objects with BIM objects. Establishing this link can't be done automatically and requires the experience of a project manager. To help the user, he's provided with a simple workflow in which he uses a list with articles on the ERP-side along with the Forge Viewer and creates a n-to-n link between ERP articles and Revit objects.



LINKING ERP ARTICLES TO BIM COMPONENTS

1. Basically, the user needs to select one or more articles in Microsoft Dynamics NAV.
2. Graphically he then selects a BIM object in the viewer which is a very easy procedure and proves again the advantage of integrating the Forge viewer within the Microsoft Dynamics NAV user interface.
3. As a result, the unique ID of the Revit object will be stored in the ERP database.

Adding additional information to the BIM objects

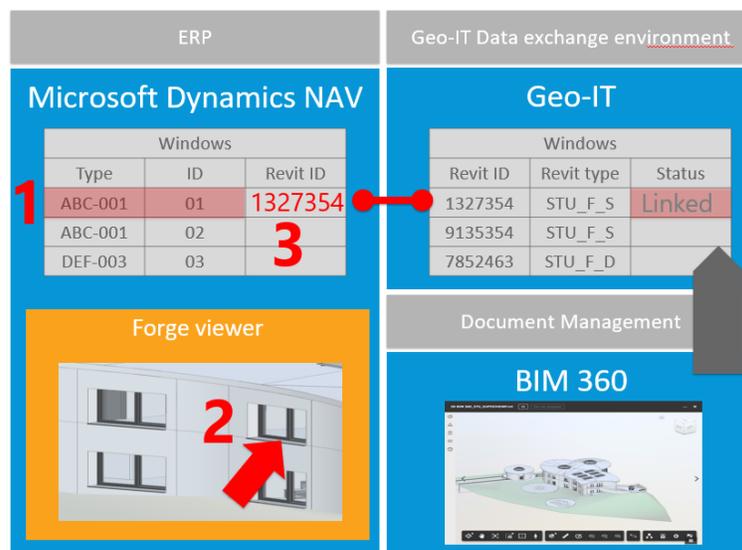
To help the user check which BIM objects has been linked, the 'linked' status of the BIM objects was shown in the viewer by highlighting the BIM components with a particular color. It allows the user to quickly determine if all BIM objects are linked.

That means that the link information needs to be stored on the BIM side too. Storing information BIM side also adds the possibility to store any additional information that may be required by after.

As the BIM data in BIM 360 was derived from the Revit model, it can't be directly modified. To achieve this, a third-party solution designed by Geo-IT is used. Geo-IT is a Belgian reseller and developer who is actively involved in integrating Microsoft Dynamics NAV with BIM 360 at Stugalux.

One of the advantages of the Geo-IT solution is that when a Revit model is uploaded in BIM 360, all the main structure of the Revit project and the main properties of each Revit object are extracted and stored in a PostGRE database. In this database it is possible to add as many custom fields that needed, and these custom fields can be modified by external applications, like Microsoft Dynamics NAV.

In this solution, fields like 'Linked' or 'Status' were added in the PostGRE database; these fields are filled in by Microsoft Dynamics NAV. For example, when a user is creating a link between an ERP object and a BIM object, Microsoft Dynamics NAV will change the values of the corresponding field.



LINKING ERP ARTICLES TO BIM COMPONENTS + UPDATE OF CUSTOM FIELDS IN POSTGRE DATABASE

1. User selects the ERP object
2. User select the corresponding Revit object

3. Next steps are automatically done by the solution
 - a) Revit ID is stored in the ERP object
 - b) In the GEO-IT PostGRE database, the Revit object is marked as “Linked”

View the status in the viewer

As previously mentioned, some information should be visually shown with color highlighting in the Forge Viewer

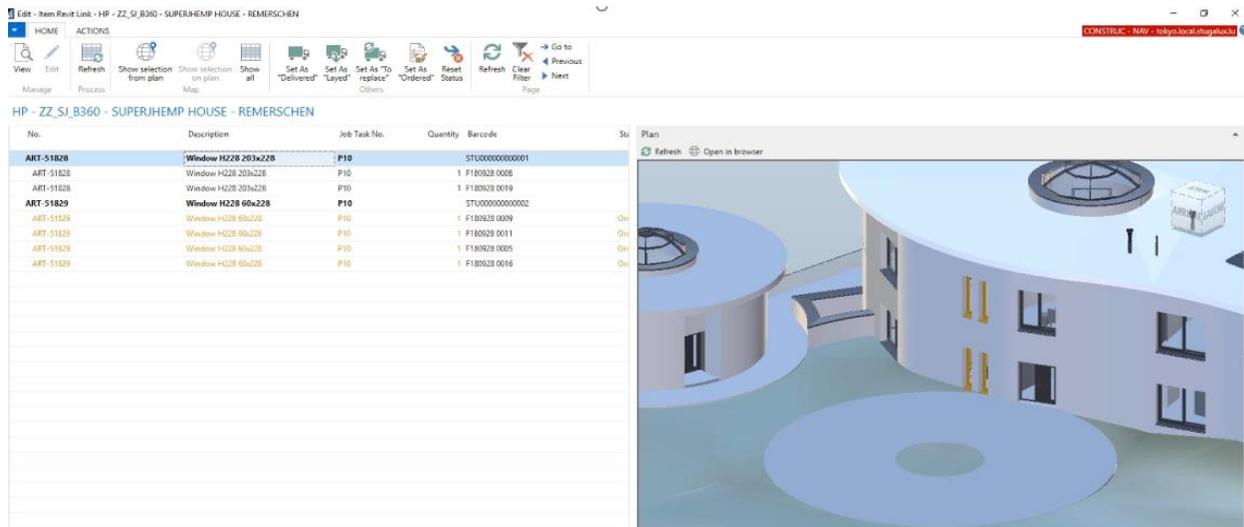
To do so Geo-IT added some functionality to the Forge viewer. With their solution the Forge Viewer will pick up all the Revit information from the BIM 360 project **AND** will then use the information from the GEO-IT PostGRE database to override the object colors in the viewer.

The magic trick is there: combine BIM 360 data with additional data and show them together in the viewer.

| ERP | | | Geo-IT Data exchange environment | | |
|---|----|----------|--|------------|--------|
| Microsoft Dynamics NAV | | | Geo-IT | | |
| Windows | | | Windows | | |
| Type | ID | Revit ID | Revit ID | Revit type | Status |
| ABC-001 | 01 | 1327354 | 1327354 | STU_F_S | Linked |
| ABC-001 | 02 | | 9135354 | STU_F_S | |
| DEF-003 | 03 | | 7852463 | STU_F_D | |
| Forge viewer | | | Document Management | | |
|  | | | BIM 360 | | |
| | | |  | | |

COMBINING DATA FROM DIFFERENT SOURCES TO BUILD A CUSTOM VIEWING OF THE MODEL

This visual feedback opens a lot of opportunities; one of them is that, in the case of linking objects, it is immediately clear if all BIM objects are already linked or not.



VISUAL REPRESENTATION OF LINKED OBJECTS USING ORANGE COLORING: LEFT IS ERP, RIGHT IS BIM

What does this mean?

This integration opens a lot of doors:

- it allows to better manage the project in **all phases**.
- It gives the team members all the information and new workflows to empower them to make better informed decisions.

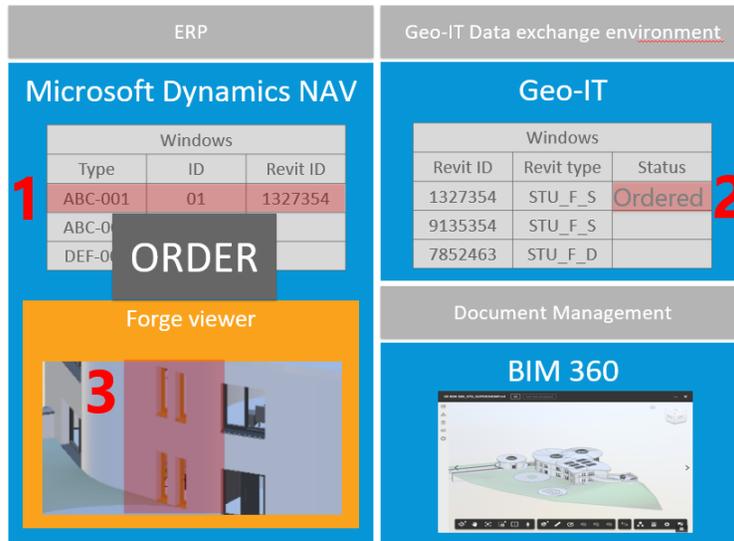
Actual uses of these functionalities include ordering of the materials, installation on site or maintenance cases.

Ordering phase: Computer Aided Ordering

During the ordering phase users want to be sure that they order the correct products, that they don't miss anything and that they ordered the right quantities of articles.

For the latter, the information from Revit can't be used as is. The experience and the knowledge of a project manager is required to analyze the Revit values and to adapt them according to the actual materials and work. For example: to calculate the right quantities for the plastering, the Revit wall area information does not take into account the returns for the windows and the unavoidable waste on the construction site. Also, in our case, it did not make sense to spend time to model everything in detail just to have 100% correct quantities at the end because our project managers already have all this knowledge and experience.

A good compromise is Computer Aided Ordering. The project manager, with all his experience, is supported by workflows, which are using the unified ERP and BIM object information, to help him to order the correct products and quantities.



COMPUTER AIDED ORDERING WORKFLOW

1. An offer of the manufacturer with all the windows is received and is imported into Microsoft Dynamics NAV. The project manager selects a window from the list, links it with a Revit object and run the ordering process.
2. The “Status” field in the Geo-IT database will change to “Ordered”
3. Automatically the integrated forge viewer will change the color of the window in the viewer

This simple workflow offers the user a lot of advantages:

- He can see in the viewer what is ordered and if this is correct.
- He can visually check if all products are ordered.



FORGE VIEWER: ALL THE WINDOWS HAVE BEEN ORDERED (YELLOW HIGHLIGHTING)

- Thanks to the link between BIM data and ERP data, it is also possible to achieve this verification in the ERP

HP - ZZ_SI_B360 - SUPERJHEMP HOUSE - REMERSCHEN

| No. | Description | Job Task No. | Quantity | Barcode | Status |
|-----------|------------------------|--------------|----------|-----------------|---------|
| ART-51828 | Window H228 203x228 | P10 | | STU000000000007 | |
| ART-51828 | Window H228 203x228 | P10 | 1 | F180928 | Ordered |
| ART-51829 | Window H228 60x228 | P10 | | STU000000000005 | |
| ART-51829 | Window H228 60x228 | P10 | 1 | F180928 0006 | Ordered |
| ART-51829 | Window H228 60x228 | P10 | 1 | F180928 0015 | Ordered |
| ART-51829 | Window H228 60x228 | P10 | 1 | F180928 0011 | Ordered |
| ART-51829 | Window H228 60x228 | P10 | 1 | F180928 0005 | Ordered |
| ART-51829 | Window H228 60x228 | P10 | 1 | F180928 0016 | Ordered |
| ART-51829 | Window H228 60x228 | P10 | 1 | F180928 0009 | Ordered |
| ART-51829 | Window H228 60x228 | P10 | 1 | F180928 0013 | Ordered |
| ART-51829 | Window H228 60x228 | P10 | 1 | F180928 0020 | Ordered |
| ART-51829 | Window H228 60x228 | P10 | 1 | F180928 0014 | Ordered |
| ART-51829 | Window H228 60x228 | P10 | 1 | F180928 0002 | Ordered |
| ART-51829 | Window H228 60x228 | P10 | 1 | F180928 0007 | Ordered |
| ART-51829 | Window H228 60x228 | P10 | 1 | F180928 0003 | Ordered |
| ART-52922 | Window H229 203x228 | P10 | | STU000000000009 | |
| ART-52922 | Window H229 203x228 | P10 | 1 | F180928 0001 | Ordered |
| ART-52922 | Window H229 203x228 | P10 | 1 | F180928 0018 | Ordered |
| ART-52922 | Window H229 203x228 | P10 | 1 | F180928 0004 | Ordered |
| ART-52922 | Window H229 203x228 | P10 | 1 | F180928 0017 | Ordered |
| ART-52922 | Window H229 203x228 | P10 | 1 | F180928 0010 | Ordered |
| ART-52922 | Window H229 203x228 | P10 | 1 | F180928 0012 | Ordered |
| ART-52923 | Door H228 203x228 | P10 | | STU000000000010 | |
| ART-52923 | Door H228 203x228 | P10 | 1 | F181004 0003 | Ordered |
| ART-52931 | Window H228 3P 303x228 | P10 | | STU000000000011 | |
| ART-52931 | Window H228 3P 303x228 | P10 | 1 | F181004 0001 | Ordered |
| ART-52931 | Window H228 3P 303x228 | P10 | 1 | F181004 0002 | Ordered |

ERP USER INTERFACE: ALL THE WINDOWS HAVE BEEN ORDERED (YELLOW HIGHLIGHTING)

At the end of the process, the project manager can perform a double check (in Microsoft Dynamics NAV and in Forge Viewer) and ensure that everything has been ordered, if the right materials are ordered and if they are ordered in the right quantities.

The ordering process is much faster less prone to (costly) mistakes.

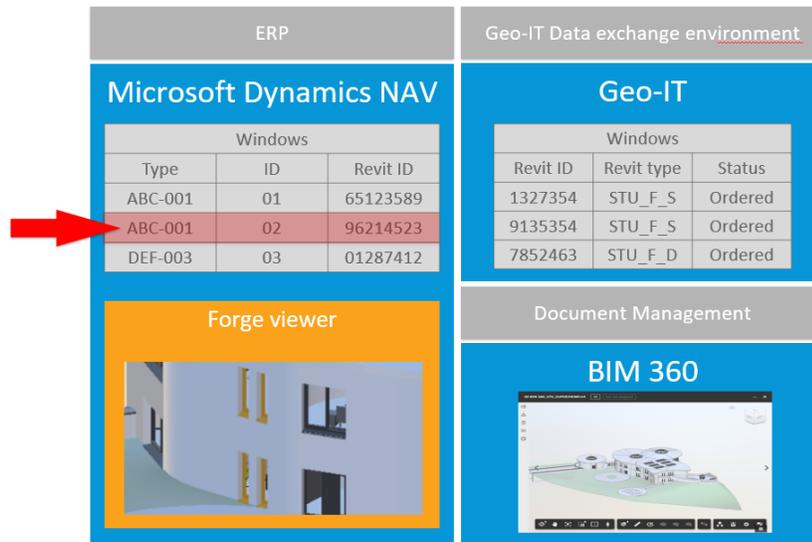
Ordering phase: change management

What happens when the Revit model is modified? How can we make sure that the project manager will know if and how he needs to review the orders?

This solution is already providing this change management.

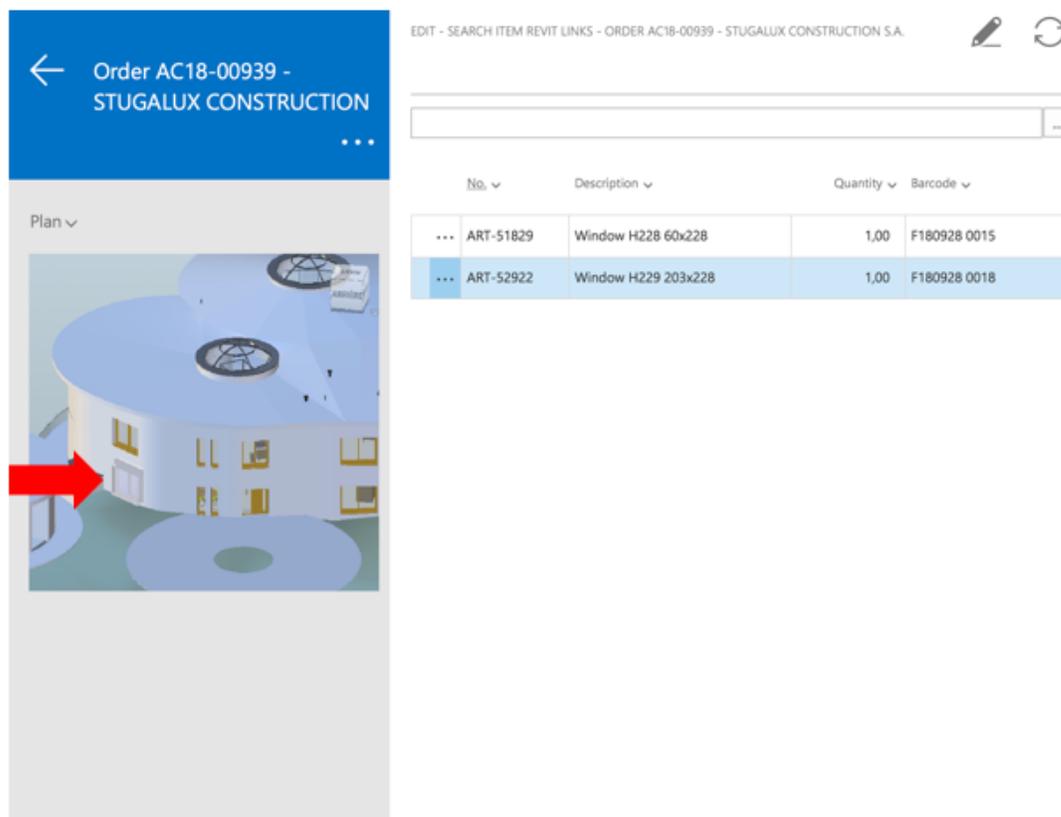
For example:

- After the Revit engineer added 2 windows in the Revit project, he uploads the new version to BIM 360.
- In Microsoft Dynamics NAV, the Geo-IT Forge viewer will automatically pick up the new model version with the 2 new windows.
- Thanks to the data from the PostGRE database, the viewer changes the color of all ordered windows to yellow.
- The "Status" field of the 2 new windows is not filled in (=not yet ordered) so their color is not changed: The 2 new windows are drawn with their standard object color.
- Image below: Project manager immediately sees that there are 2 new windows to be ordered.



WINDOW INFORMATION SEARCH

- The Microsoft Dynamics NAV mobile app presents the user with the information. The included Forge viewer will pick up the data from the BIM 360 model and will highlight the window directly



MOBILE ERP APP INCLUDING THE FORGE VIEWER

- No more hesitation or mistakes.



VERIFIED LOCATION FOR WINDOW PLACEMENT

For the teams on site, this is a simple to use workflow but with a lot of benefits:

- Avoid misplaced components
- Faster construction
- Higher profitability

Maintenance phase: get the actual information of building components

Stugalux Construction S.A. also has a real estate department responsible for managing their own houses and apartments that are being rented. A tenant will contact this department if there is a problem. But the tenant does not know all the technical specifications of all building components and will only be able to describe in general terms what is faulty.

That's why it was difficult in the past to send out a repair team with the correct replacement materials. Often, they had some standard material/components with them, arriving at the site to discover that they need other materials/components.

So, the key is to get the right information in advance which is perfectly possible with our integration. What we're providing is a workflow in which you only need to select a BIM object in the viewer and then automatically all the product information will be shown in Microsoft Dynamics NAV.

For example: if a tenant calls Stugalux Construction S.A. because of a broken window, the operator only needs to ask the tenant where the window is located.

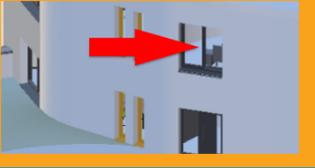
1. Then the operator/technician will select the window in the viewer
2. Then he will see all the product information in the ERP, including the manufacturer, the date of installation, etc....

ERP

Microsoft Dynamics NAV

| Windows | | |
|---------|----|----------|
| Type | ID | Revit ID |
| ABC-001 | 01 | 65123589 |
| ABC-001 | 02 | 96214523 |
| DEF-003 | 03 | 01287412 |

Forge viewer



Geo-IT Data exchange environment

Geo-IT

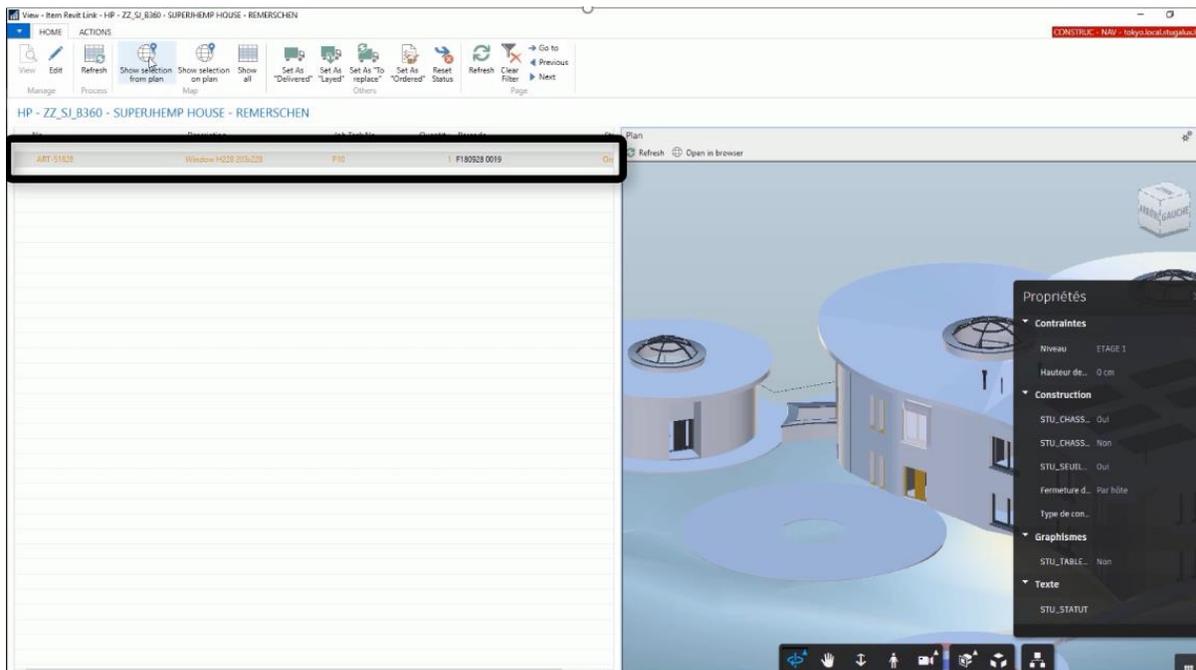
| Windows | | |
|----------|------------|---------|
| Revit ID | Revit type | Status |
| 1327354 | STU_F_S | Ordered |
| 9135354 | STU_F_S | Ordered |
| 7852463 | STU_F_D | Ordered |

Document Management

BIM 360



SELECTION OF OBJECTS AND HIGHLIGHTING WORKS BOTH WAYS



THE ERP SHOWS THE INFORMATION ABOUT THE OBJECT SELECTED IN THE FORGE VIEWER

The added values are important:

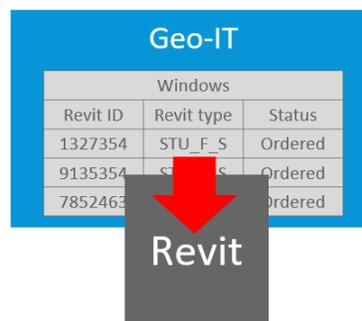
- Technician doesn't lose time in searching for the right information.
- Maintenance teams don't lose time because now they always have the right materials with them when they leave for an intervention on site.
- Higher customer satisfaction.

From ERP to Revit model

It is important that some of the information that was assigned to the BIM objects in Microsoft Dynamics NAV is also written back to the source objects in the Revit model. Although there are a lot of reasons, here are the main ones:

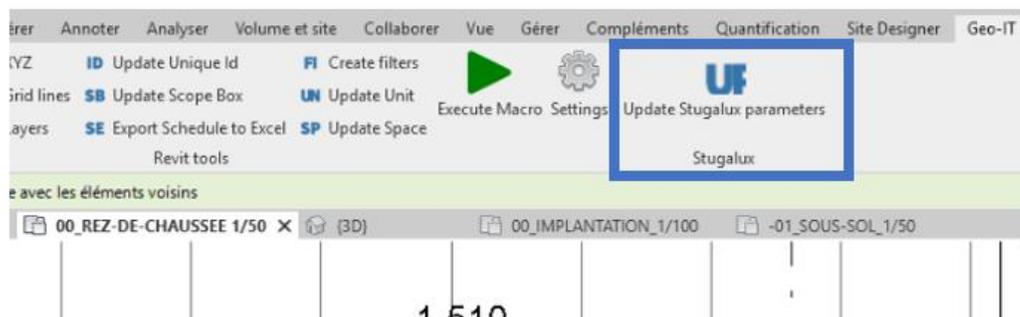
- The Revit modeler must know which objects have been ordered and/or installed because these objects may in principle no longer be changed in the Revit model.
- This information must be visible everywhere and not only in the viewer in the ERP. So even if someone opens the models directly in BIM 360, he must be able to see that information.
- For example: if a customer wants to change something in the design, the salesperson will use the models and plans in BIM 360 to check if this is still possible. So, in these models he must be able to see if what the customer wants to change has already been ordered or built.

To get the extra information back into Revit we use a Geo-IT add-in for Revit which was developed for Stugalux Construction S.A.. This add-in will pick up all the extra information from the Geo-IT database and will fill it in the Revit object properties.



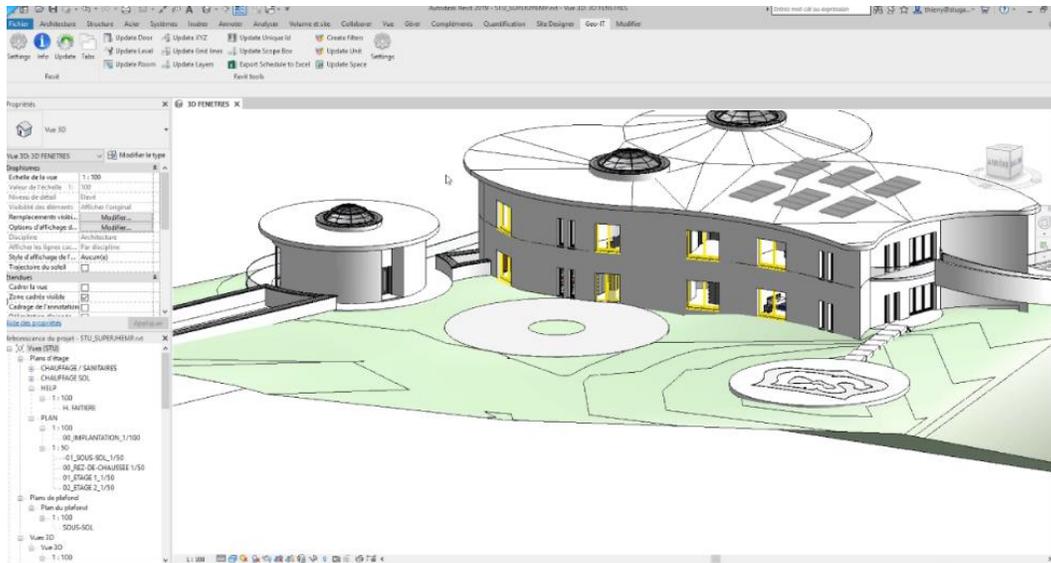
INFORMATION SET IN THE POSTGRE DATABASE FROM THE ERP TRAVELS ALL THE WAY TO REVIT

For the Revit modeler the use is very easy: he only needs to click a button in the interface. All the rest is done in the background: for this Revit project the additional information is looked up in the Geo-IT database and for each object the information is transferred to the Revit objects.



A SINGLE CLICK TO TRANSFER ALL THE DATA

After this, the Revit modeler can use all the standard Revit functionality to make use of this information, such as the view filtering to override object colors to see which objects has been ordered, which objects has been installed and so on.



THE REVIT MODELER DIRECTLY SEES WHICH WINDOWS CAN'T BE CHANGED ANYMORE

When the Revit modeler uploads the new version in the BIM 360 project, this information will also be made visible for all other team members using BIM 360.



BIM 360 WEB INTERFACE: SAME HIGHLIGHTING RULES

Conclusion

Today, the energy and effort is enormous to create fully detailed BIM models of quantities, types, qualities, sizes,... in every domain for a single family home construction.

So, by combining the best of both worlds it became possible to help and share more and better information across the whole organization without the tremendous effort of detailed BIM models.

Stugalux Construction S.A. has barely scratched the surface of the bulk of possibilities that the combination of BIM and ERP via Forge has created. Over the next months / years, a lot of processes will be streamlined and optimized.

Today, by integrating ERP and BIM, the designers get updated information from procurement: which materials have been or have not yet been ordered. All updates are a click away and distributed within minutes in the whole organization.

The managers for each craft department get, via the BIM360 app, colored plans that give them updates from their colleagues.

The project managers see on the plans the different advancements and controls/checks are so much easier.

And finally, facility management has better, more informed, interactions with the customer which at the bottom line is the most important: best possible customer experience.

ANNEXES

A1: Forge API methods call

Dialog steps between Microsoft Dynamics NAV and BIM 360 using Forge API 'Data management'

1. Generate Token (see details)
2. Calling Forge API functions (see annex A2)
 - a) URL request adaptation
 - b) Send the request
 - c) Receive the response
 - d) Return value handling (option)

A2: CURL interpretation in Microsoft Dynamics NAV

To handle URL requests in Microsoft Dynamics NAV, the codeunit 1297 *Http Web Request Mgt* is used.

```
curl -v 'https://developer.api.autodesk.com/authentication/v1/authenticate'
-X 'POST'
-H 'Content-Type: application/x-www-form-urlencoded'
-d '
  client_id=%YOUR_FORGE_API_CLIENT_ID%
  client_secret=%YOUR_FORGE_API_SECRET_ID%
  grant_type=client_credentials&
  scope=data:read
'
```

TOKEN GENERATION

One can see

- The URL corresponding to the called procedure
- The method type (GET/POST/PATCH)
- The content type
- The content itself

| CURL Code | Correspondance MS Dynamics NAV |
|-------------------------------|---|
| URL | HttpWebRequestMgt.Initialize(URL_FORGE_API); |
| Method type | HttpWebRequestMgt.SetMethod(METHOD_TYPE); |
| Content type | HttpWebRequestMgt.SetContentType(CONTENT_TYPE); |
| Content (via a BLOB variable) | TempBlob.Blob.CREATEOUTSTREAM(OStr,TEXTENCODING::UTF8); OStr.WRITETEXT(CONTENT); HttpWebRequestMgt.AddBodyBlob(TempBlob); |

The content is generated in 3 steps :

1. Data is generated in XML format by using a Microsoft Dynamics NAV XMLPort
2. Transformation of XML into JSON with dotnet function *JSONConvert*
 - a) `Newtonsoft.Json.JsonConvert.'Newtonsoft.Json, Version=6.0.0.0, Culture=neutral, PublicKeyToken=30ad4fe6b2a6aeed'`
 - b) `SerializeXmlNode` function is used
3. Insertion of JSON data into BLOB variable

The *scope* parameter is related to the Forge API method which is called.

The execution of the query is done by using the function *GetResponse* of the codeunit *Http Web Request Mgt.*. This allows the return value to be handled properly.

```
{
  "token_type": "Bearer",
  "expires_in": 1799,
  "access_token": "eyJhbGciOiJIUzI1NiIsImtpZCI6Imp3dF9"
}
```

EXAMPLE OF A TYPICAL RESPONSE

For an easy use of the return value as well as for the content generation, the function *DeserializeXmlNode* from DotNet *JSONConvert* variable must be used.

Depending on the complexity of the result, the XML data can be read by 2 different means:

- Microsoft Dynamics NAV XMLPort
- DotNet variable use
 - XmlDocument - System.Xml.XmlDocument.'System.Xml, Version=4.0.0.0, Culture=neutral, PublicKeyToken=b77a5c561934e089'
 - XmlNode - System.Xml.XmlNode.'System.Xml, Version=4.0.0.0, Culture=neutral, PublicKeyToken=b77a5c561934e089'

A3: Publication process

1. User setup
2. Creation of the new project on BIM 360
 - a) Use of POST method *projects* from Forge API
 - b) Use of POST method *projects/:project_id/users/import* from Forge API
3. Folder structure management
 - a) On the file server, with codeunit 419 *File Management* from Microsoft Dynamics NAV
 - b) On the BIM 360 Document Management, with POST method *projects/:project_id/folders* from Forge API
4. User permission fine tuning via the *Project Admin* tab in BIM 360 web interface
5. Standard checklist adding via the *Field Management* interface in BIM 360.