# Developing a Dashboard for Revit® Model Health

## Combining the Forces of the Model Checker and Power BI

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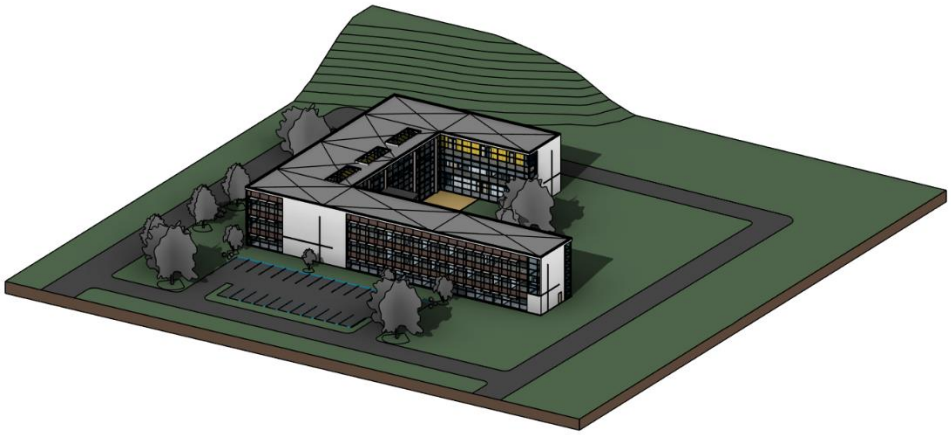
## ABSTRACT

This white paper, authored by CADD Microsystems in collaboration with Autodesk, is written to help educate Revit users on best practices and strategies for using the popular practice of data dashboards to monitor the overall "health" of a Revit model. This is done by collecting measurable markers that impact the performance of a Revit model, and by visualizing the data for easy understanding and consumption. Where possible, the strategies presented laid out are leverage low cost solutions to make them accessible to all Revit users.



## Introduction

A Revit model is typically a single source for architects, engineers, and contractors to see their design evolve and to generate construction documents. At its heart, Revit project files rely on an extensive database to collect and organize a whole host of different kinds of information.

While the software should never dictate actual design, there are certainly better techniques to use the tools and functions in Revit for a design that will help create a more robust Revit project file and avoid production performance issues through design and construction. Many BIM, VDC, and Model Managers have their own metrics to monitor the health of a Revit model, but this is often done in time consuming, manual ways. In addition, the review of this data can be difficult if the reviewer is not intimately familiar with the information collected, and how it is collected.

Over the last few years, across many industries, the use of "data dashboards" has become increasingly popular as it becomes easier to collect and organize large amounts of data, and new tools are available that let users display and share the data in easy to understand graphics. Similarly, many design and construction firms have found use in visualizing project and Revit model related data to make it easier to track trends, fix issues, and educate teams to be more effective.

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## Types of data that can be tracked

Before creating a dashboard, it is important to understand what kind of data is often collected and reviewed. Then your team can determine what data is important to them.

### Design information and requirements

Design related information can be collected and reviewed, such as design area vs. program area, code requirements around equipment counts, etc. This information is useful for PMs (Project Managers) to make sure the design is progressing along as expected and is meeting the project scope.

### Project data

Overall project information such as timeline and schedule, budget information, and staffing numbers can be organized and displayed in a dashboard and is often used by PMs and PICs (Principals in Charge).

### Model integrity

Related specifically to a Revit model, this information includes what kind of elements are being used and how they are being used as these can impact the performance of the model. This kind of information is critical to BIM Managers and Model Managers, and will be the focus of this white paper.

## The reason to track model integrity

A properly maintained Revit model can perform extremely effectively through a project's lifetime, regardless of staff changes, building square footage, or design changes. Inversely, a small project that is being produced with a seemingly simple Revit file can see a host of issues if Revit best practices are not followed.

There are many quantifiable items in a Revit model that BIM managers and Revit experts have identified over the years that may impact model performance. These items are excellent metrics to watch throughout a project's design and construction, to target and resolve to keep the model running as smoothly as possible.

Internal training is another reason to monitor model integrity. A constantly recurring model issue would be strong evidence for focused staff training and improving skillsets.

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## Identifying data to track

With the focus on model integrity for a dashboard, what data to monitor needs to be identified. This list will vary from organization to organization, but to narrow it down there are some key criteria to help identify what data is good to use and also what is easy to track in a dashboard.

**Quantifiable** | is it something that can be counted? Subjective data is not something that can be monitored.

**Trackable** | does the data correspond to information that is being collected in a Revit model?

**Typically change over time** | does the information tend to vary depending on the phase or amount of time spent on a project?

**Can be controlled with standards and best practices** | can team members impact the performance of the model by editing the monitored elements?

**Impact model performance** | do the items, when not managed properly, typically cause problems in the Revit model?

**Worthwhile beyond the project** | can the data lead to overall production strategy changes? While it may not directly impact the current project, some data and trends may lend themselves to targeted training or new policies and procedures.

### Examples

Some typical examples of Revit model integrity related data that is often used for dashboard tracking include:

- File size
- Number of views
- Number of warnings
- Model and detail groups used
- Number of elements
- Number of in-place families
- Linked files
- Purgeable elements

# Collecting the data

## Methods to collect the data

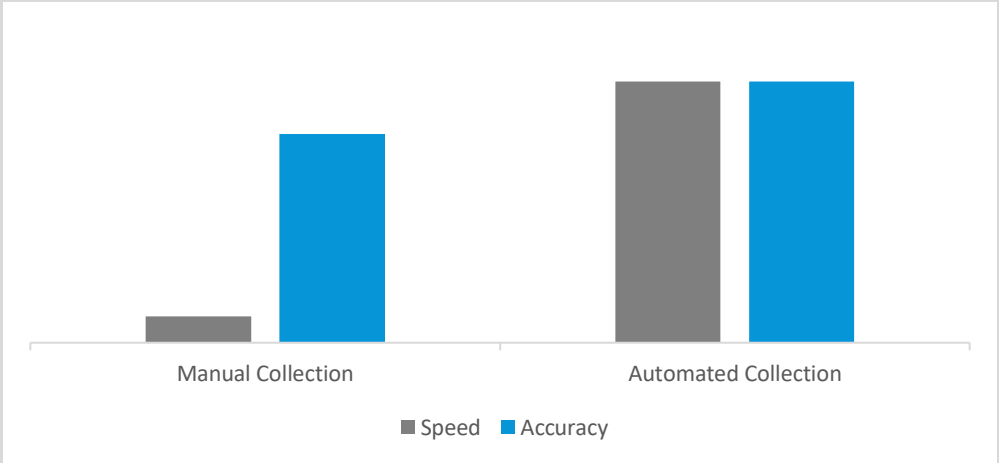
There are two primary methods of organizing and collecting the data for the dashboard: manual and automatic. This involves both organizing the data in your Revit model and exporting or putting the data in a file format that your data visualization software can consume. Usually, this is structured data in a spreadsheet, like an Excel file.

**Manual** | it is certainly possible to create Revit schedules to collect and manually document data. Some information cannot be reliably and consistently collected by hand, however, so, this process is limited and problematic.

**Automated** | using automation methods to organize and export data will always yield faster and more reliable results.

Some advanced users have found some success creating Dynamo scripts that parse through the Revit model and collect the information they need, however the customization is limited to Dynamo experts.

Another approach is to use the functionality in the Autodesk Model Checker for Revit tool (one of the free extensions available to Revit users through the Autodesk Desktop App) to create checks that count and collect the desired information and then export those reports to Excel. The examples and procedures in this document are supported by the Model Checker. The checkset XML file used can be found in the Public Library of the open dialog in the Model Checker itself, or can be downloaded directly with a Power BI template https://www.biminteroperabilitytools.com/dashboard.zip. These files can be downloaded and edited for your specific needs and use.



## How often to collect the data

There are several factors to take into consideration. And while no single schedule is appropriate for all projects, a baseline can be identified to work from and modify.

If the primary purpose of data collection is model health through design and construction, then the collection process needs to happen frequently and on a schedule so the model teams can resolve issues as they are found. If the purpose is solely to monitor standards and staff training, collecting model integrity data is probably only needed at the end of a project for review.

**Method of collection / level of automation** | a manual process of collecting and organizing model data can have a significant impact on the frequency that it will be performed. Automating the process will take an initial level of effort, however once set up, the amount of time to collect data should be minimal.

**Project file size** | one of the goals of tracking model integrity is to respond to issues in the model and keep the Revit file performing effectively. While the process of collecting data may be faster, smaller models typically have fewer opportunities to suffer from common model integrity issues. It may seem counterintuitive, but a smaller model needs less reviewing for this reason.

**Staff size** | following the lines that the main reason data is collected is to fix model issues, the team size can also be a factor when determining how often to collect data. A smaller project team has fewer opportunities to resolve issues found in the model. Integrity data collection and resolution can be part of a more consistent series of tasks for larger teams; smaller teams need to find and schedule specific opportunities to do so.

**Project timeline** | a complex project with a quick turnaround can benefit from a more aggressive schedule of data collection. Projects that tend to “linger” and have little change over periods of time won’t register much difference between report dates.

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## Recommendations for data collection

### 1 Go automatic

First and foremost, the manual method of collecting model integrity data is problematic at best. Information is missed, it is very time consuming, and often gets skipped. Any serious efforts need to focus around automating the data collection as much as possible.

### 2 Schedule it

Like any other project task, data collection happens most successfully when it becomes routine. It should be an identified scheduled task, possibly tied to another project task that is on a similar schedule:

- Project review meetings
- Model manager maintenance time
- File delivery to consultants

If the data collection is part of a series of other tasks, it will be performed more reliably.

### 3 Be consistent

It's important to not alter what data is being collected or the process of collection through a project. Data visualization requires reliable and consistent markers for tracking data over time. Any change to the data scheme will cause a break in the ability to monitor and track the information.

If data tracking across projects is desired, it is also important to make sure there is an identifier to connect the data between collections. Often this can be difficult as there will be the need to change what is being specifically tracked or how it is being collected as new techniques are learned. Therefore, cross project data monitoring over time is often lost. Historical data can still be manually reviewed as necessary.

### 4 Go beyond the baseline data

It is simple to collect metrics that relate to specific information in a Revit model. A visualization can be leveraged to look at information in new informative ways. For example, it is fairly simple to collect the number of warnings in a model and the file size. A dashboard report could easily be created that reports warnings per MB, saving report space and adding context to metrics that relate to each other.

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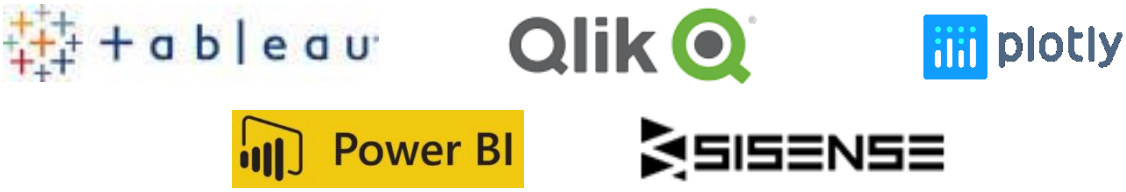
# Displaying and sharing the data

## Data visualization

Once the data is collected, or has been collected over a period of time, the next step is to create reports and visualizations that can help “tell a story” around the information. Raw numerical data is simply not interesting or easy to consume. Visually interesting graphics that convey the trends and meaning behind the data is a far more effective method of reviewing data quickly and with a larger audience.

### Data visualization tools

There are several pieces of software that can take various types and amounts of data and allow a user to create visualizations and reports around it.




This document is not intended as an endorsement of one product over another. Individual organizations need to identify their specific needs and the resources they can apply to them and compare that to different tool features.

For demonstration, Microsoft Power BI has been used for examples and best practices development, with the understanding that many features are universal to all the visualization tools, but some may be product specific. The Power BI template used can be found https://www.biminteroperabilitytools.com/dashboard.zip. Feel free to edit it for your specific needs and use.

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## Report creation

### Data identification

The first step in creating a report is to identify the data that will be in that report. As output from the Autodesk Model Checker is an Excel file, that can be the data visualization software's source. If monitoring trends over time, a folder to place the Excel files will be the data source.

### Data transformation

The raw data is previewed in a query editor, where data can be shaped or "transformed" to make creating reports easier. Therefore, it's essential to have consistent formatting of the data sources as they will define the transformations once and they need to be applied to all the data source files.

Some examples of data transformation that may need to be done include:

**Hiding data** | there is often extra information in the source that is not needed in a report. While the information won't be displayed unless a specific report is built for it, it's far easier to create impactful visualizations when only needing to focus on the data you want.

**Changing format** | often, data that is collected defaults to simple text. The need to transform the format to numerical or something quantifiable can be critical for a good report.

**Rounding** | the source data may show far more accuracy than is needed or wanted in a high-level overview. For example, there is no real value in knowing that there are precisely 253,837 placed model elements in a Revit model. Simply understanding that there are "around" 254K is sufficient.

**Pivot data** | the overview report exported from the Model Checker identifies each check in its own row to allow expansion and scalability. Once the checks to be reported on have been identified, the rows can be "pivoted" to columns with the report names as column headers. This makes report building straightforward as each check is now a "data field".

**Appending data** | with different pieces of data often in different sources, or tabs in an Excel file, data can be appended into a single query to make finding it in the report builder and maintaining consistency easier.

**Replacement** | data sources may not fill in information when it finds no values. Visualization tools may identify this as NULL. For consistency, this may need to be replaced with "0" throughout your data before report building.

| | Source.Name | Revit File | Check ID | Name | Description | |
|---|---|---|---|---|---|---|
| 1 | 001.xlsx | PacificCenter_AY_Arch-v1_d... | 9fd68140-9955-4c58-bd0e-7... | Warnings | Reports all warnings in a Revi... | Rep |
| 2 | 001.xlsx | PacificCenter_AY_Arch-v1_d... | 88fc3c24-debd-4d69-a8ed-e2... | File Size | Reports the file size of a Revit... | Rep |
| 3 | 001.xlsx | PacificCenter_AY_Arch-v1_d... | 00066391-315f-41d4-accc-b7... | Loadable Families | Will report the families in the... | Erro |
| 4 | 001.xlsx | PacificCenter_AY_Arch-v1_d... | ba83957b-ad10-4602-a89f-8... | Purgable Elements | Reports the number of eleme... | Rep |
| 5 | 001.xlsx | PacificCenter_AY_Arch-v1_d... | bfd04330-ad97-4d9e-8e3e-3f... | Worksets | Lists all user worksets for a R... | Rep |
| 6 | 001.xlsx | PacificCenter_AY_Arch-v1_d... | 8ab8e438-4a3c-4660-9175-8... | Design Options | Lists all Design Options in a R... | Rep |
| 7 | 001.xlsx | PacificCenter_AY_Arch-v1_d... | 79647916-c217-4e6e-b9e3-a... | Duplicate Instances | COUNT of redundantly place... | Rep |
| 8 | 001.xlsx | PacificCenter_AY_Arch-v1_d... | d3e04314-4aa2-4117-b68f-5f... | Linked Revit Files | COUNT of all instances of Rev... | Rep |
| 9 | 001.xlsx | PacificCenter_AY_Arch-v1_d... | 16dc5df7-adf0-441e-9dd5-ca... | Linked CAD Files | COUNT of all linked CAD files ... | Rep |
| 10 | 001.xlsx | PacificCenter_AY_Arch-v1_d... | fc03977c-48ff-4270-8044-35... | Imported CAD files | COUNT of imported CAD files... | Rep |
| 11 | 001.xlsx | PacificCenter_AY_Arch-v1_d... | 30906974-c242-4fb8-9e1a-ff... | Imported SKP files | Will report the number of im... | Rep |
| 12 | 001.xlsx | PacificCenter_AY_Arch-v1_d... | 44488eb5-2074-4f7b-bff0-62... | Raster Images | COUNT of imported images p... | Rep |
| 13 | 001.xlsx | PacificCenter_AY_Arch-v1_d... | dab002bd-2210-40cf-8425-fc... | Non built-in Object Styles | Lists all non built-in categorie... | Rep |
| 14 | 001.xlsx | PacificCenter_AY_Arch-v1_d... | f390b0b9-2699-401b-b938-a... | Views | COUNT of views in the model... | Rep |
| 15 | 001.xlsx | PacificCenter_AY_Arch-v1_d... | ac5a825a-9382-412f-aa9b-ef... | Sheets | COUNT of sheets in the mode... | Rep |
| 16 | 001.xlsx | PacificCenter_AY_Arch-v1_d... | cd787ea0-d009-4fa4-afae-3e... | Views Not On Sheets | Reports the number of views ... | Rep |
| 17 | 001.xlsx | PacificCenter_AY_Arch-v1_d... | cc5424ca-7566-443a-8757-0... | Views with Hidden Model Ele... | Lists all views in a Revit mode... | Rep |

The image above shows a portion of the imported data in its raw format. There are several ways this data should be transformed before attempting to create a dashboard report:

- Sources are not aligned in rows
- File name, Description, Check type, etc. are not needed for the report
- Individual checks are simpler to review if they are presented as unique columns, or data fields
- All data is formatted as Text

| | Source.Name | Warnings | File Size | Loadable Families | Purgable Elements | |
|---|---|---|---|---|---|---|
| 1 | 001.xlsx | 233 | 255 | 550 | 1288 | |
| 2 | 002.xlsx | 247 | 278 | 662 | 1357 | |
| 3 | 003.xlsx | 382 | 259 | 675 | 1357 | |
| 4 | 004.xlsx | 343 | 264 | 675 | 1368 | |
| 5 | 005.xlsx | 477 | 385 | 778 | 1371 | |
| 6 | 006.xlsx | 526 | 389 | 794 | 1489 | |
| 7 | 007.xlsx | 788 | 412 | 812 | 1622 | |
| 8 | 008.xlsx | 966 | 417 | 1255 | 1687 | |
| 9 | 009.xlsx | 944 | 433 | 1313 | 1693 | |

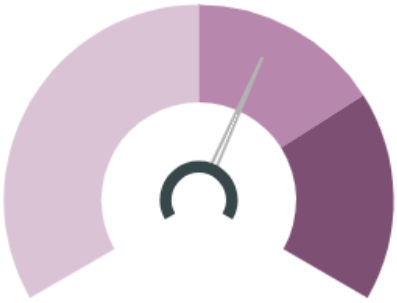
This image shows a portion of the transformed data that has unnecessary data removed, individual checks aligned as columns in source rows, and the quantifiable data is now formatted as Whole Numbers or Decimal Numbers.

## Visualization creation

Once the data is prepped, the individual visualizations need to be created. This is typically a process of finding the data field or fields wanted for viewing, identifying the appropriate visualization style, and using the application to create it. Colors, size, labels, etc. can all be adjusted.


AREA CHART


TREEMAP



TACHOMETER


LINE AND COLUMN CHART

Good visualizations will be simple and easy to understand quickly. If you have multiple metrics, they need to be related to each other so the visualization's specific story is simpler to comprehend. Like any design decision, it is driven by audience, purpose, and resources. There are numerous resources available that can help educate you on trends and good design for your specific data visualizations.

## Dashboard layout

While the visualizations are being created, consideration needs to be given to the overall layout of the dashboard. Much like the individual parts, an overall idea of the amount of data shown and why it is being shown needs to be considered.

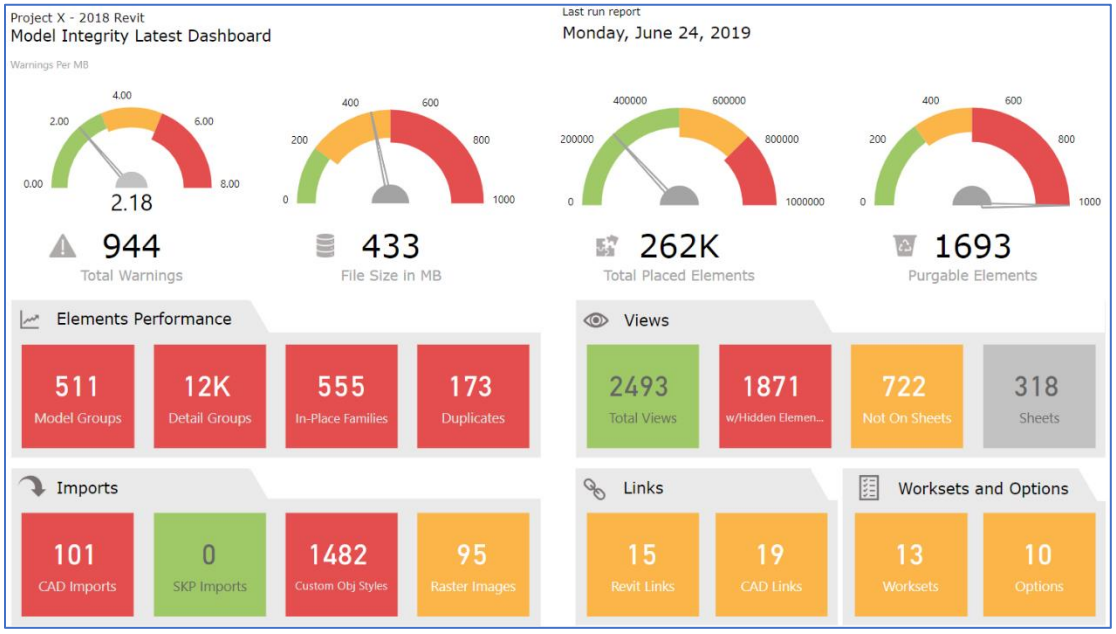
Report sections can vary by size depending on importance, and colors can be adjusted for an easier-to-view dashboard.

You may have multiple pages in your report. Take care with this approach as most users will not be using the authoring tool to view the data; it will most likely be a single image or page in a PDF. Try to succinctly collect your related data on a single page.

## Single model example

For this example, the single “current” Revit model is the data source. Model integrity metrics have been identified that are important to the BIM management team, as well as markers that will put this model in the “safe”, “warning”, or “danger” zones. Similar metrics are grouped together for easy reference, and no visualization has too much information to make it confusing. This is intended as a simple dashboard for users to glance at to get a pulse on the current model file.

Note the large numbers, tachometer styling, and colors that quickly let users know if an element is safe with green, a potential warning with yellow, or in the danger zone with red.

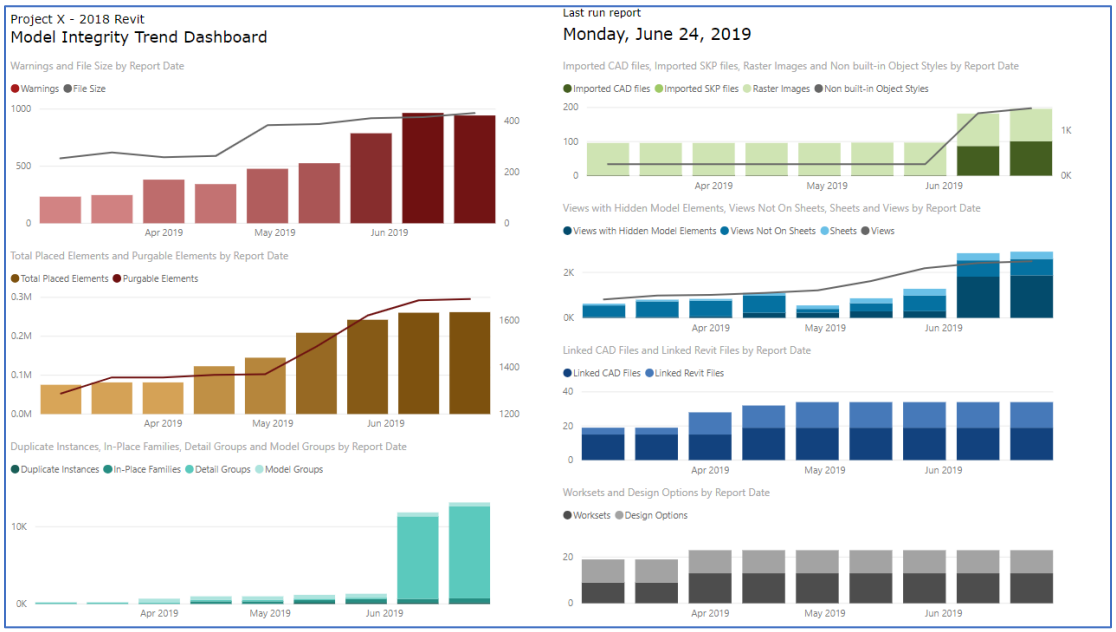



Each individual report gives a snapshot in time of the model’s status. This allows the project team to focus on egregious issues, if there are any, or to tackle “warning” zone issues before they become a major problem.

Thresholds can be adjusted in each project’s report, as one size typically does not fit all; a higher level of items in each field is typically acceptable for larger projects.

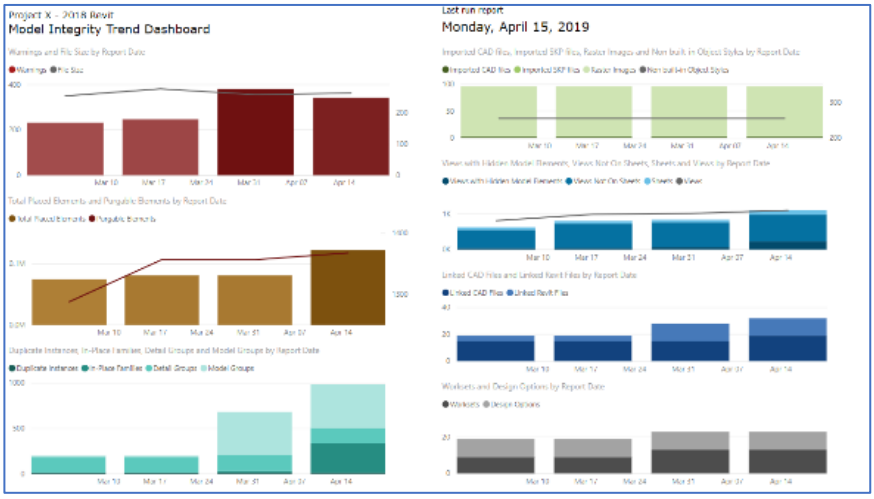
## Model trend example

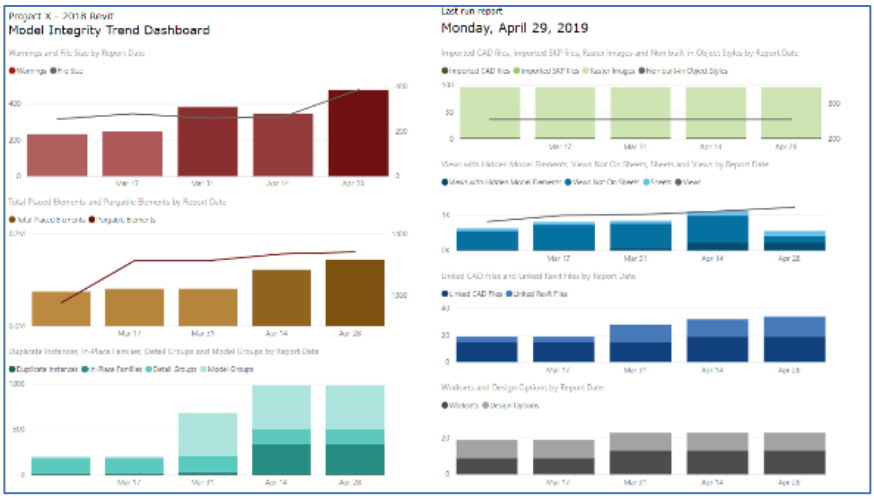
For monitoring model integrity over time, different visualization styles should be used that make it easier for the user to see changes over time. This limits the style choices, but in no way impacts the ease of reviewing the data.

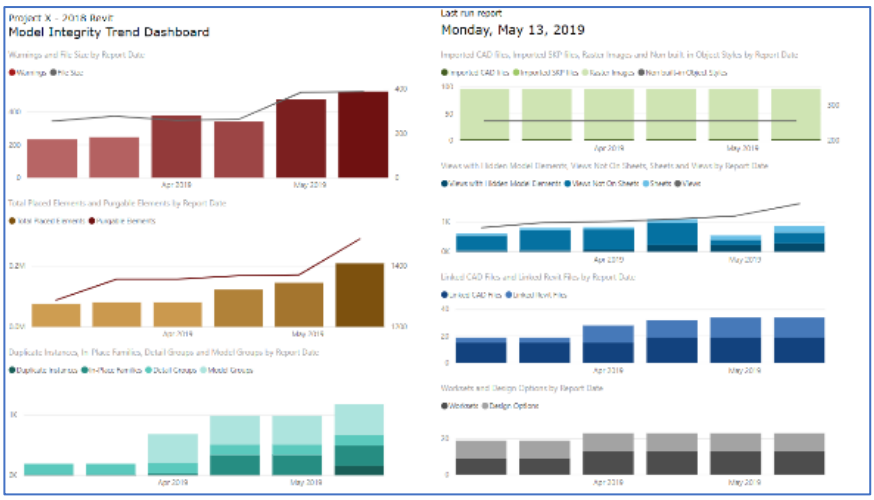



Multiple metrics are kept to a minimum on each report. Measurements that are more impactful (Warnings, Total Placed Elements) are given their own reports, with a trend line relating to a comparable metric overlaid.

As the reports are monitored and viewed over time, interesting trends in workflows can reveal themselves. BIM managers and other team members can help align quantifiable data (e.g. Number of Detail Groups) with user reported subjective data (e.g. “The model is *really* slow”) to reveal possible training opportunities or new standards and best practices to implement on all projects.




TREND DATA DASHBOARDS AT DIFFERENT POINTS OF DESIGN

## Consuming the data

Once the data is collected, transformed, and displayed in a report, it is time to share it. Most data visualization tools have their own functionality to share reports either “live” or “static”.

Typically, a live report will be a cloud hosted solution that users can view and interact with the data. The sample Revit dashboard has been designed for simplicity and ease of viewing, so a static report would be appropriate. Most tools can generate a PDF, create an image, or simply print. Power BI has the additional functionality to create a PowerPoint file from a report.

The method of sharing the reports needs to be determined and is a critical portion of a workflow.

In Revit itself, some organizations have updated their starting view to include an image snapshot of the latest dashboard. This is a very effective way to immediately get the information in front of your Revit users, but offers two main issues for resolution:

1. Do the users know how to deal with the data shared with them or who is responsible for doing so? Simply sharing report results is not enough. A plan must be in place for resolving the potential issues.
2. Revit does not natively refresh images automatically. So, a workflow needs to be developed to refresh the image when updated. This can be done manually with Reload/Reload From or programmatically with a Dynamo script or API based solution.

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## Conclusion

The continued growth of using Revit in design and construction has put more focus of quantifiable data in the Revit project files. But beyond design related data, model integrity data is an excellent metric that can be used by BIM managers and design teams to help track a model's health and try to alleviate issues throughout the life of a project.

With some 'simple to leverage' data collection tools, like the Autodesk Model Checker for Revit, developing a method to automate the collection of integrity related data can be straightforward and simple to replicate.

Once the data is consistently collected, there are numerous options in the marketplace that let users create visual reports of this data, making it far easier to monitor potential concerns than reviewing raw data itself.

Once the collection and displaying of data has been locked into a consistent workflow, model creation teams can rely on a model integrity dashboard as another powerful utility to help them actively monitor and address model crippling issues often before they become problems.

## Resources

BIM Interoperability Tools website

Data visualization on Wikipedia

Revit Model Health Dashboard Sample

Autodesk University 2017 – You Can't Manage What You Don't Measure

Autodesk University 2017 – Turn Revit Data into Useful Information with Visualization Techniques and Workflows