



CS225978

Bridging the Gap Between Design and Construction with BIM 360 Document Management

Jean Goyat
DPR Construction

Mitch Cornelius
Autodesk

Learning Objectives

- Learn to scope the necessary functions for a new document-management system
- Learn how to gain buy-in from the project team for a new document management process
- Learn how to set up BIM 360 Document Management for cross-discipline drawing management
- Understand how to integrate Document Management processes into the VDC effort to ensure consistency and accuracy of information

Description

Establishment of an effective document management system for a construction project is a critical component to project success. An effective system will successfully bridge the gap between design and construction by digitizing the document management process. Attendees of this class will see how DPR Construction used BIM 360 Document Management to host construction-related documentation and integrate it into the virtual design and construction (VDC) process. The class will go through the initial scoping development, project setup and administration, and end-user experience.



Speaker(s)

Jean Goyat

VDC Manager, DPR Construction
Redwood City, California, United States

Jean Goyat is the VDC Manager for the Bay Area at DPR Construction, with an interest in creating & overseeing the implementation of best-practices that support the Virtual Design & Construction (VDC) process. Currently managing the model-based coordination approach on a complex research lab project in San Francisco, his expertise focuses around mega-projects and the inherent challenges they entail specifically around communication and data management. Having been immersed on several project over \$700 million in the Bay Area, Jean takes advantage of his proficiency with technology to optimize VDC practices.

Mitch Cornelius

Sr. Business Consultant - Construction, Autodesk
The Woodlands, Texas, United States

Mitch Cornelius is a Business Consultant with Autodesk and has been engaged with construction companies across the US in this role since early 2016. Mitch has a passion for improving outcomes for construction companies through refining business process. Mitch has been involved in the construction industry since 2004 with a focus on application of technology to construction processes. He has worked on projects that range from very small to very large, but on every project his focus is to improve business outcome through process refinement and application of technology.

What is a document management system and why is it so important?

Any construction project, or any project for that matter, relies on easy and organized access to information, a hassle-free way to quickly and confidently understand where to find the sought-after document that will answer the most preoccupying of questions: what do am I doing here, exactly?

Quickly searching for a definition online, one of the first results explains document management as so:

A document management system (DMS) is a system (based on computer programs in the case of the management of digital documents) used to track, manage and store documents and reduce paper. Most are capable of keeping a record of the various versions created and modified by different users (history tracking). The term has some overlap with the concepts of content management systems. It is often viewed as a component of enterprise content management (ECM) systems and related to digital asset management, document imaging, workflow systems and records management systems.¹

This explanation unearths several key concepts to implementing a successful system at a project or even company level:

1. It's **digital**: in this day and age, a fast internet connection should be all you need to quickly shift through thousands of documents without having to shoulder huge binders and lug them around the trailer.
2. It's **collaborative**: considering the large number of stakeholders involved in even the smallest of construction projects, managing & facilitating collaboration between experts is key.
3. It's **trustworthy**: the system comes with a measure of trust that what is being used is accurate and traceable

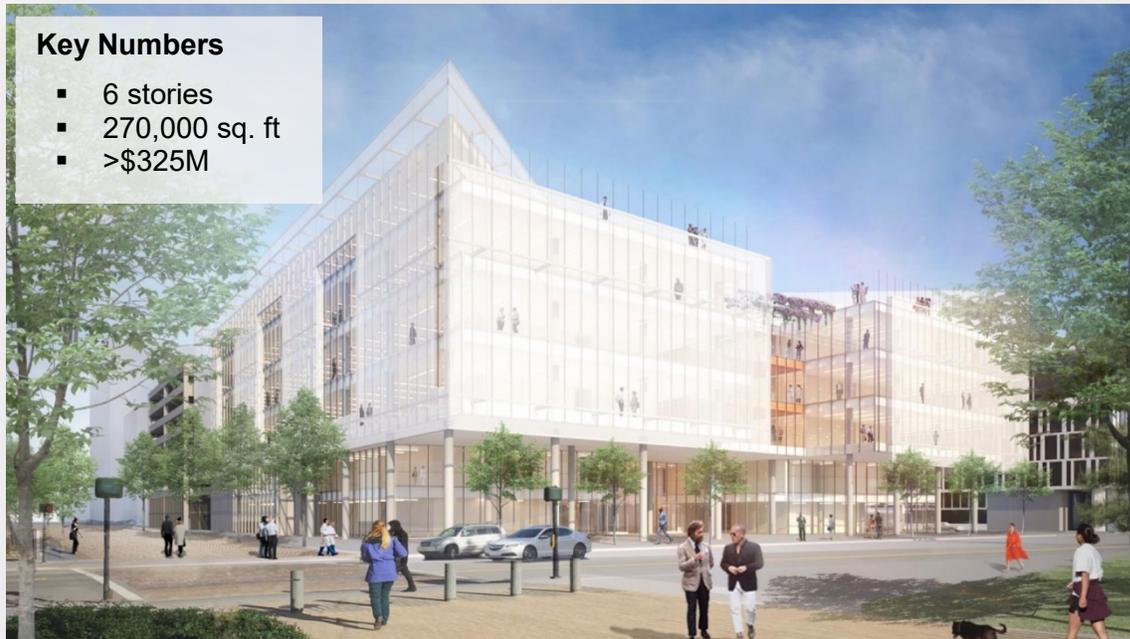
In addition to those, I would add a few more that will also be reviewed throughout this class:

1. It's **secure**: the system gives tight control of its contents, either creating or consuming the information
2. It's **integrated**: the system is supporting a workflow that involves other processes and inputs/outputs are usable outside the platform

Let's dive into how these concepts drive an actual product selection and its implementation on a large construction project in the San Francisco Bay Area.

¹ Wikipedia - Document management system

A project example: The Joan and Sanford I. Weill Neurosciences Building, San Francisco CA



Key Numbers

- 6 stories
- 270,000 sq. ft
- >\$325M

Figure a – A Rendering of the B23A Project

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“This new 270,000-sq.-ft. building will bring together psychiatry bench lab research with other neurosciences research, clinical and support spaces, to drive advances aimed at new treatments for disorders of the brain and nervous system. This ground-up project is being delivered using *Lean Integrated Project Delivery* processes, as well as team co-location in a *big room environment*.”

The neuroscience complex at UCSF Mission Bay will become one of the largest in the world.

Specialty features include:

- Clinical research space
- Desktop Research
- Low-iron glass curtainwall on three sides of the exterior
- Large atrium in the center of the building with roughly a 40' x 80' skylight
- Large outdoor terrace on the 6th floor to be used by occupants and for events
- Areas for "science on display".³

² Rendering courtesy of [Mark Cavagnero Associates](#)

³ Source : <https://www.dpr.com/projects/ucsf-block-23a-neurosciences-research-building>

Project setup & vision

Right at project inception, the University of California, San Francisco (UCSF) emphasized heavily on having all onboard parties rely on *Integrated Project Delivery (IPD)* methods that incorporate *Lean Construction* principles as well as requiring the *Integrated Design Team (IDT)* to use *Building Information Modeling (BIM)*, fostering a highly collaborative environment.

The main companies that form the IDT were:

- Owner: [UCSF](#)
- Architect of Record: [SmithGroup](#)
- Design Architect: [Mark Cavagnero Associates](#)
- General Contractor – CM at Risk: [DPR Construction](#)
- Structural Engineer of Record: [Degenkolb](#)

The team also includes a multitude of design & trade partners, about 20 companies, collocated on site in the project's *big room*:



Figure b - The UCSF B23A "Big Room"

The IDT was brought on early, before SD documentation was complete back in 2016. This gave the team the opportunity to tailor best practice workflows to best suit the technical particularities of the project:

- **90%** of people involved in design & fabrication on the project are working in **Autodesk® Revit 2018**
 - the remaining 5% were either using Trimble® Tekla Structures (for the *Rebar* and *Misc. Metals* trades), Autodesk® AutoCAD Civil 3D (for the civil scope) or AutoSPRINK (for fire protection design and fabrication)
- SmithGroup, the Architect or Record, had already setup an **Autodesk® BIM 360 Teams** site and their designers were already collaborating using **C4R**
- DPR Construction's best practice revolves around the use of **Autodesk® BIM 360 Glue** and **Autodesk® Navisworks**

- The project has to be fully coordinated to a fabrication level of detail by the issuance of the **Construction Documentation (CD)** set, requiring adequate staffing to support intense model-based coordination sessions multiple times a week.

One of the main processes the team decided to dive into is, you've guessed it, the **Document Management System**, in my opinion, one of the most critical processes to get right, especially on a very technical, highly collaborative project such as this one.

A few disclaimers before we start:

- *at that time, neither the BIM 360 **Design Collaboration** module nor the **Project Management** module were ready for production work*
- *DPR Construction (DPR) uses its own software (Oracle's CMiC) for certain Documents Control tasks. This is a company standard and is used by default on all projects to create, manage & distribute RFIs, Submittals and Change Orders. There is more flexibility regarding the management of design deliverable such as drawings and specifications.*
- *For risk mitigation reason, DPR & SmithGroup (the primary design manager) agreed to host all Revit models on SmithGroup's Team site and all collaboration material including the BIM 360 Docs platform on the DPR side, therefore using 2 different tenants*
- *DPR, across the company, also uses BOX as an online content management system for internal & external file sharing*

Developing the plan

The project team participated in a workshop to align on a foundational understanding of the current state of document management, then to use that understanding to develop a plan for document management for the project. The goal of the workshop was to specify document management process generally and the software solution to be deployed specifically.

Drawing on past experiences, the workshop team was asked to share experiences of good and poor document control practices. The following lists were the result of this discussion

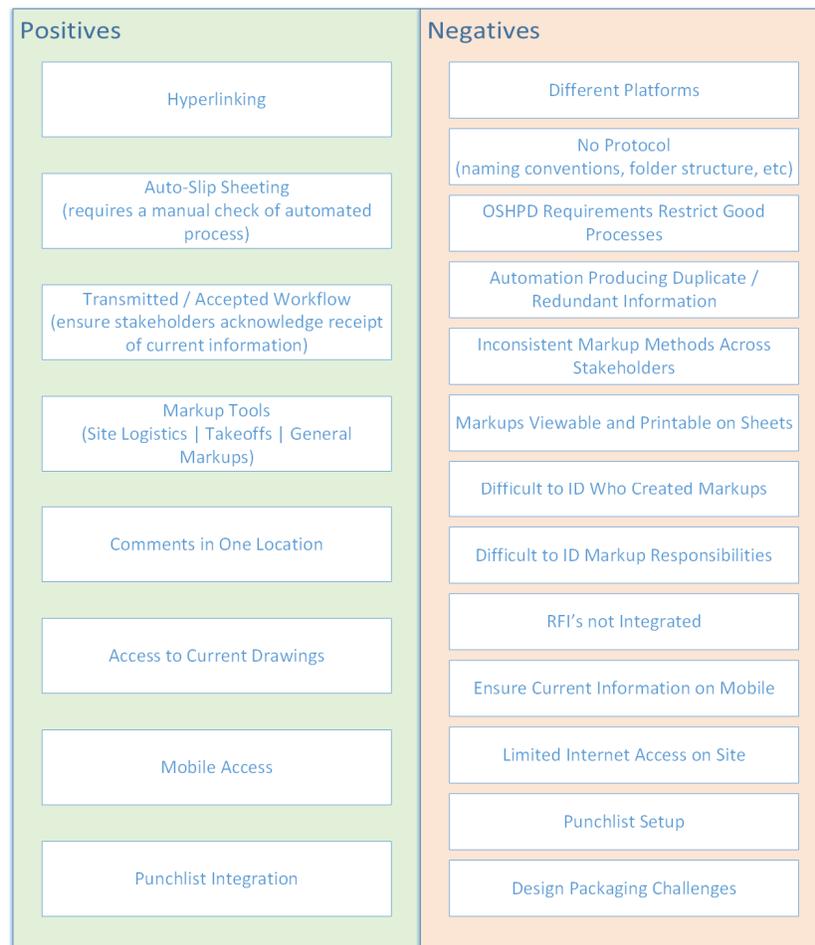


Figure c - Team's Positive & Negative aspects of past Document Management systems

The workshop participants then documented what their ideal future state would look like. A prioritized list of those characteristics was:

- **Single source of truth:** “one stop shop” for documents, no double handling of the information in different systems, accessible on desktop as well as mobile
- **Email notifications:** notification & sharing feature that integrates with email
- **Model Freeze Process:** supports the design process by clearly stating when t
- **Shop Drawing Revisions:** version control for traceable document management

- **BIM Integration:** integration into the model-based coordination process, from *design freeze* to *sign-off*
- **Change Management Reporting:** ability to compare different version to provide insight on what changed from one version to the next.
- **Automated Processes:** any potential API access or extension ability that would allow the team to expand the product features in the future
- **Access Management:** granular control over who has what type of access for a given file

The team then prioritized these desired states by order of importance and ranked them from least to most difficult to achieve. This exercise located each business function into one of 3 “zones”:

- Zone 1: a mix of *Low-Hanging* and *High-Value* – 1st priority
- Zone 2: more strategic functions – important but more difficult to achieve
- Zone 3: the least important and most difficult functions – “nice to have”

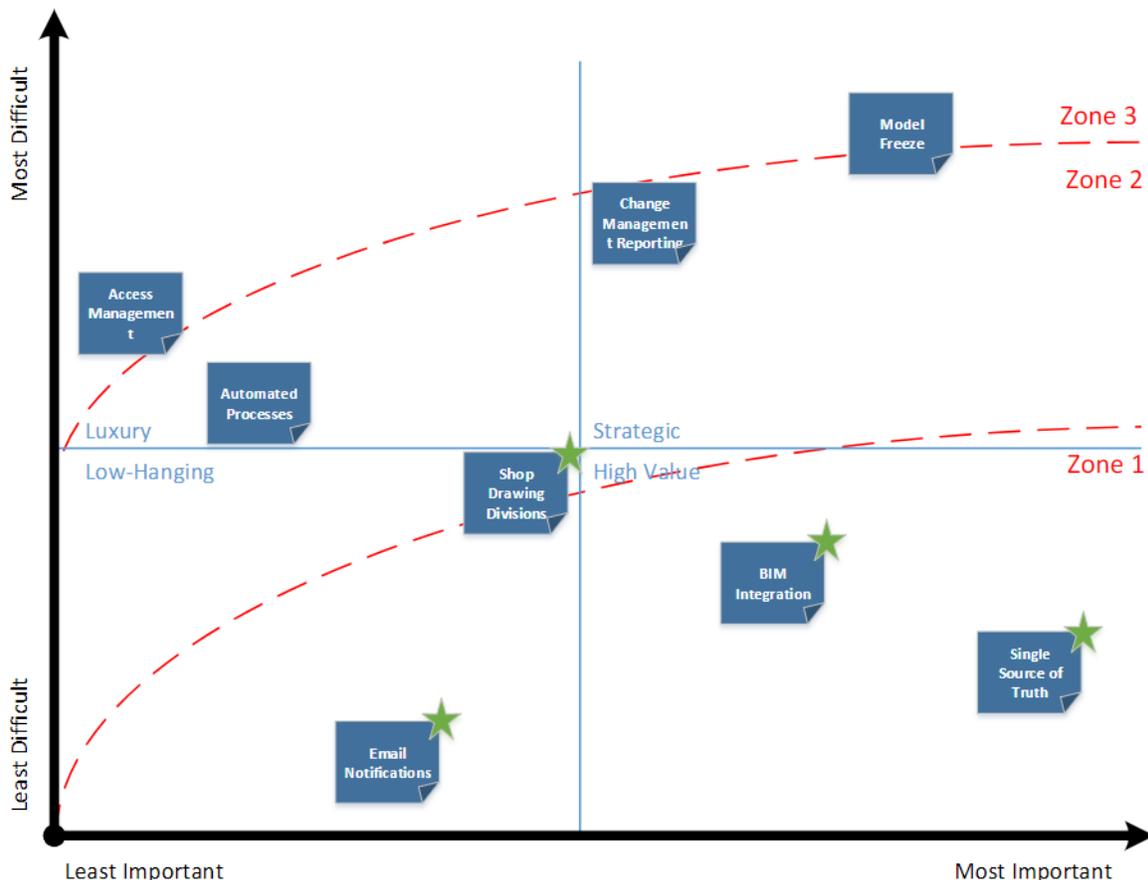


Figure d - Process function rankings in each "Zones"

For a complete detailed review of the process, please refer to the **CS225978-Goyat-AU2018-Workshop Report.pdf** attachment.

Settling on a solution

Once the criteria for what the team was looking for in a Document Management system, workshop attendees decided to evaluate how these business functions could be addressed using (4) potential software solutions:

- **Bluebeam:** combined use of *Project* and *Studio* along with the iPad app
- **PlanGrid:** combined with *BOX* for desktop PDF syncing, the team having decided PlanGrid by itself lacked the seamless utilization of PDFs
- **BOX:** exclusively using the online platform and the *BOX* app on mobile devices
- **BIM 360 Docs**

Although many more solutions were available, these were arbitrarily chosen based on the team's previous experience in order to limit the learning curve. This was the team's preference ranking:

Table a - Software Solution comparison:

	<i>Single source of truth</i>	<i>Model Freeze Process</i>	<i>BIM Integration</i>	<i>Change Management Reporting</i>	<i>Automated Processes</i>	<i>Access Management</i>
<i>Bluebeam</i>	++	-	-	++	++	+
<i>Plangrid + BOX</i>	+	-	-	++	+	++
<i>BOX</i>	+	-	-	+	+	+
<i>BIM 360 Docs</i>	++	++	++	++	++	++

Legend:

- Not applicable
- + Can perform the task
- ++ Best in class for the given task

**please note this is how the team felt about the software and how confident they knew they were at their current level of expertise – this does not reflect on the actual capabilities of a given software.*

***business functions that ranked evenly across all solutions were not represented*

At the end of the workshop, the team evaluated current software offerings and decided to implement **BIM 360 Docs**, mostly due to its integration with Revit, it's granular permission control that also affected tools such as BIM 360 Glue or Field which were already planned to be used and the potential for future developments promised by Autodesk, notably regarding mobile accessibility.

BIM 360 Docs – Setup and Usage⁴

The setup portion of the platform focused on 3 key steps:

1. Defining permission levels
2. Defining the folder structure
3. Defining & implementing the workflow for administrating access & usage

As a full time VDC Manager on the project and the most passionate about integrating the *Document Management process* with the *VDC process*, I took on the responsibility of setting up and administrating the platform; this gave me the flexibility, at the project level, to respond to minor tweaks in the setup as the project progressed while ensuring the integrity and accuracy of the content as it related to the *model-based coordination* effort happening in parallel.

The only other *project administrators* of the platform at the time included DPR team members in charge of slip-sheeting documents.

Defining permission levels

One of the key features that appealed to me was the level of granularity that the platform offered in terms of access and permission management. The ability to provide access to a specific folder either by role or by company allowed me to very precisely monitor who had access to what.

- A *design team member* would want access to all in-progress documents that the team is collaborating on regardless of the level of completeness, as long as it clearly states in which stage the document is at.
- On the contrary, a *field supervisor* only wants to be made aware (and use) and approved, final documents that can be built and inspected off of.

Based on previous experience, the following roles were selected:

- **Architect:** Smithgroup personnel only – responsible for the publication of document packages
- **Designer:** architects and their consultants, anyone that is contracted under SmithGroup including Smithgroup
- **Contractor:** DPR personnel only – considering DPR is self-performing work, this includes not only the General Contractor personnel but also the self-perform trades (which are each listed as separate companies in the system)
- **Subcontractor:** all of DPR's trade partners regardless of their contract type (design-build, design-assist or plan & spec).

The ability to add multiple roles per company came in handy to be able to give Smithgroup access to all documents their consultants had as well as giving them elevated rights to certain folders to support their design management responsibilities.

The *field-related roles* were left to be defined later once construction activities were about to start the following year.

⁴ For any help regarding the activation of the service please refer to the [online help](#) provided by Autodesk

Defining the folder structure

BIM 360 Docs is by default organized in a **Plans** and **Project Files**.

The Plans folder automatically extracts individual sheets from multi-page documents. Here is the layout of this folder for the project as is now stands:

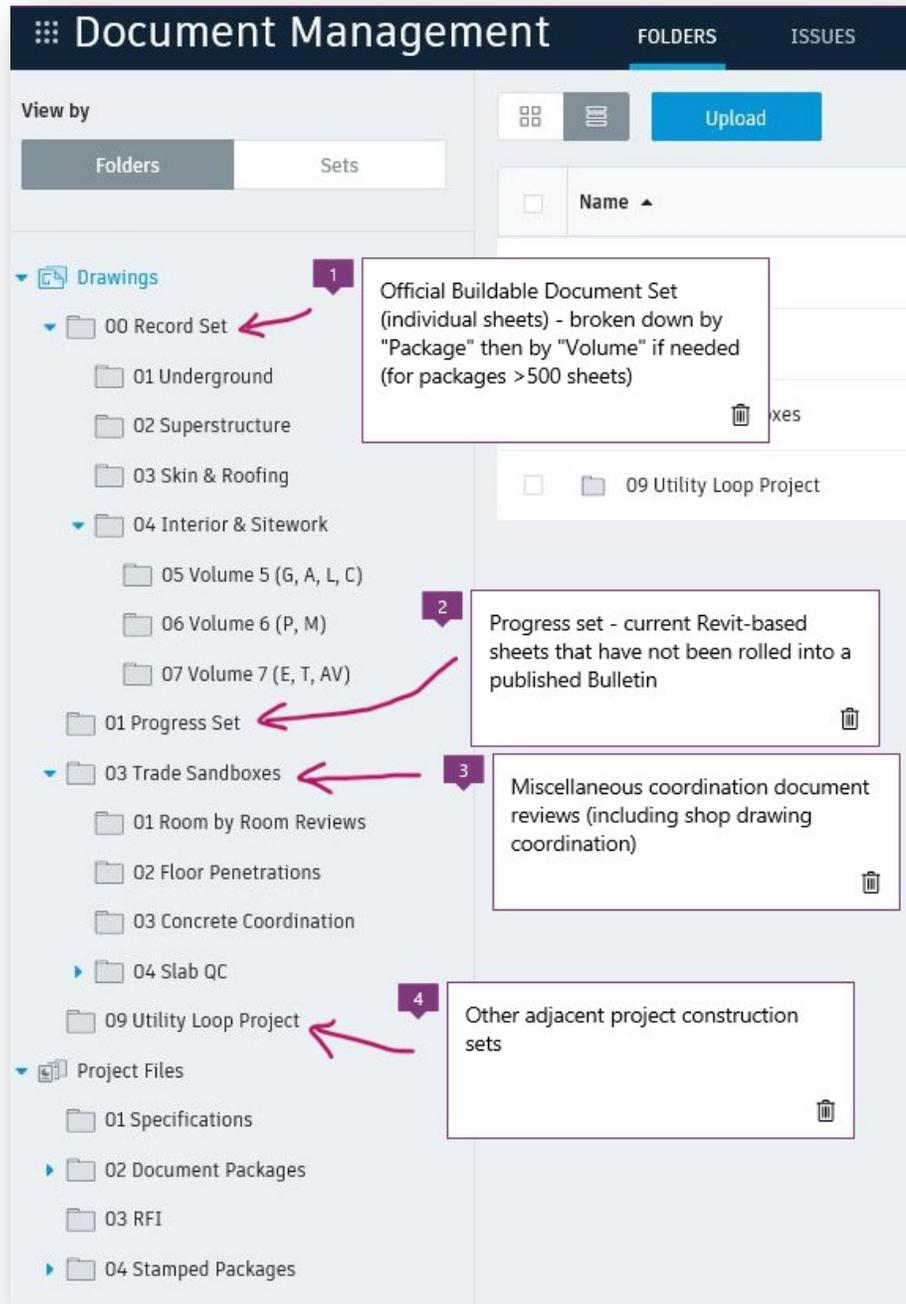


Figure e - Plans folder breakdown

The **Project File**'s folder is organized as such:

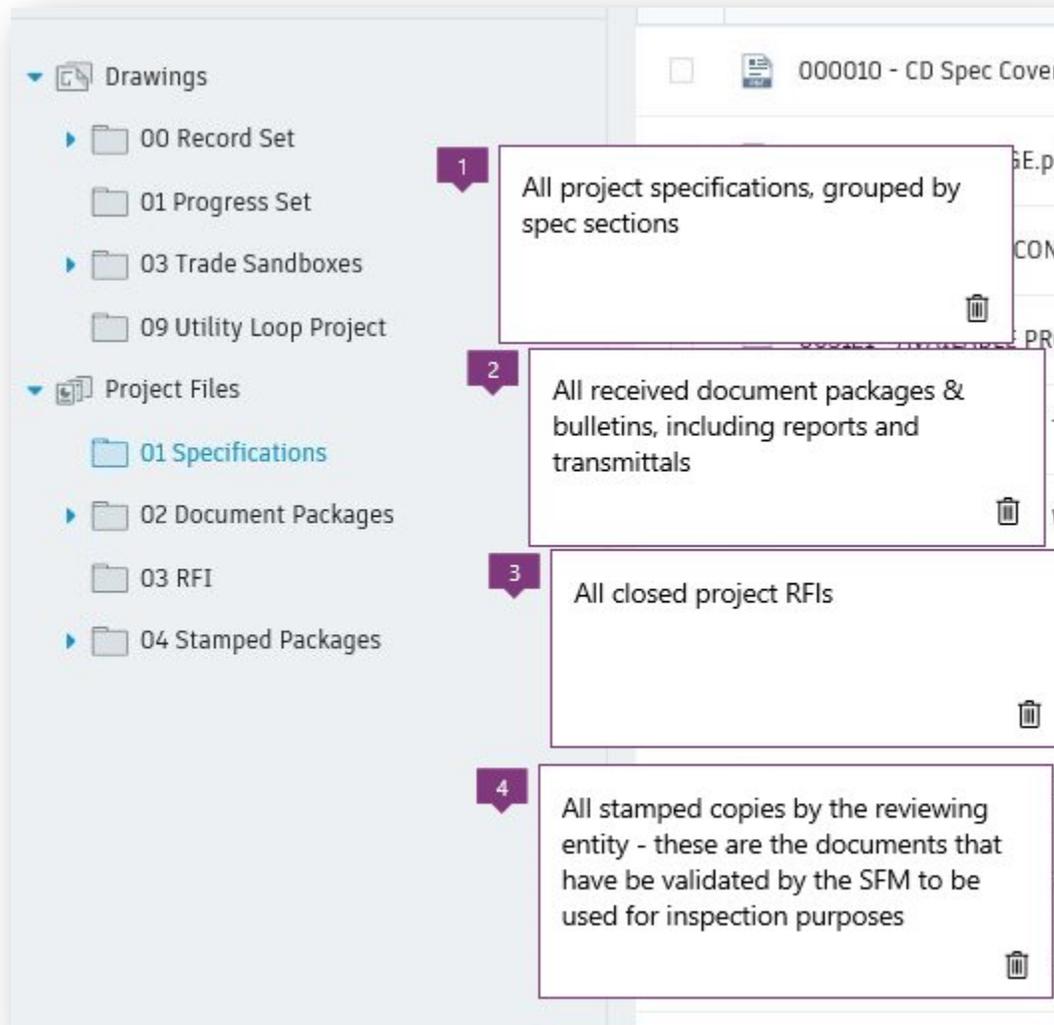


Figure f - Project File folder breakdown

Some notable aspects:

- The above screenshots show the view associated with Contractor view rights. Although variable viewing rights for each role were kept to a minimum, the **Progress set** and **Trade Sandboxes** folders are kept hidden from anyone that is not involved in the development of design components.
- The *State Fire Marshall (SFM)* is the regulating authority on the UCSF campus in charge of reviewing design intent for code conformity and delivering construction permits

Some of the limitations of the software drove the team to breakdown the **Record Set** folder into multiple subfolders due to:

- The limited search & filtering capabilities
- The 500-page limit on simultaneous downloads

The Record set folder is populated using the multipage drawing sets uploaded to the Document Packages in the Project files folder – this was intentionally setup to use only what was officially transmitted instead of the live Revit model saved on BIM 360 Teams.

The **Progress Set** folder was created to house a weekly update to floor plans and RCPs as well as certain noteworthy elevation sheets that were to be used on a regular basis – the team felt the need to always be able to have access to the latest and greatest iteration of the current design somewhere other than on BIM 360 teams in model format.

- The progress set was populated using a saved copy of the Revit model published to BIM 360 Teams and uploaded to BIM 360 Docs⁵
- This was purposefully setup so the team had access to the Revit metadata and 3D views offered by using a Revit model instead of a PDF.

As is already apparent, even the best setup in the world is only as good as the first time it needs to change... which we discovered as we started using the platform.

“Everyone has a plan until they get punched in the mouth” – Mike Tyson

Usage & Modifications

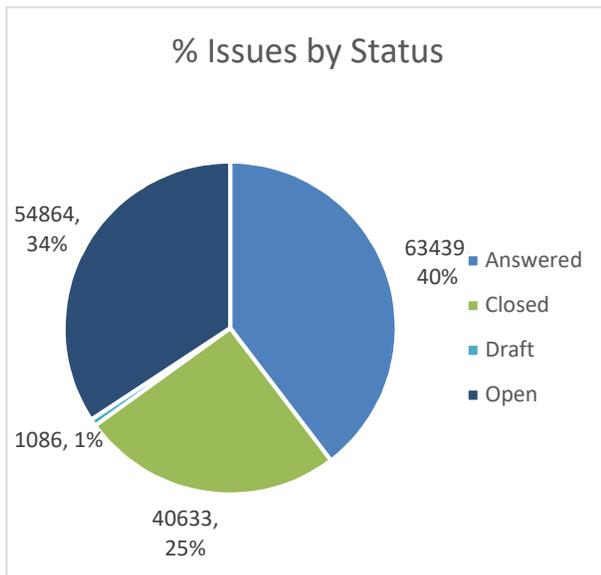
I mentioned previously some modifications were made to the folder structure to better adapt to the workings of the project team and although this is possible from a technical standpoint it requires, as just about anything rolled out in a production environment, discipline.

Inherited permission levels for subfolders meant several other new “root” folders needed to be created along with 2 new roles:

- An **Inspector** role: a view only role to the Stamped Packages
- A **Superintendent** role: for DPR personnel, similar view rights to the Inspectors along with the ability to view certain Sandbox folders showing “QC” drawings (pre-pour documents and checklists for example)

Having one place, and one place only to go to review drawings, specifications or closed RFIs help build the confidence required to have all the field and inspection personnel involved. The platform is successfully being used as the single source of truth and is also now serving as an active platform to bring up and answer design questions through the Issues module.

⁵ As explained previously, the *Design Collaboration* module was unfortunately not production-ready at the time this process was setup – the module now offers a more seamless way to load Revit content into the *Document Management* portion of the platform



Although this was not initially scoped out in the setup of the platform, the system currently counts over 160,000 issues that were raised and most of time answered as part of the design process and avoided the creation of an RFI, which would have required additional administrative steps to process. In order to manage those efficiently, some strict rules regarding the description and location data were developed to help organize the increasing number tags and pins managed by various team members.

See example of issues being used on sheet on the next page (Figure g)

Along the same lines on the administration side, some additional feature were put to use to help the searching and filtering of the ever-growing content the end users were having to deal with:

- Various new **titleblock** definitions for shop drawings in the *Sandbox* folder
- **Document attributes** in the *Project Files* folder that allowed tagging each document issuance with the Package (Underground, Superstructure, Skin + Roofing, Interior + Sitework) it was part of.⁶

Conclusion

All things considered, using BIM 360 Docs as a document management system adequately answered the main key features requested during the workshop while the initial setup provided enough flexibility to accommodate minor requests and process changes down the line.

Scoping out requested features in advance helped gain buy in from the team up front which help alleviate frustrations as team members stretch the platform to the limits. Although the team in looking forward to future developments, notably in terms of mobile applications, the system provides a level of trust and an ease of access that, coupled with the minimal effort required for maintenance, does meet the expectations set at the start along with new opportunities for design collaboration.

⁶ This was before the “Sets” feature got released [in August 2018](#)

A-1102 - LEVEL 2 OVERALL PLAN V26 Set not assigned

Issues

Filter ▾ Sort ▾

OPEN Unspecified

#1088 - Wall alignment
Assigned to: [redacted]
Location: V28 (current)

ANSWERED Unspecified

#1081 - Electrical Room Door height
Assigned to: [redacted]
Location: V28 (current)

OPEN Unspecified

#1061 - Fur wall change
Assigned to: [redacted]
Location: V28 (current)

OPEN Unspecified

#1060 - 2Hr rated wall
Assigned to: [redacted]
Location: V28 (current)

OPEN Unspecified

#1059 - Framing around pocket door
Assigned to: [redacted]
Location: V28 (current)

OPEN Unspecified

#1058 - [redacted]
Assigned to: [redacted]
Location: V28 (current)

[Create Issue](#)

GENERAL SHEET NOTES

UCSF
UNIVERSITY OF CALIFORNIA
SAN FRANCISCO

SMITHGROUPJJR
ARCHITECTS

DPR
CONSTRUCTION

CAVAGNERO
ARCHITECTS

SHEET KEYNOTES

GRAPHIC LEGEND

LEVEL 2 OVERALL PLAN

DATE: 01/12/2017
BY: CD
PROJECT: A-1102

Figure g - An example of a sheet used to track design questions or issues

Usage by the Numbers:

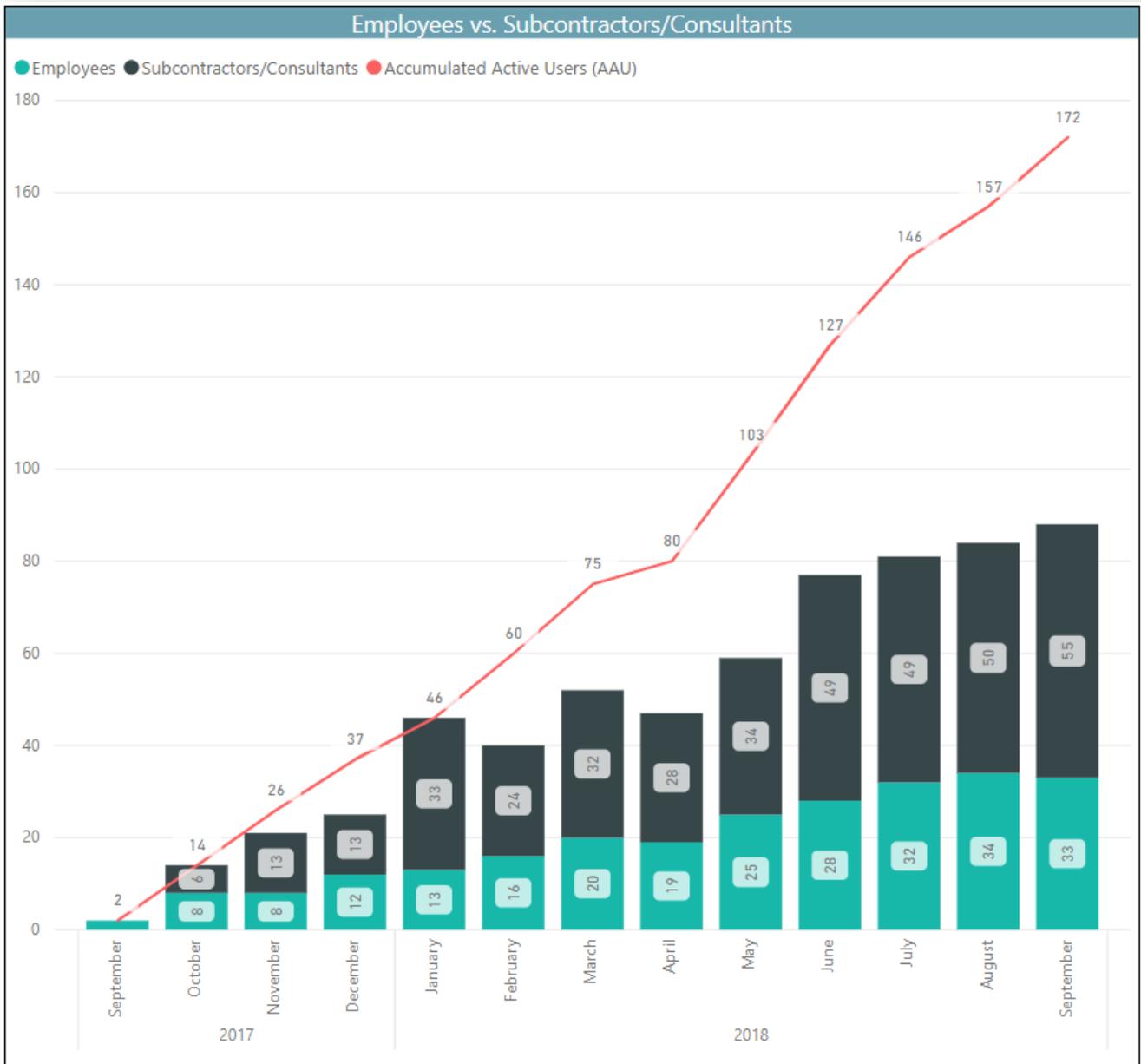


Figure h - A representation of the usage spread between DPR Employees and other team members on the project

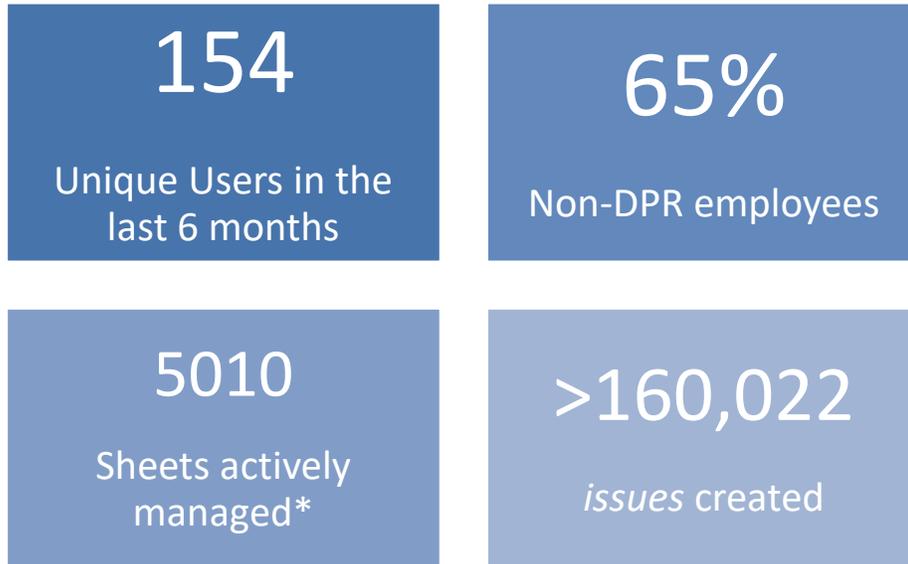


Figure i - BIM 360 Docs metrics - *only record set drawings, includes versions

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List of Acronyms

BIM	Building Information Modeling, 1, 5, 8, 9, 10
IDT	Integrated Design Team, 5
IPD	Integrated Project Delivery, 5
SFM	State Fire Marshall, 12
UCSF	University of California, San Francisco, 4, 5