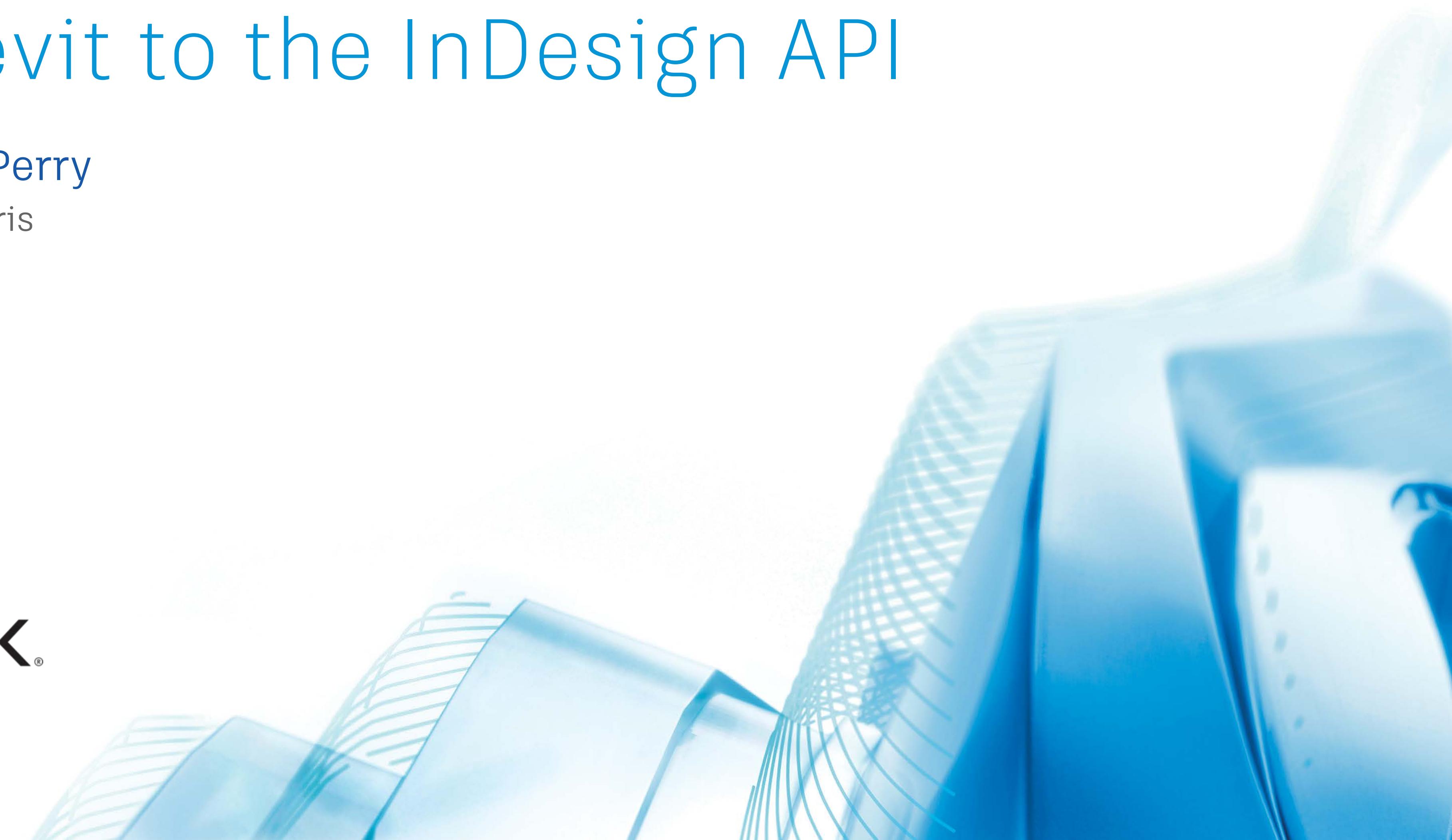


One-Click Model Reports: Connect Revit to the InDesign API

Oliver Green & Aaron Perry

Allford Hall Monaghan Morris



Thanks for Joining Us

Session Overview

Introduction

About AHMM, Digital Design Group, Speakers

Model Reviews

Overview of our Model Review Process, QA at AHMM

InDesign's API

Introduction to InDesign API, Interprocess Communications

Automated Model Reviews

Assembling Everything Into a Finished Product





About AHMM

Allford Hall Monaghan Morris

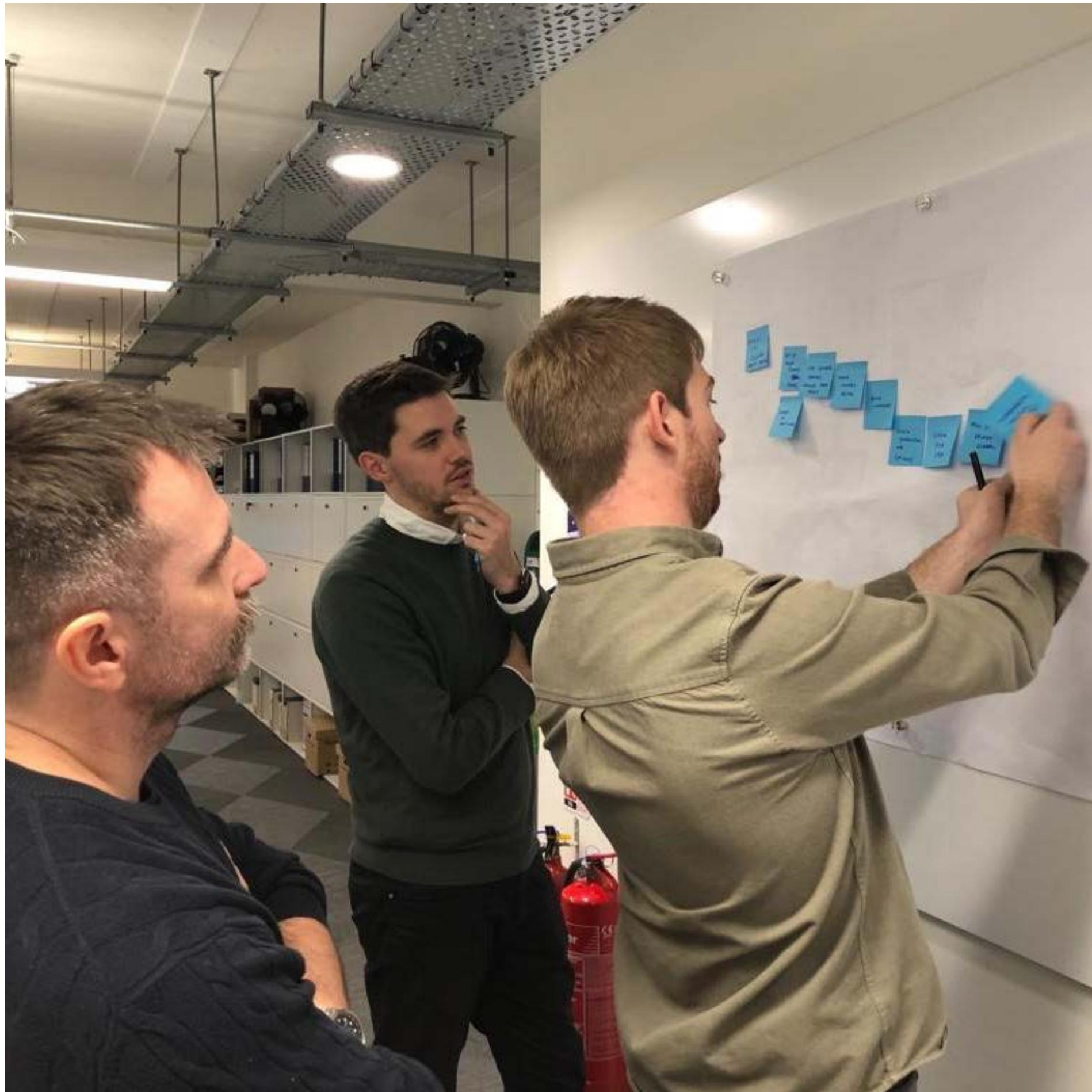
AHMM is a large architecture firm (480+) with offices in London, Bristol and Oklahoma

Works across all sectors and sizes

Stirling Prize winners 2015

AJ100 Practice of the Year 2018

Building Magazine Practice of the Year 2018



Digital Design Group

Office-Wide Support

Within AHMM, the Digital Design Group offers full time project assistance in all areas of Digital Design strategy, application support, content and computation

The DDG develops and tests strategies for model maintenance, best-practice workflows, training, standards and QA

AHMM has extensive experience developing custom tools in-house to assist architectural teams



About the Speaker

Aaron Perry

Practice BIM manager and lead of AHMM's digital design group since 2015

Responsible for digital design across the entire practice, its multiple offices, stretching all live and future projects. This involves mitigating risk, engaging client / contractor, managing infrastructure and software, driving change and inspiring staff to embrace digital design authoring, review and visualisation technology



About the Speaker

Oliver Green

Designs and develops custom tools to assist AHMM's architects. This involves anything from building design tools, model analysis, data management to full process automation

Formerly worked as an architect
Before that, a video games designer

Self-taught developer, using Python, C# and Dynamo in daily work

The Value of Model Metrics?

Aaron Perry
Administrator

Oliver Green
Administrator

Project Details
Projects / Project number: #17027

#17027 - Central House

TEAM

Client:	Revit Lead:	Revit version(s):	Last used:	Last update:	Last sync:	Users:
Revit Lead:	Revit version(s):	10-06-2019 16:02	10-06-2019 17:17	10-06-2019 17:18	10-06-2019 17:18	5

STATISTICS

Category	Value	Status
Orange activities	2173	top 10%
Red activities	2173	top 10%
Elements Created	131061	top 10%
Elements Deleted	7943465	top 10%

Syncs | **Users**

KEY EVENTS for Monday, June 03, 2019

- @ OFFICE\RDervishi overrode dimension value in project Central House
- @ OFFICE\RDervishi deleted 442 elements from project Central House
- @ OFFICE\RDervishi overrode dimension value in project Central House
- @ OFFICE\RDervishi overrode dimension value in project Central House

Total time: 608.0 hours | Warnings: 0 | Sync with central avg.: 1.55 mins

TEAM

User	Client:	Revit Lead:	Revit version(s):	Last used:	Last update:	Last sync:	Users:
OGreen	Revit Lead:	Revit version(s):	12-06-2019 12:17	12-06-2019 12:17	23-05-2019 21:13	104405	5
RDervishi	Revit Lead:	Revit version(s):	12-06-2019 12:17	12-06-2019 12:17	23-05-2019 21:13	27419	5
AKuric	Revit Lead:	Revit version(s):	12-06-2019 12:17	12-06-2019 12:17	23-05-2019 21:13	587	5
admindp	Revit Lead:	Revit version(s):	12-06-2019 12:17	12-06-2019 12:17	23-05-2019 21:13	587	5
gconzo	Revit Lead:	Revit version(s):	12-06-2019 12:17	12-06-2019 12:17	23-05-2019 21:13	104405	5

STATISTICS

Category	Value	Status
Orange activities	587	average
Red activities	587	average
Elements Created	27419	average
Elements Deleted	104405	average

Syncs | **Users**

KEY EVENTS Monthly View

Min. Priority: 1 | Date: June 2019

Sunday Monday Tuesday Wednesday Thursday Friday Saturday

26 27 28 29 30 31 1
2 3 4 5 6 7 8
9 10 11 12 13 14 15

Digital Projects Dashboard

We could never open all models and manually review them on a weekly basis. It is very difficult to know when something is going wrong on a project, updates from some teams is very light.

AHMM run a monitoring tool that records all usage of Revit. When key activities occur on a project, we are notified. Healthy/unhealthy projects and comparison, Training/Support requirements and cross projects business insights.

QUESTION PERFORMANCE - SCORE

SELECT ASSESSMENT, DATE AND RANGE

AHMM Revit Architecture [Advanc...

AHMM Revit essentials training

AHMM Revit Architecture [Fundamentals]

AHMM Revit Users Annual Assessment

Revit Architecture 2016 Fundamentals

Test Date

17/08/2015

20/05/2019

Question Score

-19

100

Time Taken (mins)

5

14150

Question Score ● Average Company Score1

-20 = SKIPPED QUESTION

9K

8K

7K

6K

5K

4K

3K

80

75

70

65

Dynamic Group Name

Group Name

KnowledgeSmart Assessments

I don't know what you don't know

Custom AHMM assessments to understand where knowledge gaps exist for us to then develop a training roadmap/plan

AHMM TRAINING OUTLINE

REVIT DEVELOPED DESIGN



Intended Audience

Those working on Revit projects between RIBA stages 2-3. Revit Developed Design is part of AHMM's core Revit training program. Users interacting with a Revit project between stages 2-3 will be expected to understand the basic principles and best practice when working with Revit at AHMM or have completed AHMM's Revit Basics training.

Session Goals

By the end you will understand how to develop and manage a project RIBA stage 2-3 at AHMM using Revit. Understand Revit's interface and terminology, how to create the model using architectural components, creating and modifying Revit system families, dynamic drawing schedules and understand Revit project collaboration.

Session Overview

System Family Editing
Edit type
Duplicate and create a new type
Naming standards
Edit system family structure
Create and control constraints

Schedules Basics
Schedules building components
Schedule by Category
Add fields (Parameters)
Properties tabs
Filters and formatting

Families Walk through
Introduction to loadable families
Family placement
Duplicating family types
Families Options Basics

Session Duration: One Day

AHMM TRAINING OUTLINE

REVIT CONTENT CREATION ESSENTIALS



Intended Audience

Those who have completed Revit Developed Design training and are moving on to a project where they will be interacting with Revit families frequently. Revit Content Creation Essentials is part of AHMM's core Revit training program. The practices and techniques put forward in this training session will be required when taking part in more advanced training sessions and workshops.

Session Goals

By the end of the session you will have an understanding of how Revit families are created and controlled. You will have an overview of the common practices and techniques used in AHMM's content. On completion of the training session an attendee will have the confidence to interact with families in a live project or from the AHMM library.

Session Overview

Introduction to Revit Families
Load families v system families
Revit categories + sub-categories
Family templates

Fully Parametric Table Exercise
Family creation best practice
Ref planes, dimensions and parameters
Associating geometry to reference planes
Hidden constraints
Work planes

Nesting
The concept of nesting
Levels of nesting
Best practice when nesting families
Visibility Controls For Families

Session Duration: 4 Hours

AHMM TRAINING OUTLINE

REVIT WORKSHOP VISUALISATION



Intended Audience

This workshop is designed for those looking to create renders directly from Revit using Enscape. Exploring how to get the best out of Revit materials and appropriate application of ArchVisions RPC content. Those wanting to gain a better understand Revit materials and how best to manage them in a project.

Session Goals

By the end of this session you will understand Revit materials, the elements that make up Revit materials and where to find AHMM's central Revit material resources. An introduction to Enscape, navigation, creating views, exports, VR experiences and best practice. An introduction to ArchVisions RPC content for Revit. An introduction to AHMM content for visualisation, mannequin people and lighting families. Best practice when using all of this content in a Revit project.

Session Overview

Introduction to Revit Materials
Revit materials browser
Material identity, graphic and appearance
Material creation and duplication
z_Revit materials, hatches and textures
Materials container file

Enscape
Starting View
Navigation walking vs flying
Creating views Enscape to Revit
Exporting from Enscape
Enscape Settings

AHMM Mannequin People
When to use mannequin people
Where to find ENT families
Creation technique
How to control render appearance

Session Duration: 1.5 Hours

Training Courses

AHMM run regular training sessions almost every day

40+ Internally-developed training courses - from 1 hour workshops to full day Revit training sessions

Our experienced team delivers training in a standardised way, contextualised within the way we work at AHMM

Model Reviews

A detailed 40-page InDesign document we prepare for each project per stage
Some parts automated export from Revit, other parts human-authored commentary

Not just a data export; a way of measuring Revit skills & imparting applied knowledge

AHMM MODEL REVIEW

PROJECT 18070
TOWER HAMLETS TOWN HALL



ALLFORD HALL MONAGHAN MORRIS

3 April 2019

© Allford Hall Monaghan Morris

AHMM MODEL REVIEW

PROJECT 15119
D3D4 WOOD WHARF



ALLFORD HALL MONAGHAN MORRIS

29 May 2019

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AHMM MODEL REVIEW

PROJECT 16092
TOTTENHAM HALE CENTER ISLAND SITES

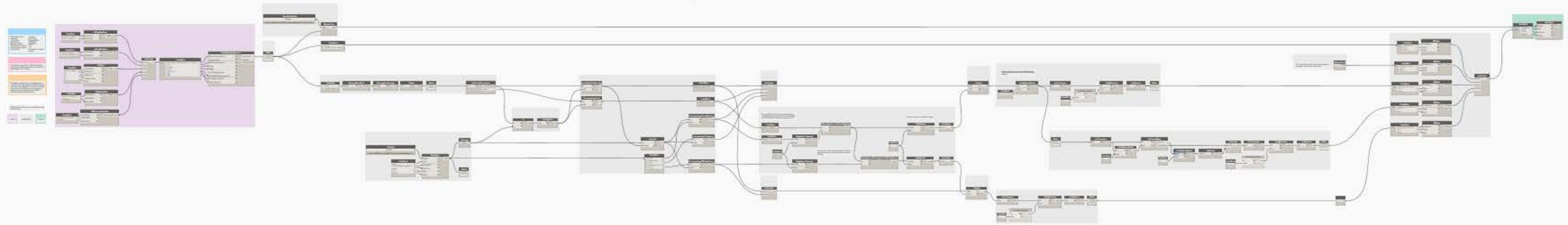


ALLFORD HALL MONAGHAN MORRIS

8 April 2019

© Allford Hall Monaghan Morris

Not Just a Technology Talk

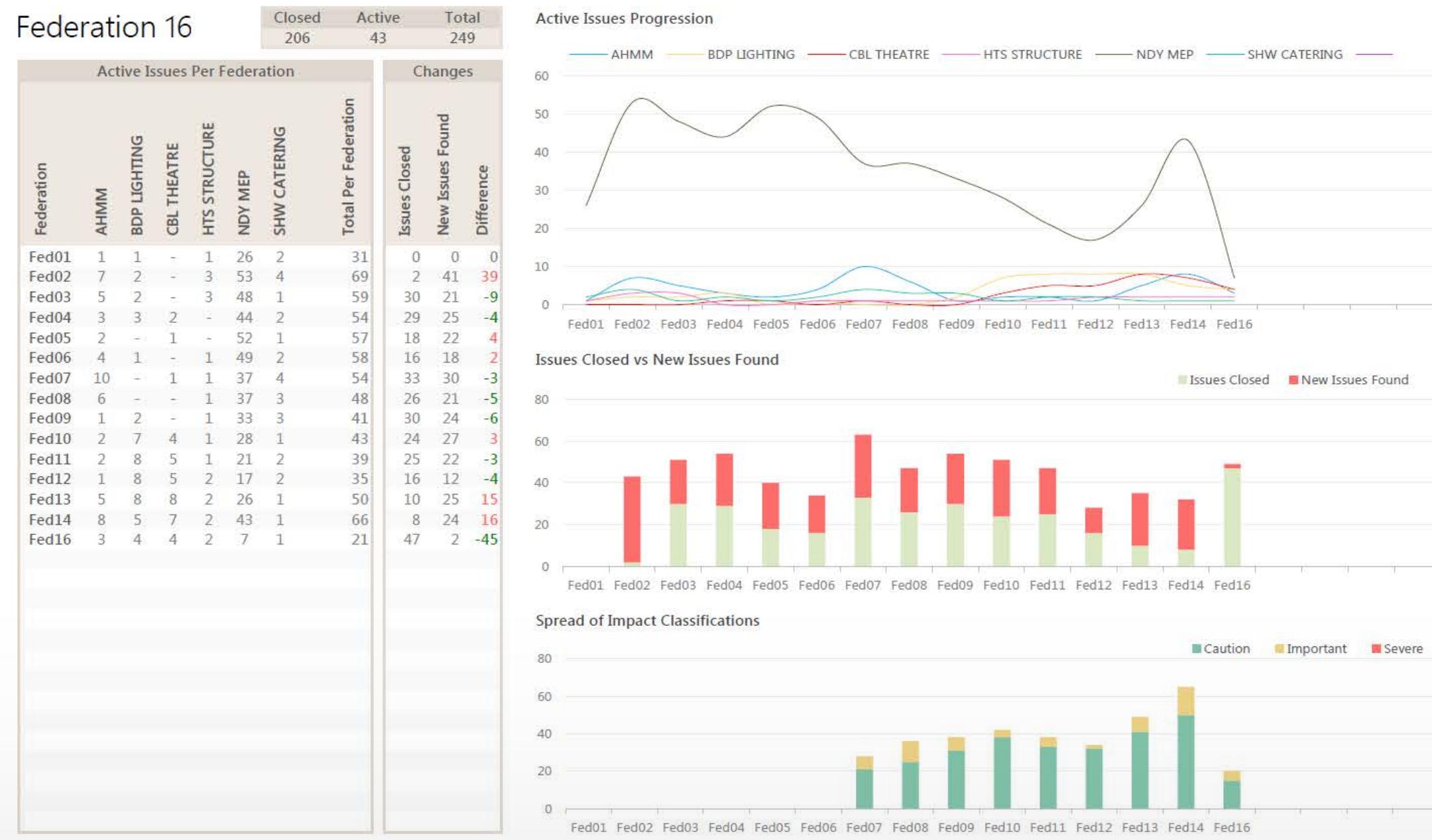


Development at AHMM

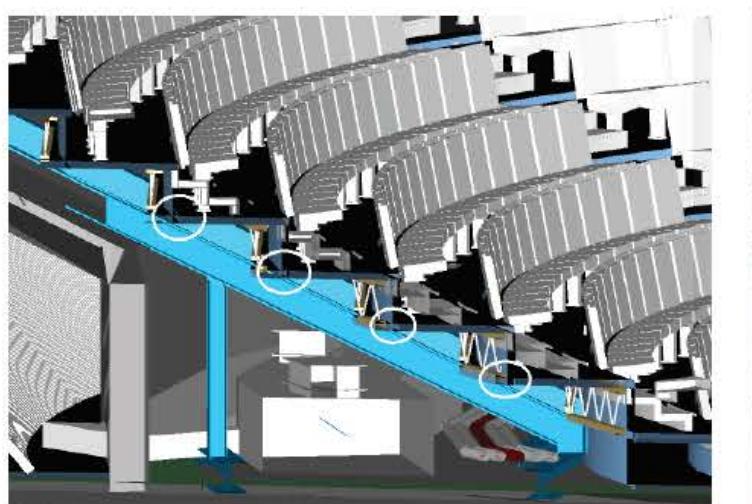
We develop our own tools in-house to allow for custom UI, high-performance functionality that meets our needs.
A library of pre-built and audited content, Dynamo & Python scripts, our C# Revit Ribbon (+ WPF front-end)

Whatever we can do to "let architects be architects"

Visual Coordination Summary



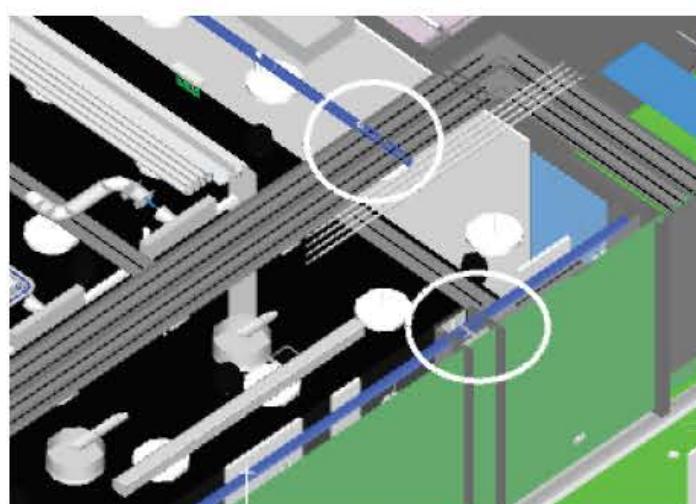
Visual Coordination Highlighted Issues



HTS to lower beam in order to fit buildup for seating

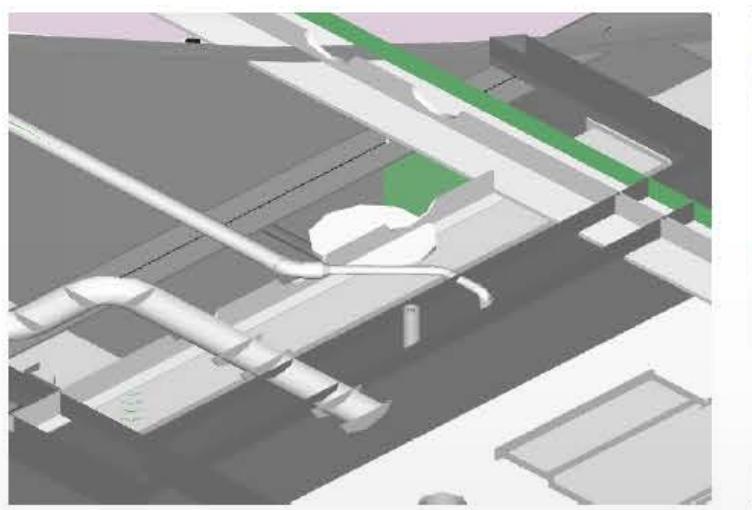


CBL has moved speakers away from structural beam, however they are now clashing with lighting tracks and MEP pipes

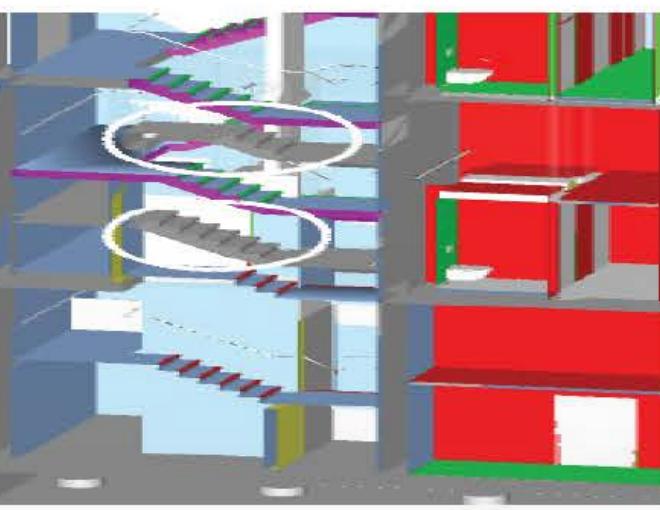


BDP to review light track location as it is going through a structural column and a cable tray

Oustanding Historic Issues



BDP to amend lighting fixture location and avoid clash with structure and mep



HTS To review staircase to match base build model



NDY to coordinate to align with AHMM

Digital Coordination Report

We use InDesign a lot at AHMM - it's powerful, flexible and creates beautiful reports that are easy to edit
Automating InDesign has been on our wish list for a long time

Not just for architects – potentially helpful for all parts of AEC

LONDON.2018 DYNAMO STUDIO BUILDING DESIGN & ENGINEERING DESIGN

INDUSTRY TALK AULON33182 Create Instant Professional Reports Using Dynamo Oliver Green

Share Comment Bookmark Recommend (0)

Search this class

Definition Deconstruction

Overview

- Video 44 min 30 sec
- Presentation 51 slides
- Downloads 2 files

Process Automation

Use Dynamo to automate your data collection
Automate summaries & formatting
Use Python to generate reports from a template

Visual Coordination Summary

Federation 16

Federation	AHMM	BDP LIGHTING	CBL THEATRE	HTS STRUCTURE	NDY MEP	SHW CATERING	Total Per Federation
Fed01	1	-	1	26	2	31	0
Fed02	7	2	-	3	53	4	60
Fed03	5	2	-	3	48	1	59
Fed04	3	3	2	-	44	2	54
Fed05	2	-	1	-	52	1	57
Fed06	4	1	-	1	49	2	58
Fed07	10	-	1	37	4	54	33
Fed08	6	-	-	1	37	3	48
Fed09	1	2	-	1	33	3	41
Fed10	2	7	4	1	28	1	43
Fed11	2	8	5	1	21	2	39
Fed12	1	8	5	2	17	2	35
Fed13	5	8	8	2	26	1	50
Fed14	8	5	7	2	43	1	66
Fed15	3	4	4	2	7	1	21
Fed16	47	2	41	39	25	22	-3

Impact Classification Key

Critical: Awaiting further information (such as a survey) and can have a significant impact. Low impact: Model adjustment that can be made without significant impact. Escalated: High impact. Multiple consultant discussion required.

Active Issues Progression

Issues Closed vs New Issues Found

AU 2018 Presentation

Last Year's AU London Presentation was also about creating reports
A different take - using Dynamo. This is more manual, but more accessible technologically

Also a talk about data visualisation and displaying accurate information in a succinct way

A2 : X ✓ fx 39333-PCL-01-ZZ-M3-G-0001-RM-S1-P02.rvt

	A	B	C	D
1	Revit Link Name	Count	Shared Site?	Element ID
2	39333-PCL-01-ZZ-M3-G-0001-RM-S1-P02.rvt	1	No Shared Site	1387076
3	39333-PCL-02-ZZ-M3-G-0001-RM-S1-P02_PROPOSED.rvt	1	No Shared Site	1387079
4	39333-PCL-03-ZZ-M3-G-0001-RM-S1-P02.rvt	1	No Shared Site	1387082
5	39333-PCL-04-ZZ-M3-G-0001-RM-S1-P01.rvt	1	No Shared Site	1387085
6	39333-PCL-05-ZZ-M3-G-0001-RM-S1-P02.rvt	1	No Shared Site	1389686
7	39333-PCL-ZZ-ZZ-M3-G-0001-RM-S1-P01.rvt	1	No Shared Site	1389689
8	3989-AKT-XX-XX-M3-S-Proposed Structural Model.rvt	1	No Shared Site	1432178
9	007317-HAP-V00-ZZ-M3-A-0002-AUDIT.rvt	1	No Shared Site	1614326
10	007317-HAP-V00-ZZ-M3-A-0001-AUDIT.rvt	1	No Shared Site	1614364
11	007317-AKT-V00-ZZ-M3-S-100LS-AUDIT.rvt	2	No Shared Site	1769146
12	2089_AM(XX)GA_XX_01_P01.rvt	1	No Shared Site	1769149
13	1FA-AHMM-ZZ-ZZ-M3-A-XX001_CLEAN.rvt	1	No Shared Site	2439644
14	39333-PCL-02-ZZ-M3-G-0001-RM-S1-P02.rvt	1	No Shared Site	6361387
15	007317-AKT-V00-ZZ-M3-S-100LS-AUDIT.rvt	2	No Shared Site	6384314
16				
17				
18				
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21				
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24				
25				
26				
27				
28				
29				

1.0 Detailed Findings & Model Size

1.7 Linked Revit Files

There are **14** linked RVT files in the model. This is a slightly high number and the naming strategy is not as clear as it could be. Some links have been placed multiple times in the model.

Name	Count	Shared Site?	Element ID
39333-PCL-01-ZZ-M3-G-0001-RM-S1-P02.rvt	1	No Shared Site	1387076
39333-PCL-02-ZZ-M3-G-0001-RM-S1-P02_PROPOSED.rvt	1	No Shared Site	1387079
39333-PCL-03-ZZ-M3-G-0001-RM-S1-P02.rvt	1	No Shared Site	1387082
39333-PCL-04-ZZ-M3-G-0001-RM-S1-P01.rvt	1	No Shared Site	1387085
39333-PCL-05-ZZ-M3-G-0001-RM-S1-P02.rvt	1	No Shared Site	1389686
39333-PCL-ZZ-ZZ-M3-G-0001-RM-S1-P01.rvt	1	No Shared Site	1389689
3989-AKT-XX-XX-M3-S-Proposed Structural Model.rvt	1	No Shared Site	1432178
007317-HAP-V00-ZZ-M3-A-0002-AUDIT.rvt	1	No Shared Site	1614326

Semi-Automated Model Review

Initial forays streamlining InDesign workflows – best practice templates, styles and using Text Variables
We created Dynamo definitions to generate images highlighting aspects of the model

This saved lots of time... but still involved lots of manual copy-pasting data from an Excel export!

The screenshot shows the InDesign Data Merge panel. On the left, a room data sheet template is displayed with fields like Room Function, Key Information (Area, Capacity, Reverberation Time, Modelling), Ventilation, Heating, and Fire Alarm & Life Safety. The right side shows a preview of a CSV file with two rows of data: one for 'FINAL SUBMISSION' and one for 'End of Stage Revision'.

Date	Revision	Description
31.12.18	03	FINAL SUBMISSION
29.12.18	02	End of Stage Revision

CSV Preview:

	Room Name	Ventilation Design Occupancy	Ventilation Rate	Source Control	Ventilation Source	Detection Type	Fire Detection Type
T	Atlantis Town Hall	<<Number>>	<<Name>>	<<Ventilation Rate>>	<<Ventilation Control>>	Alarm Type	<<Fire Alarm Type>>

AU 2018 Datamerge

A year ago we demonstrated generating 536 Room Data Sheets in 1 minute
InDesign's database publishing tool – combines structured data with a page template

We wanted the ability to generate the kinds of InDesign documents a user would normally create – from scratch

Initial Explorations

INDESIGN SDKS AND TOOLS

Access To The InDesign Product Family SDK (Software Developer Kit)

The InDesign SDKs (Software Developer Kit) are for C++ programmers and scripters who want to learn how to write plug-ins and scripts for Adobe® InDesign, InCopy, and InDesign Server. They are designed to give an introduction to plug-in and script development, show how to create some simple plug-ins and scripts, and teach the architecture behind the InDesign product family.

Adobe InDesign CC SDK

[Adobe InDesign CC SDK](#)

InDesign SDK

Initial research showed yes - there's an InDesign API, and an SDK with documentation
Downloaded SDK & read through docs. InDesign Server or short, simple scripts

Lots and lots of JavaScript mentions, some TypeScript and AppleScript

[About](#)[About](#)[Adobe InDesign CC 2019 \(14.0\) Object Model](#)[Application](#)[Document](#)[MasterSpread](#)[Spread](#)[Page](#)[Link](#)[Story](#)[Swatch](#)[Tint](#)[Color](#)

Document

A document.

[Go to Property Listing](#) | [Method Listing](#)

Methods:

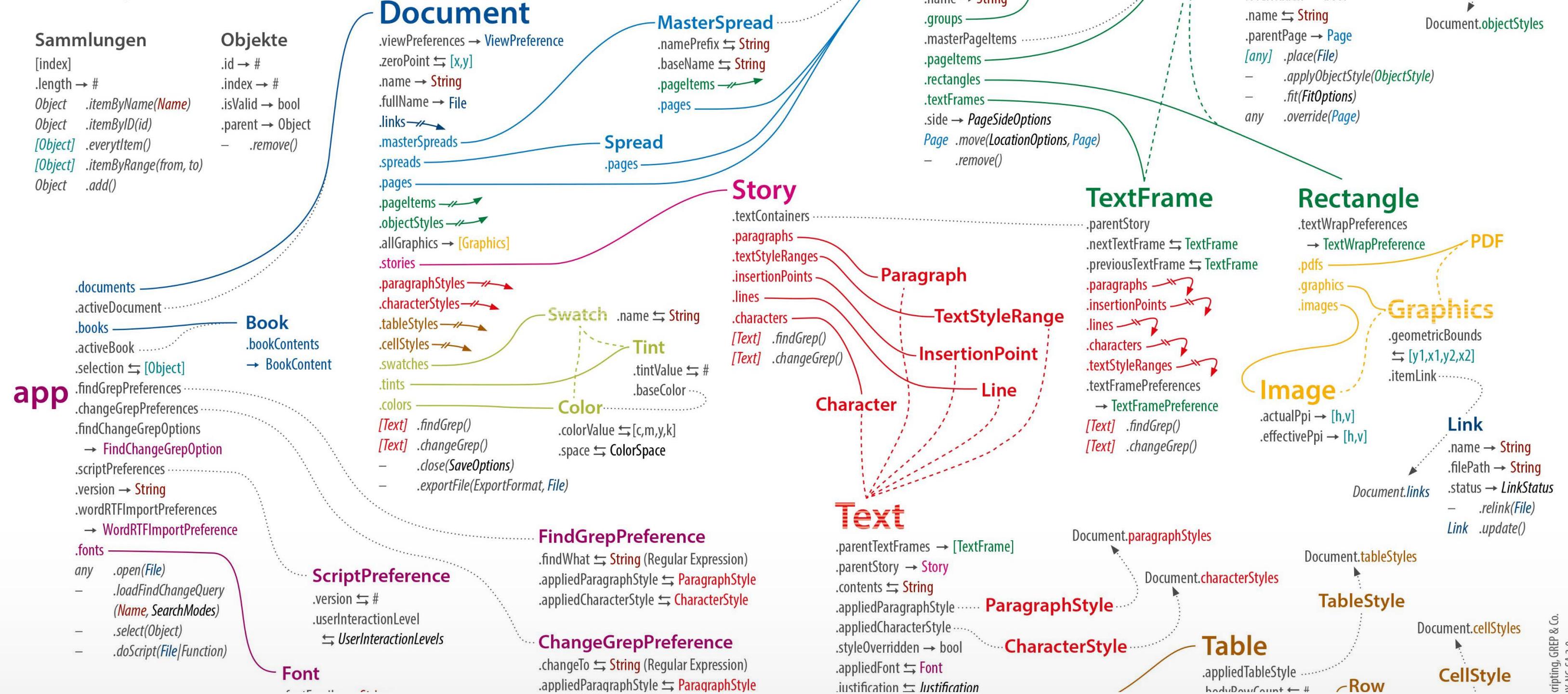
`addEventListener, adjustLayout, align, asynchronousExportFile, changeComposer, changeGlyph, changeGrep, changeObject, changeText, changeTransliterate, checkIn, clearFrameFittingOptions, close, colorTransform, createAlternateLayout, createEmailQRCode, createHyperlinkQRCode, createMissingFontObject, createPlainTextQRCode, createTOC, createTextMsgQRCode, createVCardQRCode, deleteAlternateLayout, deleteUnusedTags, distribute, embed, exportFile, exportForCloudLibrary, exportPageItemsSelectionToSnippet, exportPageItemsToSnippet, exportStrokeStyles, extractLabel, findGlyph, findGrep, findObject, findText, findTransliterate, getAlternateLayoutsForFolio, getElements, getSelectedTextDirection, getStyleConflictResolutionStrategy, importAdobeSwatchbookProcessColor, importAdobeSwatchbookSpotColor, importDtd, importFormats, importPdfComments, importStyles, importXML, insertLabel, loadConditions, loadMasters, loadSwatches,`

InDesign API Documentation

Documentation online and in downloadable SDK

Some helpful, but incomplete 'mind maps' online. Not always intuitive

Wanted a fully .NET-based solution if possible; easier to integrate with existing Revit / WPF tech we use

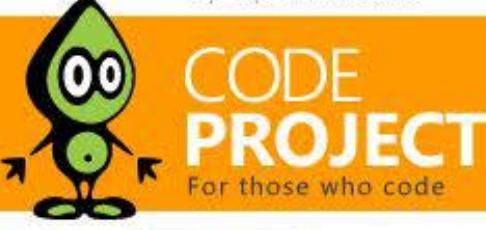


InDesign API Documentation

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 Some helpful, but incomplete 'mind maps' online. Not always intuitive

Wanted a fully .NET-based solution if possible; easier to integrate with existing Revit / WPF tech I use

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Article

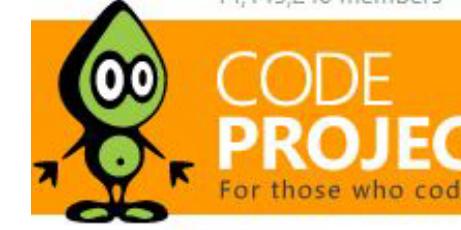
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- [Stats](#)
- [Revisions](#)
- [Alternatives](#)
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Tagged as

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- [C#](#)
- [Windows](#)
- [.NET](#)
- [Visual-Studio](#)
- [COM](#)

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Create an Adobe InDesign Document with c#

#andy, 7 Nov 2010  4.67 (3 votes) Rate this: 

An article showing how to access Adobe InDesign CS COM objects from .NET

I needed to make an application that read product information from a database and inserted it in an Adobe InDesign template to create a catalog ready for printing. There is not much information about this subject to be found on the Internet, so I thought I might share this article with you.

Note: Adobe InDesign CS and the InDesign SDK need to be installed on the development computer.

Sample code to get you started

I tested some libraries that create InDesign Interchange XML-documents, but was not happy with the results. So if you want to create an InDesign document with C#, you need to

- install Adobe InDesign
- reference "Adobe InDesign CSx Type Library" in your application

Because I didn't find a good documentation, here's some code to get you started as well.

```
// Create application instance
Type type = Type.GetTypeFromProgID("InDesign.Application");
Application application = (Application)Activator.CreateInstance(type);

// Set unit type
application.UIType = 1;
```

[Hide](#) [Shrink ▲](#) [Copy Code](#)

C# Examples

Early 2019 I started reading about InDesign's API in depth - I found just a few examples using C# Example script would open a new InDesign document and create five blank pages

Being able to see a test script implied it should be possible to create something in C# that talks to InDesign

I found the C# application to hang when I ran it next, so had to close InDesign down, and let C# open it up by itself! Example:

```
Type type = Type.GetTypeFromProgID("InDesign.Application");
Application app = (Application)Activator.CreateInstance(type);

var doc = app.Documents.Add();

for (var i = 0; i < 5; i++)
    doc.Pages.Add(idLocationOptions.idAtBeginning);
```

[share](#) [edit](#)

answered May 14 '16 at 16:29



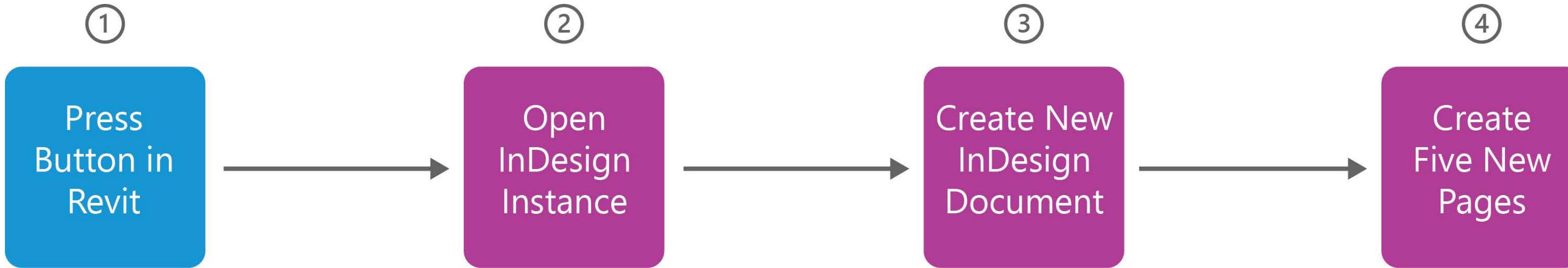
[user3791372](#)

2,574 ● 2 ● 25 ● 57

Thank You user3791372!

This was the initial script I read (on Stackoverflow) that I based our proof of concept on.

Sometimes, this is all you need to set off developing something.



Simple Proof of Concept Workflow

I put together a proposal for a 'minimum test case' to see if we could create a working proof of concept
Our end goal was to read a Revit model's information into a ready-made InDesign template

POC was to see if I could click a button in Revit that would open InDesign and a new document and edit it



Revit User Guide



Raise Support Ticket



DDG on KITE



Support + Guidance

Ribbon Buttons in Revit

We already had some experience with building our own ribbon, so I can give you an outline of what we did

There are two straightforward ways to launch your own code from the Revit ribbon: these are referred to as `ExternalCommands` and `ExternalApplications`

Intro to External Commands

ExternalCommands & ExternalApplications

Both are a way of bringing external code into Revit

We used Microsoft Visual Studio as our "Integrated Development Environment" (i.e. where we write our code)

Written in C# using the Revit API's Classes

Code gets compiled into a .dll file and placed somewhere Revit can see it (e.g. AppData)

On Revit application startup, it loads in these resources

With both approaches the .dll file will also contain the code that fires when you launch your command or click on each custom-made button

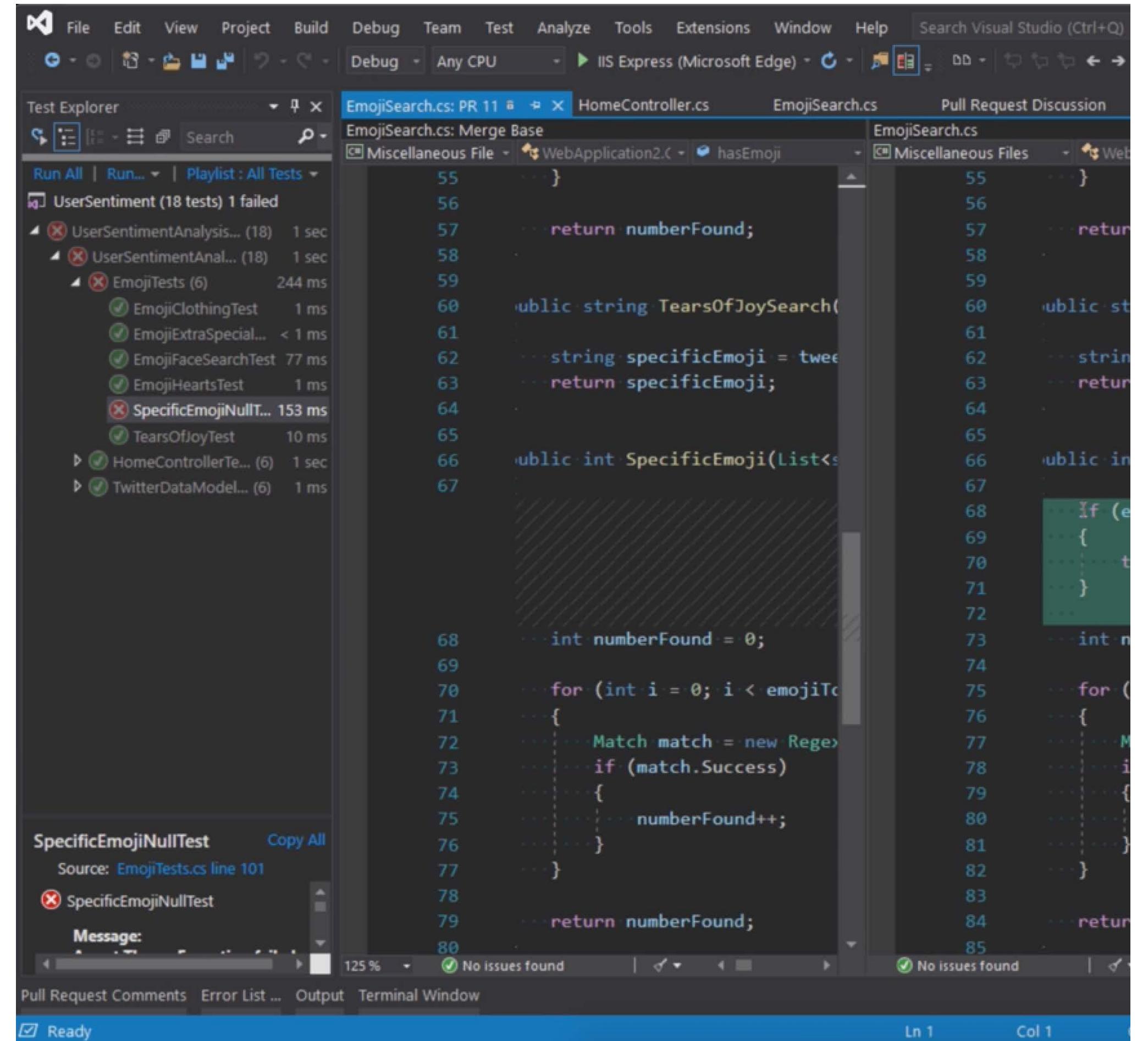
Within this code, you can access Revit's API to make adjustments to the model just like in a Macro

Visual Studio Overview

Visual Studio is the program everyone uses to compile their Revit addins

It's a code-editor, a UI designer, database administration tool, debugger, and more all in a single program

It's where we compile all our scripts together into a single DLL, which Revit can then run

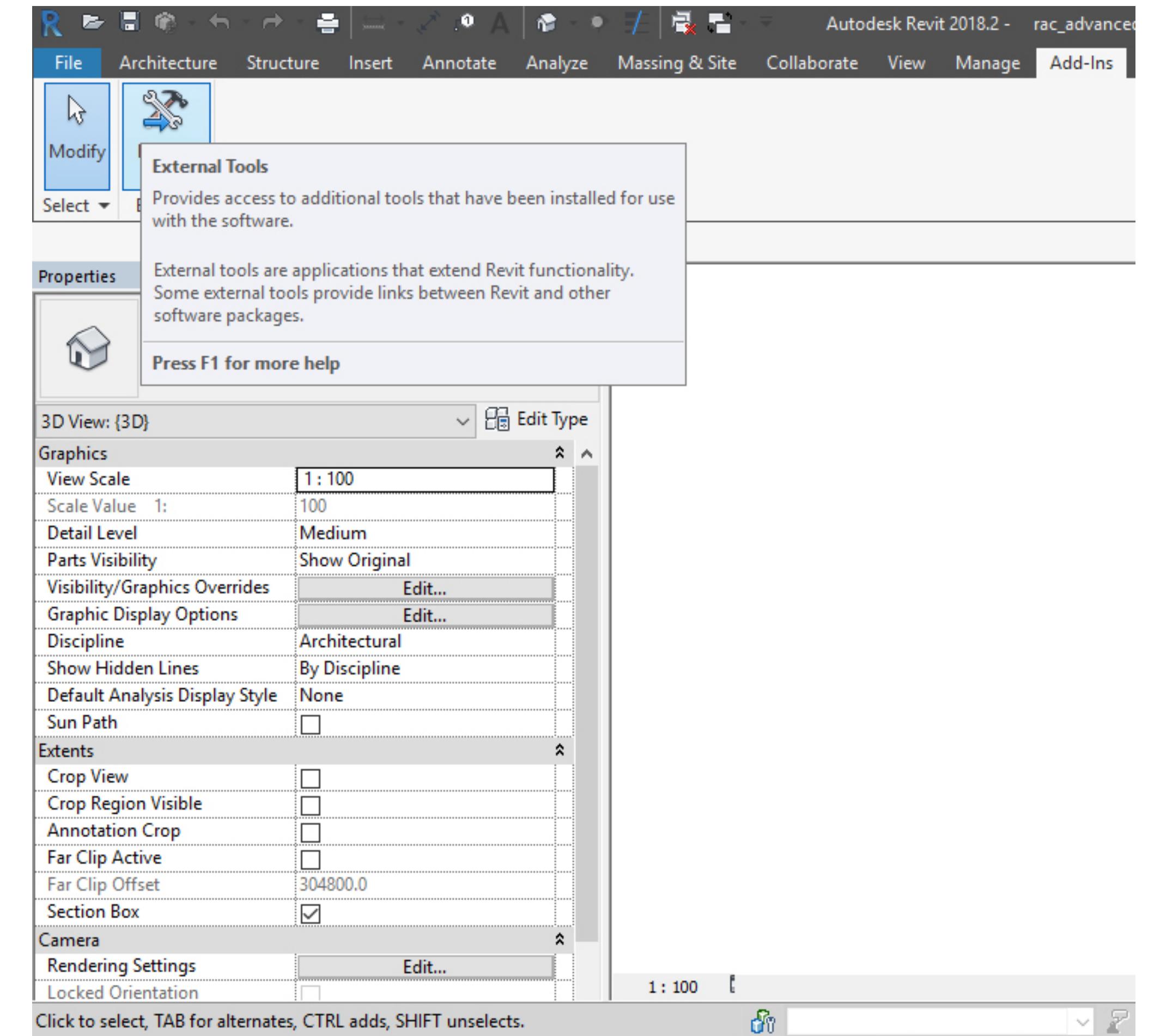


ExternalCommands

If your tool is an ExternalCommand, Revit will read the .dll file and load it in as a button

This button will appear in Revit under the Add-ins tab in the External Tools drop-down menu

The ExternalCommand approach is a bit like firing a macro - it's a one-off command you're launching



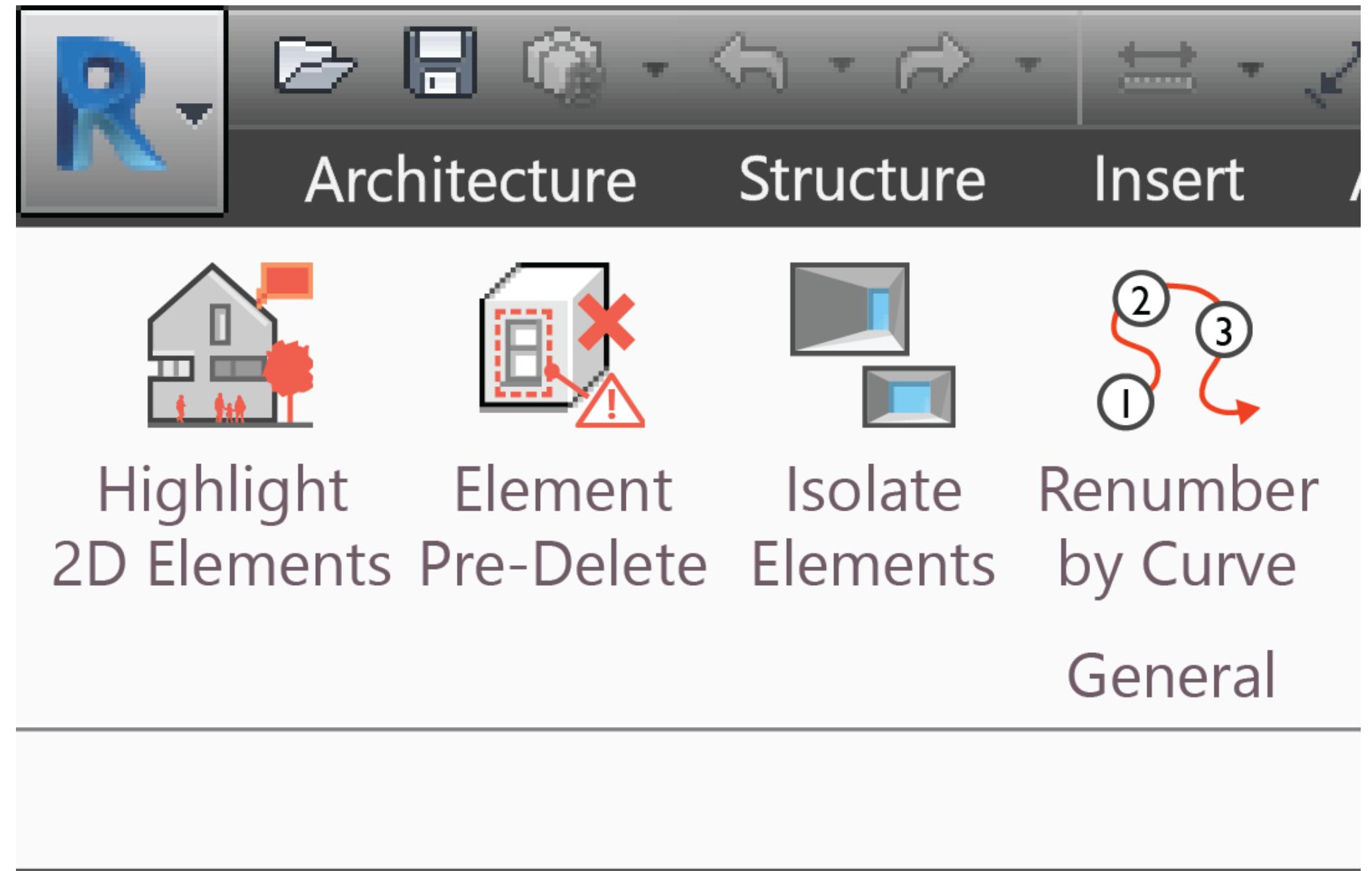
External Applications

If your tool is an ExternalApplication it probably lives in its own custom Revit ribbon tab

Revit reads your .dll upon opening and creates your ribbon tabs, ribbon panels and buttons

The Revit ribbon buttons essentially fire off their own ExternalCommands, but there are some differences

The ribbon is always accessible from within Revit, meaning you can retain data between tool runs



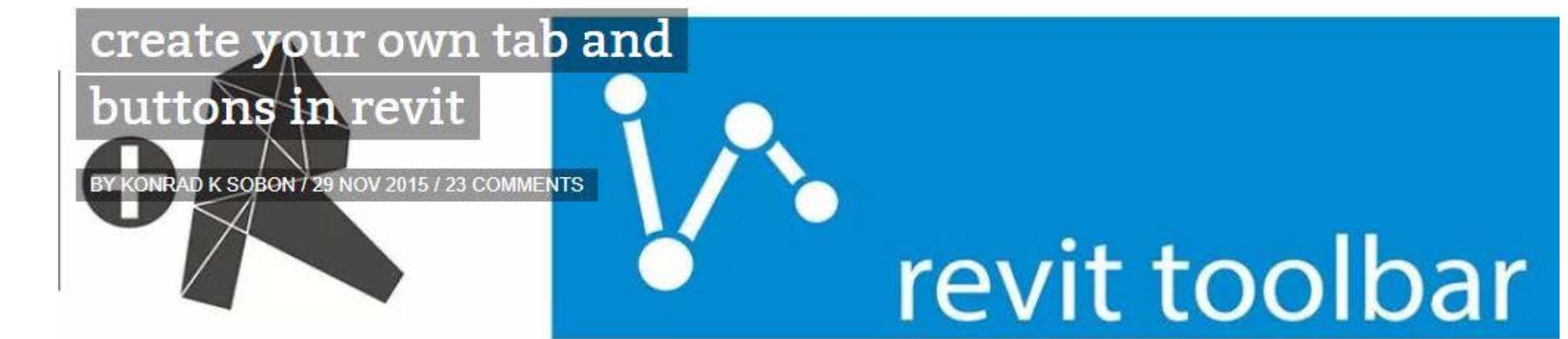
Further Reading

If you'd like to learn how to build your own custom Revit ribbon, or ExternalCommand button I would recommend archi-lab's blog

<http://archi-lab.net>

Clear step-by-step instructions on how to build ExternalCommands and ExternalApplications from scratch

If this helps you, consider supporting Konrad!



In the last few posts I have outlined in great detail how to make a simple Revit Add-in using the IExternalCommand implementation. Doing that is a great and really fast way of adding new tools to Revit, but after a while we will realize that we just need a little more organization. Luckily for us Revit API offers a way to create our own tab in Revit and an array of different ways to add buttons to it. For the sake of keeping this tutorial simple and easy to follow, I will only show you how to convert our all-ready CurveTotalLength tool to a button.

In this post we will cover a few things like:

- IExternalApplication implementation
- new RibbonPanel
- new PushButton
- resource management

First let's open our Visual Studio session that we worked on last week. It should look like this:

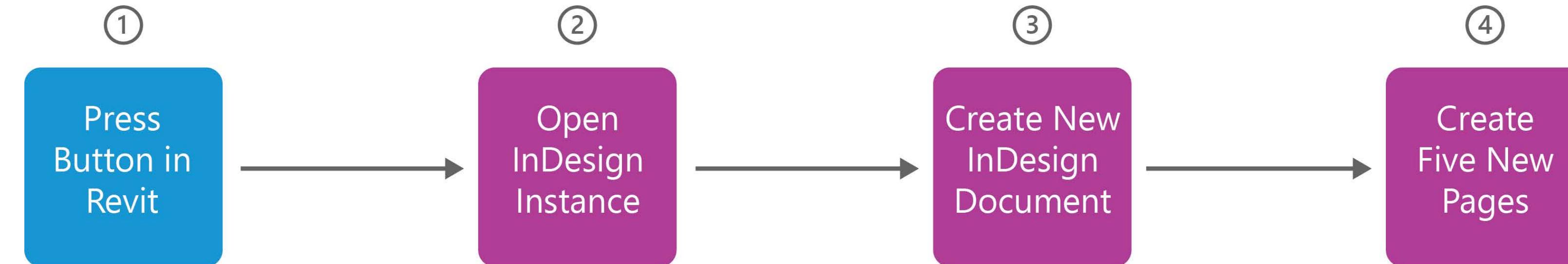


SEARCH
To search type and hit enter

CATEGORIES
Select Category

RECENT POSTS

- playing with Power Shell commands and Post Build events. May 19, 2019
- grids #1 April 13, 2019
- archi-lab + Patreon April 6, 2019
- dll hell is real March 18, 2019



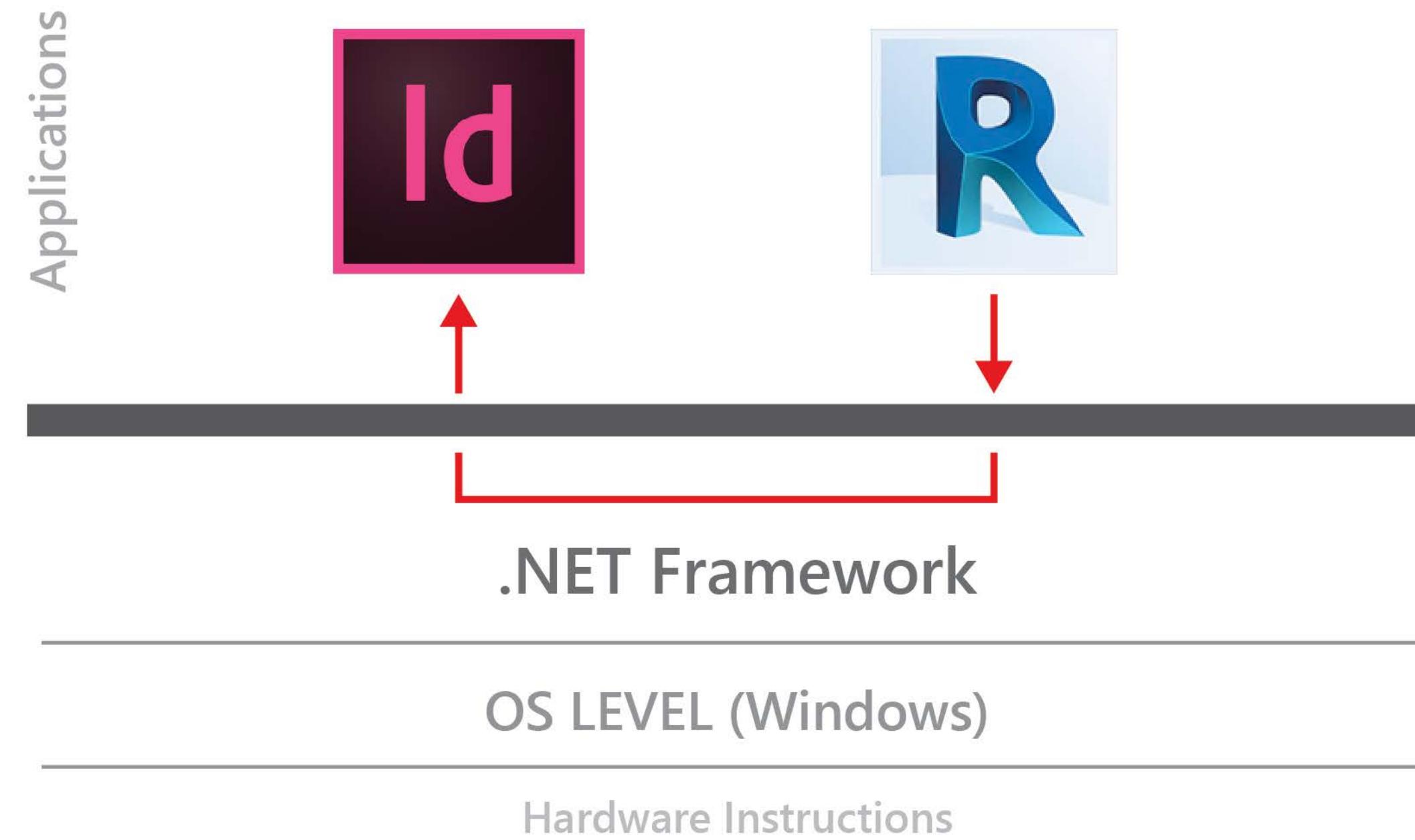
ExternalCommand or
ExternalApplication
using Visual Studio

Back to Proof of Concept

We want our code to fire when we press a button in Revit, so we're using an ExternalApplication to create our custom AHMM ribbon and place buttons in there. These buttons will fire off our custom code.

Next, we want to learn how to open an instance of the InDesign application from within our custom code.

Interprocess Communications



Revit and the .NET Framework

Revit is a Windows application and it runs on top of the .NET Framework

Microsoft's .NET Framework is the lower-level architecture that unifies software running on a Windows machine, provides important class libraries and resources.

This lets us have conversations with other applications, access external servers, databases, run tests, etc

We have access to all different parts of Windows to play with if we want - can access speakers, webcams, files

Interprocess Communications - V X +

https://docs.microsoft.com/en-us/windows/desktop/ipc/interprocess-communications#using-windows-sockets-for-ipc

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Interprocess Communications

> Mailslots
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> Pipes

Interprocess Communications

05/31/2018 • 9 minutes to read • Contributors  

The Windows operating system provides mechanisms for facilitating communications and data sharing between applications. Collectively, the activities enabled by these mechanisms are called *interprocess communication* (IPC). Some forms of IPC facilitate the division of labor among several specialized processes. Other forms of IPC facilitate the division of labor among computers on a network.

Typically, applications can use IPC categorized as clients or servers. A *client* is an application or a process that requests a service from some other application or process. A *server* is an application or a process that responds to a client

In this article

- Using the Clipboard for IPC
- Using COM for IPC
- Using Data Copy for IPC
- Using DDE for IPC
- Using a File Mapping for IPC
- Using a Mailslot for IPC
- Using Pipes for IPC

Interprocess Communications

Windows provides many approaches for sending data between applications - 'inteprocess communication' (or IPC) is one fo them. Refer to MSDN Website for developers who want to develop on top of Microsoft systems

"Interprocess Communications" just means getting pieces of software to talk with one another

I found this page, which outlines multiple IPC technologies: IPC, Sockets, Data Copy, Pipes...

Interprocess Communications - V X +

https://docs.microsoft.com/en-us/windows/desktop/ipc/interprocess-communications#using-windows-sockets-for-ipc

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Using COM for IPC

Applications that use OLE manage *compound documents*—that is, documents made up of data from a variety of different applications. OLE provides services that make it easy for applications to call on other applications for data editing. For example, a word processor that uses OLE could embed a graph from a spreadsheet. The user could start the spreadsheet automatically from within the word processor by choosing the embedded chart for editing. OLE takes care of starting the spreadsheet and presenting the graph for editing. When the user quit the spreadsheet, the graph would be updated in the original word processor document. The spreadsheet appears to be an extension of the word processor.

The foundation of OLE is the Component Object Model (COM). A software component that uses COM can

In this article

- Using the Clipboard for IPC
- Using COM for IPC**
- Using Data Copy for IPC
- Using DDE for IPC
- Using a File Mapping for IPC
- Using a Mailslot for IPC
- Using Pipes for IPC

COM (Component Object Model)

COM is old (1993) technology but is still supported by .NET using the System.Runtime.InteropServices namespace. For instance, Dynamo's Bumblebee package uses COM to open & edit Excel documents

Spoiler Alert: As we will see later, this is the approach I would have to use

Visual Studio Setup

Back to Visual Studio

Our code in Visual Studio would need to bring everything together.

It's where we have the code for creating our Revit ribbon, buttons and model review functionality (e.g. counting the number of warnings).

It's also where we need to have the code which launches and manipulates InDesign.

The screenshot shows the Visual Studio interface with the following details:

- Test Explorer:** Shows 18 tests in the `UserSentiment` category, with 1 failing test named `SpecificEmojiNullTest`.
- Code Editor:** Displays `EmojiSearch.cs` with the following code:public string TearsOfJoySearch(string specificEmoji) {
 if (specificEmoji == null)
 return null;
 int numberFound = 0;
 for (int i = 0; i < emojiToCount.Length; i++)
 {
 Match match = new Regex(specificEmoji).Match(emojiToCount[i]);
 if (match.Success)
 numberFound++;
 }
 return numberFound;
}
- Status Bar:** Shows "Ready".

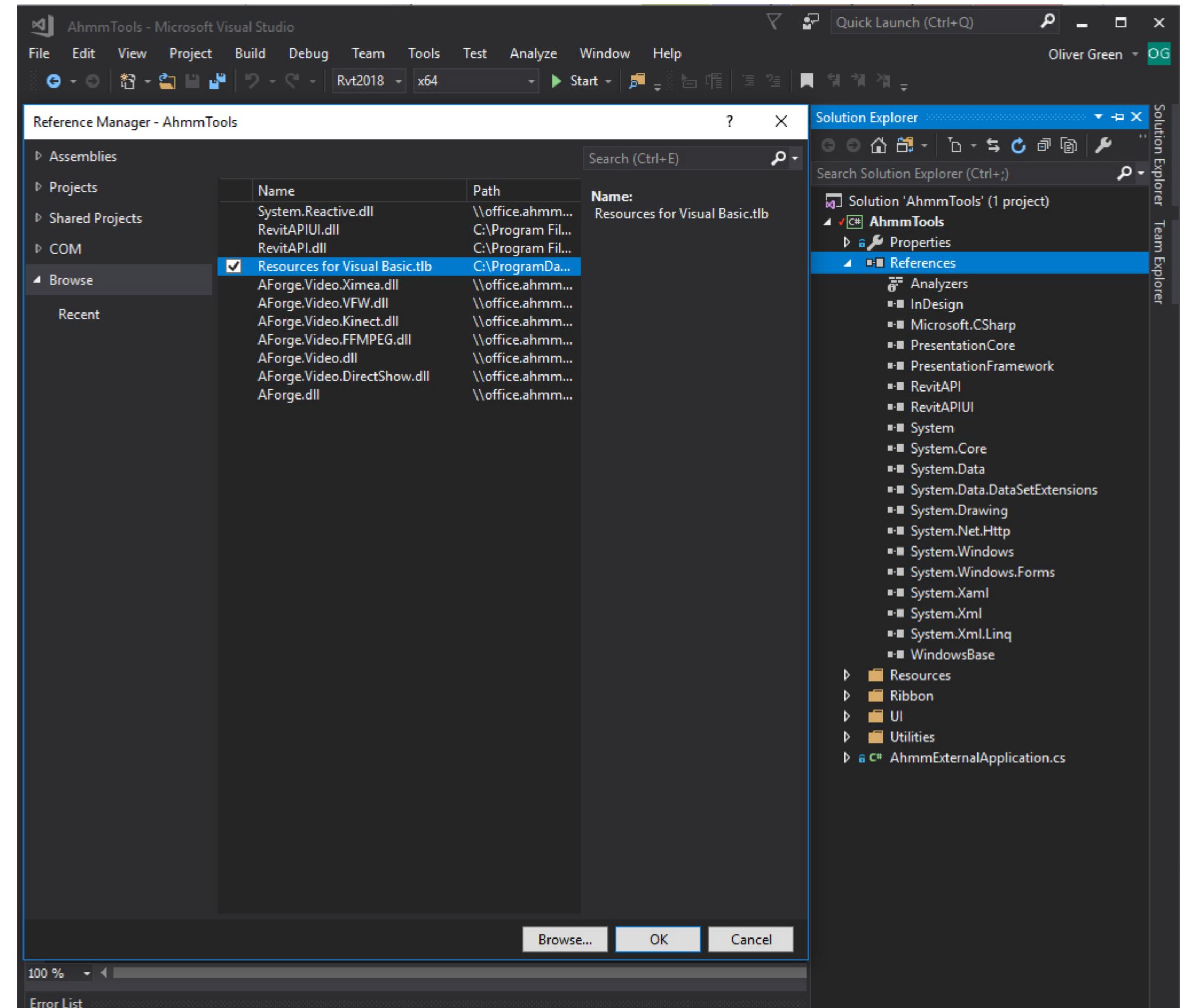
Add Reference to InDesign API

The online script had lots of reference to InDesign's native classes (such as Page)

In order to resolve these references, I needed to add a reference to InDesign's API

I was entirely sure how to do this so, some Googling later, I found it's called ResourcesForVisualStudio.tlb, which is a COM type library file

That's how I knew I was going to use the COM approach to Interprocess Communications



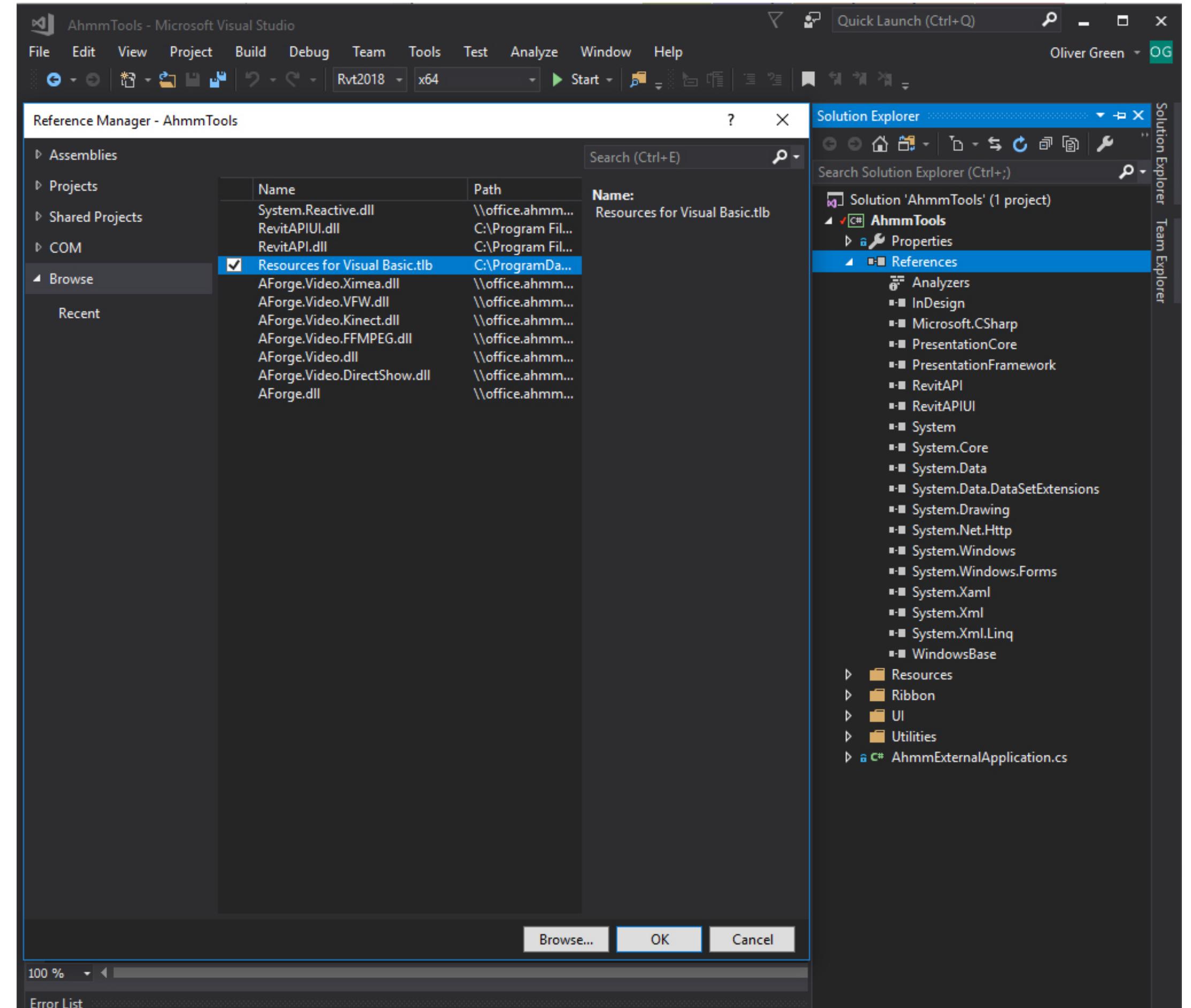
Add Reference to InDesign API

If you have InDesign installed, you can find it at:
C:\ProgramData\Adobe\InDesign\Version
11.0\en_GB\Scripting Support\11.0\Resources for
Visual Basic.tlb

(Exact path address depends on Version but will
be almost exactly the same)

Right-Click on your Solution > Add Reference >
Browse and select .tlb file

Add 'using InDesign;' to your using directives at
the top of your C# file, references should resolve



AhmmTools - Microsoft Visual Studio

File Edit View Project Build Debug Team Tools Test Analyze Window Help

Rvt2018 x64 Start

InDesignSampleAU2019.cs

```
1  using System;
2  using InDesign;
3  using Autodesk.Revit.DB;
4  using Autodesk.Revit.UI;
5  using Autodesk.Revit.Attributes;
6
7  [Transaction(TransactionMode.Manual)]
8  public class InDesignSampleAU2019 : IExternalCommand
9  {
10     public Result Execute(ExternalCommandData commandData, ref string message, ElementSet elements)
11    {
12        try
13        {
14            Type type = Type.GetTypeFromProgID("InDesign.Application");
15            Application inDesignApp = (Application)Activator.CreateInstance(type);
16
17            InDesign.Document inDesignDocument = inDesignApp.Documents.Add();
18
19            //Create 5 new blank pages
20            for (var i = 0; i < 5; i++) inDesignDocument.Pages.Add(idLocationOptions.idAtBeginning);
21
22            return Result.Succeeded;
23        }
24        catch (Exception ex)
25        {
26            message = ex.Message;
27            return ResultFailed;
28        }
29    }
30 }
```

Quick Launch (Ctrl+Q)

Solution Explorer Team Explorer

Item(s) Saved Ln 3 Col 1 Ch 1 INS 0 5 AhmmTools master

Autodesk Revit 2018

Error - cannot be ignored

Unable to cast COM object of type 'System.__ComObject' to interface type 'InDesign.Application'. This operation failed because the QueryInterface call on the COM component for the interface with IID '{ABD4CBB2-0CFE-11D1-801D-0060B03C02E4}' failed due to the following error: No such interface supported

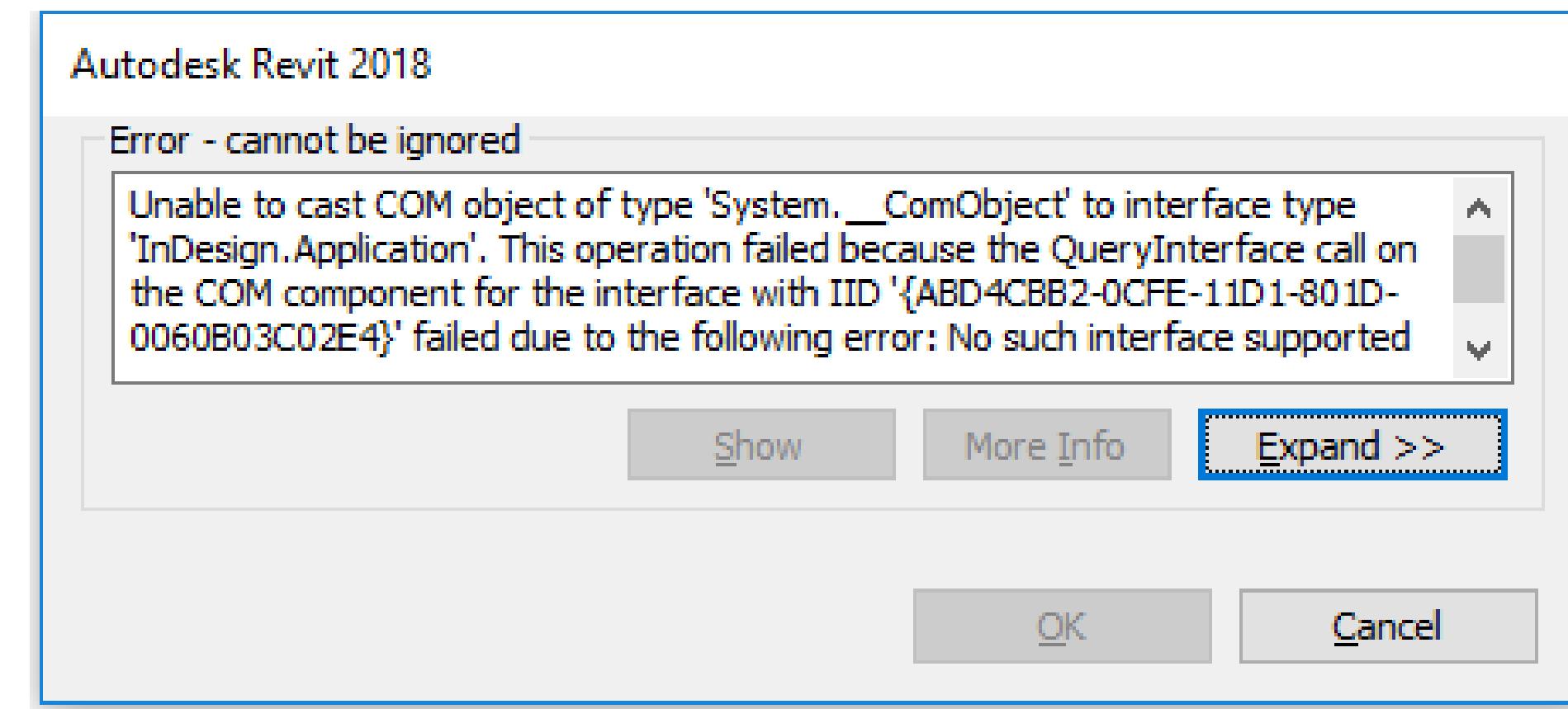
Show

More Info

Expand >>

OK

Cancel



Note: COM error messages are almost worthless!

Fixing COM Error

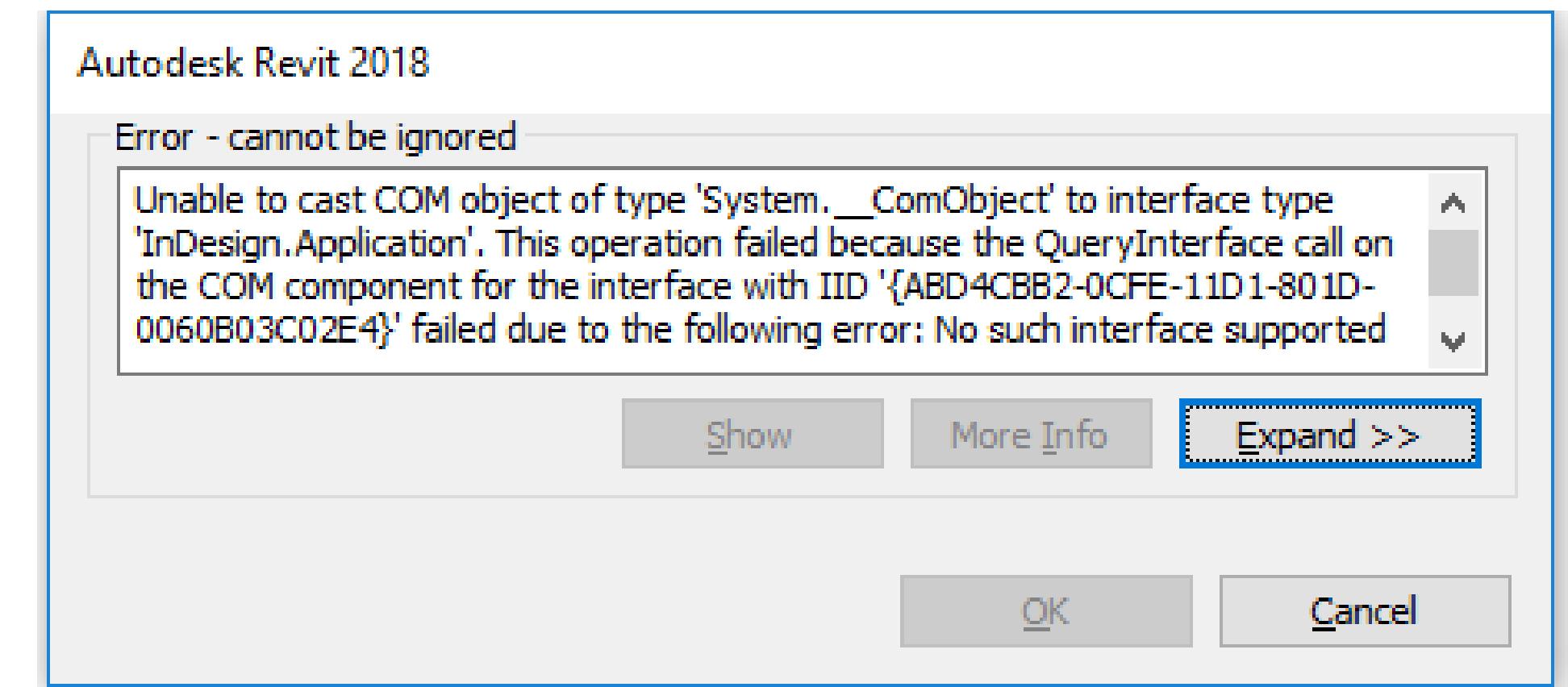
Find your InDesign .tlb file and delete it
Then run InDesign as Administrator

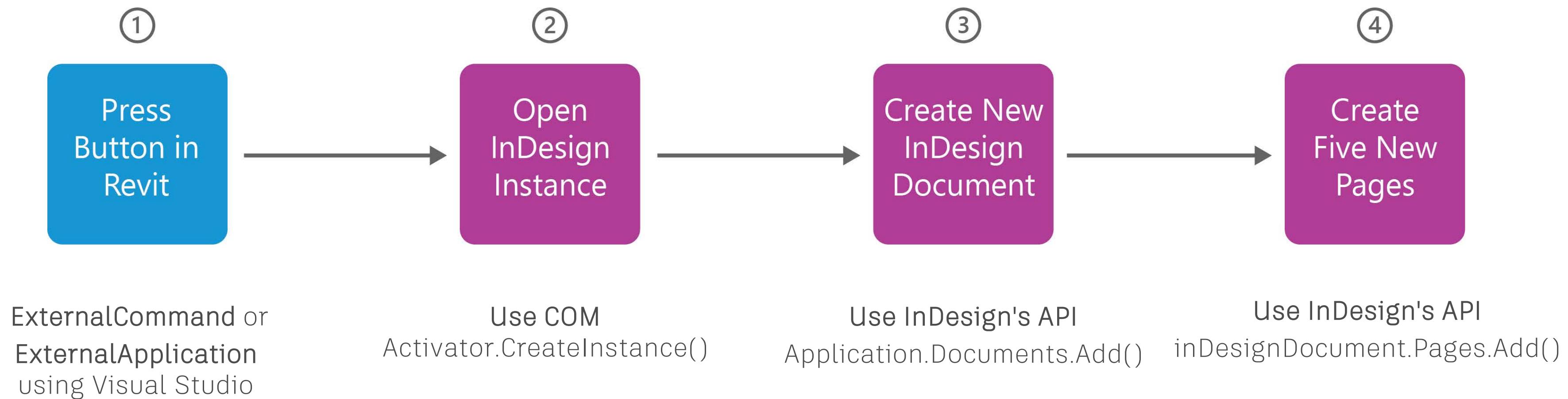
This will recreate the .tlb file, which should no longer throw an error

The test script worked, opening InDesign and creating 5 new blank pages!

Tested on Revit 2017/2018/2019.
Windows 10 with InDesign CC

ExternalApplication is compiled to x64 architecture / solution platform.





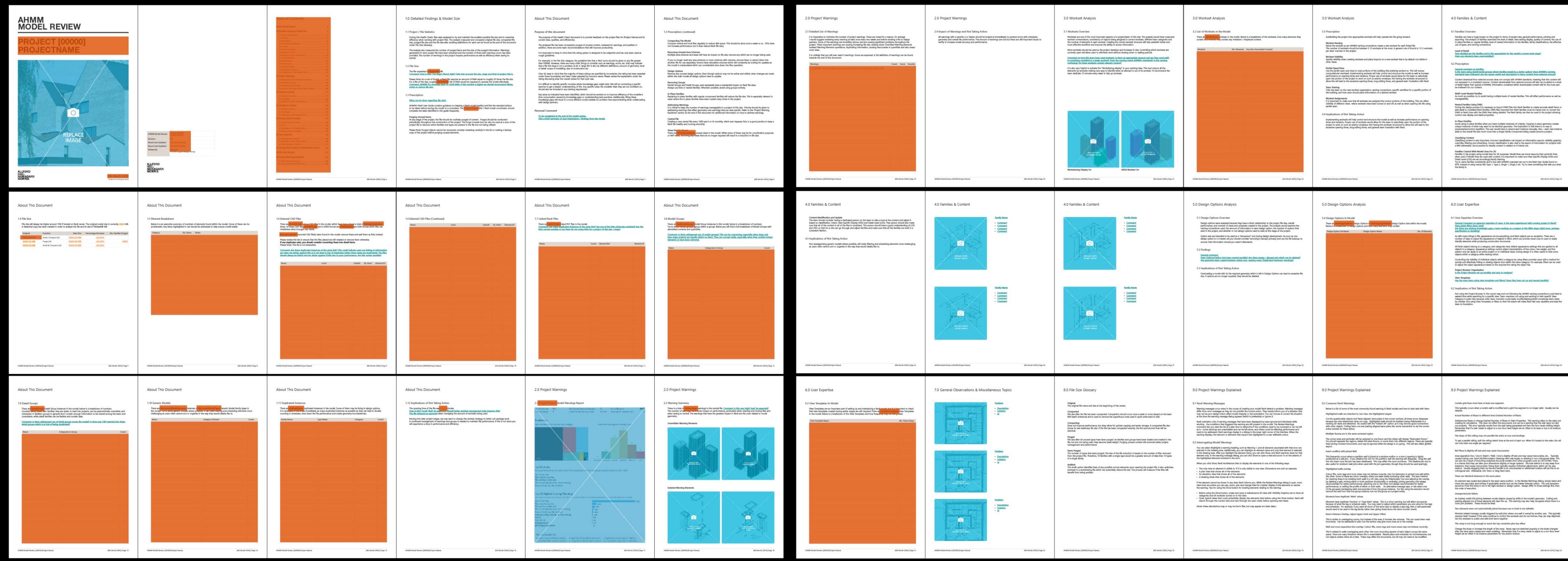
Back to Proof of Concept

We create an instance of the InDesign application using COM's Activator.CreateInstance() method. This gives us a handle on an opened session of InDesign.

From here, we need to create a Document to edit. I create a blank document as a proof of concept.

Once we have a Document we can do nearly anything we want to. In our example code we created five pages.

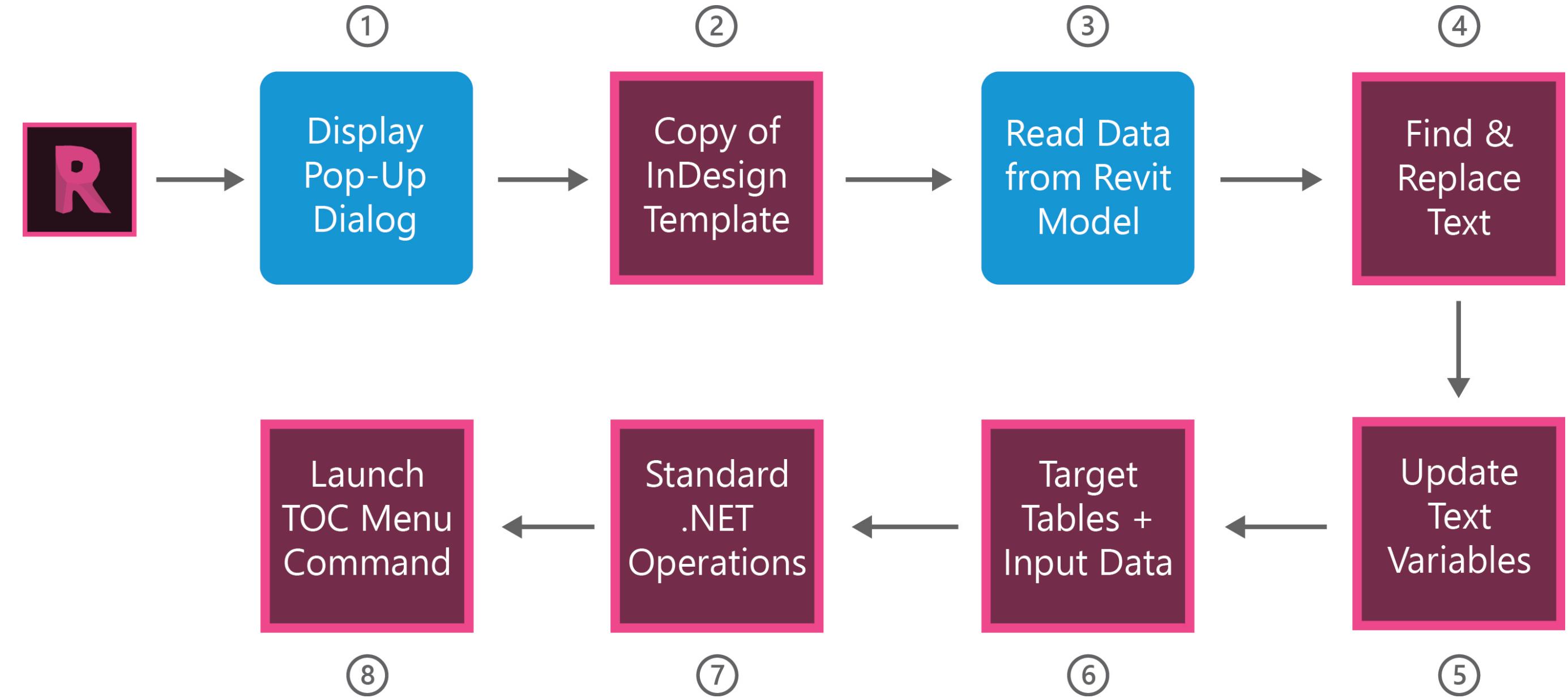
Preparing The Model Report Process



What Can We Automate?

Proof of Concept worked so I printed out our Model Report and marked up in red what I thought we could automate
It was a lot, maybe 80% of the information in the report

Around 40 pages - a structured & formatted report, made up of a mix of tables, images, critical commentary



Full Proposed Process Diagram

Having marked up our report I could differentiate different key tasks our tool would need to complete
 We already demonstrated we had working access to the InDesign API from within Revit

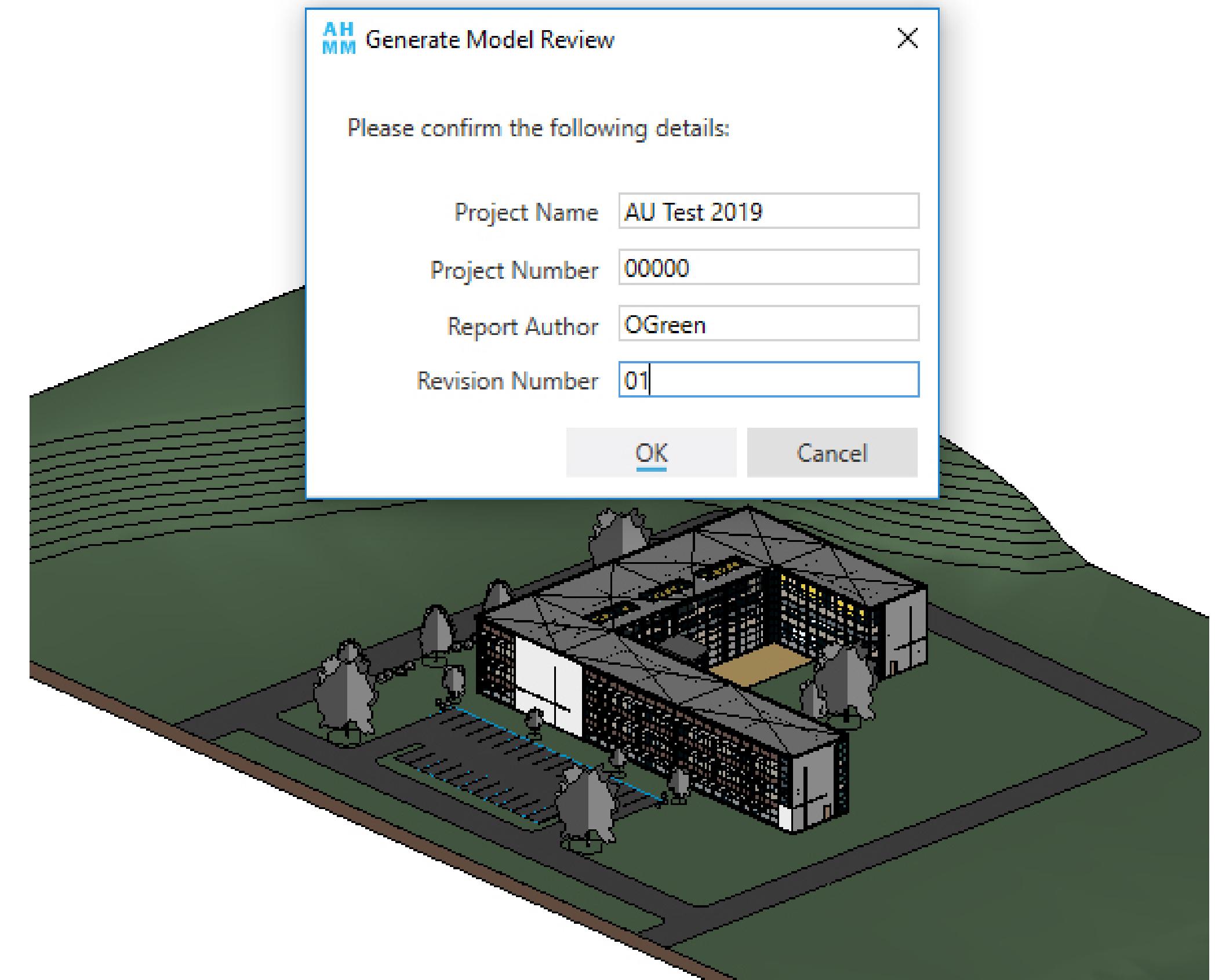
Next, I had to work out if, and how, these could be automated in code

1. Pop-Up Dialog for Input Info

The process would seek to confirm a few key values from the user at the start of each run

This is a WPF pop-up dialog window to let users enter the project name and number

Where possible, they are pre-populated from the Project Information parameters, but ultimately having a user confirm they're useful and valid values



2. Create New File from Template

I would need to begin the process by opening an instance of the InDesign application using COM. I found examples of how to do this online. I needed to specify InDesign.Application as the type, as Revit has its own native Application Type

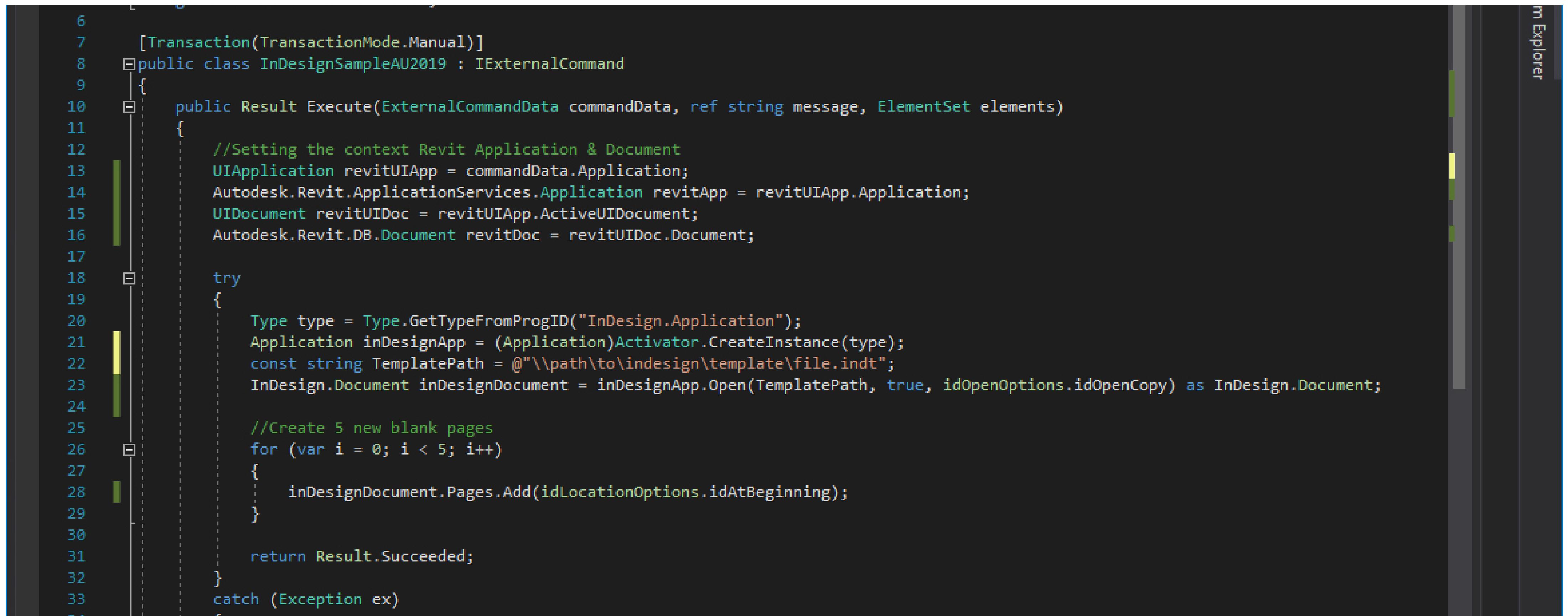
```
Type type = Type.GetTypeFromProgID("InDesign.Application");
InDesign.Application indesignApplication = (InDesign.Application)Activator.CreateInstance(type);
```

Activator.CreateInstance is used to open the application, which I cast back to the InDesign.Application type, allowing me access to the application's members (methods, events, properties, etc)

Finally, I was able to open an copy of an existing template file and create a handle for it:

```
InDesign.Document inDesignDocument = inDesignApp.Open(TemplatePath, true, idOpenOptions.idOpenCopy) as
InDesign.Document;
```

2. Create New File from Template



The screenshot shows a Visual Studio code editor window with a dark theme. The code is written in C# and defines a class `InDesignSampleAU2019` that implements the `IExternalCommand` interface. The class contains a method `Execute` which performs the following steps:

- It retrieves the Revit application and document context.
- It creates an instance of the InDesign application using the `Activator.CreateInstance` method.
- It opens a template file named "file.indt".
- It adds 5 new blank pages to the InDesign document.
- It returns a success result.

```
6
7     [Transaction(TransactionMode.Manual)]
8     public class InDesignSampleAU2019 : IExternalCommand
9     {
10         public Result Execute(ExternalCommandData commandData, ref string message, ElementSet elements)
11         {
12             //Setting the context Revit Application & Document
13             UIApplication revitUIApp = commandData.Application;
14             Autodesk.Revit.ApplicationServices.Application revitApp = revitUIApp.Application;
15             UIDocument revitUIDoc = revitUIApp.ActiveUIDocument;
16             Autodesk.Revit.DB.Document revitDoc = revitUIDoc.Document;
17
18             try
19             {
20                 Type type = Type.GetTypeFromProgID("InDesign.Application");
21                 Application inDesignApp = (Application)Activator.CreateInstance(type);
22                 const string TemplatePath = @"\path\to\indesign\template\file.indt";
23                 InDesign.Document inDesignDocument = inDesignApp.Open(TemplatePath, true, idOpenOptions.idOpenCopy) as InDesign.Document;
24
25                 //Create 5 new blank pages
26                 for (var i = 0; i < 5; i++)
27                 {
28                     inDesignDocument.Pages.Add(idLocationOptions.idAtBeginning);
29                 }
30
31                 return Result.Succeeded;
32             }
33             catch (Exception ex)
34             {
35             }
36         }
37     }
```

3. Find & Replace Text

With the template copy open, we can get to work!

The first edit I'd want to make would be to target specific placeholder words in our Model Review template and replace them with meaningful values

The template we designed for automation purposes was created full of placeholder words for certain values, such as "There are NoWarnings in the model". I wanted to build a method to switch out these placeholder values

3. Find & Replace Text

The InDesign API has find & replace functionality using GREP - Global Regular Expressions Print. GREP operations are very quick & efficient, using regular expressions
I created a method called FindAndReplaceGREP():

```
void FindAndReplaceGREP(string stringToFind, string stringToReplace) {  
    inDesignApplication.ChangeGrepPreferences //to initially set up parsing rules. These will not change  
    inDesignApplication.FindGrepPreferences.findWhat = stringToFind;  
    var findGrep = inDesignDocument.FindGrep();  
    inDesignApplication.ChangeGrepPrerences.changeTo = stringToReplace;  
    inDesignDocument.ChangeGrep(); }
```

With that method set up, this is all that's required to find and replace text within the target document

3. Find & Replace Text

I created a 'GREP Dictionary', which is just a dictionary to associate certain specific words to their replacement values

Then I could iterate through all entries in this dictionary to set the values I wanted, while keeping all data together

```
Dictionary<string, string> grepDictionary = new Dictionary<string, string>()
{
    {"ProjectName", modelReviewInfo.TextBoxProjectName.Text},
    {"NoImportInstances", allImportInstances.Count.ToString()},
    {"NoCADLinks", allCadLinkTypes.Count.ToString()},
    {"NoRVTLinks", allRevitLinkId.Count.ToString()},
    {"NoDWGLinks", numberDwgLinks.ToString()},
    {"NoDGNLinks", numberDgnLinks.ToString()},
    {"NoImportedCAD", numberImportedCad.ToString()},
    {"NoUnplacedViews", numberUnplacedViews.ToString()},
    {"NoViewTemplates", allViewTemplates.Count.ToString()},
    {"NoModelGroups", allModelGroups.Count.ToString()},
    {"NoDetailGroups", allDetailGroups.Count.ToString()},
    {"NoGenericModelTypes", allGenericModelTypes.Count.ToString()},
    {"NoGenericModelInstances", allGenericModelElements.Count.ToString()},
    {"NoWorksets", allWorksets.Count.ToString()},
    {"FileSizeMB", fileSizeMB.ToString()},
    {"FileSizeRAM", Math.Round(fileSizeMB*(20.0/1000), 0).ToString()},
    {"NoDesignOptions", allDesignOptions.Count.ToString()},
    {"NoDesignOptionSets", allDesignOptionSetIds.Count.ToString()},
};

//Iterate through the grepDictionary to replace keywords
foreach (KeyValuePair<string, string> item in grepDictionary)
{ FindAndReplaceGREP(item.Key, item.Value); }
```

4. Update Text Variables

I wanted to target the document's Text Variables, which are defined once and implemented in many places across the document

Accessed via [Document.TextVariables](#) which returns a list of TextVariables we can loop through

In a similar manner to my 'GREP dictionary', I created a 'Text Variables Dictionary' to associate text variable names to their values

The values can be set using [TextVariable.VariableOptions.Contents](#)

```
Dictionary<string, string> textVariableDictionary = new Dictionary<string, string>
{
    { "Project Name", modelReviewInfo.TextBoxProjectName.Text},
    { "Project Number", modelReviewInfo.TextBoxProjectNumber.Text},
    { "Report Author Name", modelReviewInfo.TextBoxWrittenBy.Text},
    { "Model Last Updated Date", DateTime.Now.ToString("d MMMM yyyy")},
    { "Document Revision", modelReviewInfo.TextBoxRevision.Text},
    { "Document Issue Date", DateTime.Now.ToString("d MMMM yyyy")},
};

//Iterate through the textVariableDictionary to set text variable values
foreach (KeyValuePair<string, string> item in textVariableDictionary)
{ TrySetTextVariable(item.Key, item.Value); }
```

```
//Function to set a value to a text variable
void TrySetTextVariable(string textVariableName, string textValue)
{
    foreach (TextVariable textVariable in inDesignDocument.TextVariables)
    {
        if (textVariable.Name == textVariableName)
        {
            textVariable.VariableOptions.Contents = textValue;
        }
    }
}
```

5. Target Tables & Input Data

Tables were difficult to access because the API is a bit odd in places

Tables cannot be accessed conveniently using Document.Tables, or even Page.Tables

They are accessed as Document > Pages > TextFrames. Tables are a kind of TextFrame, but so are normal text boxes in InDesign

There are tests to determine which is which, but this all seemed a bit backwards as I wanted the ability to target specific tables

1.0 Detailed Findings & Model Size

1.6 External CAD Files

There are **NoCADLinks** unique CAD files in the model, which have been placed a total of **NoImportInstances** times. Of these CAD files, **NoDWGLinks** are in DWG format and **NoDGNLinks** are DGN format (DGN files can misbehave when brought into Revit).

No imported CAD file(s) were found in the model; remove these and add them as links instead.

Please review this list to ensure that the files placed are still needed or remove them otherwise.
If any duplicates exist, you should consider converting these into detail items.

Please Note: This list is not exhaustive.

Comment: Are there duplicated instances of the same link? This could indicate users are linking in information per view; we advise against this as it can lead to lots of duplicates (when these views are duplicated). The files should always be linked and we advise against DGNs due to poor performance. Are link names sensible?

5. Target Tables & Input Data

In InDesign all elements have an arbitrary ID number, like 6 or 52

The InDesign API lets us select items by their ID

But it would be a bad idea to hard-code the IDs of each table in the template; this could easily change as I make new copies of or update the model review template

I wanted an approach to guarantee I was selecting the right table every time, regardless of its ID

1.0 Detailed Findings & Model Size

1.6 External CAD Files

There are **NoCADLinks** unique CAD files in the model, which have been placed a total of **NoImportInstances** times. Of these CAD files, **NoDWGLinks** are in DWG format and **NoDGNLinks** are DGN format (DGN files can misbehave when brought into Revit).

NoImportedCAD imported CAD file(s) were found in the model; remove these and add them as links instead.

Please review this list to ensure that the files placed are still needed or remove them otherwise.
If any duplicates exist, you should consider converting these into detail items.

Please Note: This list is not exhaustive.

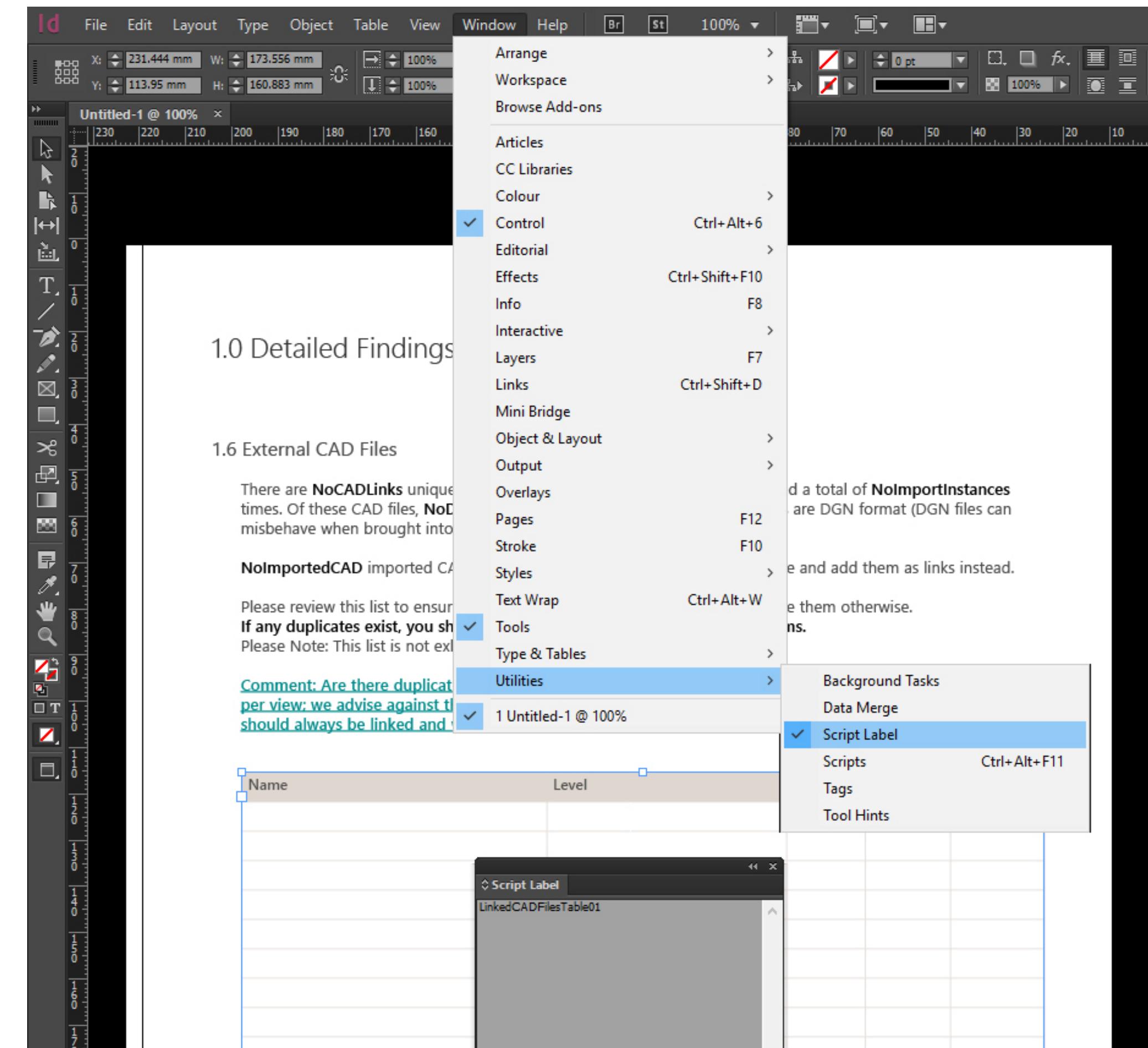
Comment: Are there duplicated instances of the same link? This could indicate users are linking in information per view: we advise against this as it can lead to lots of duplicates (when these views are duplicated). The files should always be linked and we advise against DGNs due to poor performance. Are link names sensible?

5. Target Tables & Input Data

However, InDesign lets you apply something called '**Script Labels**' (readable strings) to elements

We can't search for elements by their Script Label. Therefore, I created a dictionary to map each table (with its script label) to its internal ID when the ExternalCommand first runs

This would let us create a method to search for a table by its label and have it returned to us (courtesy of its ID)



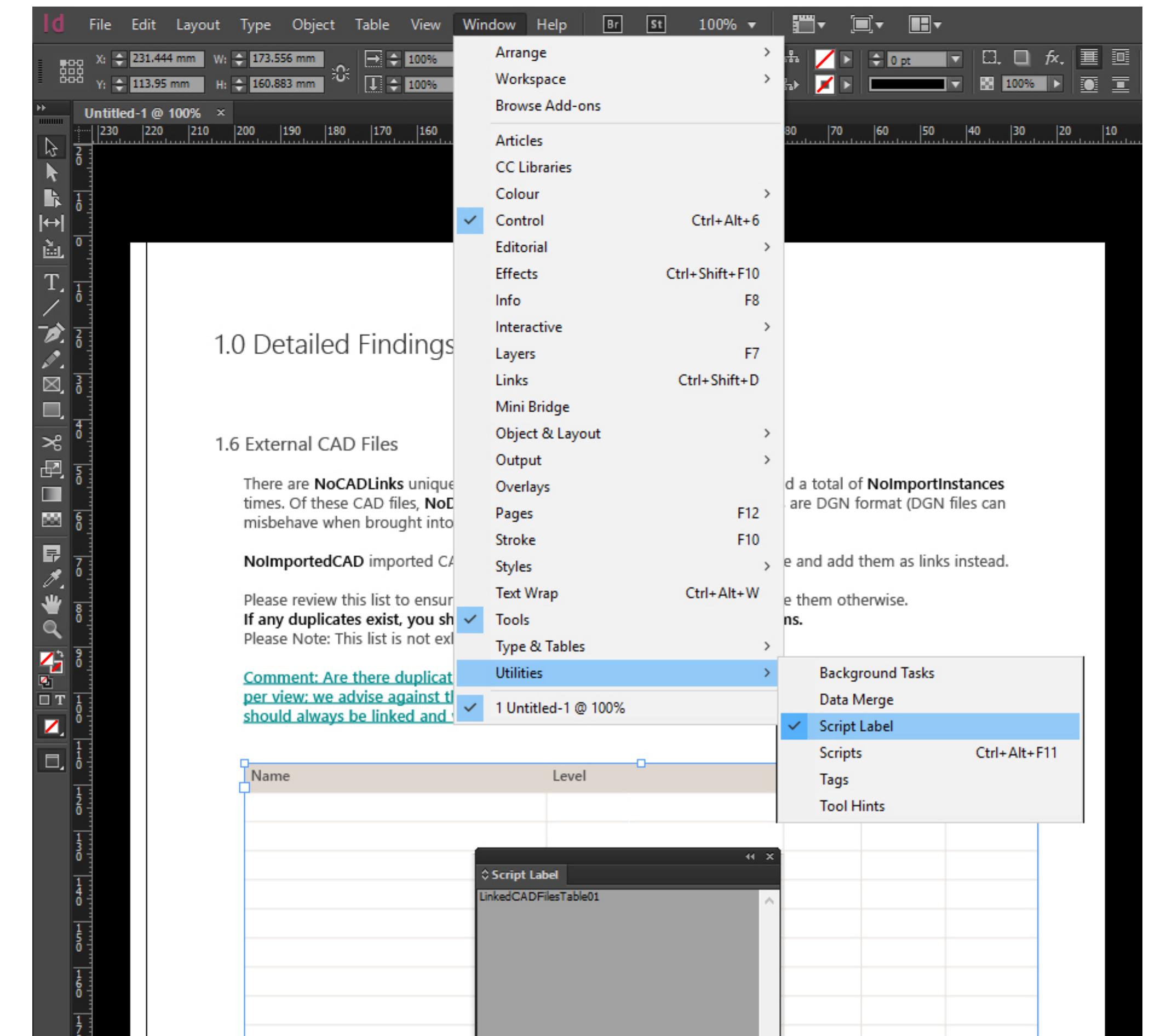
5. Target Tables & Input Data

We can't access a document's Tables directly

Since tables are a subclass of TextFrame, we have to iterate through all of these, querying whether each TextFrame has a Script Label applied to it. In order to access TextFrames, we need to iterate through the pages in the document

We can do this and populate our Script Label / ID reference dictionary. We need to create this dictionary only once at the start of our script run

We can then use it for reference to look up Tables



5. Target Tables & Input Data

I created a method called FindTable, which simply takes the ScriptLabel name as its key, and which returns the Table I'm after

We now have the ability to target specific tables by their name

```
Table linkedRevitFilesTable =  
FindTable("LinkedRevitFilesTable");
```

The table's contents are accessed via its Contents property, which needs to be passed an array of strings

```
//Logging the ID of every table for faster access  
foreach (Page page in inDesignDocument.Pages)  
{  
    TextFrames textFrames = page.TextFrames;  
    if (textFrames != null && textFrames.Count > 0)  
    {  
        foreach (TextFrame textFrame in textFrames)  
        {  
            if (!tableIdDictionary.ContainsKey(textFrame.Label))  
            {  
                tableIdDictionary.Add(textFrame.Label, textFrame.Id);  
            }  
        }  
    }  
  
//Function to return Table according to its Script Label name in InDesign  
Table FindTable(string labelName)  
{  
    int textFrameId = tableIdDictionary[labelName];  
    TextFrame textFrame = inDesignDocument.TextFrames.ItemByID(textFrameId);  
    return textFrame.Tables.FirstItem();  
}
```

6. Normal .NET Operations

There were some key values I wanted the report to be able to display which I knew could be accessed using the .NET class libraries

I read the current date and time and formatted them using `DateTime.Now.ToString("yyyyMMdd");`

I set the Text Variable for the Report Author's name to read their login name, e.g. OGreen, using `System.Environment.UserName`

These were used to set Text Variables or for Find & Replace operations

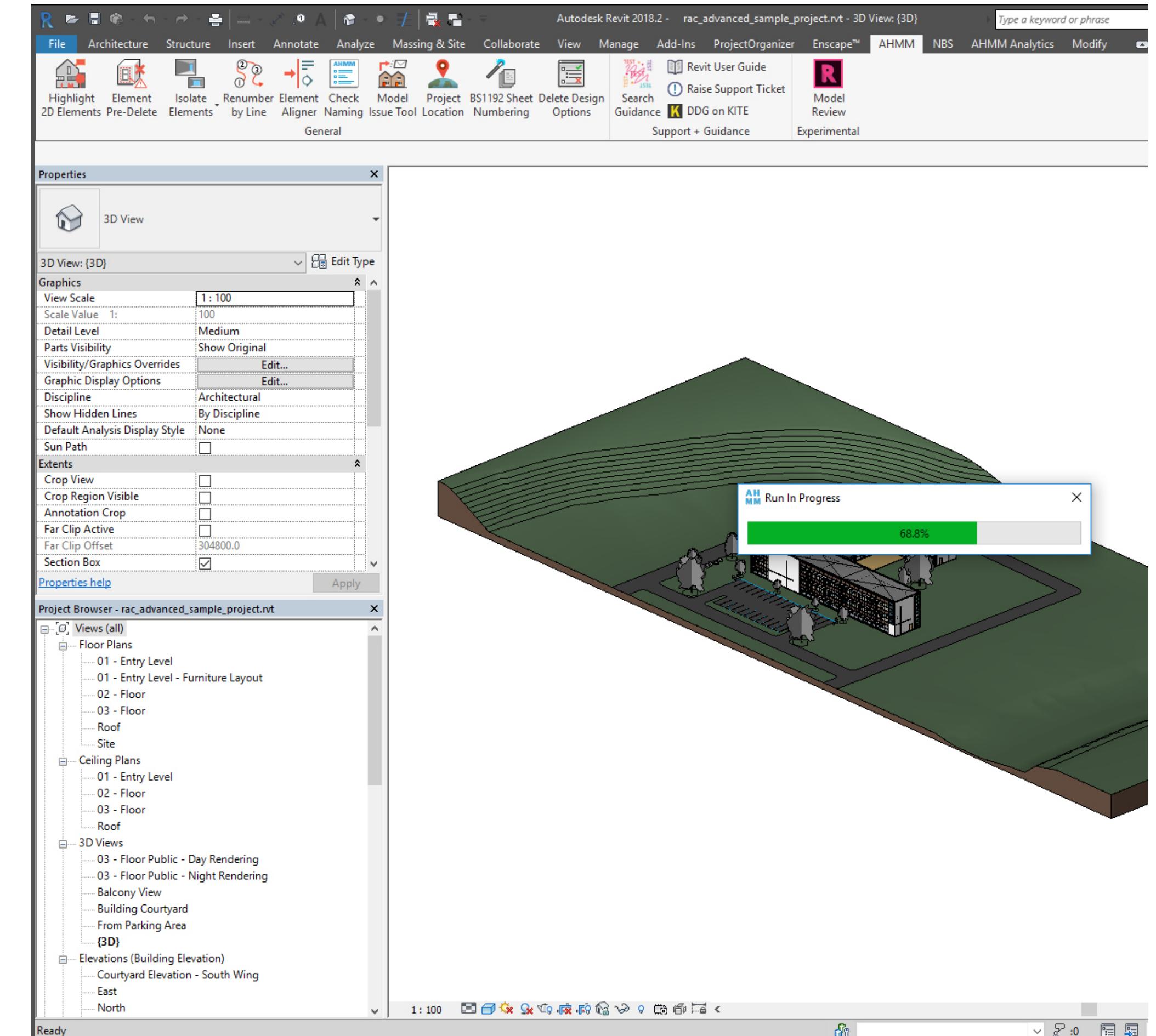
6. Normal .NET Operations

I used .NET's threading libraries and WPF to display a live-updating progress bar

This updates in its own thread to get around Revit's single-threadedness

Progress percentage was somewhat arbitrary; I decided how many steps there were and wrote code to update the progress bar after each step

How does one accurately reflect progress?
Seems to be a classic programming debate...



6. Normal .NET Operations

Finally, I used some Precompiler Directives in my code to adjust certain operations for different versions of Revit's API

For instance, I couldn't access the number of model warnings via the Revit 2017 API to write this value into our document

```
354  
355 #if REVIT2018 || REVIT2019  
356  
357     List<FailureMessage> allWarnings = revitDocument.GetWarnings().ToList();  
358     FindAndReplaceGREP("NoWarnings", allWarnings.Count.ToString());  
359  
360 #endif  
361
```

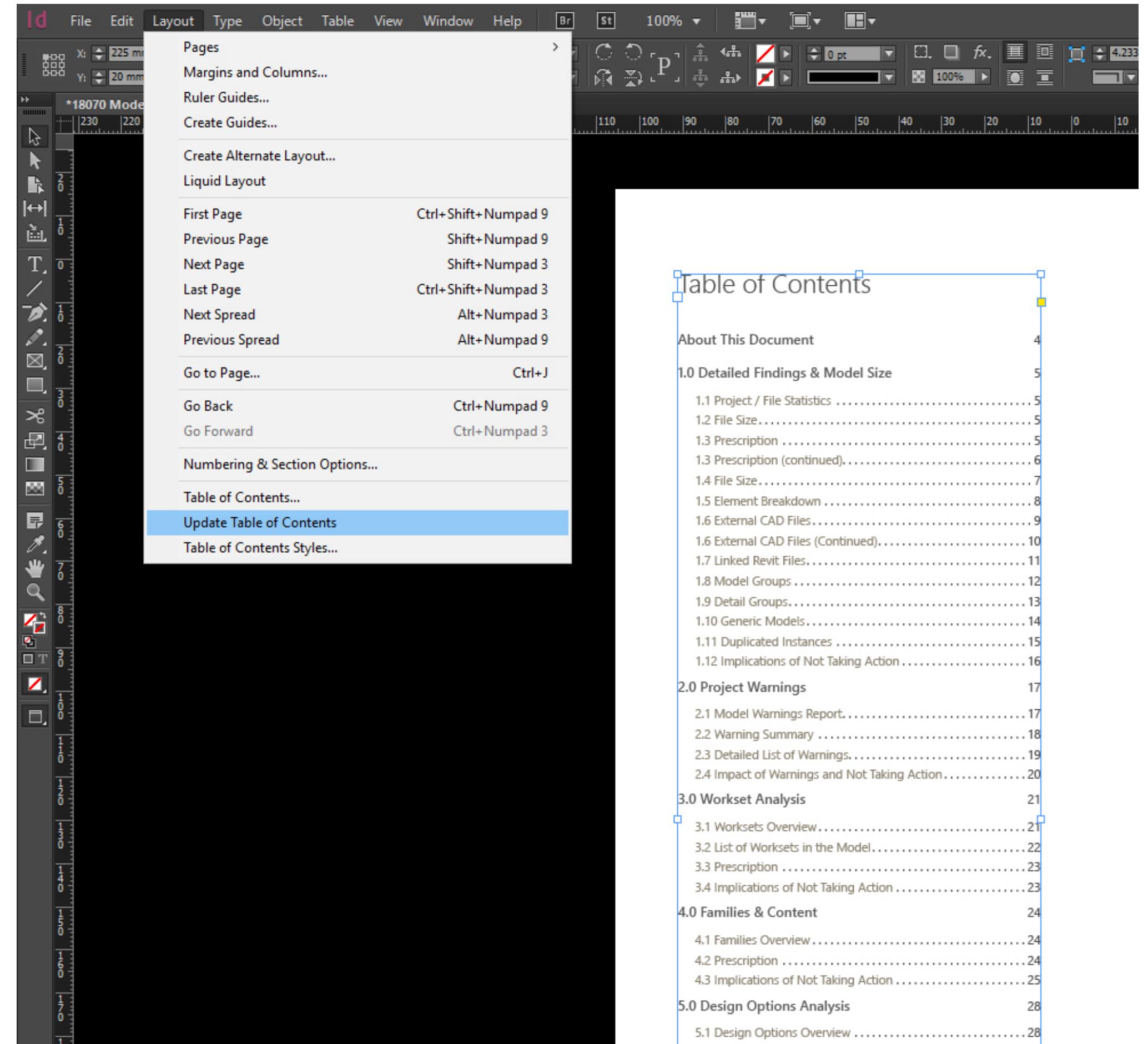
7. Launch UI Menu Commands

As the last step in our report generation, I needed the ability to update the Table of Contents

This is normally accessed in the UI via the Layout Menu > Update Table of Contents

Menu Commands in InDesign each have a specific 'Command ID'

I found a free Javascript script online, written by a Lancaster-based typesetter called Peter Kahrel



7. Launch UI Menu Commands

The script creates a mini menu of all CommandIds in InDesign

I could then sort these menu commands or search using keywords to find the ID of the menu action I needed (it was 71442)

I needed to find the TextFrame containing the Table of Contents using its Script Label, and select it in code using Application.Selection

Menu actions (21 items)		
Name	Area	ID
Update Table of Contents	Layout Menu	71442
Updates...	Other	91340
Update All Assignments	Panel Menus:Assignment	104975
Update Selected Assignments	Panel Menus:Assignment	104974
Update Content	Panel Menus:Assignment	102161
Update Out-of-Date Assignments	Panel Menus:Assignment	105210
Update Chapter & Paragraph Numbers	Panel Menus:Book	65944
Update All Numbers	Panel Menus:Book	65943
Update Page & Section Numbers	Panel Menus:Book	65811
Update All Cross-References	Panel Menus:Book	79431
Update Cross-Reference	Panel Menus:Cross-References	79383
Show Log of Update Results	Panel Menus:Data Merge	108043
Update Content in Data Fields	Panel Menus:Data Merge	108042
Update Data Source	Panel Menus:Data Merge	108039
Update Hyperlink	Panel Menus:Hyperlinks	79373
Auto Update URL Status	Panel Menus:Hyperlinks	79441
Update Preview	Panel Menus:Index	78085
Update Library Item	Panel Menus:Library	34410
Update Link	Panel Menus:Links	132610
Update All Links	Panel Menus:Links	132633
Update missing font list	Text and Tables	119653

On the right side of the interface, there are four input fields with dropdown menus:

- Name:
- Keystring:
- Area: [All]
- ID:

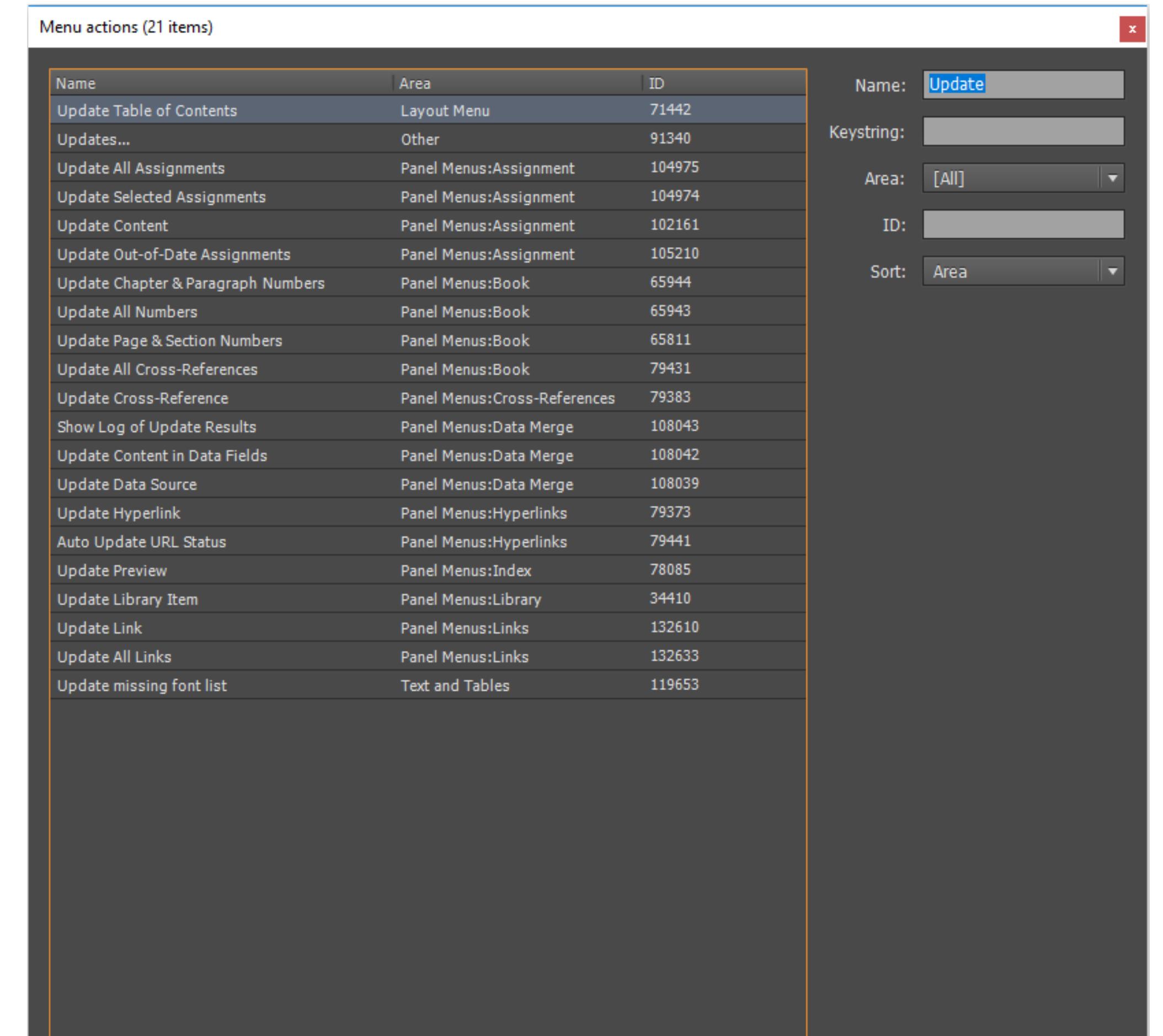
Sort: Area

7. Launch UI Menu Commands

Then I could use the `MenuAction` and
`inDesignApplication.MenuActions.ItemByID(71442);`

To select the Action, followed by
`menuAction.Invoke()` to invoke the command

This Updated the Table of Contents



The screenshot shows the 'Menu actions' dialog box from Adobe InDesign. The title bar says 'Menu actions (21 items)'. On the right, there are filter and search controls: 'Name: Update', 'Keystring:', 'Area: [All]', 'ID:', and 'Sort: Area'. A list of 21 menu actions is displayed in a table with columns for Name, Area, and ID. The first item, 'Update Table of Contents', is highlighted with a blue selection bar. The table data is as follows:

Name	Area	ID
Update Table of Contents	Layout Menu	71442
Updates...	Other	91340
Update All Assignments	Panel Menus:Assignment	104975
Update Selected Assignments	Panel Menus:Assignment	104974
Update Content	Panel Menus:Assignment	102161
Update Out-of-Date Assignments	Panel Menus:Assignment	105210
Update Chapter & Paragraph Numbers	Panel Menus:Book	65944
Update All Numbers	Panel Menus:Book	65943
Update Page & Section Numbers	Panel Menus:Book	65811
Update All Cross-References	Panel Menus:Book	79431
Update Cross-Reference	Panel Menus:Cross-References	79383
Show Log of Update Results	Panel Menus:Data Merge	108043
Update Content in Data Fields	Panel Menus:Data Merge	108042
Update Data Source	Panel Menus:Data Merge	108039
Update Hyperlink	Panel Menus:Hyperlinks	79373
Auto Update URL Status	Panel Menus:Hyperlinks	79441
Update Preview	Panel Menus:Index	78085
Update Library Item	Panel Menus:Library	34410
Update Link	Panel Menus:Links	132610
Update All Links	Panel Menus:Links	132633
Update missing font list	Text and Tables	119653

Live Demonstration

Conclusion

Our Model Review tool did everything we wanted it to: copying a template, filling tables & key values

About 80% of the report's content was auto-generated, saving many hours per model review

It was naturally limited in its scope:
"Let's not spent months on this, but what could we reasonably achieve?"

It is certainly possible to take this further

AHMM MODEL REVIEW

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Further Possibilities

Use Revit API to create isolated images of warning elements / worksets, save an image and dynamically update template's image placeholders

Intelligent commenting based on pre-existing knowledge of filesize, RIBA stage and number of elements in the model

Automatic formatting of paragraphs according to a condition

Using WPF data visualisation libraries to create charts & graphs (e.g. LiveCharts)

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Now It's Your Turn

Have any reports you want to automate?

We have uploaded skeleton code samples to AHMM's Github repository

We have just scratched the surface of what Revit and InDesign's API can do together

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Resources

archi-lab blog for very detailed posts on creating ExternalCommands and ExternalApplications

The Building Coder blog for Revit API reference

InDesign's SDK for API docs and examples

YouTube: Jamie King's channel for helpful explanations of C# concepts

Our Github - to get started

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