**Python Programming Conversion of Facility Maintenance KPIs**

**Case Study Impact Report**

**Challenge**

The Department of General Services calculates and compares Key Performance Indicators (KPIs) in order to evaluate efficiency and performance across divisions. An internal audit to reproduce these measures with accuracy in measure and process produced inconsistent results. Additionally, we found great variance in frequency of analyzing the indicators related to time and level of effort across department divisions.

**Impact**

Using free, open source software, we created clear calculations, documentation, and access outlets for two Facilities Maintenance KPIs in Python (a computer coding language), which will save employees approximately 5-6 hours bi-monthly and will allow staff to provide meaningful KPI updates at a higher frequency rate.

**Background**

The Business Process Improvement Office (BPIO) works to provide the best possible service for client agencies and partner organizations by making quantifiable improvements to processes. We work with divisions within the agency to help identify, measure and analyze their opportunities, challenges, and Seven Wastes of Lean Manufacturing. This informs our recommendations or assistance in expanding, creating or modifying programs related to several Key Performance Indicators (KPIs).

From Fiscal Year 2014-2017 the BPIO determined 2 of the 5 Facilities Maintenance Division KPI metrics related to the percentage of work orders closed on time and the ratio of preventative maintenance to corrective maintenance through a series of calculations using Microsoft Excel, outlined on the Department of General Services [Github page](https://github.com/melanieshimano/Data-Validation). Because there was limited documentation about the analysis process, relevant staffers would spend up to 6 hours every year calculating these metrics. Also, when tasked, staff with limited prior experience with the metrics did not have the instructions available to reproduce the measure accurately. As a result this analysis was not done on a more frequent basis, which would aide management decisions and increase operational awareness and flexibility.

**Solution**

We developed scripts (in Python) that quickly calculate and clearly outline each step of the above mentioned KPI metrics. This allows current and future users to:

* Calculate updated KPI calculations for new fiscal years and other time periods within seconds
* Consolidate relevant information from 4 folders and 5 documents into one easy-to-follow script
* Show a simple computer coding solution to engage other employees and agencies in civic technology efforts such as using Python to help automate routine work

This codebase in addition to using Jupyter Notebook—an open source web application that enables creating and sharing live code, equations and visualizations—allows internal staff or external interested parties working with the code to understand the creator’s thought process and to make future changes as necessary. This is a significant improvement on our previous method of spending up to 6 hours performing calculations in Microsoft Excel. These scripts not only save staffers time and allow them to provide meaningful and more frequent KPI analyses to division chiefs and managers, they also provide a framework for how we can use Python scripts for future analyses that save days (and costs) of routine labor.

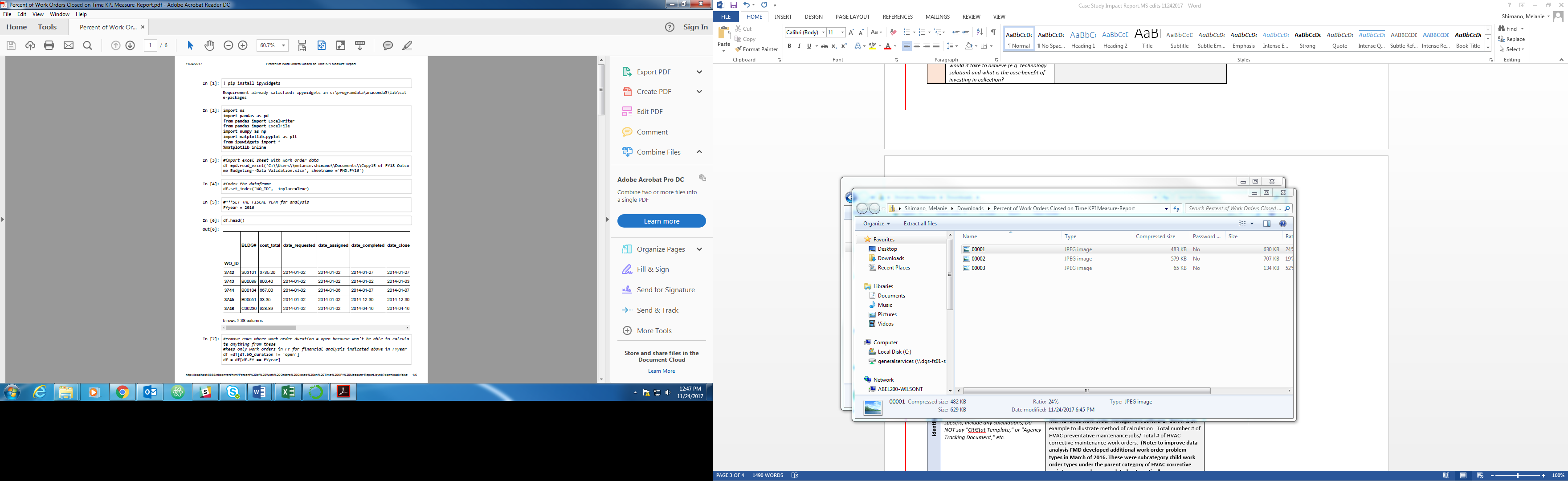
**Case Study Supplements: Previous and Current Facilities Maintenance KPI Documentation**

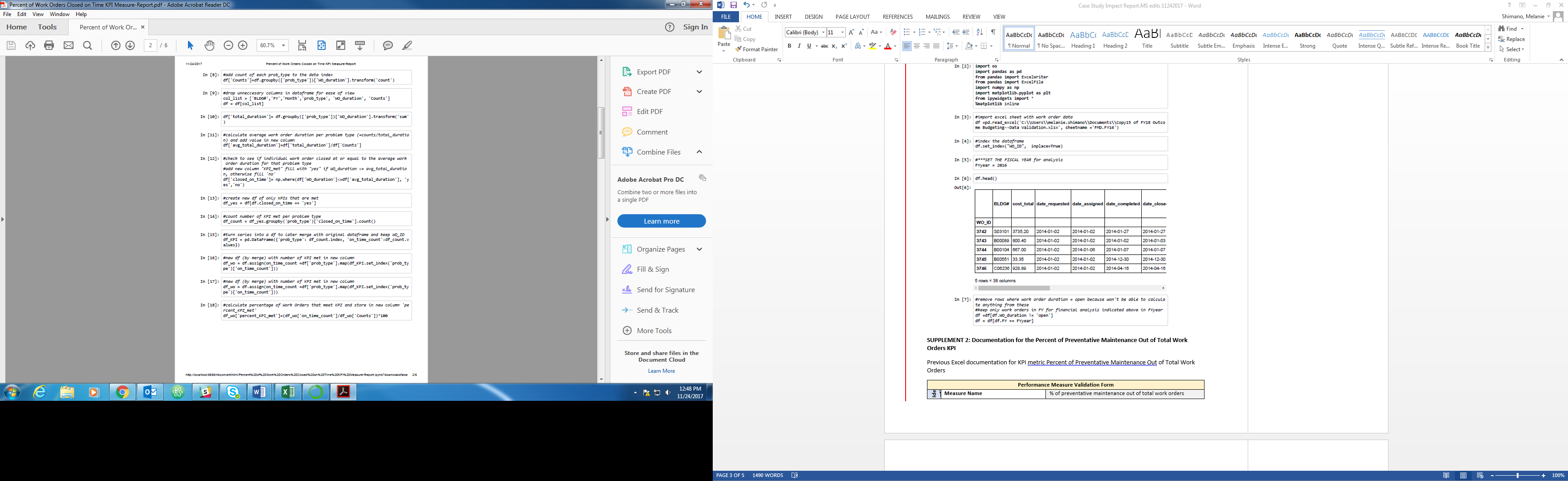
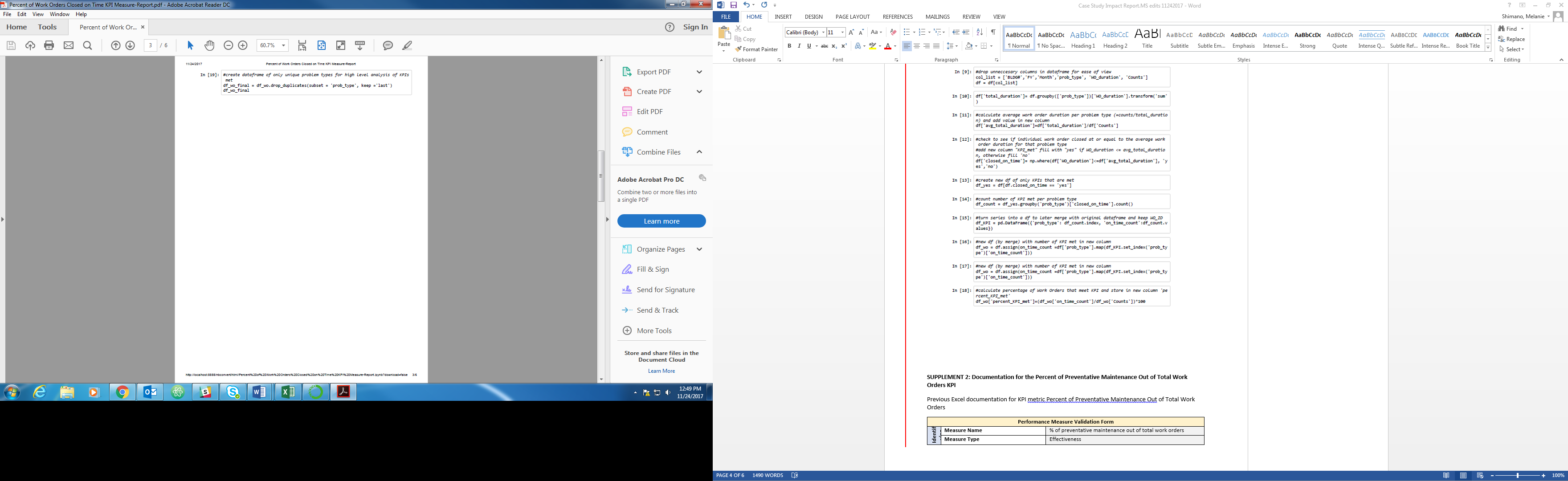
**SUPPLEMENT 1: Documentation for the Percent of Work Orders Closed on Time KPI**

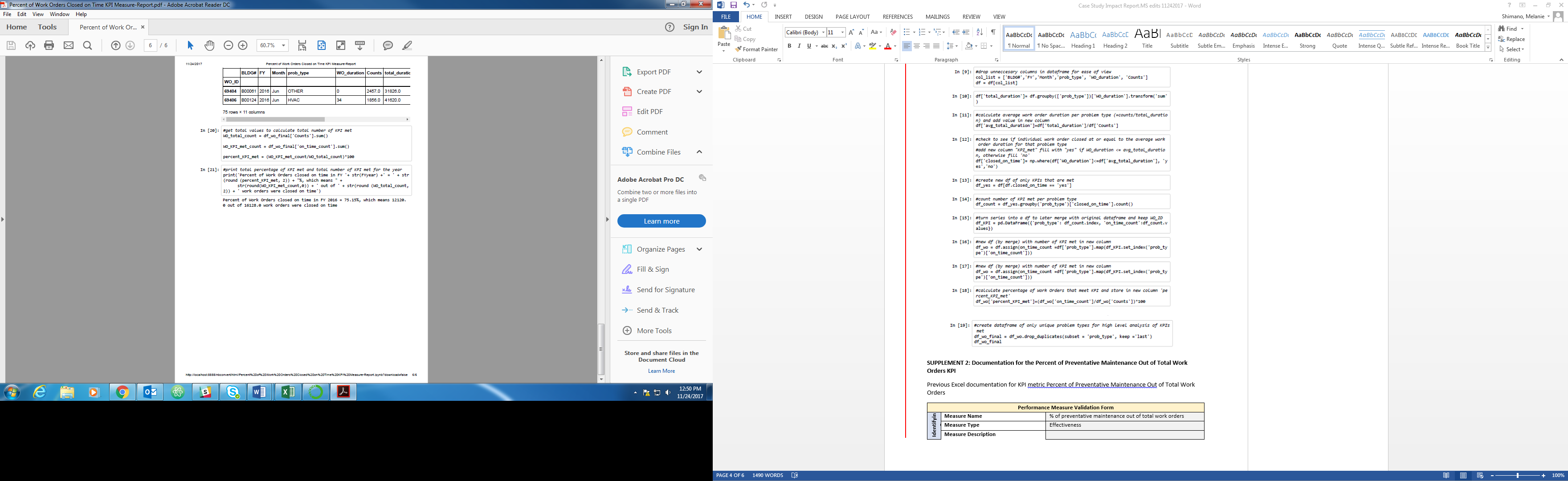
Previous Excel documentation for KPI metric Percent of Work Orders Closed on Time

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| --- | --- | --- | --- | --- | --- | --- |
| **Performance Measure Validation Form** | | | | | | |
| **Identifying Information** | **Measure Name** | | % of work orders closed on time | | | |
| **Measure Type** | | Efficiency | | | |
| **Measure Description** | | This KPI provides information on how long it takes to close facility maintenance work orders . It measures the average work order duration of each individual work order within in each of the various work order problem types and captures both the duration of each specific work order as well as the average work order duration categorically for each work order problem type. Determining which and the total number of individual work orders that exceed the average duration for their respective problem type provides insight on the percentage of work orders closed below and above normal duration. (This approach allows the department to compare apples to apples with respect to work order workload and duration because of natural variations in the amount of time needed to close a work order that are directly related to the type of work order request. For example, it will take longer to close a roofing work order than a door knob repair or a custodial work order given the nature of the work and potential for waiting time for parts.) | | | |
| *what, exactly, are you measuring? Include any key definitions.* | |
| **Data Source** | | Source of this data is the Archibus--the DGS Facility Maintenance work order management software. Below is an example to illustrate method of calculation. Total # of work orders with duration at or below the average duration for its specific work order problem type = TWOOT. Total # of work orders in fiscal year = TWOFY. The measure is ((TWOOT/TWOFY)\*.01) | | | |
| *specific, include any calculations, Do NOT say "CitiStat Template," or "Agency Tracking Document," etc.* | |
| **Methodology** | **Location** | | Archibus--the Facility Maintenance Division work order management software system. | | | |
| *where are the data stored? (e.g. CitiWorks system, 311 system, etc.)* | |
| **Method of Collection** | | Collection of the raw data is automated; each instance of a work order is stored in a SQL database supporting Archibus. | | | |
| **Purpose** | **How are these data used?** | | This measure allows us to effectively compare activity on work orders against quarterly, yearly or other periods. This indicator has helped to develop problem type specific and Facility Maintenance shop specific strategies to address strengths, weaknesses and opportunities. Use of this indicator can support the future development of more granular duration standards by category. It also informs the division on the potential impact that factors such as parts and equipment delivery may have on customer service perceptions. | | | |
| *How does this measure inform operations in the service? Why is it meaningful?* | |
| **Measurement Improvement** | | Support and resources for the automation of the reporting into a management dashboard from structured SQL queries are required to make maximum, real time management use of this data. | | | |
| *If the agency does not currently have a valid way of capturing these data, what would it take to achieve (e.g. technology solution) and what is the cost-benefit of investing in collection?* | |
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New Python script documentation for KPI metric Percent of Work Orders Closed on Time







**SUPPLEMENT 2: Documentation for the Percent of Preventative Maintenance Out of Total Work Orders KPI**

Previous Excel documentation for KPI metric Percent of Preventative Maintenance Out of Total Work Orders

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| **Performance Measure Validation Form** | | | | | | |
| **Identifying Information** | **Measure Name** | | % of preventative maintenance out of total work orders | | | |
| **Measure Type** | | Effectiveness | | | |
| **Measure Description** | | The preventative maintenance to corrective maintenance ratio performance indicator or (PM:CM) is important because it measures whether or not the Department was effective in taking action to perform preventative maintenance necessary to prolong the health and improve investment value of City buildings. Because many of the buildings managed by DGS are spread throughout the City, not organized around a central hub or axis and have no dedicated maintenance staff, establishing a preventative maintenance program helps identify issues with operational systems and address them before they fail or become more expensive capital projects. This performance measure captures the amount of preventative maintenance in HVAC related to the volume of HVAC corrective maintenance work orders. | | | |
| *what, exactly, are you measuring? Include any key definitions.* | |
| **Data Source** | | Source of this data is the Archibus--the DGS Facility Maintenance work order management software. Below is an example to illustrate method of calculation. Total number # of HVAC preventative maintenance jobs/ Total # of HVAC corrective maintenance work orders. **(Note: to improve data analysis FMD developed additional work order problem types in March of 2016. These were subcategory child work order types under the parent category of HVAC corrective maintenance and are populated automatically upon completion and categorization of diagnostic work by technicians. Therefore, to ensure consistency in analysis of the data across multiple fiscal years, building this KPI after 2016 requires use of the following work order problem types to capture the volume of Total # of HVAC corrective maintenance: 'boiler', 'chillers', 'HVAC' 'HVAC Infrastructure', 'HVAC repair')** | | | |
| *specific, include any calculations, Do NOT say "CitiStat Template," or "Agency Tracking Document," etc.* | |
| **Methodology** | **Location** | | Archibus--the Facility Maintenance Division work order management software system. | | | |
| *where are the data stored? (e.g. CitiWorks system, 311 system, etc.)* | |
| **Method of Collection** | | Collection of the raw data is automated; each instance of a work order and preventative maintenance is stored in a SQL database supporting Archibus. | | | |
| **Purpose** | **How are these data used?** | |  | | | |
| *How does this measure inform operations in the service? Why is it meaningful?* | |
| **Measurement Improvement** | | Support and resources for the automation of the reporting into a management dashboard from structured SQL queries are required to make maximum, real time management use of this data. | | | |
| *If the agency does not currently have a valid way of capturing these data, what would it take to achieve (e.g. technology solution) and what is the cost-benefit of investing in collection?* | |
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New Python script documentation for KPI metric Percent of Preventative Maintenance Out of Total Work Orders

