Business Impact Review:

Applications of Data Analytics at Baymar Solutions

Michael E Brown

August 21, 2024

Table of Contents
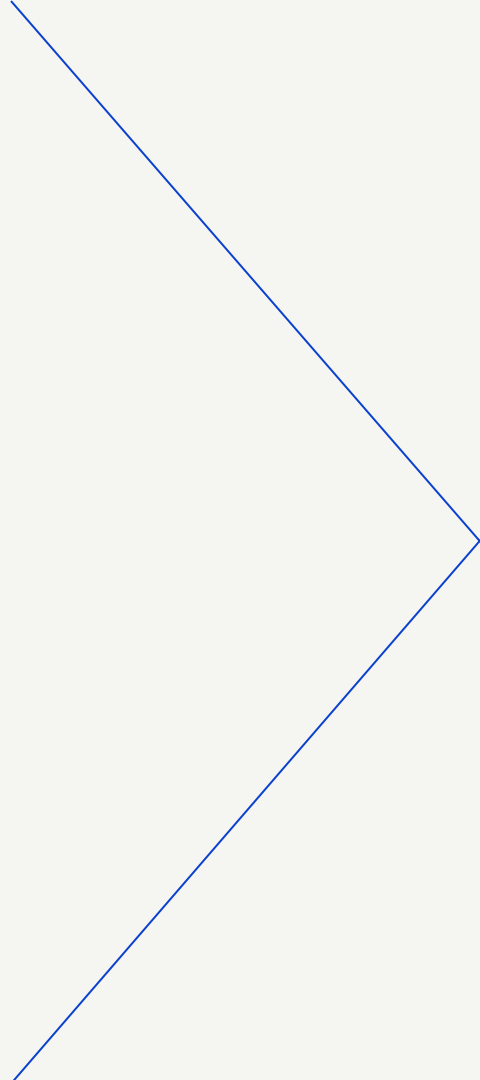
Profit Margins Exploration

Profit Margins Exploration
Business Case

- Company has seen growth in headcount and number of project

- With growth comes complexity, with complexity comes potential financial inefficiencies

- A need exists to identify and explore key variables that may influence profit margins

    - High impact variables can be monitored & controlled to reduce inefficiencies

Questions & Hypotheses

- Serving which **clients** have yielded the **most** profits?
  - Hypothesis: <u>Long standing</u> clients due to well established understanding of their people & processes

- Serving which **products/instruments** have yielded the **most** profits?
  - Hypothesis: <u>Older</u> products due to well established understanding of the system's characteristics and functions

- Engaging in which **types of work** have yielded the **most** profits?
  - Hypothesis: <u>Knowledge work</u> that requires more experienced staff billed at higher rates to the client (e.g. <u>Design</u> & <u>Development</u>, <u>Validation</u> testing)

- Engaging in which **types of work** have yielded the **least** profits?
  - Hypothesis: <u>Manual work</u> that requires less experienced staff billed at lower client rates (e.g. <u>Machining</u>, work instruction updates)
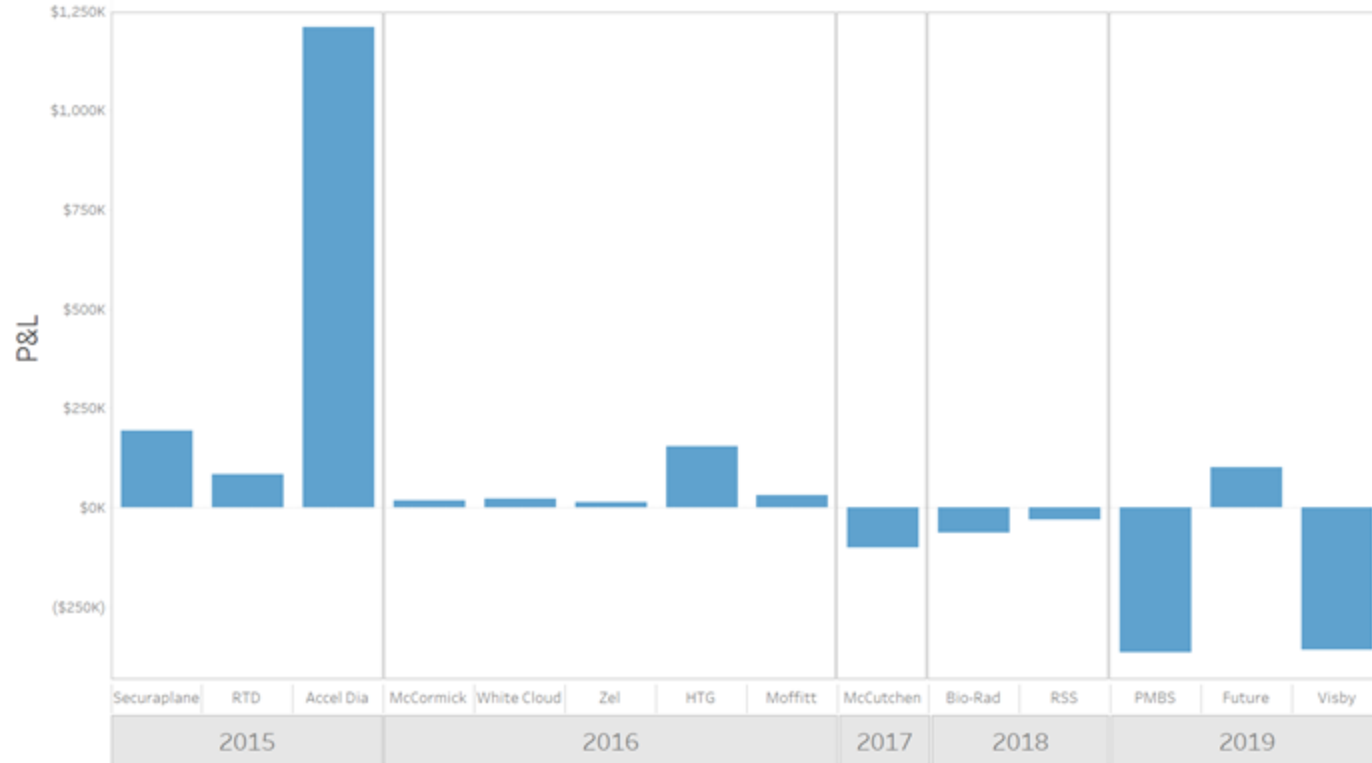
High Level Exploratory Data Analysis
Approach and Analysis

- Accessed web-based <u>MySQL</u> database phpMyAdmin
    - Boundaries → All financial <u>transaction data</u> from 2015-2021

- Used MySQL to export data table .<u>csv</u> files
    - Timesheet table
        - Cost → Staff billed rate, task duration, task type, work type
    - Purchase Orders table
        - Revenue → PO amounts (funds received)

- Imported tables into <u>BigQuery</u> for pre-processing data, formatting, cleaning, aggregating

- Imported BigQuery export into <u>Tableau</u> for further processing, graphical visualization

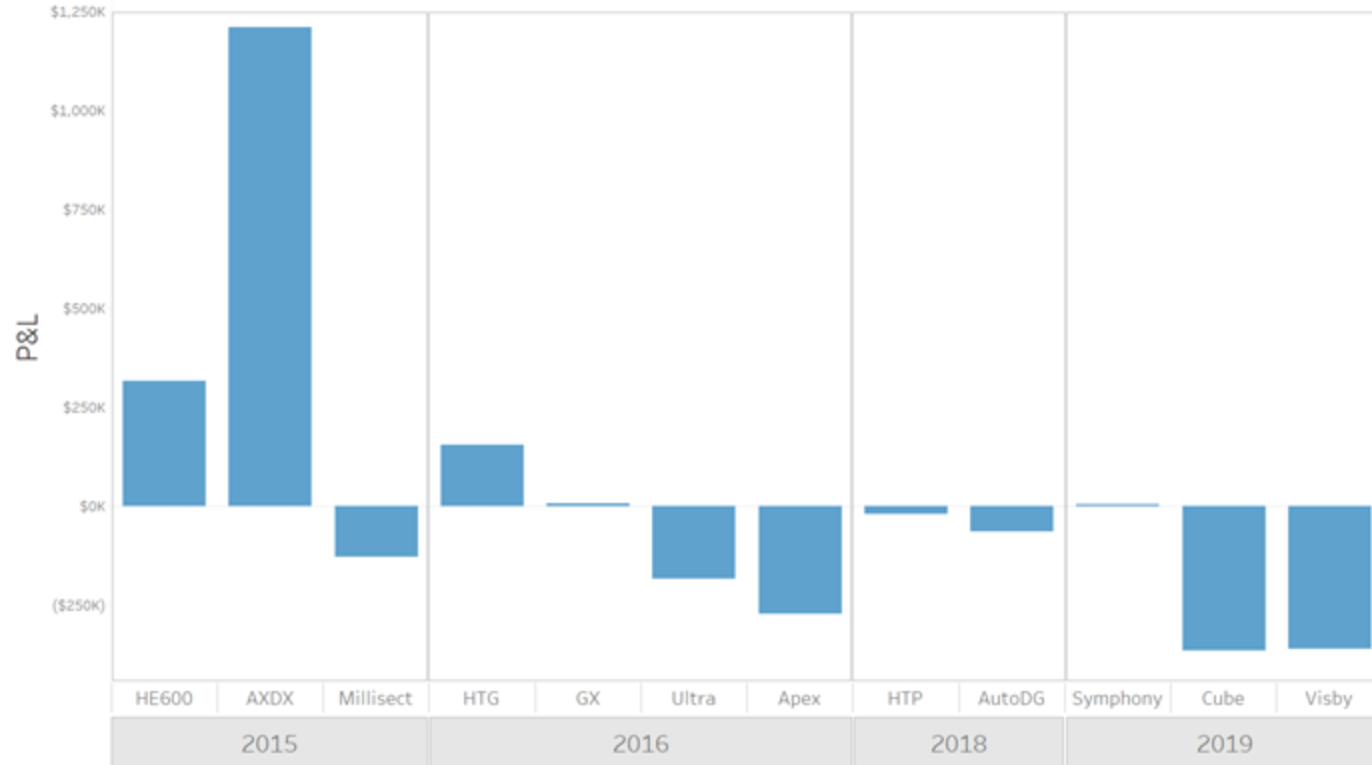# High Level Exploratory Data Analysis

Results - Client Comparison by Year of Partnership Establishment

P&L = PO Amount minus hours billed at client rate
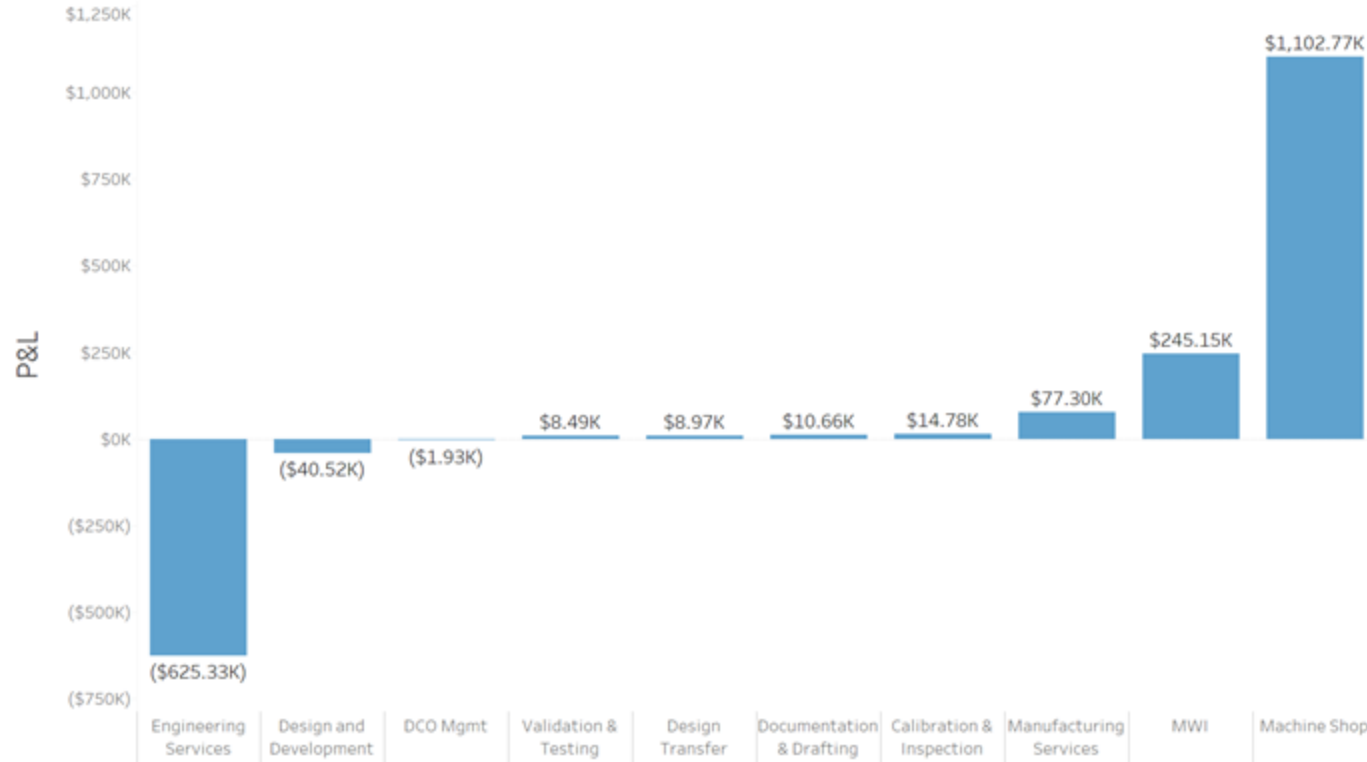
High Level Exploratory Data Analysis

Results - Product Comparison by Year of Product Conceptualization

P&L = PO Amount minus hours billed at client rate
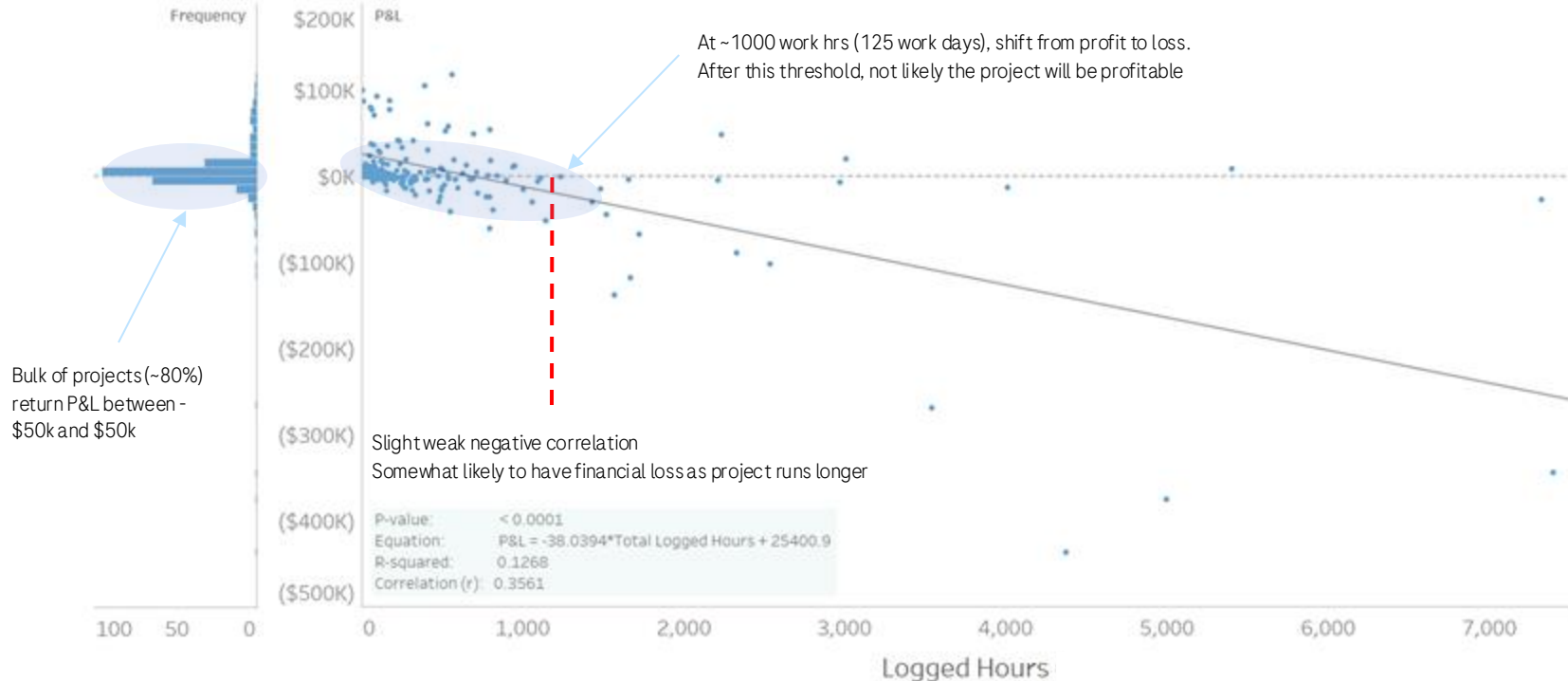
High Level Exploratory Data Analysis

Results - Work Type Comparison by Total Labor Cost

P&L = PO Amount minus hours billed at client rate

High Level Exploratory Data Analysis

Bonus Metric - Profits v Total Logged Project Time

At ~1000 work hrs (125 work days), shift from profit to loss.
After this threshold, not likely the project will be profitable

Bulk of projects (~80%)
return P&L between -
$50k and $50k

Slight weak negative correlation
Somewhat likely to have financial loss as project runs longer

P-value:	< 0.0001
Equation:	P&L = -38.0394*Total Logged Hours + 25400.9
R-squared:	0.1268
Correlation (r):	0.3561

P&L = PO Amount minus hours billed at client rate
Bin size = $10k

High Level Exploratory Data Analysis
Results

- High profit **clients** → Accel Diagnostics, Securaplane, HTG
    - Hypothesis **possibly confirmed** pending further investigation
- High profit **products** → AXDX, HE600, HTG
    - Hypothesis **possibly confirmed** pending further investigation
- High profit **work** types → Manufacturing services, machine shop
    - Hypothesis **possibly rejected** pending further investigation

- Recommended Actions
    - Simulate characteristics found working with high profit clients and apply them to low profit clients
        - Strong stakeholder relationship?
        - Ability to negotiate higher awarded contract amount?
        - Selection of products/systems with greater simplicity?
    - Scope projects to have faster leadtimes to reduce potential losses
    - Identify sources of costs to reduce spend & create actions to mitigate

- Next Steps
    - Take a deeper look at losses seen in Engineering services projects
    - Focus on identifying sources of high cost & find solutions to reduce their contribution

High Level Exploratory Data Analysis
Challenges & Caveats

- Likely many <u>revenue sources were missing</u> from model
    - PO amounts assumed to be total project revenue
    - Engineering change orders not included, thus results do not fully capture financial impact

- Likely many <u>cost sources were missing</u> from model
    - Other data sources exist that were not available at the time of the analysis (ex: manufacturing COGS)

- Labor cost of staff in model is the <u>rate billed to the client, not the staff's expensed rate</u> to the company
    - Cost are inflated and might not fully capture financial impact

- Turning a profit takes time, thus performance of newer items could change in the future

Deeper Analysis
Contributors to thin margins

- Continuation from prior EDA

- Deep dive goals:
    - Identify sources of high costs in select engineering services projects
    - Offer recommended actions to mitigate/eliminate these sources

- Focus area:
    - Staff labor costs on project tasks

- Projects chosen were of similar scope to mitigate effects of uncontrolled random variables
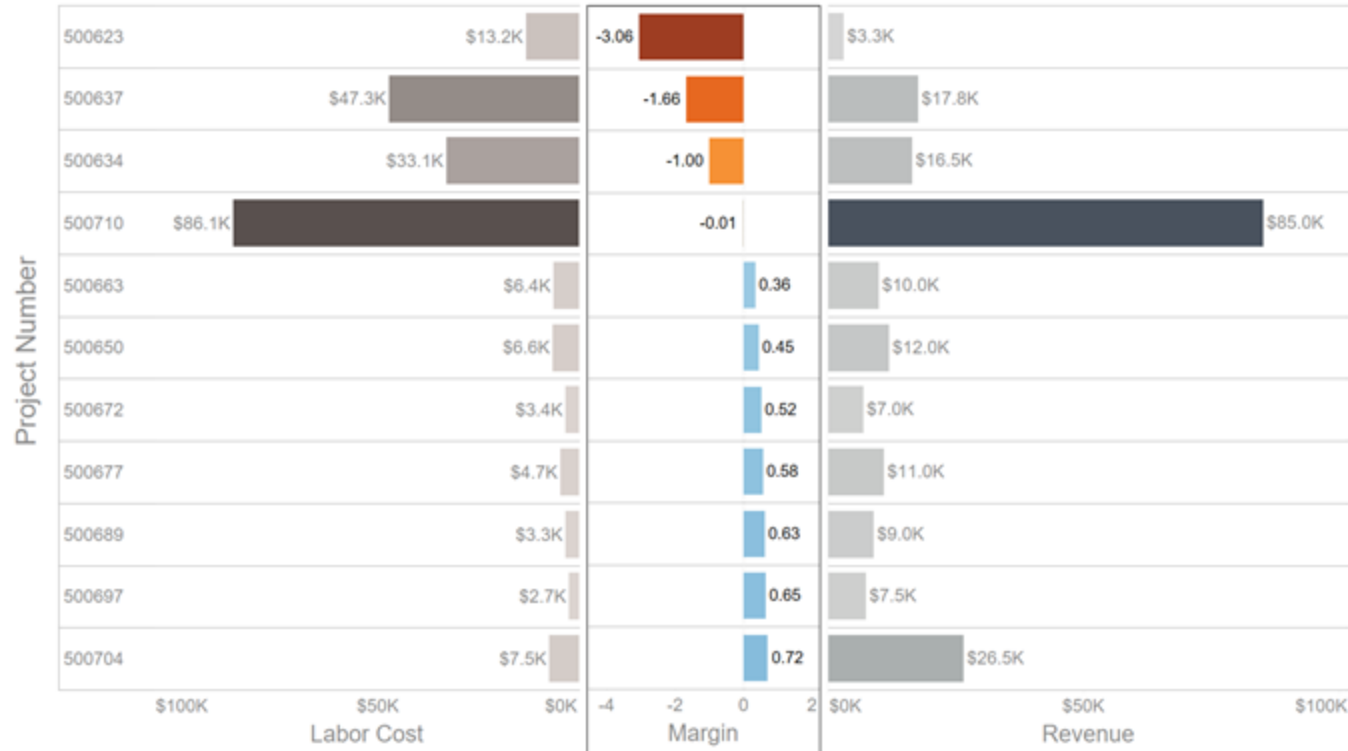
Deeper Analysis
Approach and Analysis

- Accessed web-based MySQL project database phpMyAdmin

- Used MySQL to export data table .csv files
    - Timesheet table
        - Cost → Task duration, task type, work type
    - Personnel expense rate table
        - Project labor cost

- Used Quickbooks export revenue table
    - Revenue → PO amounts (funds received)

- Imported tables into Google Sheets for additional processing/cleaning
    - Standardized names

- Imported sheets into Tableau for further processing, graphical visualization
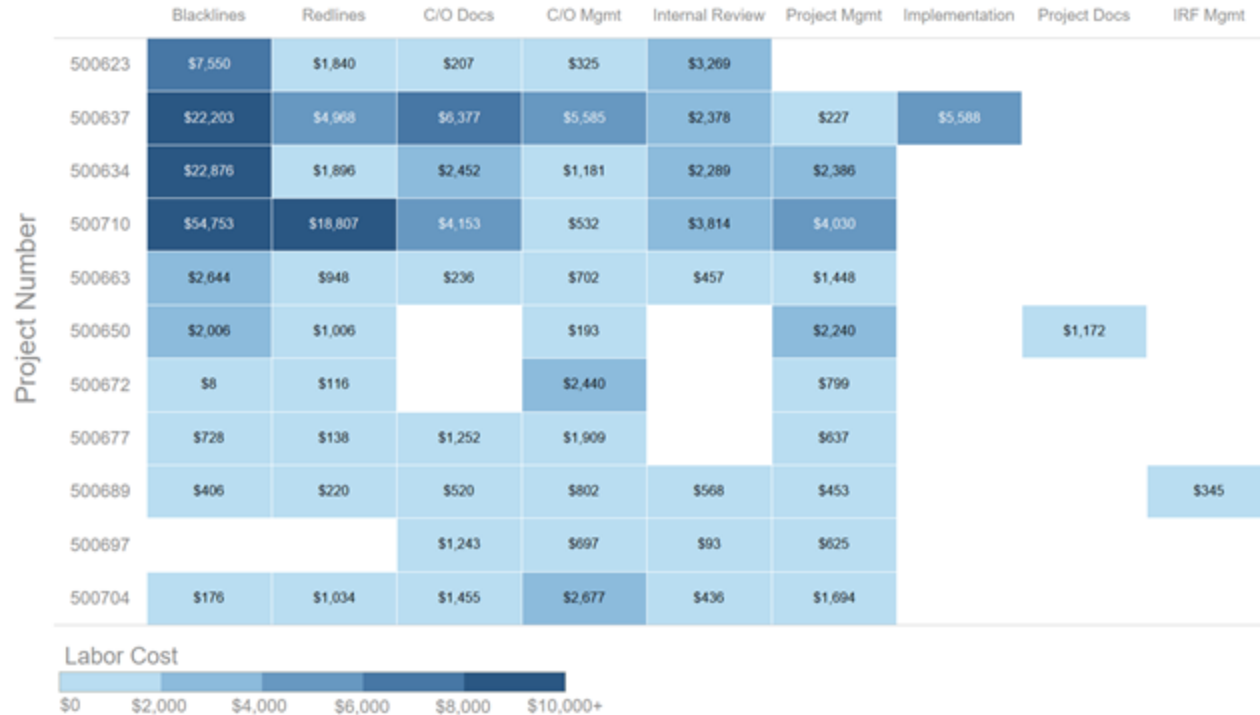
Deeper Analysis

Results - A glimpse into project finances

Margin = (Revenue - Cost) ÷ Revenue

Deeper Analysis

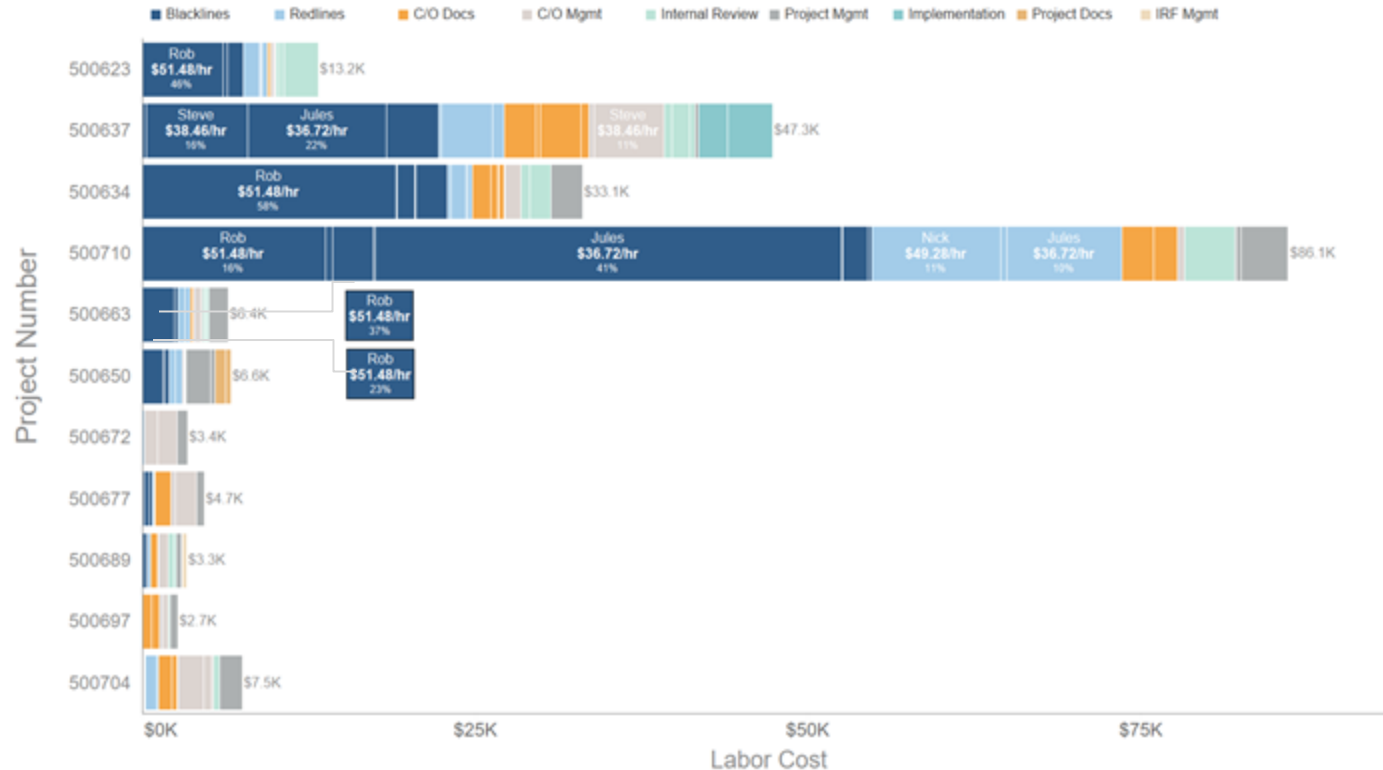Results - Cost Breakdown by Task

Project Number	Blacklines	Redlines	C/O Docs	C/O Mgmt	Internal Review	Project Mgmt	Implementation	Project Docs	IRF Mgmt
500623	$7,550	$1,840	$207	$325	$3,269				
500637	$22,203	$4,968	$6,377	$5,585	$2,378	$227	$5,588		
500634	$22,876	$1,896	$2,452	$1,181	$2,289	$2,386			
500710	$54,753	$18,807	$4,153	$532	$3,814	$4,030			
500663	$2,644	$948	$236	$702	$457	$1,448			
500650	$2,006	$1,006		$193		$2,240		$1,172	
500672	$8	$116		$2,440		$799			
500677	$728	$138	$1,252	$1,909		$637			
500689	$406	$220	$520	$802	$568	$453			$345
500697			$1,243	$697	$93	$625			
500704	$176	$1,034	$1,455	$2,677	$436	$1,694			

Labor Cost

$0 $2,000 $4,000 $6,000 $8,000 $10,000+

Deeper Analysis

Results - Task Breakdown by Staff & Expense Rate

Each task has a fixed billed rate to the client, regardless of staff selected to perform it

Deeper Analysis
Results

- Staff selection could potentially affect project margins
    - Higher paid staff working tasks with fixed lower client bill rates (blacklines, change order mgmt)

- Estimates of certain tasks underestimated during quoting

- <u>Recommended Actions</u>
    - Assign staff with low expense rates to tasks with low client bill rate (blacklines)
    - Assign staff with high expense rates to tasks with high client bill rate (redlines)
        - Ex: Jr. Engineers receive instructions from Sr. Engineers via redlines, who then convert the redlines into blacklines
    - Adjust future contracts with more required blackline hours than initially estimated
    - Monitor spend rate of blackline and change order budget consumption

- <u>Next Steps</u>
    - Build dashboards to monitor project spend & margins to pivot plans as needed
    - Build quotes that access & reference past project data to achieve higher estimate accuracy

Deeper Analysis
Potential Improvements to Analysis

- Use more subqueries to simplify SQL code

- Use database connectivity + SQL queries to remove intermediate .csv steps and improve efficiency

- Include overhead costs to capture additional impact to business

Conclusions

- Profitability from doing business with **clients** appears to be linked with **age of partnership**
    - Long standing clients slightly more profitable than new ones

- Profitability from servicing **products** appears to be linked with their **maturity**

- **Manufacturing & fabrication services** tend to be more profitable

- **Engineering services** are less profitable

- Contributing factors of low Engineer Services margins could be linked to financial **mismatch of staff to task**
    - Use of data could help with reducing costs

- Things to keep in mind
    - For simplicity, several sources of revenue and costs (ex: overhead) have been omitted at the expense of accuracy
    - The use of statistical analysis & higher sample size will aid in creating higher confidence in results
    - Many factors influence profitability
        - These exploratory analyses are a great launching pad for running experiments!

Financial & Project Dashboards
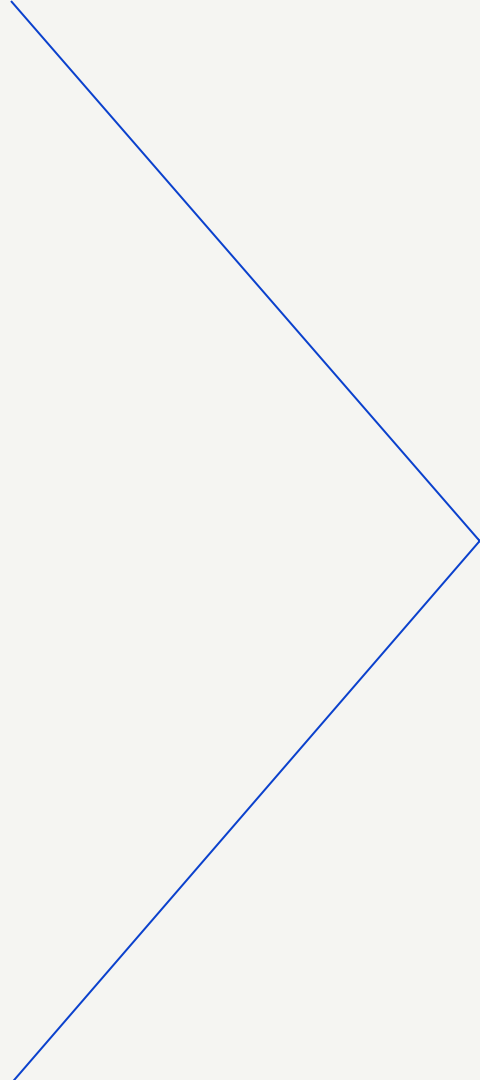
Financial & Project Dashboards
Business Case

- Due to lower than expected profit margins, leadership requested teams more closely monitor project spend and implement corrective actions early and often

- Dashboard visualization requirements were as follows:

    - Project spend over time for individual and all projects
    - Weekly report of hours worked for each project per individual staff
    - Forecasted vs actual monthly resource expenditure
    - Report of project margins over time
   - Monthly report of total project budget goal attainment over time

Financial & Project Dashboards
Approach

- Configured Quickbooks database connectivity using ODBC integration tool

- Used SQL with integration tool to develop queries to pull relevant data

- Used Power Query to linked Quickbooks & project planning data sources to PowerBI

- Used Power Query & simple M-code to process & clean data

- Created Power BI dashboards to display dynamic project status as follows:
    - Project spend
    - Resource allocation
    - Resource forecasting
    - Project margins (based on billed rate, not pay rate)
    - Budget goal attainment over time

- Bonus: Created slicer dashboard tool to assist Project Managers for building future quotes based on prior aggregated project task & spend data

Financial & Project Dashboards
Results
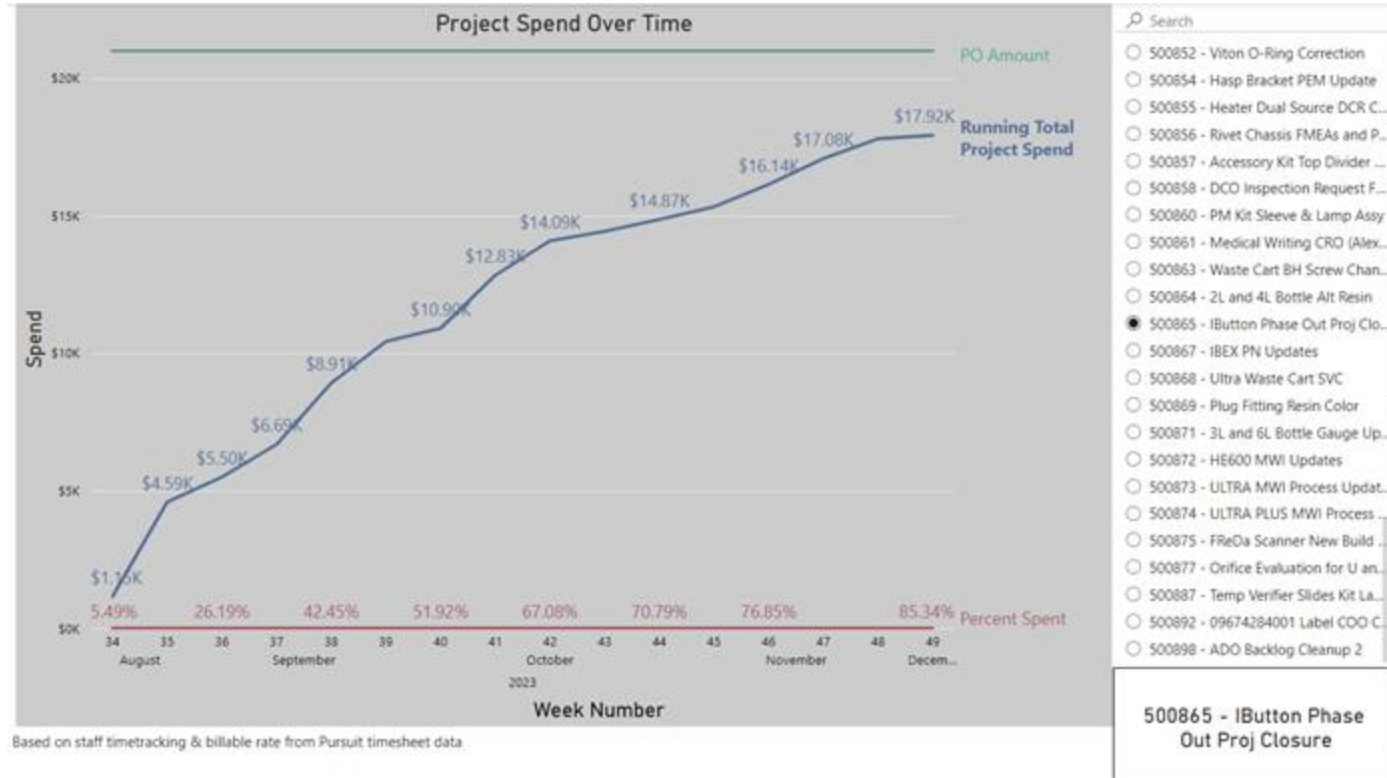
Benefit: Visualize project expenses to identify spend rate. Allows PMs to act before budget is unrecoverable.

Financial & Project Dashboards
Results

Benefit: Visualize resource spend each week to monitor budget consumption. Allows PM to reach out to resource to uncover problems if an unfavorable trend is identified.

Financial & Project Dashboards
Results

Project Spend Matrix

WeekNum	45	46		47		48		49	
Project	%	PO	%	PO	%	PO	%	PO	%
500854 - Hasp Bracket PEM Update									
500858 - DCO Inspection Request Form Sup.	68.48%	$38,398.00	73.34%	$38,398.00	76.25%	$38,398.00	81.11%	$38,398.00	85.97%
500860 - PM Kit Sleeve & Lamp Assy	101.13%	$16,800.00	107.08%	$16,800.00	108.20%	$16,800.00	113.20%	$16,800.00	119.15%
500861 - Medical Writing CRO (Alexis)	36.41%	$85,000.00	40.70%	$85,000.00	43.05%	$85,000.00	46.60%	$85,000.00	51.05%
500863 - Waste Cart BH Screw Change	72.76%	$11,985.00	73.79%	$11,985.00	74.31%	$11,985.00	76.36%		
500864 - 2L and 4L Bottle Alt Resin						$7,836.00	26.05%	$7,836.00	35.07%
500865 - IButton Phase Out Proj Closure	72.96%	$21,000.00	76.85%	$21,000.00	81.31%	$21,000.00	84.75%	$21,000.00	85.34%
500867 - IBEX PN Updates						$13,250.00	37.82%		
500868 - Ultra Waste Cart SVC	75.75%	$18,770.00	77.41%	$18,770.00	78.74%	$18,770.00	79.97%	$18,770.00	81.72%
500869 - Plug Fitting Resin Color									
500871 - 3L and 6L Bottle Gauge Update	58.51%	$43,000.00	73.25%	$43,000.00	74.67%	$43,000.00	75.39%		
500872 - HE600 MWI Updates	18.06%	$29,790.00	22.28%	$29,790.00	25.90%	$29,790.00	42.28%	$29,790.00	52.60%
500873 - ULTRA MWI Process Updates	51.33%	$26,650.00	54.67%	$26,650.00	55.41%	$26,650.00	58.60%	$26,650.00	60.60%
500874 - ULTRA PLUS MWI Process Updates	77.50%	$34,000.00	91.63%	$34,000.00	92.47%	$34,000.00	93.72%	$34,000.00	95.87%
500875 - FReDa Scanner New Build Data Pak		$45,873.00	10.20%	$45,873.00	11.97%	$45,873.00	17.01%	$45,873.00	24.37%
500877 - Orifice Evaluation for U and UP	14.01%	$26,083.00	14.49%						
500887 - Temp Verifier Slides Kit Label		$7,500.00	15.44%	$7,500.00	25.47%	$7,500.00	43.99%	$7,500.00	70.84%
500892 - 09674284001 Label COO Change		$5,115.00	14.02%	$5,115.00	16.25%	$5,115.00	17.46%	$5,115.00	22.46%
500898 - ADO Backlog Cleanup 2						$27,000.00	12.16%	$27,000.00	31.16%

Year, Month
- ☐ 2022
- ☑ 2023
  - ☐ January
  - ☐ February
  - ☐ March
  - ☐ April
  - ☐ May
  - ☐ June
  - ☐ July
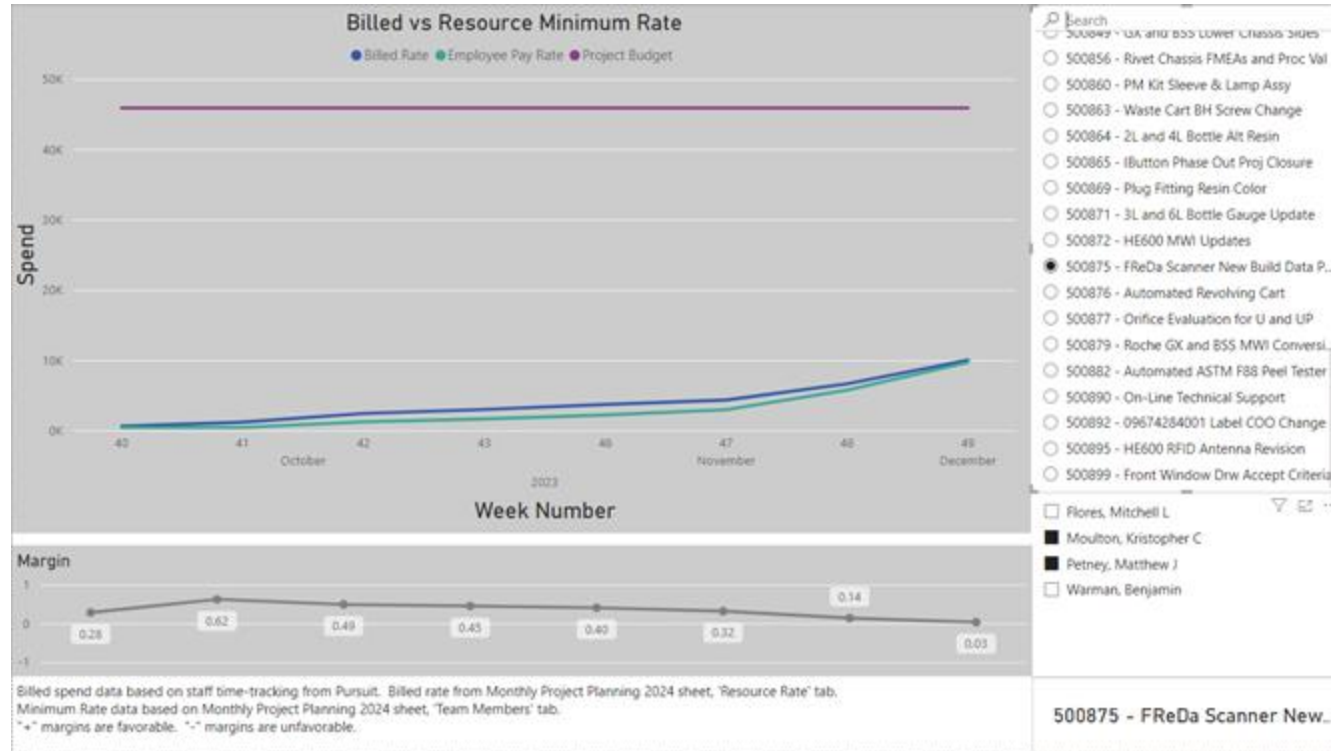 - ☐ August
  - ☐ September
  - ☑ October
  - ☑ November
  - ☑ December

Benefit: Visualize project expenses to identify spend rate. Allows Program Manager to act before budget is unrecoverable.
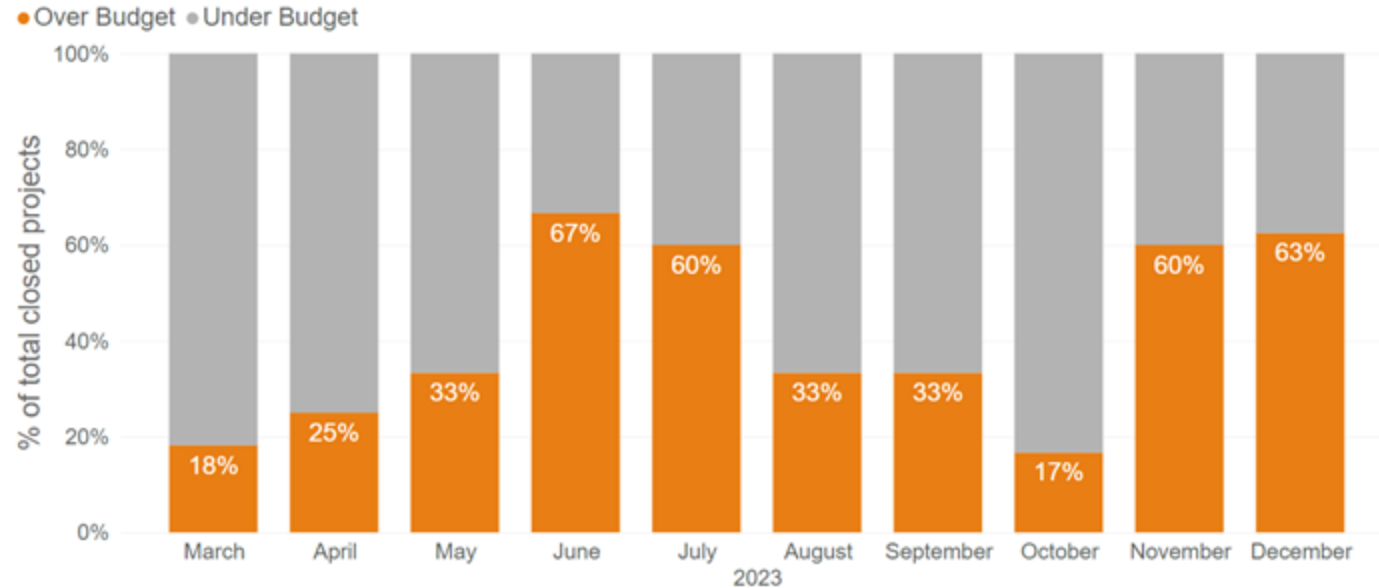
Financial & Project Dashboards
Results

Benefit: Ensures employees are working on tasks that are billed to the client at the rate commensurate of their pay.

Financial & Project Dashboards

Results

Budget goal attainment over time

● Over Budget ● Under Budget

Month of closed project date determined when Clickup status is marked 'Complete' in the Project Tracking List

Benefit: Instills curiosity and creates questions to spark investigation and action into project execution. Adopted from "Storytelling with Data" by Cole Nussbaumer Knaflic

Financial & Project Dashboards

Results - Task slicer & aggregation tool

Benefit: Build quotes/SoWs based on previous project duration data instead of conjecture

Financial & Project Dashboards
Challenges & Caveats

- Challenges
  - Missing staff rate data was identified, creating spend data inaccuracies
    - Investigation uncovered data input errors. Issue resolved after entry correction

  - Power Query data process errors prevented visualization rendering
    - Investigation uncovered exporting errors in upstream source. Issue resolved through additional Power Query transformation steps

- Caveats

  - Given shared access to the dashboard, staff billed rates were used instead of true staff expense rates for anonymity

  - Difference between billed and pay rates provides a buffer between displayed and actual financial values, thus dashboards used for ballpark reference purposes only

"The most valuable contribution an analyst can make is inspiring a decision-maker to consider courses of action they didn't know they needed to think about"

- Cassie Kozyrkov

Thank you

Appendix
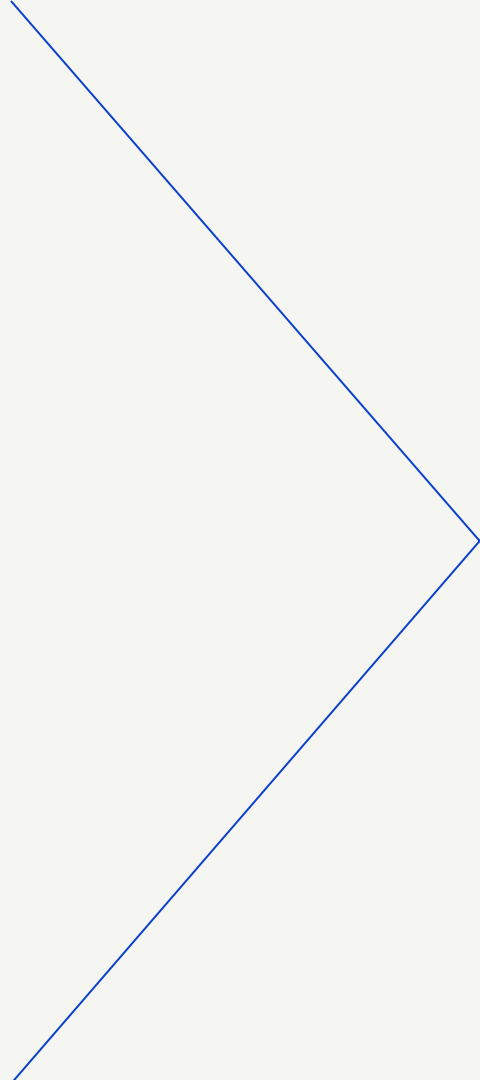
Financial & Project Dashboards
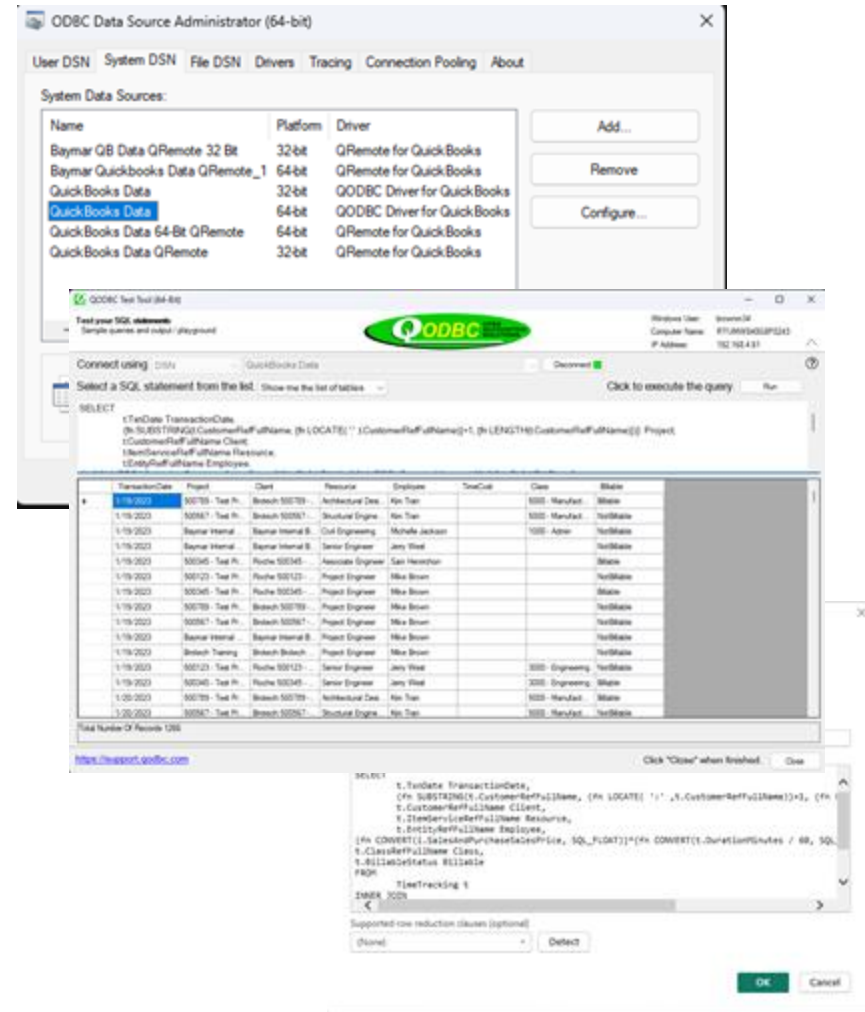Approach Details

- Front end data submitted in the QB desktop UI
    - Employee salary
    - Job PO
    - Timesheet

- Back end QB database access required additional tool

- FLEXquarters.com QODBC API connected to QB database through windows std ODBC interface. Acted as intermediary to connect with various visualization apps

Financial & Project Dashboards
Approach Details

- QODBC rundown
  - Configured to acquire QB data from specific company file
  - Manually set up ODBC data source connection
  - Tested QB database connection through API test tool
  - Connected QODBC data source to PowerBI
- QODBC API test tool used to develop queries
  - Confirmed script pulled relevant data that met requirements for dashboard inputs

Financial & Project Dashboards
Approach Details

- Power Query
  - Manually pasted SQL statement from QODBC test tool into data source options to pull correct data from QB
  - Imported data scanned for errors
    - Missing data
    - Wrong data type
  - M-code or applied steps created in Editor to clean & transform source data
  - If needed, modified SQL code to clean data at the source