BLD225462

BIM 360: Putting All the Puzzle Pieces Together

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Learning Objectives

- ✓ Understand how BIM 360 can help connect a construction project's tasks
- ✓ Discover new or adjusted workflows that could be applied to your daily work
- ✓ Discover how BIM 360 connects different teams for every specific project phase using real-life examples
- ✓ Learn how to connect BIM 360 to external data systems using Forge

Description

BIM 360 software introduces a common language for all construction stakeholders, from design to facility management. We will show you how to organize this common language and use all the new BIM 360 modules (Document Management, Design Collaboration, Model Coordination and Project/Field Management) in the smartest way. We will also show how you could connect BIM 360 to external applications and databases using our Forge development platform. Implementing the use of this common language is like solving a puzzle, as there are different BIM 360 pieces of technology (cloud and desktop) that we need to put together in the right order and position. This presentation will be based on our knowledge and users' feedback.

SPEAKER(S)

Jose Ariza

Jose Ariza joined Autodesk in 2017. He works as a Technical Sales Specialist for EMEA focusing on Autodesk's building and construction portfolio. Before joining Autodesk, Jose had worked as a BIM consultant freelancer and also as a BIM Manager for a Spanish Autodesk Partner. As a result, for more than 8 years so far Jose has helped the main companies in the AEC sector during the BIM implementation process and in the development of both national and international interdisciplinary projects using Autodesk technology. Moreover, he has collaborated with the University of Córdoba (Spain) as Associate Professor. Born in Córdoba, Jose holds a BSc in Technical Industrial Engineering and a MD in Architectural and Engineering Layout Techniques and Design Methods from the University of Córdoba.

Alexandre Mihalache

Alexandre Mihalache is part of the European AEC technical specialists team. He is based in Paris France and has a structural engineering background. Over the last years, he has been covering structural analysis for both pre and post sales operations and is now focused on collaboration and data management for the AEC sector, as well as Plant design. He helps spreading the Autodesk BIM vision for both Autodesk partners and customers helping them with their BIM collaboration workflows.

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1 Autodesk cloud timeline

At Autodesk with started working on and with cloud solutions many years ago, at first for static collaboration purposes such as basic file sharing.

As Building Information Modeling (BIM) was making its way in our industry, we realized we needed a collaboration platform addressing all project stakeholders and phases needs of a construction project. Those stakeholders all have different needs in terms of software features and they all need a consistent integrated collaboration system.

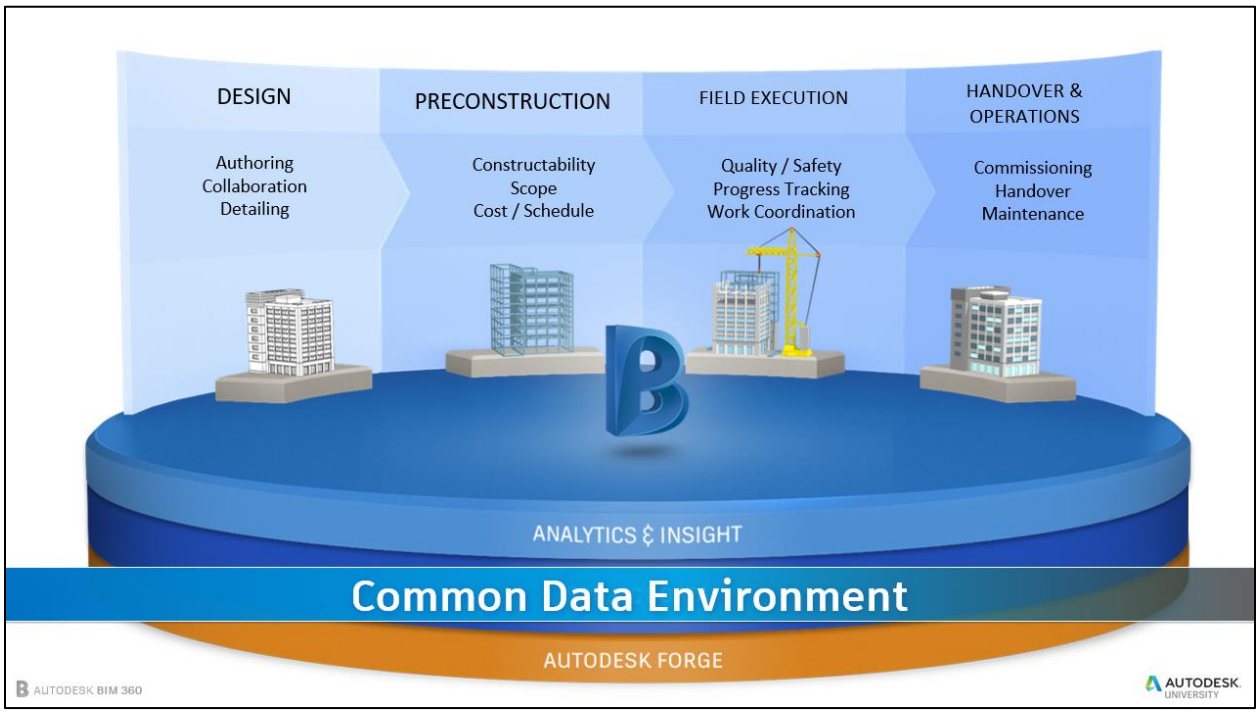
We believe that cloud is the answer and should be the core of such a system, since it represents the best way today to collaborate on multi-company projects between multiple offices teams. Cloud is simple to set-up, to use and it has become a large part of our professional and private lives.

This cloud collaboration system is BIM 360 which introduces a common language for all construction stakeholders, from design to facility management.

Implementing the use of this common language is like solving a puzzle, as there are different BIM 360 pieces of technology (cloud and desktop) that we need to put together in the right order and position.

2 BIM 360

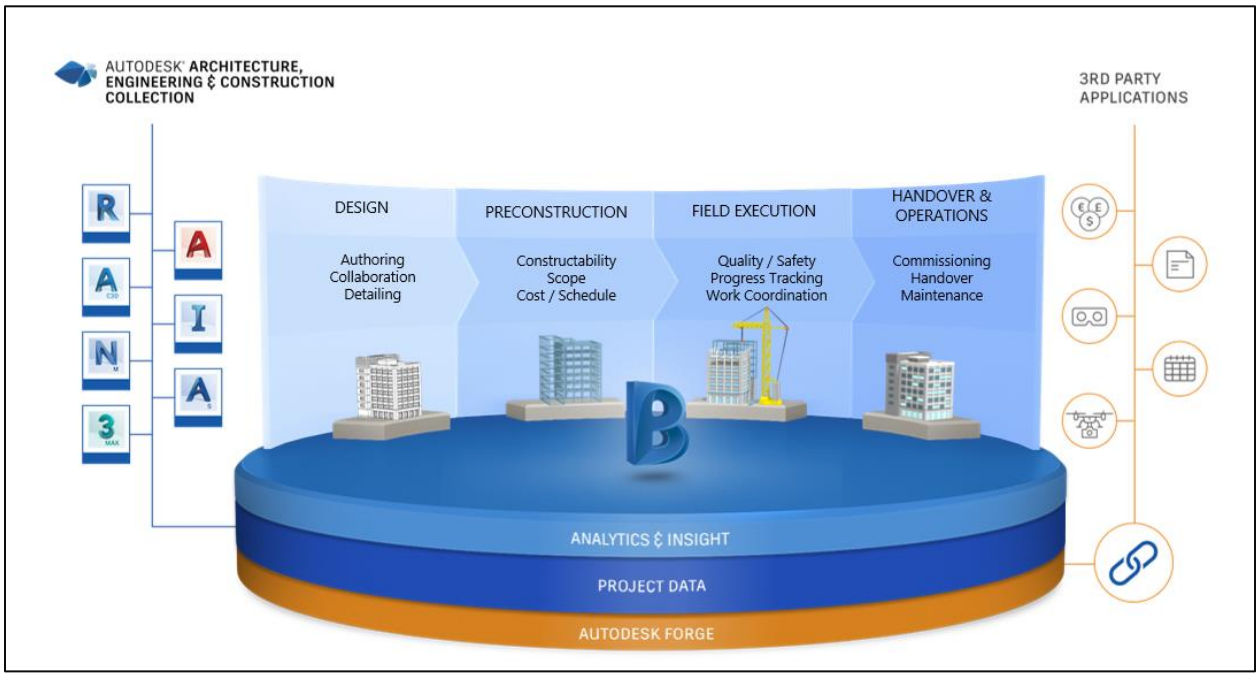
2.1 The platform



We spent a few years creating the foundations for this collaboration platform, this product is called BIM 360 Docs, our cloud common data environment.

The strategy was to build products addressing each specific construction project phase (from design to maintenance) based on this common data environment (data is unique as a single source of truth). Those products are BIM 360 Design, BIM 360 Glue and BIM 360 Build.

2.2 Interoperability and Forge



BIM 360 products are connected to most of the Autodesk desktop software such as Revit, AutoCAD, InfraWorks, Navisworks, etc.

Our development teams built the BIM 360 platform using our cloud APIs (Application Program Interface) included in the Forge platform. We also opened Forge, so customers and integrators can:

- Customize existing BIM 360 products
- Create new cloud products
- Connect BIM 360 products to external ones or external databases to federate data

We will illustrate the data federation aspect in the last part of our presentation, when addressing the handover and operations phase (page 23 of this document).

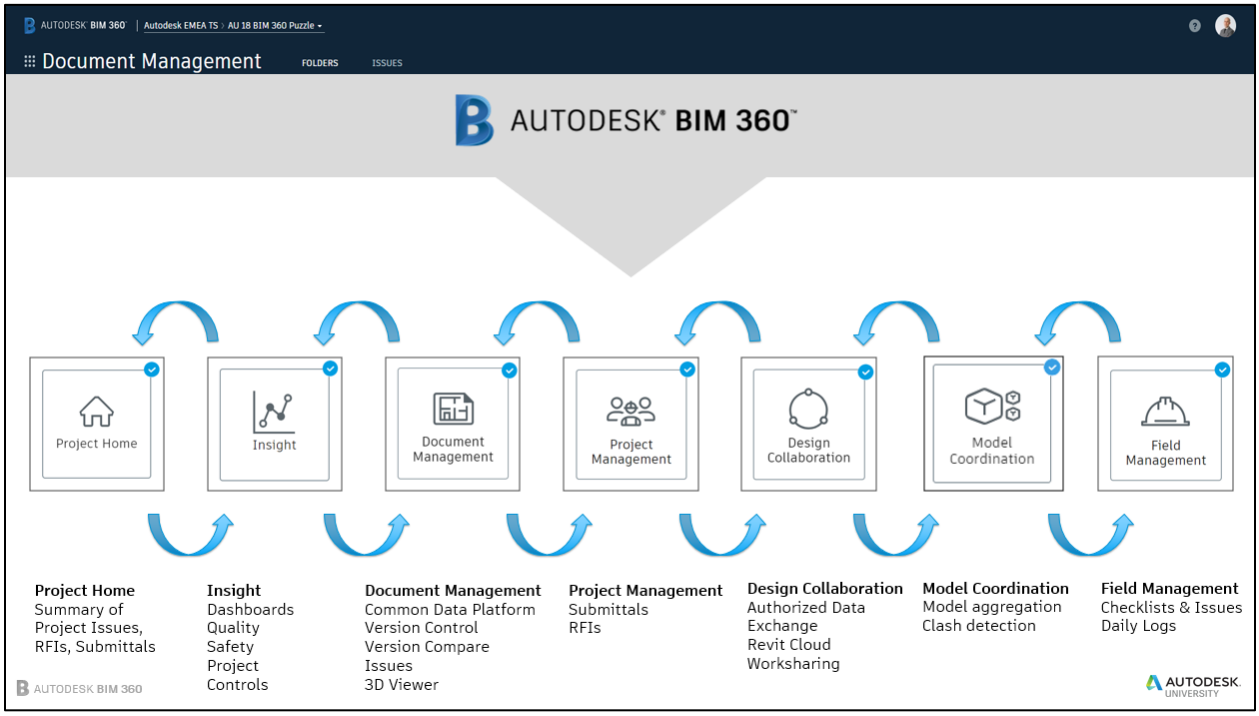
2.3 Modules

The next picture clarifies the vocabulary we will use for the rest of this presentation (platform, product, modules and features).

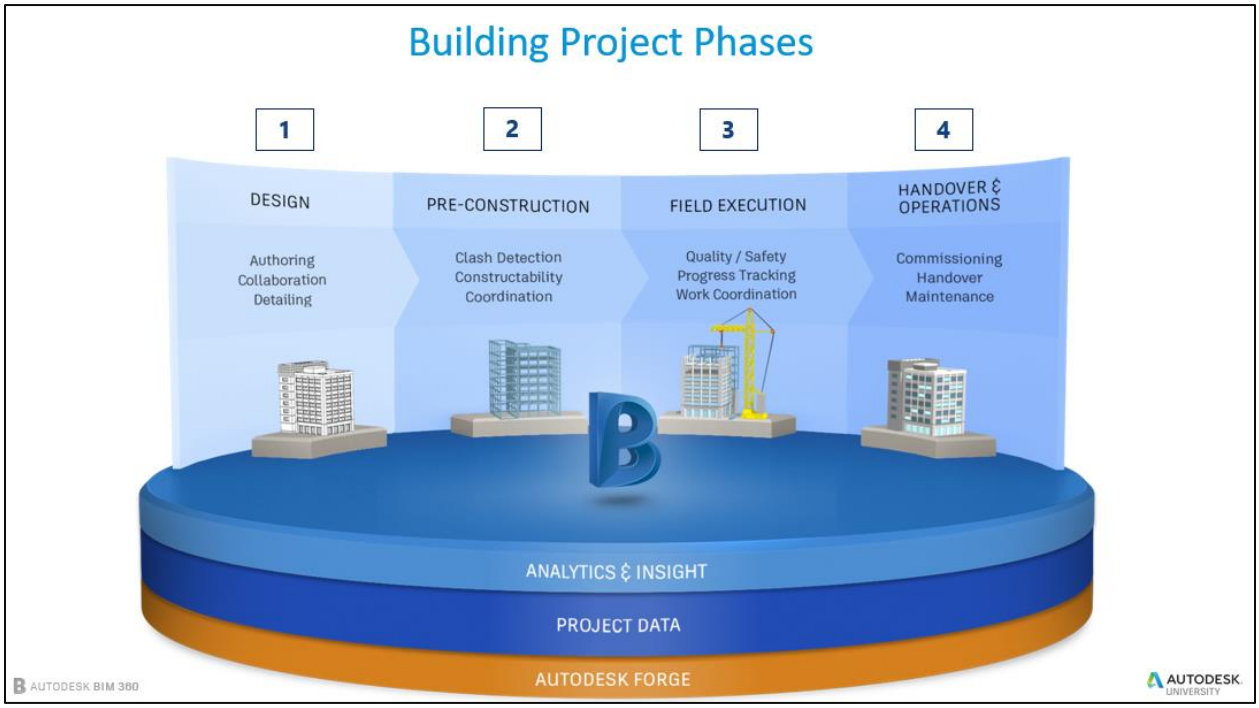
Platform nomenclature

- BIM 360 is our project delivery and construction management platform
- BIM 360 Docs, BIM 360 Design, BIM 360 Glue, and BIM 360 Build are products
- Design Collaboration, Document Management, Model Coordination, etc. are modules
- Issues, checklists, permissions etc. are features or capabilities

Now we are familiar with this vocabulary, we can look at a list of features per module on the next image:



3 Building project phases



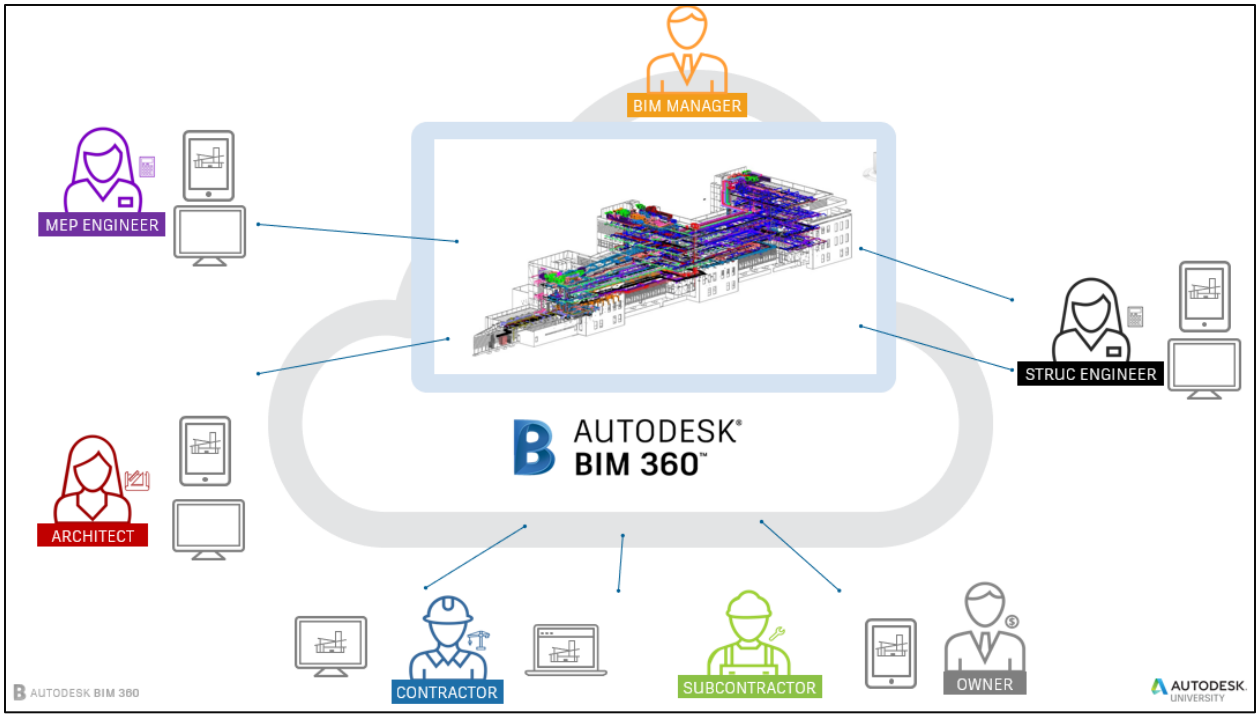
4 Personas

The personas we will use to illustrate next chapter's workflows are:

- Owner
- Architect
- MEP Engineer
- Structural Engineer
- General contractor
- Sub-contractor

While some of the personas like the engineers will work at their desk, some of the others will work from the construction site (for example the sub-contractor as shown on the image below). People working on site will of course need mobile solutions, so most of the time they will use tablets or phones for our workflows.

Another aspect of mobility tasks is of course the possibility to work off-line. These user profiles will in general load the data on their device, take it on site for offline work (create issues for example) and sync their changes to BIM 360 when a connection is available.

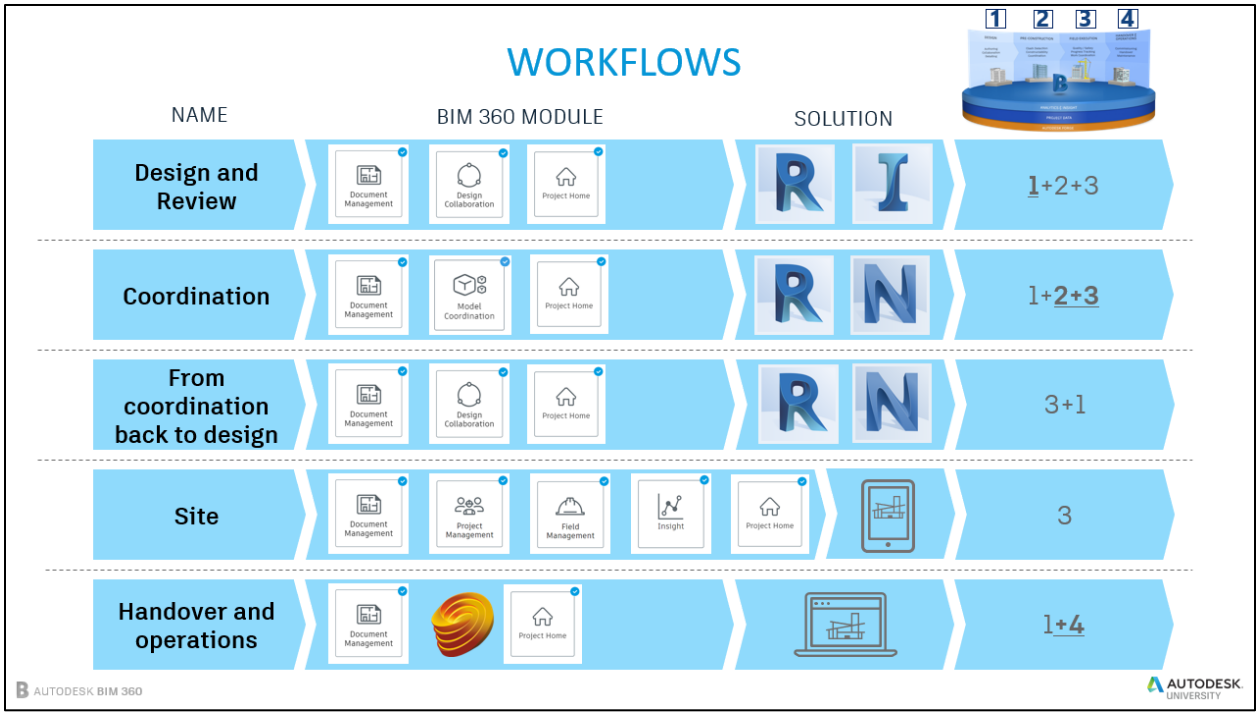


5 Workflows

5.1 Overview

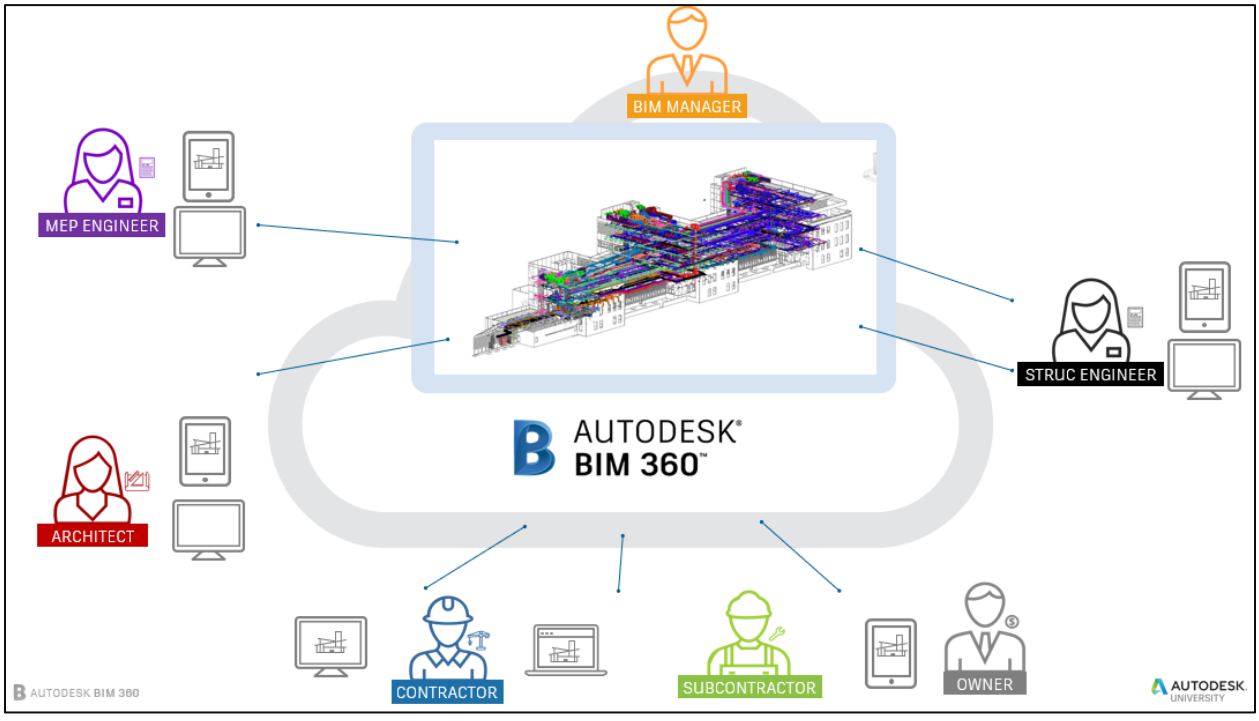
For this class we selected five types of workflows we believe are representative of a construction project. They are examples and of course not exhaustive.

The following picture shows those five workflows, the BIM 360 modules we used, the solutions we used (desktop or mobile) and the covered phases of a construction project (the focus phases appear in bold characters):



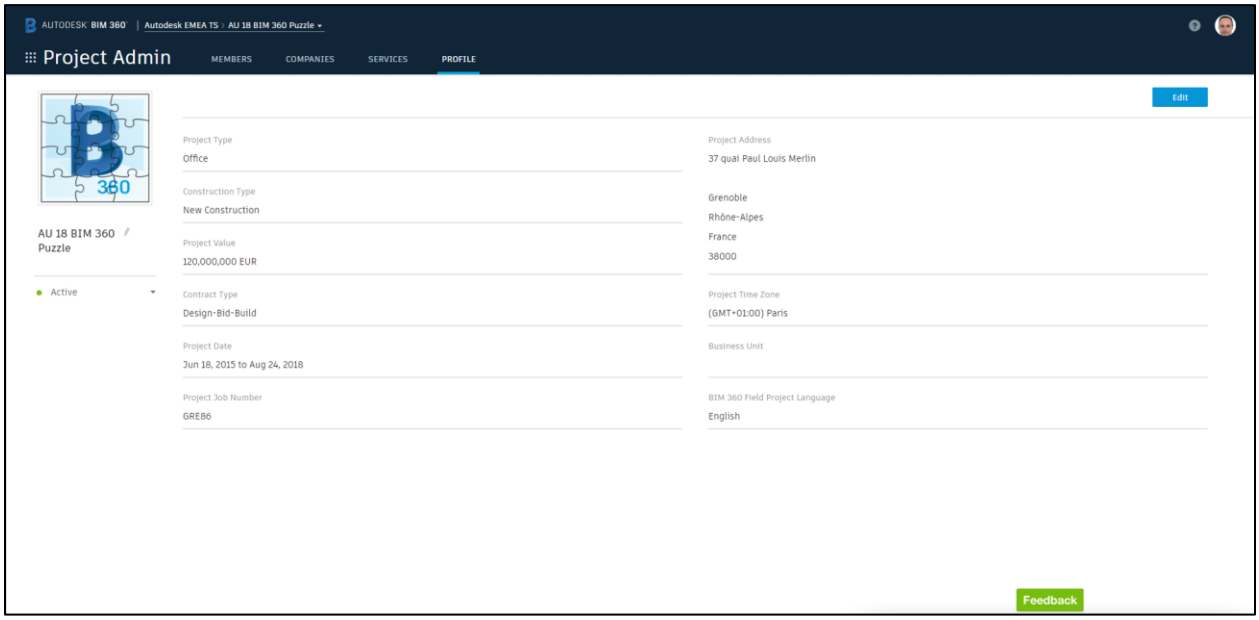
5.2 Project overview

As shown on the picture below all personas will use the same common data environment: BIM 360.

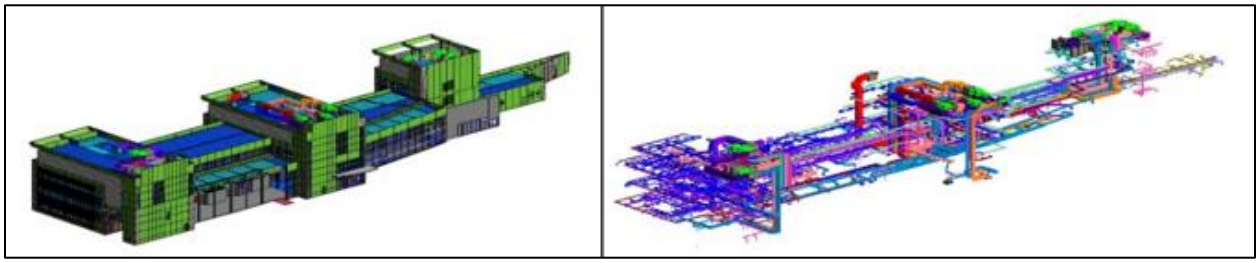


The models and documents we used for this presentation are part of the "GreenOValley" project. The Owner, Schneider Electric is an Autodesk customer, they kindly provided their data, so we could illustrate our workflows.

The project is composed of two office buildings located in Grenoble (France). We considered one of these two buildings, which is called "T-Pole". The next screenshot shows a few details (cost, contract type, dates) in the BIM 360 project profile.



Six different disciplines design Revit models were provided, they represent the starting point of our workflow (see the architecture and HVAC models on the screenshots below):



The design was conducted by Artelia, an engineering company and Autodesk customer in France.

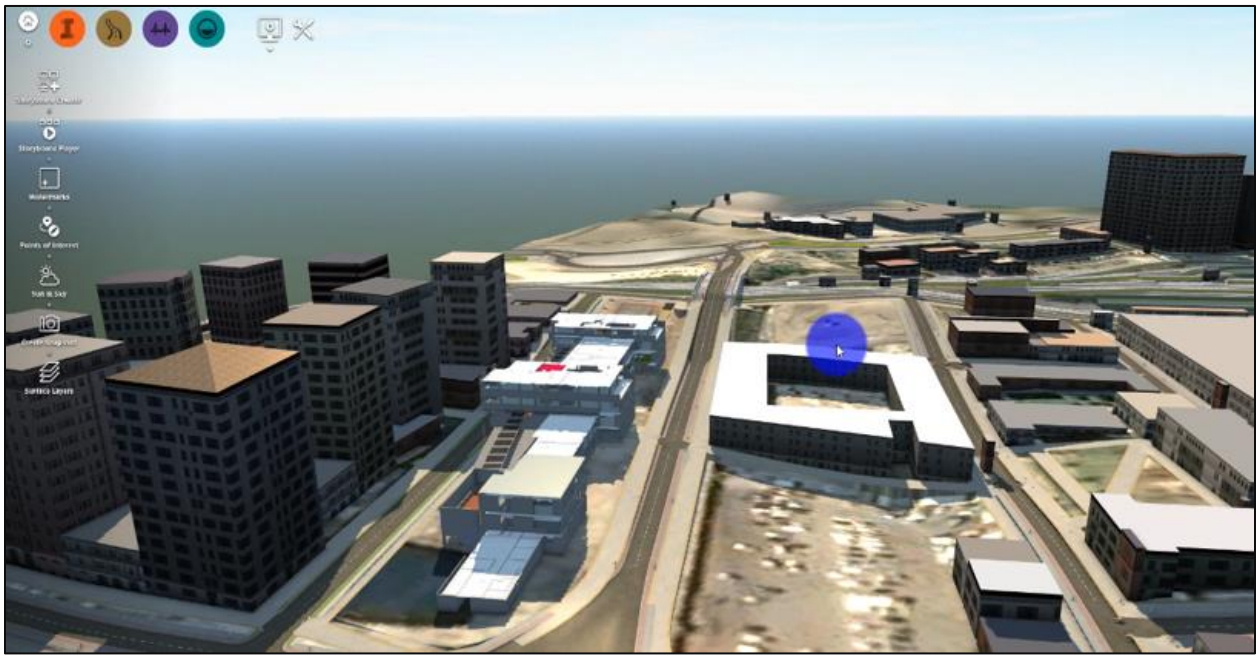
5.3 Preliminary design

Before considering the design and review phase, let's discuss preliminary design. To illustrate this project very early stages phase, we used our infrastructure design software InfraWorks and Revit.

InfraWorks is the perfect example of a desktop software which can read its data from the cloud (BIM 360).

As shown in our presentation (slide 20), a portion around the project location was selected in InfraWorks using the tool called Model Builder. This constitutes our building real conditions surroundings, which are based on satellite imagery (buildings, topography, rail tracks, river, etc.)

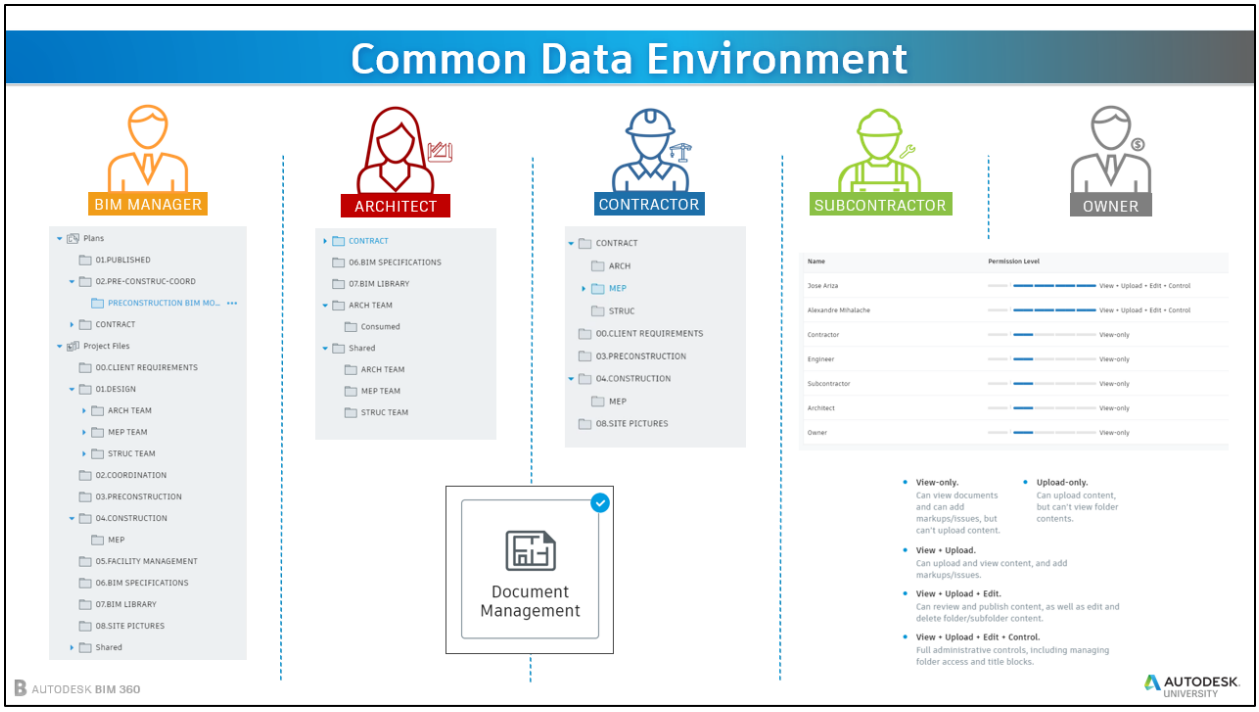
The building's Revit model was then inserted in the infrastructure model by the architect allowing the building's owner to see it in context before advanced design phases. This helps making better design decisions and saves time / money through all construction phases.



The InfraWorks project is in BIM 360 Docs, our common data environment, it will be also used for our Design and review workflows (see page 13 section "Connecting design and site" of this document).

BIM 360 Docs data appears in a folder / subfolders hierarchy, which can be setup in terms of access permissions. This is essential in a multi-firm environment.

The following image shows the permission levels and the way three of our personas (BIM manager, Architect and Contractor) see the folder hierarchy in their interface (depending on their permissions).



5.4 Design and review

5.4.1 Design and review

BIM 360 Modules:

- Project Home
- Document Management
- Design Collaboration

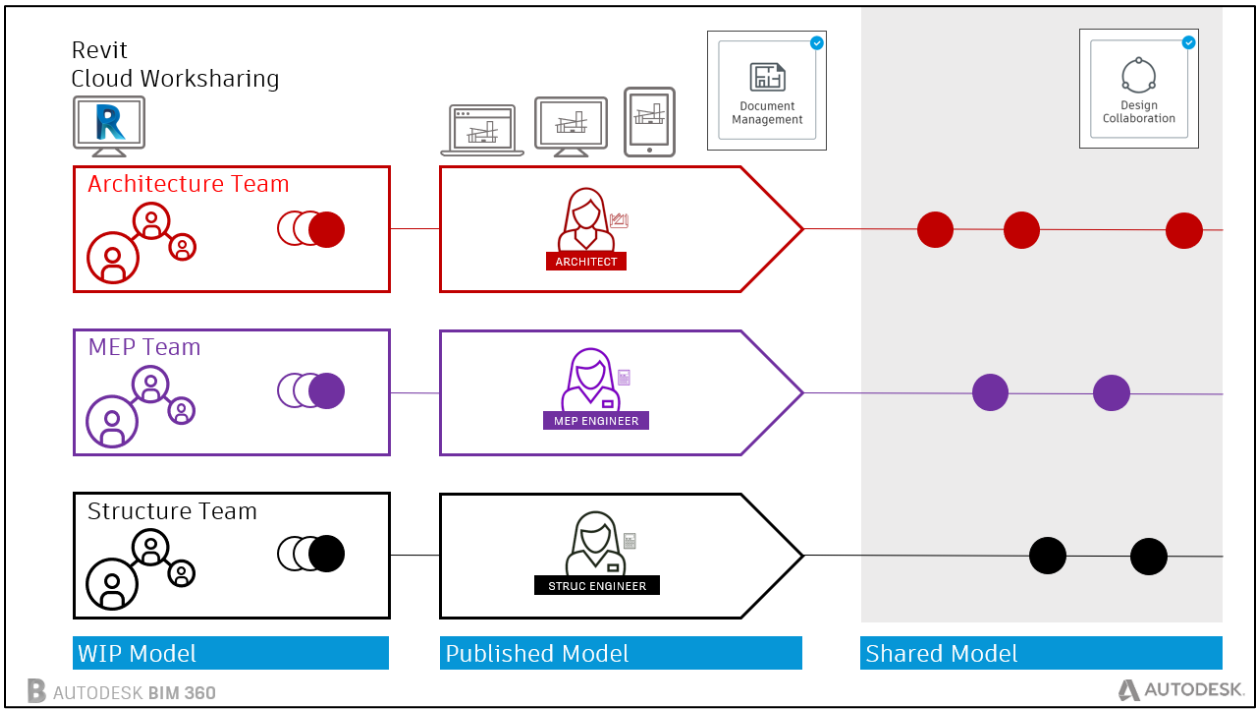
Personas involved:

- Architect
- MEP engineer
- BIM manager

In this example consider 3 different teams (Architecture, MEP and Structure) collaborating on Revit workshared cloud models (BIM 360 Design).

Designers work on their Work In Progress (WIP) models in Revit. They synchronize their changes and publish the views and sheets from Revit when models are ready to be shared on BIM 360 for their own team.

The team leaders can use the Design Collaboration module to prepare and share the 3D views and sheets with the other teams. They will also use this module to review and consume other teams' data.



Our Microsoft PowerPoint presentation (see slides 25 and 26) explains how Revit models are synchronized, published and how packages (views and sheets) are shared and consumed. The animated slides also explain how BIM 360 handles the automatic copies of Revit files for each workflow step in BIM 360 Docs.

The video we included describes how team leaders can analyze their team's data before sharing it and how they analyze packages shared with them by other teams.

5.4.2 Document approval

BIM 360 Module:

- Document Management

Personas involved:

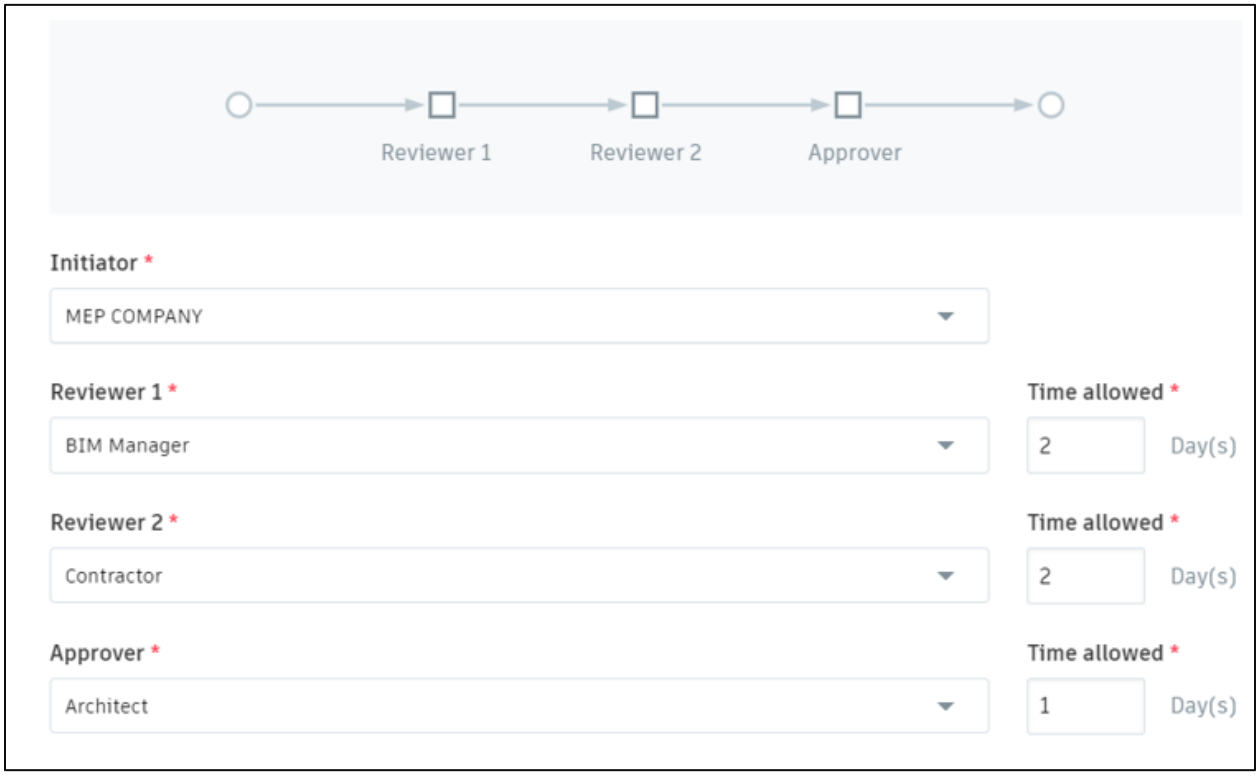
- Architect
- MEP engineer
- BIM manager
- Contractor

This new and highly expected BIM 360 Docs feature allows users to setup and use an approval workflow for one or more documents or models.

Our workflow involves an initiator (MEP Company) who prepares the documents and starts the approval workflow, two reviewers (BIM Manager and Contractor) and a final approver (Architect) who will decide if the submitted documents can be approved or not. The reviewers and the approver can use the markup features and comments at a document level to bring input, ask questions or simply explain why they refused or approved the document.

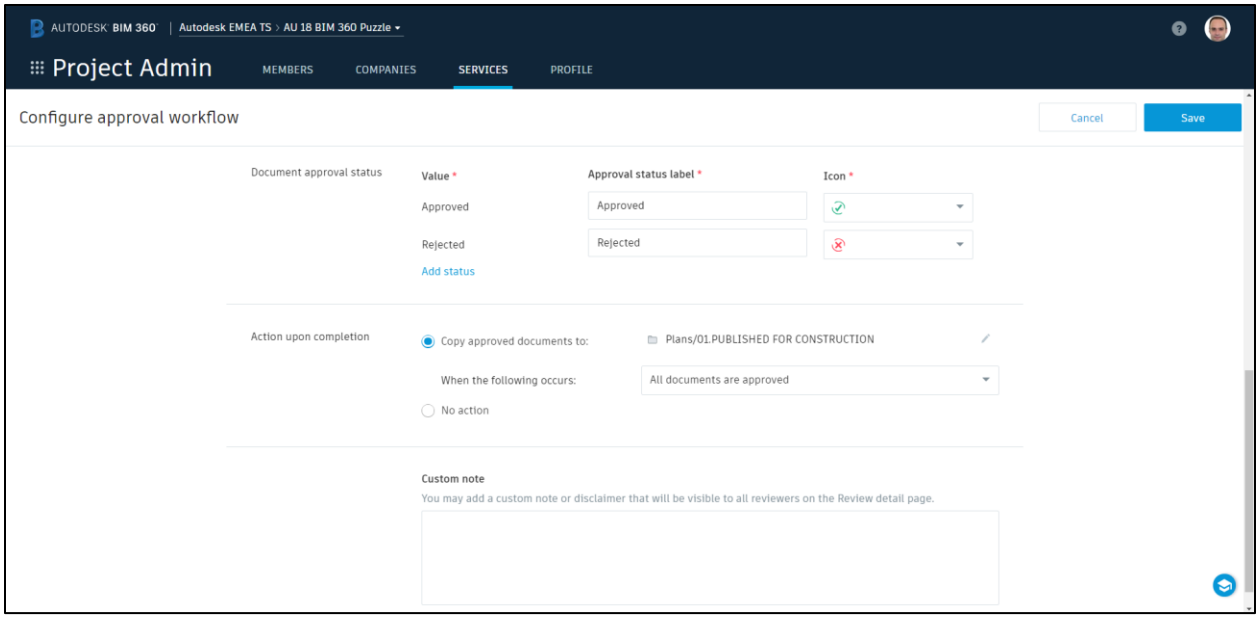
Approval workflows involving just one reviewer (or none) can also be set up.

The next picture shows the time allowed for every stakeholder to perform his review or approval task.



We have set up 2 types of status with their respective icons. More status can be added if needed.

Once approved, our workflow will copy the documents to another folder. This is particularly important because project admins can decide to use specific permissions for this folder (read-only in our case), to ensure approved documents can't be modified, deleted, etc.



Our presentation video shows all the detailed steps for this workflow (see slide 29).

5.4.3 Connecting design and site

BIM 360 Modules:

- Project Home
- Document Management

Personas involved:

- MEP engineer
- Contractor

For this workflow, we described how the MEP firm engineer working on a computer in the office can interact with the contractor who is on site and is using a mobile device.

We used the new unified issue management feature. The engineer generates an issue in the office and assigns it to the contractor. The contractor reviews and adds information (attachment, root cause, etc.) to this issue on an Android tablet on the construction site.

See our presentation video on slide 30.

5.4.4 BIM contract compliance and data analysis

BIM 360 Module:

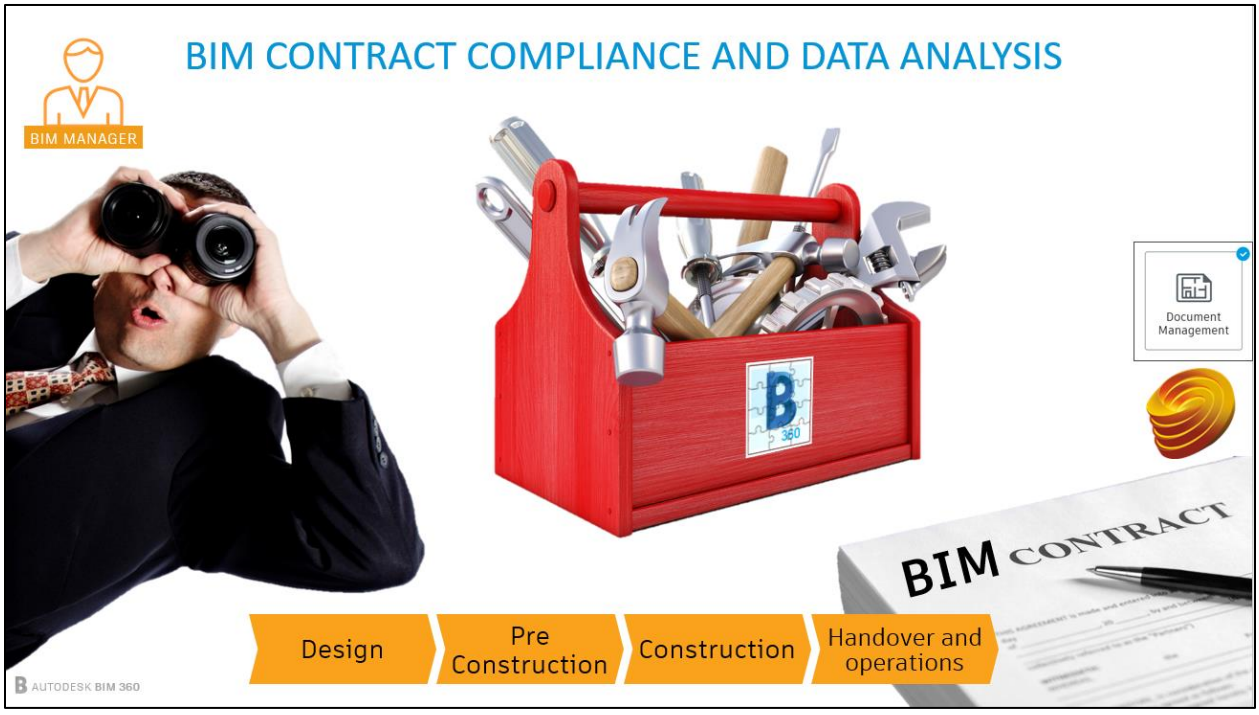
- Document Management

Persona involved:

- BIM manager

This workflow involves a BIM manager who uses the new BIM 360 feature to export a report on the documents previously approved (see our approval workflow section on page 11 of this document).

BIM 360 can send a Microsoft Excel spreadsheet by email with a summary of the folder's documents, their properties (including the approval status in our case) and hyperlinks for every document. The hyperlinks point to the respective document in BIM 360, this way users can easily identify, view and interact with online documents or models in their web browser.



We also used two Autodesk Forge apps to illustrate the data analysis aspect. The apps are built by Autodesk and available for free on the Autodesk App Store:

Visual reports:

- Ready to use Forge app
- Extracts data from Revit to show dashboards (pie and bar charts) along with 3D and 2D views
- Can be used for graphic analysis of elements and views of a Revit model
- Slide 33 of our presentation

Export to Excel:

- Ready to use Forge app
- Extracts Revit model data from BIM 360 to a Microsoft Excel spreadsheet
- Can be used to analyze the content of Revit models and eventually perform postprocessing on Revit data
- Video on our slide 34

5.5 Coordination

BIM 360 Modules:

- Project Home
- Document Management
- Model Coordination

Personas involved:

- Architect
- MEP engineer
- BIM manager
- Contractor

We considered 3 types / levels of coordination in this presentation and compared them to a written document review process:

- Quick check which could be compared to an autocorrect feature available in all word processing software (Microsoft Word) or when writing messages on a mobile phone
- Proper check which could be compared to spellcheck

- Thorough check which can be compared to having a friend / colleague proofread your document

Quick check can be performed in the design software (Revit in our case) while the models are stored in BIM 360 Docs. Visual check or clash detection can be performed in Revit. The BIM 360 Document Management (BIM 360 Docs) module also allows visual check and deeper analysis with element filtering and version comparison.

Proper check can be performed with the BIM 360 Model Coordination module. Data comes from BIM 360 Docs.

The thorough check is usually done using Navisworks with models from BIM 360 Docs.

Our coordination workflow starts with a BIM manager working with BIM 360 Model Coordination module which will perform automatic clash detection on the Revit model views extracted to the Plans folder of BIM 360 Docs. Clashes are presented in a matrix as shown on the next picture:

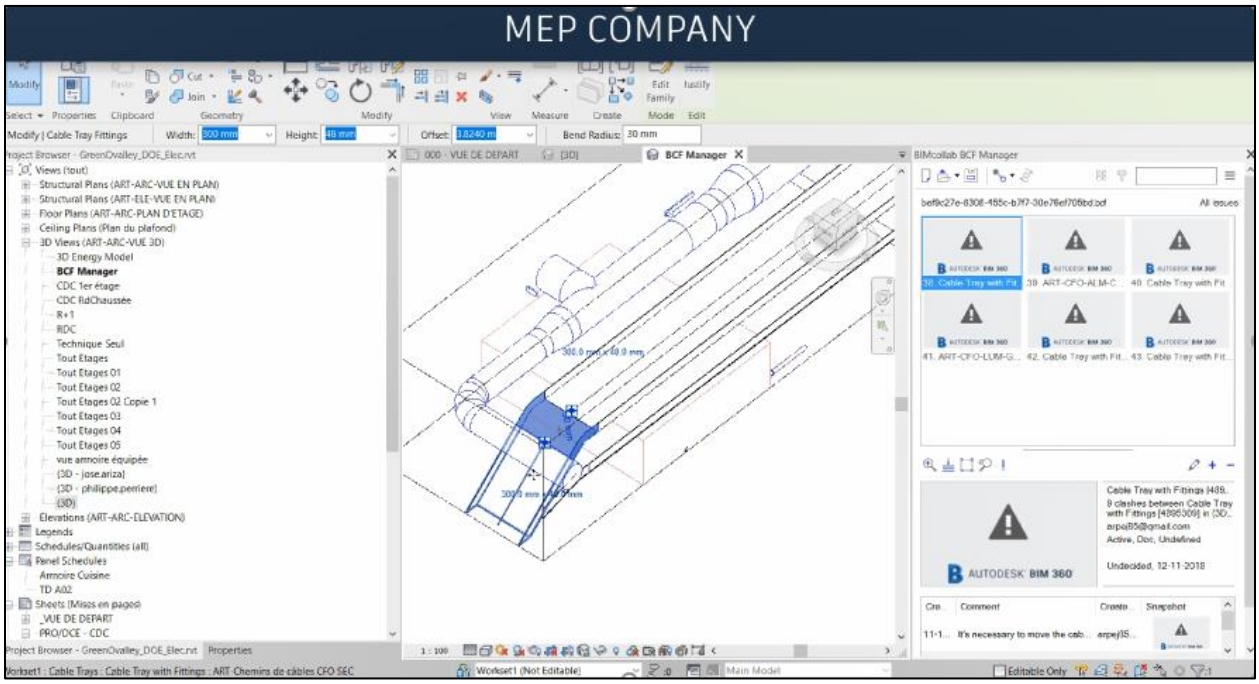
	3D_1st Floor Area_ GreenOv...COORD.rvt	3D_Main Area_ GreenOvalley_ DOE_STR_COORD.rvt	3D_Technical Zone_ GreenOv...COORD.rvt	3D_Top Area_ GreenOvalley_ DOE_STR_COORD.rvt	3D_Zone 1_ GreenOvalley_ HVAC_COORD.rvt	ARC(CAR)-T_ GreenOvalley_ DOE_ARC_COORD.rvt	ARC(FPD)-T_ GreenOvalley_ DOE_ARC_COORD.rvt
3D_1st Floor Area_...alley_HVAC_COORD.rvt 321 clash groups		49				4	232
3D_Main Area_Gree...y_DOE_STR_COORD.rvt 595 clash groups	23		30	224		69	123
3D_Technical Zone_...alley_HVAC_COORD.rvt 36 clash groups		36		36			
3D_Top Area_Green..._DOE_STR_COORD.rvt 321 clash groups		224	30		9		44
3D_Zone 1_GreenOvalley_HVAC_COORD.rvt 43 clash groups				13			23
ARC(CAR)-T_GreenO...y_DOE_ARC_COORD.rvt 60 clash groups	3	36					

The BIM manager can analyze clashes and decide which ones really impact design. If they can be ignored he then uses the “Not an issue” feature to ignore them. If design needs to be modified, the BIM manager creates an issue and assigns it to the MEP engineer in our example.

The MEP engineer can use Model Coordination to identify the impacted elements based on their ID and make and understand the context of the requested design change.

This workflow is illustrated by the video on slide 39 of our Microsoft PowerPoint presentation.

5.6 From coordination back to design



This workflow (see video of slide 42 of our presentation) starts with the MEP engineer who exports the issue assigned by the BIM manager in BCF file format. This BIM 360 BCF export feature was highly requested by users and we are happy to be able to show feature which is in a beta stage.

BCF files are imported into Revit by the MEP team (using for example the BIMcollab® BCF Manager), which helps identifying the requested changes, so they can modify their BIM 360 Design collaborative models and synchronize their changes. The MEP engineer can then mark the issue as “Answered” and our BIM manager can analyze design changes using the BIM 360 version compare feature and close the issue.

5.7 Site management

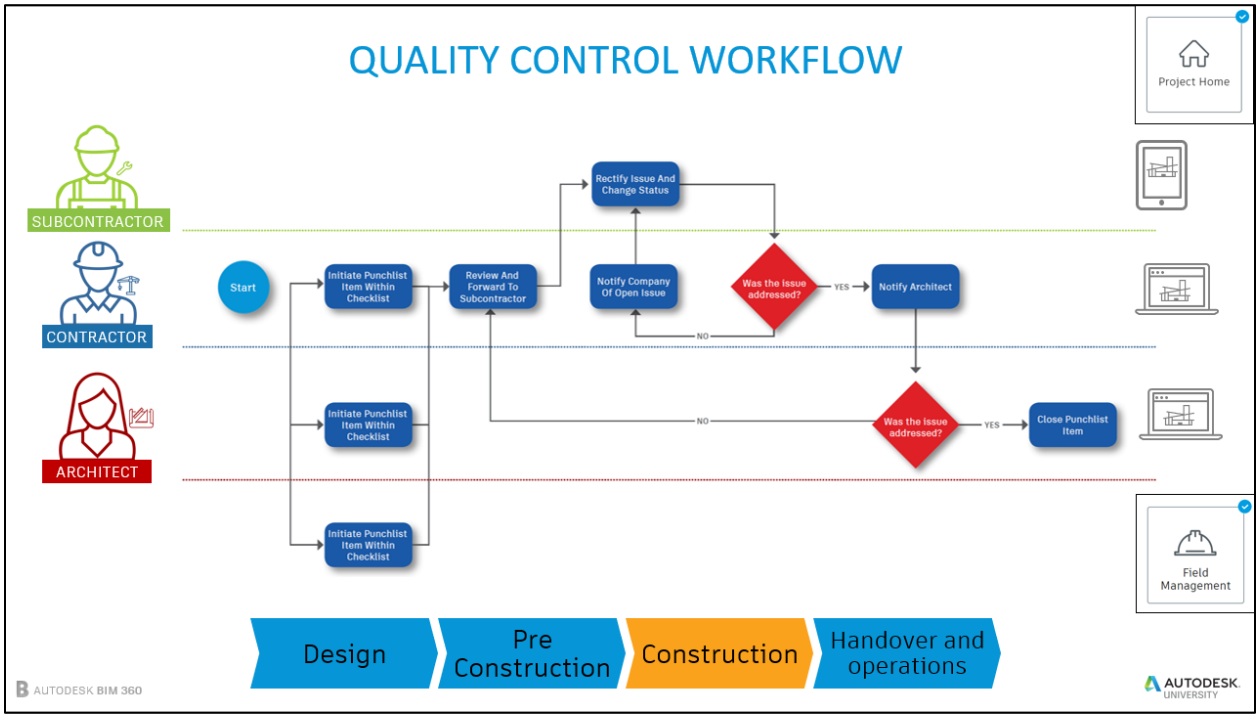
5.7.1 Quality control

BIM 360 Modules:

- Project Home
- Field Management

Personas involved:

- Subcontractor
- Contractor
- Architect



Our quality control workflow example (video on slide 46 of our presentation) is initiated by the main contractor who will select a BIM 360 prepared checklist. Checklists can be setup in BIM 360 or imported from Microsoft Excel.

The contractor can then eventually modify the checklist and assigns it to a subcontractor in our example (could also be a colleague) and specifies a due date (the system will send email alert reminders).

The subcontractor uses a tablet to fill up the checklist and eventually create issues and / or comments. In our example a quality verification wasn't valid, so the subcontractor creates an issue to be handled by the main contractor.

BIM 360 keeps track of each checklist verification and issues / comments created. The system is consistent, the issues and comments are specific to a checklist section and can be easily accessed for review or status change from the checklist. Attachments from BIM 360 or eventual pictures taken from site on a mobile device can be added at any time. A complete activity log is saved by BIM 360, so users with adequate permissions can review it.

Once the checklist is completed it can be closed and a report is available for download or sharing (see section “Project reports” on page 31 of this document).

Even if BIM 360 allows safety workflows, we didn’t discuss them in our class due to timing considerations. Our Learn BIM 360 web site proposes a large collection of helpful videos and documents around BIM 360 modules. A specific section dedicated to safety workflows is available on the web site. All you need to access it is an Autodesk ID.

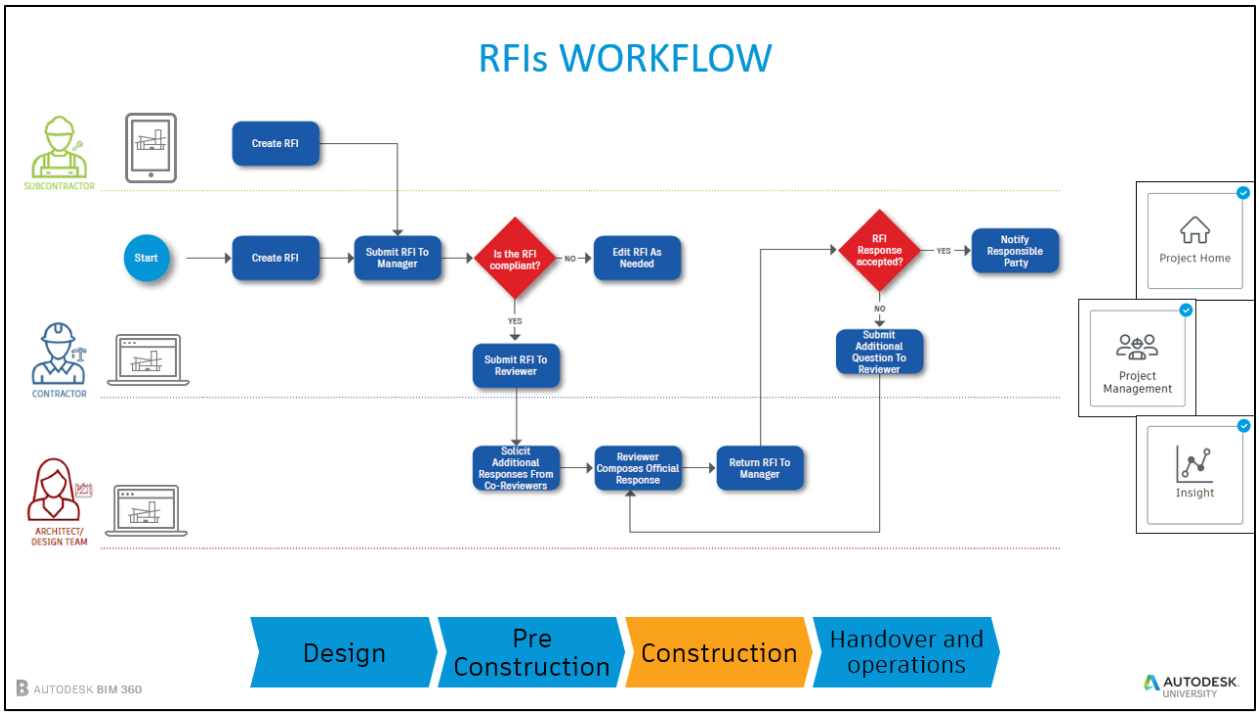
5.7.2 Requests For Information (RFIs)

BIM 360 Modules:

- Project Home
- Project Management
- Insight

Personas involved:

- Subcontractor
- Contractor
- Architect



Our RFI workflow starts with a subcontractor asking for clarification on construction sequence of a balcony wall. The subcontractor uses an iPad to create the RFI (can also be used in an offline mode if network is not available on the construction site) and adds a picture to illustrate the RFI.

The main contractor is alerted by email and reviews the RFI using a web browser. The BIM 360 “dual view” feature, allows him / her to view both 3D and 2D views or sheets of the Revit model. This helps the contractor analyze the request, before routing it to the architect.

The architect uses the Project Home module to access the RFI and provide an official response to the subcontractor, who can check it on his mobile device. Our Microsoft PowerPoint presentation includes a video of this workflow on slide 48).

BIM 360 allows submittal workflows, but for the same reason we didn't consider safety workflows, we didn't discuss submittals in this class either. Material about submittal workflows can be found on our Learn BIM 360 web site.

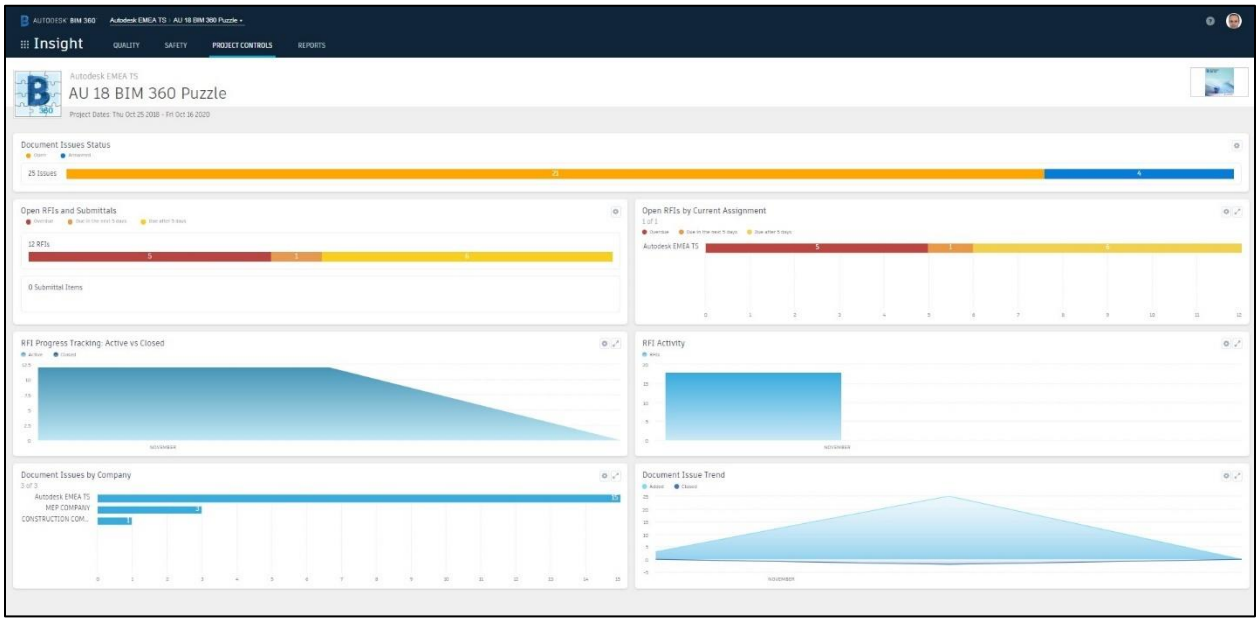
5.7.3 Project reports

BIM 360 Module:

- Insight

Personas involved:

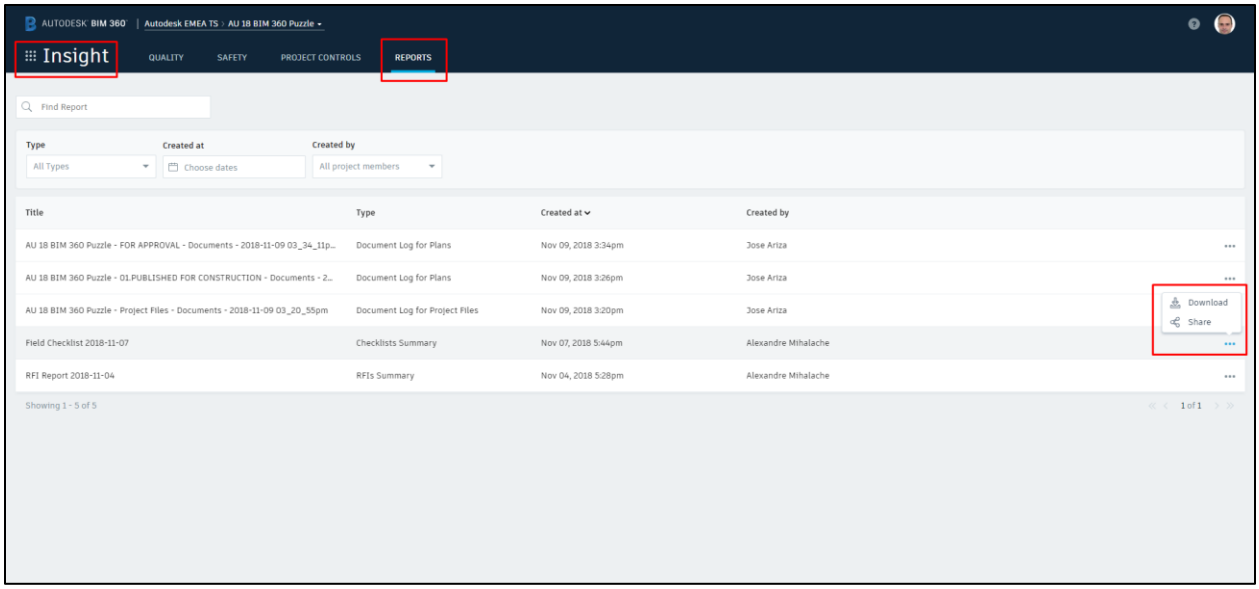
- Contractor
- Architect
- Owner

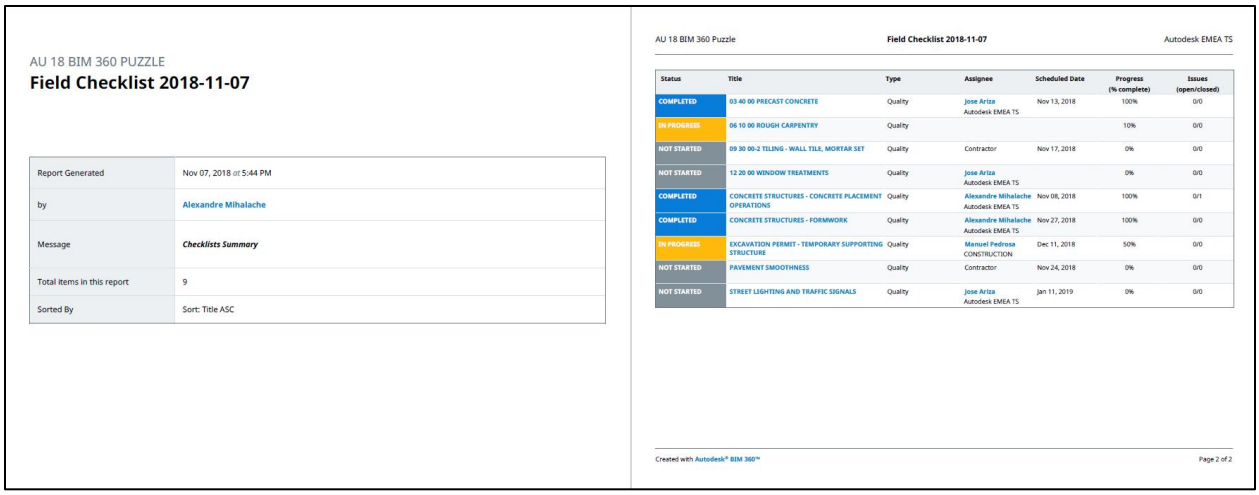


The Insight module provides project level reports (visual and logs) for management level users.

Available reports include quality and safety metrics, as well as overviews of RFI and submittal workflows.

A new feature has also been added last week to the Insight module. It allows managers to search, filter, download and share existing reports (issues, checklists, RFIs and submittals). To illustrate this feature, we have added a few screenshots below.





AU 18 BIM 360 PUZZLE

Field Checklist 2018-11-07

Report Generated	Nov 07, 2018 *at* 5:44 PM
by	Alexandre Mihalache
Message	***Checklists Summary***
Total items in this report	9
Sorted By	Sort: Title ASC

AU 18 BIM 360 Puzzle — **Field Checklist 2018-11-07** — Autodesk EMEA TS

Status	Title	Type	Assignee	Scheduled Date	Progress (% complete)	Issues (open/closed)
COMPLETED	03 40 00 PRECAST CONCRETE	Quality	Jose Ariza Autodesk EMEA TS	Nov 13, 2018	100%	0/0
IN PROGRESS	06 10 00 ROUGH CARPENTRY	Quality			10%	0/0
NOT STARTED	09 30 00-2 TILING - WALL TILE, MORTAR SET	Quality	Contractor	Nov 17, 2018	0%	0/0
NOT STARTED	12 20 00 WINDOW TREATMENTS	Quality	Jose Ariza Autodesk EMEA TS		0%	0/0
COMPLETED	CONCRETE STRUCTURES - CONCRETE PLACEMENT OPERATIONS	Quality	Alexandre Mihalache Autodesk EMEA TS	Nov 08, 2018	100%	0/1
COMPLETED	CONCRETE STRUCTURES - FORMWORK	Quality	Alexandre Mihalache Autodesk EMEA TS	Nov 27, 2018	100%	0/0
IN PROGRESS	EXCAVATION PERMIT - TEMPORARY SUPPORTING STRUCTURE	Quality	Manuel Pedrosa CONSTRUCTION	Dec 11, 2018	50%	0/0
NOT STARTED	PAVEMENT SMOOTHNESS	Quality	Contractor	Nov 24, 2018	0%	0/0
NOT STARTED	STREET LIGHTING AND TRAFFIC SIGNALS	Quality	Jose Ariza Autodesk EMEA TS	Jan 11, 2019	0%	0/0

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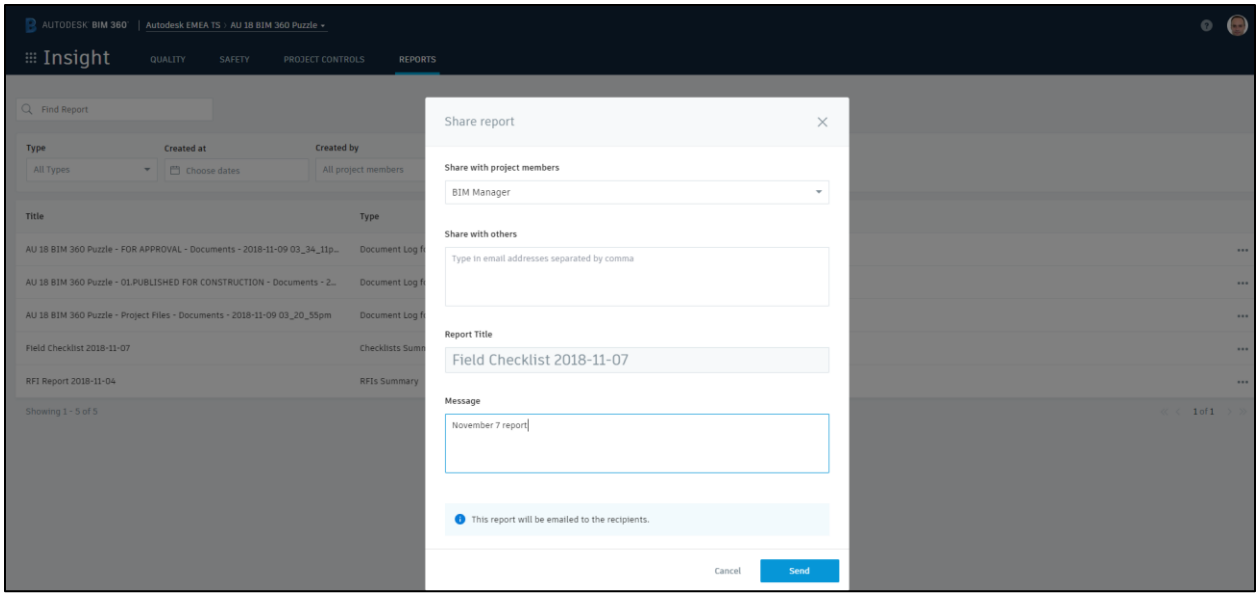
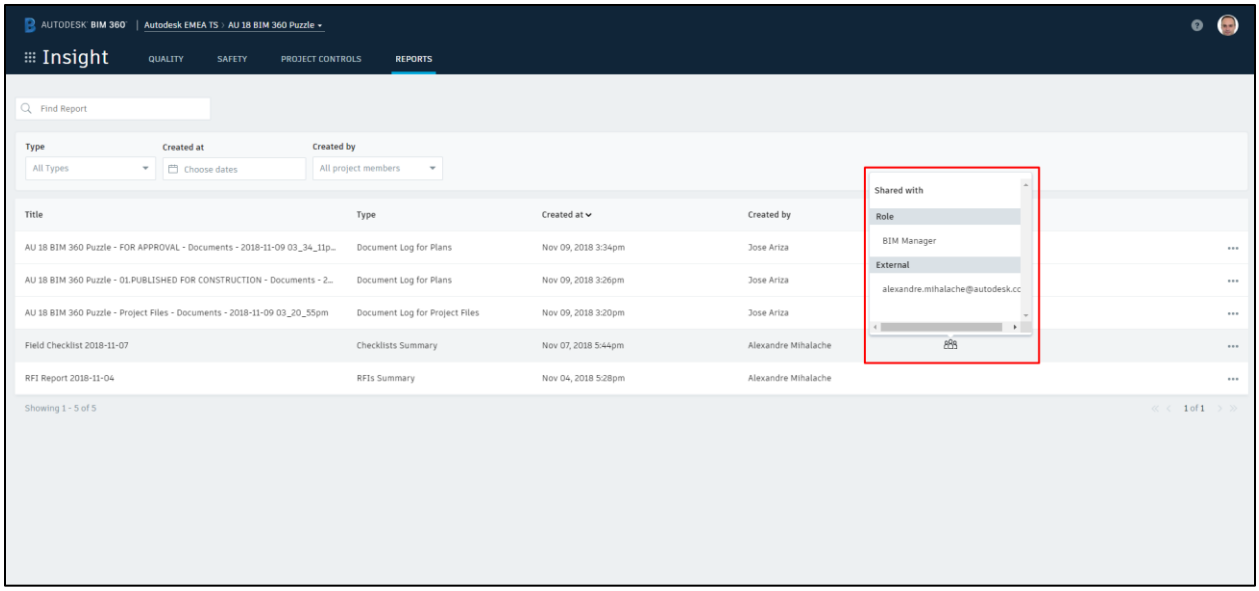




5.8 Handover and operations

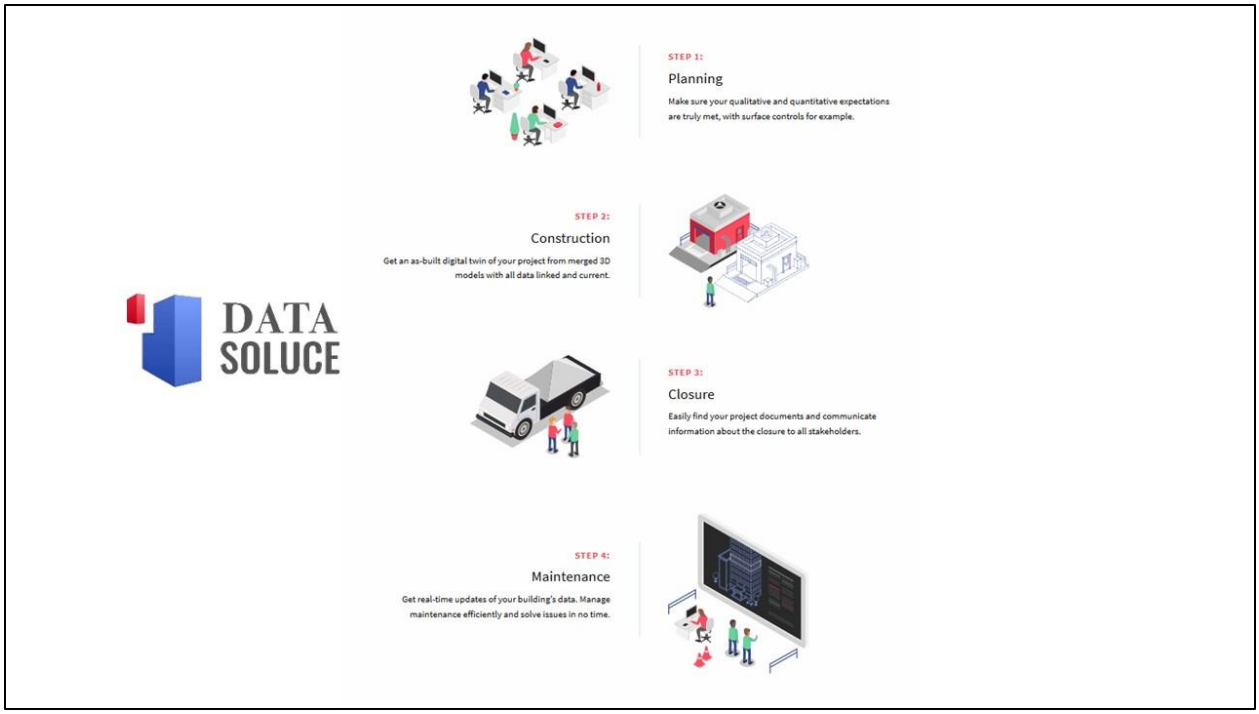
BIM 360 Modules:

- Document Management
- Autodesk Forge

Personas involved:

- Owner
- Contractor

For this workflow we used one of our Forge partners called Data Soluce solution. This solution connects Owners and Operators to BIM data, so they can build, manage and maintain their assets.



BIM data driven planning, construction, handover and maintenance can then be performed seamlessly. This BIM data is in BIM 360 Docs (our common data environment).

The Owner merges and analyzes the BIM models based on his needs in terms of zones, room areas, surfaces, volumes, etc. The maintenance contractor easily identifies the systems and elements to be worked on in a web browser. Our video on slide 51 of our presentation illustrates this workflow.

6 Conclusion

Our BIM 360 solutions evolve at a very fast pace, development teams bring new features to the products every two weeks or so. This fast development pace is possible thanks to the cloud. At Autodesk we believe the cloud democratizes BIM for all stakeholders who can access, analyze and share data easily.

We stated that BIM 360 software introduces a common language for all construction stakeholders, from design to facility management.

We modestly hope we helped you see how this common BIM language helps to solve the BIM 360 puzzle.