Session 3.3

How We Leveraged Data to Overcome Resistance to Investment in Automation

Matthew Collier, IMEG | Michael Kilkelly, IMEG | John Cook, IMEG

Additional Handouts On GitHub https://github.com/MatthewACollier/BILT2023

Class Description

Over the past few years, IMEG has grown its automation capabilities from a handful of Dynamo graphs to a full-fledged software development team. The cornerstone of this growth is usage data. In this presentation, we will discuss how we collected and leveraged this data to convince leadership to invest heavily in custom tools and build a team dedicated to supporting this effort.

About the Speakers:

Matthew Collier is the Electrical Applications Product Owner at IMEG, a full-service engineering firm with over 60 offices throughout the US. He has a passion for building automation tools designers and engineers love to use. He started at IMEG Corp. immediately after receiving his BSEE from University of Illinois at Chicago. He spent several years designing electrical systems and was always looking for ways to improve workflows and quality. He convinced IMEG leadership to make those interests a full-time job in 2019 and hasn't looked back. During that time, he has led the development of a full suite of electrical engineering and general productivity plug-ins for Revit.

Michael Kilkelly is the Structural Applications Product Owner at IMEG, a full-service engineering firm with over 60 offices throughout the US. In this role, he works with the structural engineering group to develop digital tools and workflows that help design teams work smarter and more efficiently. Michael is a registered architect and practiced architecture for 15 years, most recently with Gehry Partners in Los Angeles. After leaving Gehry Partners in 2012, he founded Space Command, a BIM and automation consultancy. He received his Bachelor of Architecture from Norwich University in 1995 and Master of Science in Design and Computation from MIT in 1999. Michael taught architectural and computational design at The Boston Architectural College, Wentworth Institute of Technology and Northeastern University. Michael is also the founder of ArchSmarter, a website dedicated to helping AEC professionals work smarter, not harder. His writing on design and technology has appeared in ARCHITECT magazine, among other publications.

As the Automation Product Manager at IMEG, a full-service engineering firm with over 60 offices across the US, John brings with him over two decades of experience in the AEC industry. Though he started his career with a focus in electrical design, John has worked for various firms in the Architectural, Civil, and MEP domains, gaining significant expertise in project types such as roadways, education, laboratories, and healthcare. John now oversees a team of discipline-specific product owners at IMEG, responsible for the research, development, implementation, and

education of the firm's Smart Engineering Tools software portfolio, which comprises over 50 advanced tools. John's expertise in automation and tool development has been instrumental in driving the firm's success.

Summary

Over the past five years, IMEG has grown its automation capabilities from a handful of Dynamo graphs to a full-fledged software development team. It takes a significant and ongoing investment to build and maintain a custom software. Our leadership is all in on automation, but that was not always the case. Whenever we share the story of the IMEG automation journey, the most common question we get is "How did you convince your leadership team to invest so heavily in automation?" One of the most important factors to gaining the support of leadership is quantification of the impact automation has on the organization.

While many of us know the value of tools we build, leadership typically requires hard data to justify the expenditure of resources. During the tool planning process, this requires estimating potential time savings, and determining what a successful implementation looks like. Once a tool has been released, we then collect actual usage metrics, quantify the actual time saved, and verify that the success metrics have been met. The usage data is most easily visualized and digested via rich, interactive dashboards using software such as Microsoft Power BI. This serves as a powerful tool for demonstrating value to leadership.

In this session, we will demonstrate how to collect and visualize tool usage data at any stage of your automation journey, how to calculate the impact of each tool, and how to leverage that information to negotiate for more resources. We will show you ways to collect user metrics and build dashboards to track usage, utilization, and estimated time saved for each tool, discipline, office, and team.

No matter the size of your organization, automation has the potential to increase productivity, create more consistent results, and reduce errors and omissions. As automation creators and technology enthusiasts we understand the value, but typically we must prove it to firm leadership before they will invest the required resources. Once you get started, those resources typically need to scale as your catalogue of tools grows. Quantifying the impact of automation within your organization through measurable data that is easily visualized allows you to confidently demonstrate the value to your organization's leadership. This is the evidence you can lean on when negotiating for additional resources as your automation efforts evolve.

IMEG's Automation Journey

This presentation had its genesis at the four previous BiLT events. At BiLT NA 2017, in Scottsdale Arizona, John attended Michael's presentation on "Code vs Node". He'd been experimenting with Dynamo and started to build a small library of scripts. It was at this event that John met up with his co-worker, Sarah Garthaus, who is the firm-wide BIM manager at IMEG. She'd been poking around his Dynamo folder and saw what he was up to. She asked him if he'd be interested in further developing his script library and rolling it out firmwide.

Fast-forward to BiLT NA 2018. John and Michael meet up in the corridor between sessions. John tells Michael he'd converted some of his Revit macros to Dynamo. Interested, Michael pressed for more details. He then tells Michael that he and Sarah have deployed the scripts across their whole firm. "How big is your firm?", Michael asks. "A little over a 1,000 people," John replies. Now Michael is DEFINTELY interested. To put things in context, IMEG is one of the largest consulting engineering firms in the US, with 65 offices and over 1,700 employees. IMEG provides engineering services for nineteen disciplines, including civil, MEP, structural, and technology.

They chat more and Michael asks John if he'd be interested in being interviewed for an article for ArchSmarter. A few months later, John, Sarah, and Michael talk for a couple hours about IMEG, Dynamo, and the challenges of deploying it in a large firm environment. Michael had a lot of questions about the nuts and bolts of the process, which John and Sarah were more than happy to answer. The interview led to an article on ArchSmarter, which went on to become one of the most popular articles on the site that year. After the article was published, John and Michael talk about developing the article into a presentation, so they could get more into the specifics of the process. They submit the proposal, it was accepted, and presented at BiLT 2019 in Seattle.

Simultaneously to all this, Matt Collier, an electrical engineer at IMEG, was tasked with exploring better options for electrical design within Revit. He started a task force and began talking with other engineers about their experiences and frustrations with the software. A year later, Matt joined IMEG's Technical Operations group on a one-year assignment, along with another electrical engineer. The two of them planned out a full suite of custom electrical tools and started development. Matt joined Technical Operations full-time in 2020.

Around this time, Michael started working for IMEG as a consultant. Realizing some of the limitations of Dynamo, John and Sarah wanted to convert some of their more popular Dynamo scripts to add-ins. After working in this capacity for almost two years, Michael had a discussion with John about joining IMEG full-time. Michael liked working with them and was impressed with their commitment and

dedication to working smarter. It seemed like a great fit. Michael joined IMEG full-time in November of 2021 and immediately got to work on some new tools.

At BiLT 2022 in Anaheim, we presented on our ongoing efforts to develop custom Revit tools and the systems and processes we employ to do so. Today, we will discuss how we capture data from these tools and leverage it to gain support from firm leadership.

Obstacles to Growth

It's a given that organizations need to constantly strive for growth and innovation to stay ahead of the competition. However, progress often encounters internal obstacles that can impede expansion and development. Two common hurdles are the resistance to change and the perceived financial risk of untested automation. This was particularly the case within IMEG.

As the automation team slowly grew, IMEG leadership demonstrated initial resistance. Change can be daunting, particularly when it involves adopting new technologies and strategies that disrupt established workflows. Additionally, concerns regarding the financial implications of implementing automation further fuelled their apprehension. Understandably, no one wanted to invest significant resources without guaranteed returns. It was a “chicken or the egg” problem. The team needed resources to build the tools but leadership needed proof the tools would save money before they would grant additional resources.

To navigate these obstacles, the IMEG automation team realized the need to demonstrate the value of the tools they had already deployed. They understood that by showcasing tangible results and positive impacts, they could justify additional resources and gain support for further expansion. By collecting and analyzing relevant data, the team would provide evidence of improved productivity and reduced errors. Ideally, this approach would instill confidence in leadership and solidify the case for continued growth.

Our Data Collection Journey

Embarking on a data collection journey is a complex process. It requires starting small, building incrementally, and adapting to evolving data requirements. From rough projections and persuasion to implementing advanced visualization tools, our data journey demonstrates the power of data-driven decision-making and the importance of constantly refining and expanding data collection efforts.

Phase 01: The Early Stages

In the initial stages, we focused on generating rough projections, persuading stakeholders, and establishing trust. The team started by collecting primary data, such as when the user clicks a tool. These clicks were sent to a specific Slack channel. Periodically, the channel data was manually exported to Excel for visualization. The data collected at this stage was limited to user information, specifically the

Windows username. It was a crude, manual process, but these early insights helped lay the foundation for future data collection efforts.

Phase 02: Expanding Data Collection

As the team gained momentum, they moved from Excel to a more robust database solution, collecting clicks and leveraging Active Directory data to define teams, disciplines, and other relevant information. This expansion allowed for more comprehensive Power BI visualizations, providing insights into user behavior and team dynamics. These basic visualizations were a stepping stone for deeper analysis and informed decision-making.

Phase 03: Refining Insights

Realizing the need for more granular data, the team extended their data collection efforts to capture actions per click. This additional layer of information provided valuable context and insights into user interactions. IMEG's data team came in to support our efforts and leverage their expertise in creating more in-depth visualizations using Power BI. These advanced visualizations enabled stakeholders to understand user behavior comprehensively and identify specific areas for improvement.

Phase 04: Quantifying Impact

To demonstrate the value of the data collection efforts, the team started measuring the estimated time savings based on small user group surveys. By capturing user feedback and calculating time saved per action, they could quantify the tangible benefits of the tools deployed. This approach provided valuable insights and helped build a strong case for further investments in automation and data-driven decision-making.

Phase 05: Expanding Data Sources

Recognizing the potential of integrating data from multiple sources, the team created a data lake to consolidate information from Active Directory, Deltek, Salesforce, and Workday. This cross-referencing of data allowed for deeper analysis and provided a more holistic view of user behaviour, team dynamics, and organizational performance. The data lake became a valuable resource, enabling stakeholders to make more informed decisions based on comprehensive and interconnected insights.

Phase 06: Continuous Improvement

To further enhance the data collection process, we introduced automated user surveys. These surveys were activated when users interacted with the tools, capturing real-time feedback and usage patterns. By integrating this data into the calculations, the team updated the calculated time savings with more accurate averages. Additionally, projections and potential opportunities were incorporated into Power BI dashboards, leveraging assumptions for increased adoption, company growth, and the introduction of new tools.

We now have comprehensive dashboards to track tool usage throughout IMEG. These dashboards allow us to target specific tools or teams based on the data. If we notice a team is not using certain tools, we schedule training to make sure they know the tools exist and know how to use them. Likewise, if we see

that the usage of a tool has dropped off, we take a close look at the tool to identify if it is no longer doing the intended job.

Planning for Data Collection

Effective data collection is the foundation of data-driven decision-making and is crucial in driving automation growth and efficiency. In this section, we explore the planning phase of data collection, focusing on the critical data elements to collect and methods for quantifying the saved time. Additionally, we delve into quantifying the area of opportunity by examining project time saved and potential growth scenarios resulting from hiring, mergers, and acquisitions.

Step 1: Identify data to collect

To gain comprehensive insights into tool usage, collecting data on clicks and user activity is essential. Initially, capturing information about who used the tool, including their name, role, and team, provides a basic understanding of tool adoption and user engagement. Additionally, gathering project-specific data such as project number, project name, project efficiency, project team, project manager, and project leads allows for a deeper analysis of tool usage in the context of project-related activities. Furthermore, tracking which projects are opened and actively worked on in Revit provides valuable insights into project activity and engagement.

Step 2: Quantify actual time saved

Measuring the saved time is crucial to demonstrating the value of the tools deployed. One approach to determining time saved per action is through educated guesses based on understanding the tool's functionality and impact. However, to obtain more accurate data, surveys can be employed. Manual surveys, consisting of the right questions regarding time saved and tool effectiveness, provide qualitative insights from users. Automated surveys, triggered at specific criteria, can capture real-time feedback and provide a quantitative understanding of time savings and tool efficiency.

Step 3: Quantify the area of opportunity

Comparing project time saved by active tool users to non-users is essential to identifying the area of opportunity. This analysis provides insights into the potential impact of tool adoption on project efficiency and productivity. Moreover, as organizations grow through hiring, mergers, and acquisitions, quantifying the projected time saved becomes crucial. By extrapolating data and assumptions, it is possible to estimate the time saved across the organization, considering the increased workforce and expanded project portfolio resulting from growth initiatives.

Planning for data collection lays the groundwork for insightful analysis and data-driven decision-making. Collecting clicks/usage data, project information, and quantifying time saved per action through surveys and educated guesses are key steps in demonstrating the value of tools deployed. Additionally, quantifying the area of opportunity by comparing project time saved and considering growth scenarios helps uncover potential benefits for the organization. By focusing on these aspects, organizations can

leverage data to optimize efficiency, improve project outcomes, and make informed decisions for sustainable growth.

Collecting Data

Collecting data from your Revit add-ins is crucial for analyzing usage patterns, identifying areas for improvement, and making informed decisions. We will explore two different methods for collecting data from Revit add-ins, highlighting the pros and cons of each approach.

Method 1: Webhook to Existing Messaging Platform

One method to collect data from Revit add-ins involves leveraging an existing messaging platform such as Slack. The add-in can make a webhook call to a specific channel in the Slack workspace by enabling incoming webhooks. This approach allows real-time access to usage data, as the add-in can post messages or updates to the designated channel.

1. Create Slack workspace and channels for your data https://slack.com/
2. Enable incoming webhooks in your workspace https://api.slack.com/messaging/webhooks
3. Add webhook call to your plugin or Dynamo script
    a. C# example https://gist.github.com/jogleasonjr/7121367

```
//from https://gist.github.com/jogleasonjr/7121367
private static void LogToSlack(string logData, string channel)
    {
      try
      {
        var urlWithAccessToken = "https://hooks.slack.com/services/T00000000/B00000000/XXXXXXXXXXXXXXXXXXXXXXXX";
        var client = new SlackClient(urlWithAccessToken);

        client.PostMessage(
              username: username,
              text: logData,
              channel: channel);
      }
      catch (Exception e)
      {
        //clear
      }
    }
```

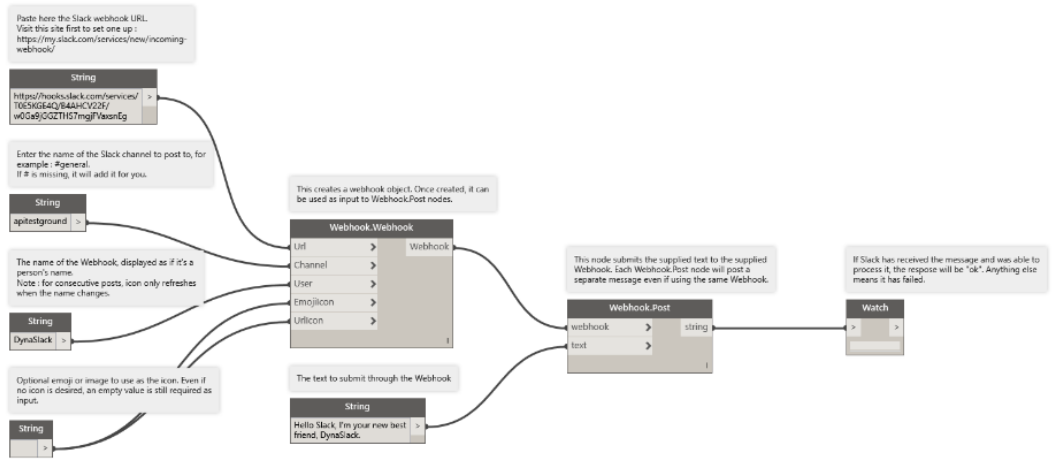
```
class SlackClient
  {
    // from https://gist.github.com/jogleasonjr/7121367
    // ------------------------------------------------

    private readonly Uri _uri;
    private readonly Encoding _encoding = new UTF8Encoding();

    public SlackClient(string urlWithAccessToken)
    {
      _uri = new Uri(urlWithAccessToken);
    }

    //Post a message using simple strings
    public void PostMessage(string text, string username = null, string channel = null)
    {
      Payload payload = new Payload()
      {
        Channel = channel,
        Username = username,
        Text = text
      };

      PostMessage(payload);
    }

    //Post a message using a Payload object
    public void PostMessage(Payload payload)
    {
      ServicePointManager.SecurityProtocol = SecurityProtocolType.Tls | SecurityProtocolType.Tls11 | SecurityProtocolType.Tls12 |
SecurityProtocolType.Ssl3;

      string payloadJson = JsonConvert.SerializeObject(payload);

      using (WebClient client = new WebClient())
      {
        NameValueCollection data = new NameValueCollection();
        data["payload"] = payloadJson;

        var response = client.UploadValues(_uri, "POST", data);

        //The response text is usually "ok"
        string responseText = _encoding.GetString(response);
      }
    }
  }

  //This class serializes into the Json payload required by Slack Incoming WebHooks
  public class Payload
  {
    [JsonProperty("channel")]
    public string Channel { get; set; }

    [JsonProperty("username")]
    public string Username { get; set; }

    [JsonProperty("text")]
    public string Text { get; set; }
  }
```

b. Dynamo example https://radumg.github.io/DynaSlack/

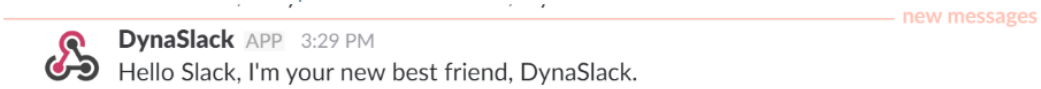
Simple example

The `samples` folder includes a simple example that shows you how to post a message using webhooks.

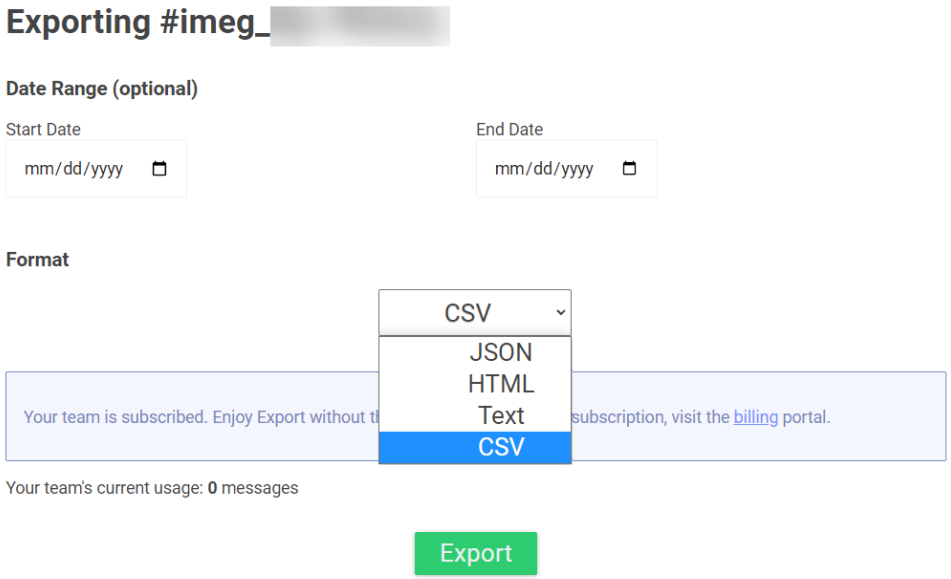
The definition is pictured below :



The result of this will show up Slack as below :



4. Export messages to CSV file using "/export" command in Slack



Pros:

- Easy Implementation: Implementing the webhook to a messaging platform like Slack is relatively straightforward and requires minimal coding.
- Real-Time Access: With the webhook, usage data can be accessed and monitored in real time, providing immediate insights into add-in usage.

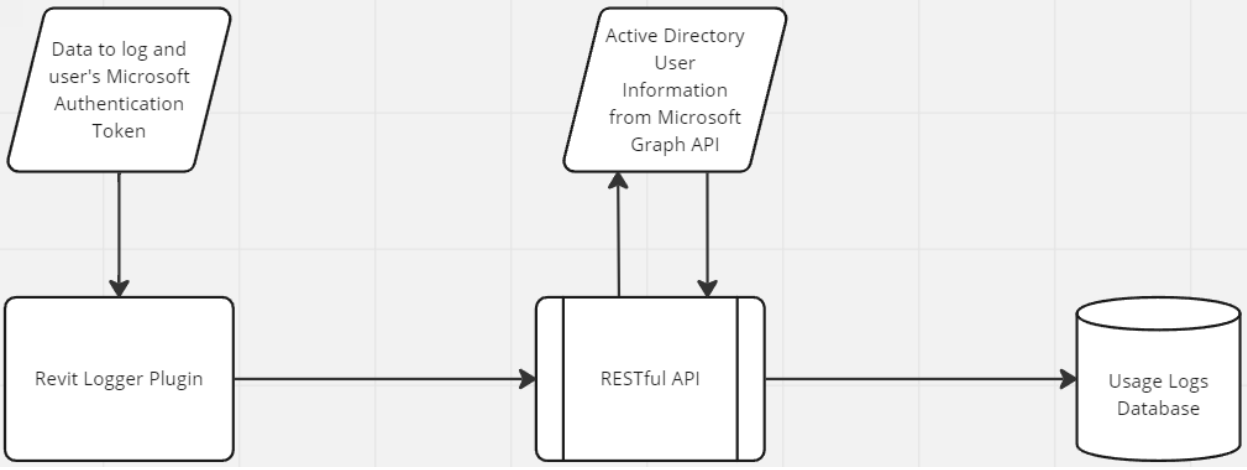
Cons:

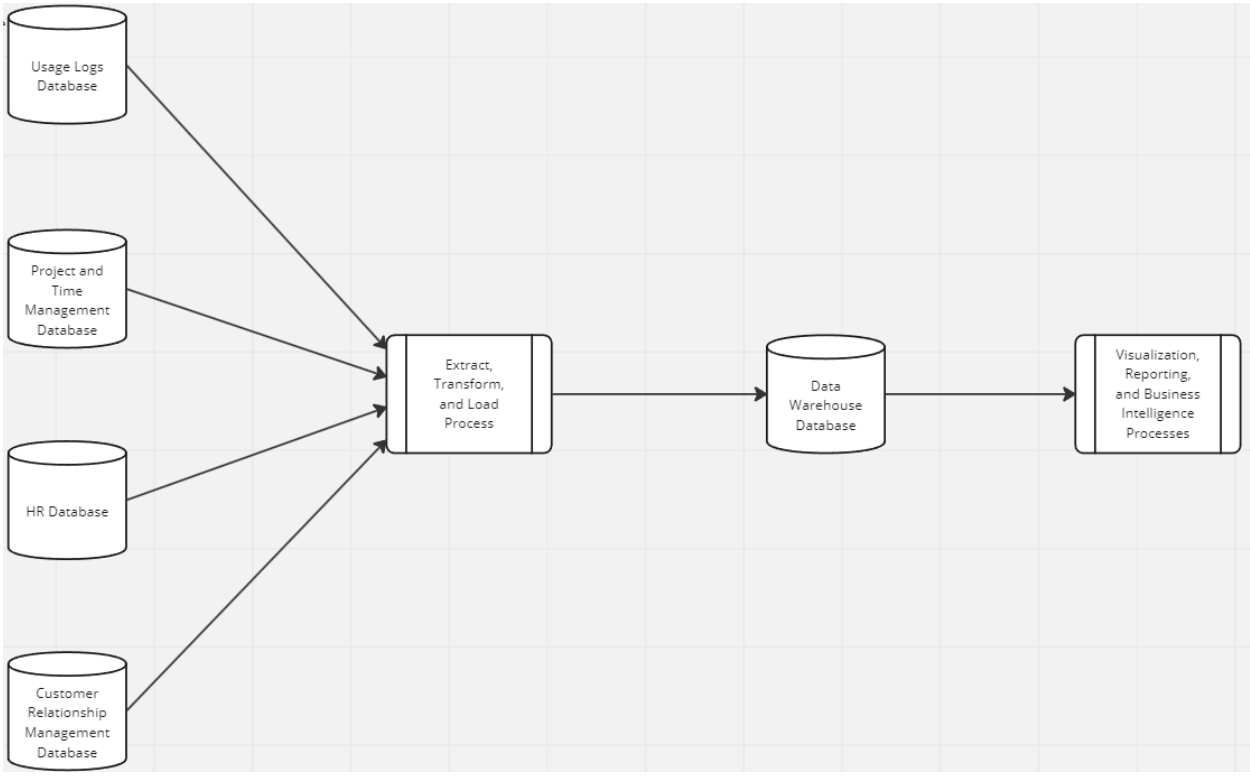
- Data Extraction Challenges: While real-time access to user data is beneficial, extracting and manipulating aggregated data from the messaging platform can be cumbersome. Using commands like "/export" in Slack to export message data may require additional data manipulation and analysis steps.

Method 2: Log to Database Using Custom RESTful API

Another approach involves logging data to a database using a custom RESTful API. This method provides more flexibility and can include user-specific data from sources like Microsoft Graph API, which incorporates Active Directory user information.

To implement this method, the add-in can utilize a Revit Logger plugin to capture the usage data and the user's Microsoft Authentication token. The plugin then uses a RESTful API to push the usage logs to a designated database, incorporating relevant user information retrieved from the Microsoft Graph API. Establishing a data warehouse to help collect and normalize data from multiple sources for comprehensive analysis is also possible.





Pros:

- Easy Data Extraction: Logging data directly to a database simplifies extracting and analyzing the collected information. Data can be easily queried and manipulated for further analysis and reporting.
- Incorporation of User-Specific Data: By leveraging the Microsoft Graph API, user-specific data from Active Directory can be seamlessly integrated into the database, providing deeper insights into user behavior and add-in usage patterns.

Cons:

- Implementation Complexity: Compared to the webhook method, setting up a custom RESTful API and database integration requires more technical expertise and effort during the implementation phase.

Collecting data from Revit add-ins is vital for gaining insights into usage patterns and maximizing the potential of these powerful tools. While both methods discussed - webhooks to an existing messaging platform and logging data to a database using a custom RESTful API - have their advantages and challenges, and organizations can choose the approach that best suits their specific needs and resources. Whether opting for real-time access through a messaging platform or utilizing a custom API

for comprehensive data analysis, the key is establishing a systematic data collection process that enables informed decision-making and continuous improvement in architectural design workflows.

Visualizing Usage Data

Microsoft Power BI is a powerful tool that enables your to transform raw data into interactive visualizations and meaningful insights. By leveraging usage data from various sources, organizations can create dynamic dashboards that provide real-time analytics and facilitate data-driven decision-making. Here's a step-by-step guide on starting with Power BI, adding data sources, creating visuals, and publishing the report.

1. Getting Started with Power BI: To begin using Power BI, download and install the Power BI Desktop application. Once installed, launch Power BI Desktop and start a new project. You'll be presented with a blank canvas to create your dashboard. https://powerbi.microsoft.com/en-us/getting-started-with-power-bi/
2. Adding Data Sources: Power BI supports many data sources, including Excel spreadsheets, SQL databases, and cloud-based platforms. To add data sources, navigate to the "Home" tab and select the appropriate data connection option. Follow the prompts to connect to your desired data source and import the relevant datasets into Power BI. https://learn.microsoft.com/en-us/training/modules/get-data-power-bi/3-connect-data-sources-power-bi-desktop
3. Adding Visuals to the Report: With the data sources connected, it's time to add visuals to your report. Power BI offers a rich collection of visualization options, such as charts, graphs, tables, and maps. Select the desired data fields from the "Fields" pane to add a visual and drag them onto the canvas. Power BI will automatically generate a visual based on the selected data, which you can customize further using the formatting options available. https://learn.microsoft.com/en-us/training/modules/visuals-in-power-bi/
4. Creating Interactive Dashboards: Power BI allows you to create interactive dashboards by adding multiple visuals and linking them together. For example, you can create filters and slicers to dynamically control the data displayed across different visuals. This interactivity enables users to drill down into specific data subsets, explore trends, and gain deeper insights.
5. Publishing the Report: Once you have designed your dashboard, you can publish it to the Power BI service to share it with others. To publish, select the "Publish" button in the Power BI Desktop application. You will be prompted to sign into your Power BI account and choose the appropriate workspace for the report. After publishing, your report will be available on the Power BI web portal, where you can manage access permissions and share it with colleagues or embed it in other applications. https://learn.microsoft.com/en-us/training/modules/publish-share-power-bi/

In conclusion, Power BI empowers organizations to leverage usage data and transform it into actionable insights through interactive dashboards. By following these steps to get started with Power BI, adding data sources, creating visuals, and publishing the report, organizations can unlock the full potential of their usage data, drive informed decision-making, and gain a competitive edge in the data-driven landscape.

Conclusion

IMEG's automation journey has evolved over the past five years, from a small collection of Dynamo graphs to a full-fledged software development team. However, gaining the support of leadership for such a significant investment in automation took work. To convince leadership, quantifying the impact of automation on the organization was essential. This quantification involved estimating potential time savings during the tool planning process and collecting usage metrics once the tools were released.

One effective method of quantifying impact was through data collection and visualization using Microsoft Power BI. By collecting and analyzing usage data, we were able to demonstrate the value of their tools to leadership. Power BI's interactive dashboards allowed for the creation of rich visualizations that showcased the data in a comprehensive and digestible manner. By collecting user metrics and building dashboards to track usage, utilization, and estimated time saved, organizations of any size can effectively demonstrate the value of automation to leadership.

Overcoming obstacles to growth, such as resistance to change and perceived financial risk, required the team to demonstrate tangible results and the positive impact of automation. Through data-driven decision-making and the ability to visualize and quantify the value of automation, IMEG successfully gained support from leadership and continued to expand their automation efforts.

Automation has proven to increase productivity, ensure consistency, and reduce errors and omissions. However, to secure the necessary resources and investment, organizations must quantify the impact of automation through measurable data that can be easily visualized. This evidence-based approach allows for confident decision-making and effective negotiations for additional resources as automation efforts evolve. We hope that IMEG's automation journey serves as an inspiring example of how data collection, visualization, and value demonstration can drive successful automation initiatives within your organization.