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Job Standard Optimization

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When you work in discrete manufacturing, having bad data (or no data) on machine performance can lead to bad decisions with sometimes serious consequences. It may lead a production manager to decide (or "guess") that a part production run should take two weeks when, if that manager had access to good, accurate machine performance data, he or she could easily see that the run as specified could not realistically be done in less than four. Whether estimating labor, materials, scheduling, or production cost, having inaccurate or non-existent machine performance data can make production resource planning in discrete manufacturing largely a matter of guesswork and luck.

This article explains how you can use the MachineMetrics Production Report to analyze and evaluate the accuracy of the MachineMetrics Job standards you are using, and provides guidance in how to refine and optimize those standards to get the most accurate picture of your machine performance, so that your production estimates can be much more realistic.

Article Topics

This article contains the following topics:

MachineMetrics Job Standards

A manufacturing "job" can be defined in many ways. In MachineMetrics, a **Job** represents the production standards used in a discrete manufacturing environment for machine operations. MachineMetrics "Job standards" are created for each machine operation used in the manufacturing process for a particular part. For example, if a part takes 10 separate operations on 10 separate machines (lathe turning, milling, and so on), one Job in MachineMetrics will be used to represent each of the 10 separate machine operations. See the Jobs article for complete information on how Jobs are created and used in MachineMetrics.

Key Metrics for Job Standard Optimization

The MachineMetrics Production Report can return data on a wide variety of metrics based on machine Job performance. However, when you want to optimize the accuracy of your Job standards, the following Production report metrics are the most relevant:

- **Expected Part Time:** The amount of time that the Job operation is expected to take to process one part, including activities such as part loading and unloading ("button-to-button" part processing).
  - **Note:** This value may be the Expected Part Time value set in the Job dialog or Job Import CSV file, or the calculated value converted to expected part time from the settings for Expected Part Rate or Expected Cycle Time. See the Jobs article for more information on these Job settings.

- **Actual Part Time:** The time that the Job operation actually took to process each part, including activities such as part loading and unloading ("button-to-button" part processing). This is the median time value of all parts produced.
  - **Note:** The median is the middle point in any data set, where half of the data points are smaller than the median and half of the data points are larger. One reason the median time is used for this metric instead of the mean (average) time is to prevent a single outlying data point (large or small) from distorting the overall metric value.
- **Total Parts:** The total number of parts processed by the Job operation at the time the report was run.
- **Performance:** The expected part processing time for the Job compared to the actual part processing time reported by MachineMetrics when the Job is run, expressed as a percentage:

$$\text{Performance (\%)} = \frac{\text{Expected Part Processing Time}}{\text{Actual Part Processing Time}} \times 100$$

Note the following about this metric:

- **Performance = 100%:** A Performance value of 100% means that the actual processing time is the same as the expected processing time.
- **Performance > 100%:** A performance value greater than 100% means that the actual processing time is shorter (faster) than the expected processing time.
- **Performance < 100%:** A performance value less than 100% means that the actual processing time is longer (slower) than than the expected processing time.

Choosing the Job Standard Optimization Goal

MachineMetrics believes that an optimized Job standard should not deviate more than 15% from the expected part processing time. In practice, that means the following:

- **Performance <85%:** Actual processing is significantly slower than expected. Job standards run on machines that cannot achieve at least 85% performance should be evaluated to determine whether the Job standard for the machine/Job is too **high (fast)**.
- **Performance >115%:** Actual processing is significantly faster than expected. Jobs that machines perform at more than 115% of the performance goal should be evaluated to determine whether the Job standard for the machine/job is too **low (slow)**.

This Job standard optimization goal is a "rule of thumb" best practice based on MachineMetrics experience and expertise, but may not be applicable to every environment. Companies can and should choose their Job standard optimization goal based on the performance tolerances considered acceptable in their environment.

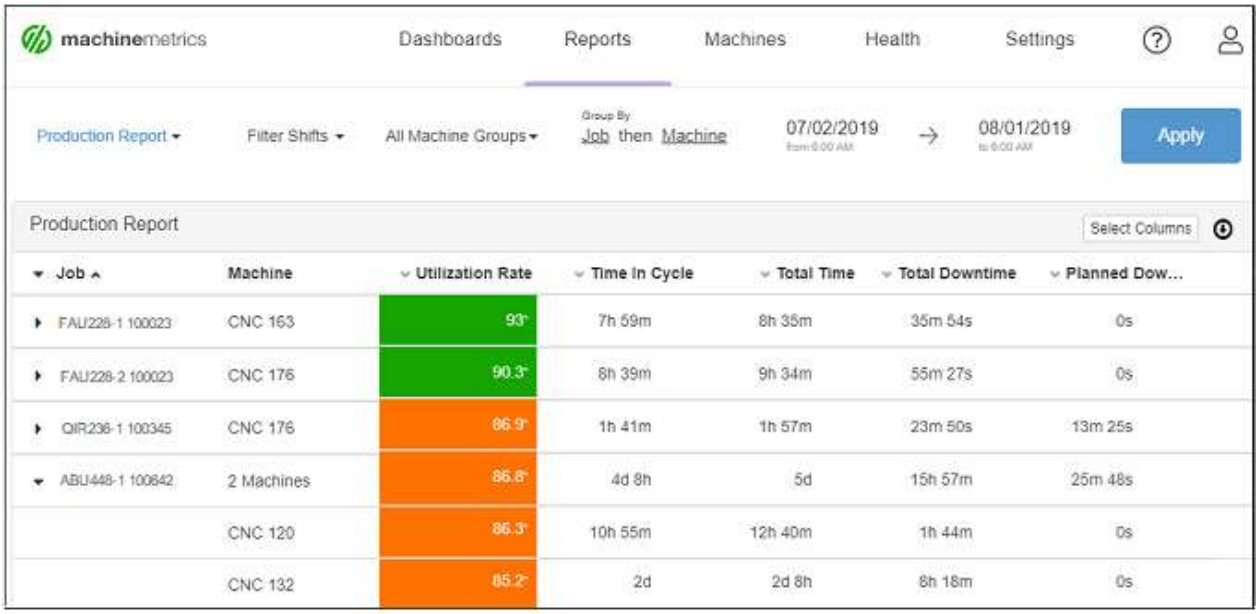
The remainder of this article explains how to create a Production report in MachineMetrics that contains the Job standard optimization metrics, and guidance for how to use the report data to analyze and optimize your Job standards.

Creating the Job Standard Optimization Report

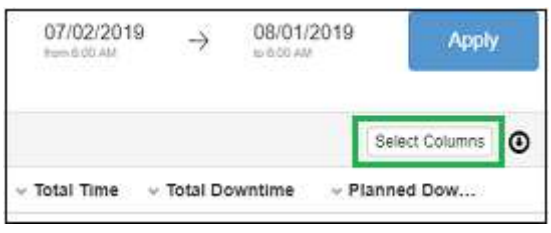
By default, the MachineMetrics Production Report contains the data for all the metrics collected by MachineMetrics. To create a report you can efficiently use to help you in the Job standard optimization process, you can exclude from the report all metrics except those key metrics described in the preceding section.

To create a production report to use in Job standard optimization, do the following:

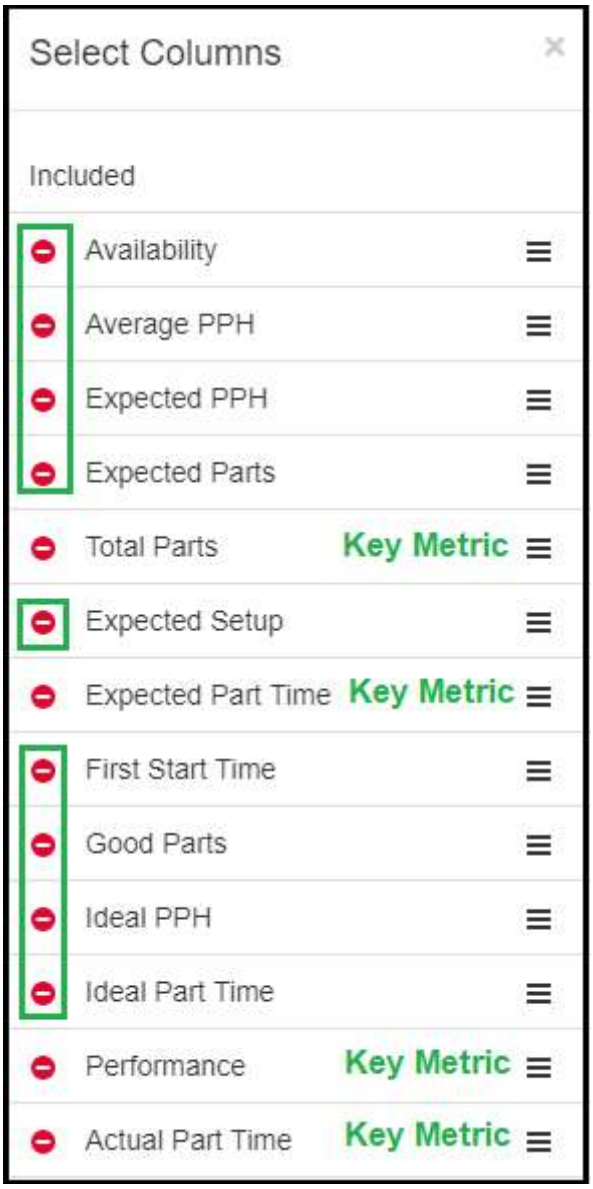
1. From the MachineMetrics main menu, select **Reports**.
2. The **Production Report** will run and display current data. By default, the Production Report will display all available metrics:



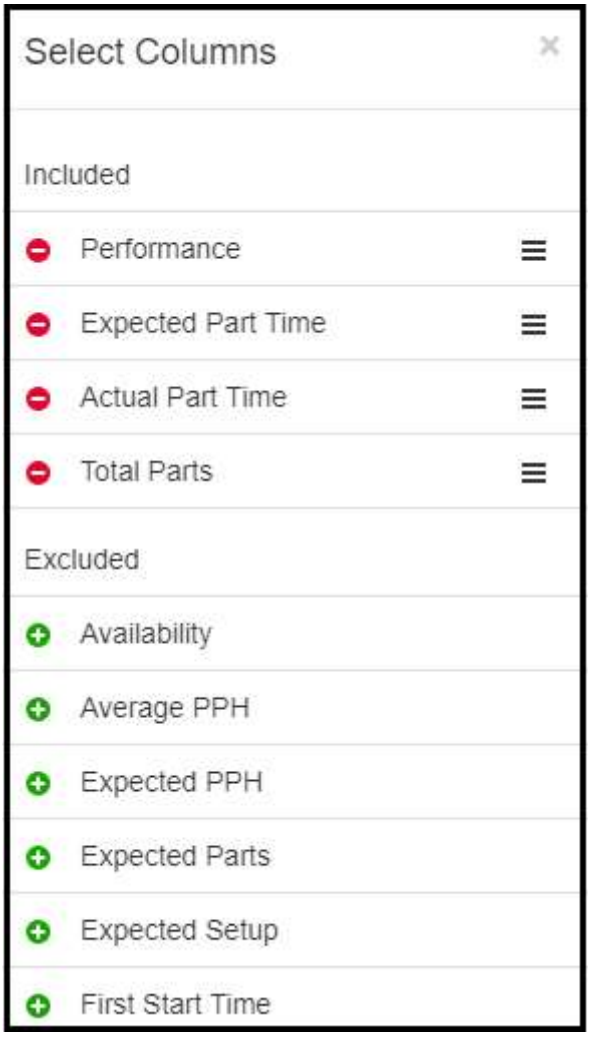
3. Click the **Select Columns** button in the top right corner of the Production report (beneath the **Apply** button):



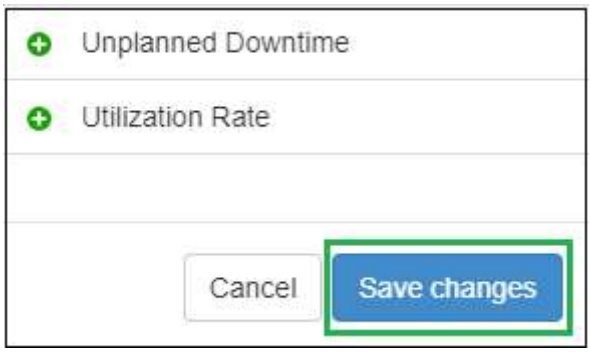
4. In the **Select Columns** dialog, click the red "minus" icon associated with all metrics in the **Included** section except for the key performance metrics. This will move the unneeded metrics to the **Excluded** section of the dialog.



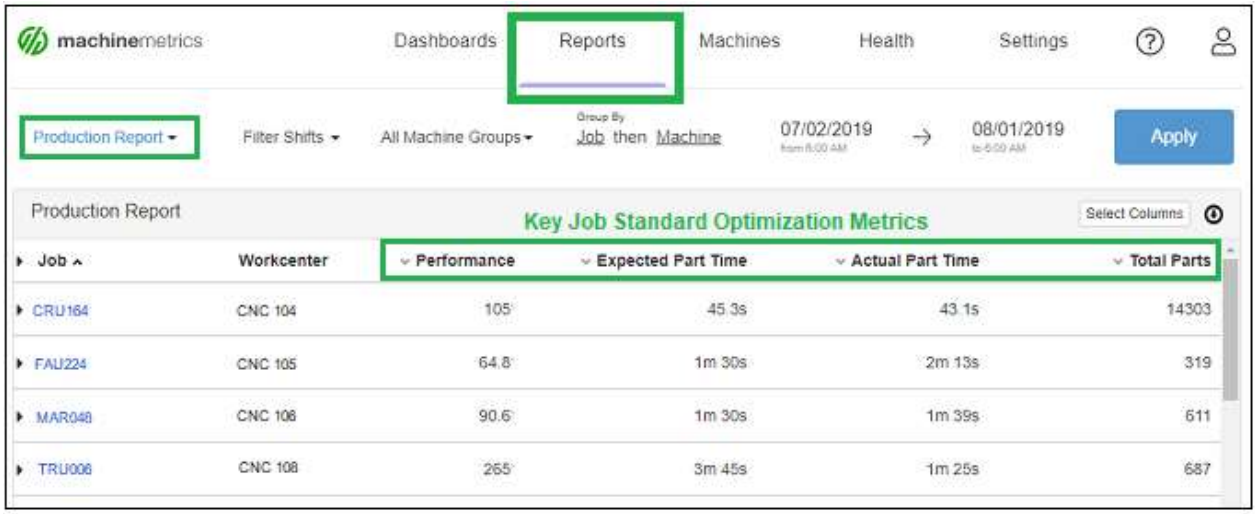
5. Put the Included key metric columns in the desired order for the report. To do this, click on a column name and drag it to the desired position in the column order. When complete, the **Select Columns** dialog should look similar to the following:



6. To apply the new Production Report layout, click the **Save Changes** button at the bottom of the dialog:



7. The Production Report page will display with only the key Job standard optimization metrics, similar to the following:



Customizing the Production Report Results View

The following figure highlights the capabilities that the Production Report page offers which allow you to choose how you want to view the report results.

The following sections describe the purpose and function of each of these capabilities.

Filtering Report Results By Shift

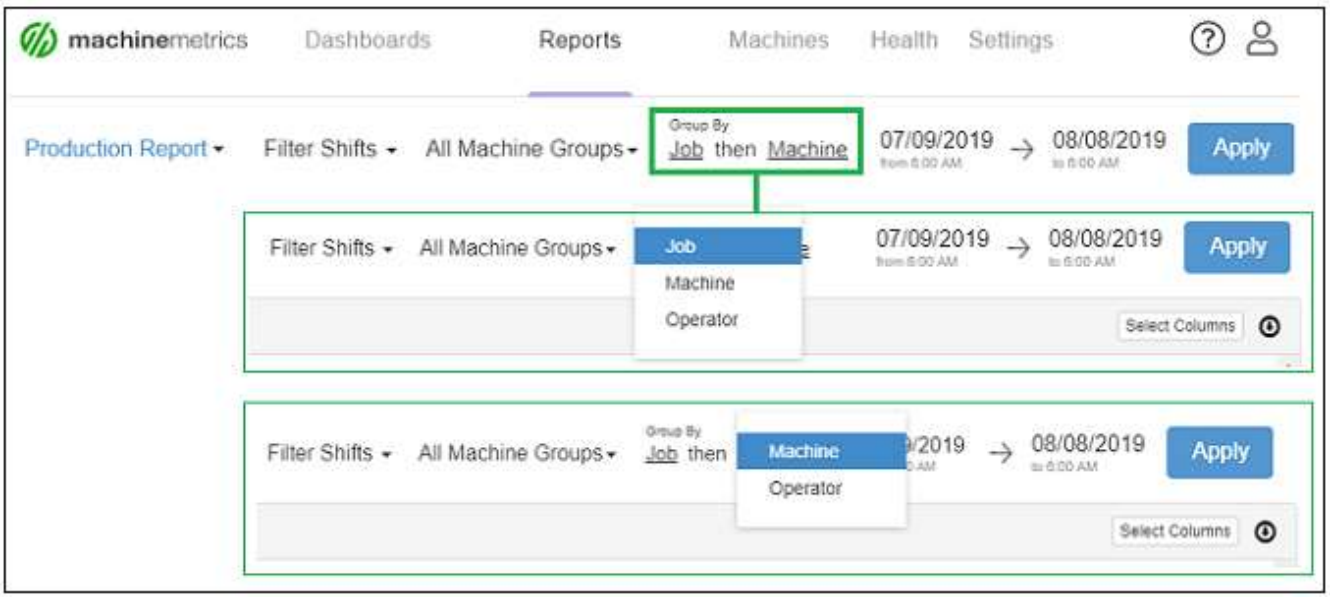
Clicking on the **Filter Shifts** menu, you can filter the Production Report results so that it only shows the production results for selected shifts and/or selected Workcenter Groups.

Filtering Report Results by Machine Group

By default, the Production Report shows data for all machine groups. Clicking on the **All Machine Groups** pull-down menu, you can filter the Production Report results so that it only shows the production results for selected Machine Groups.

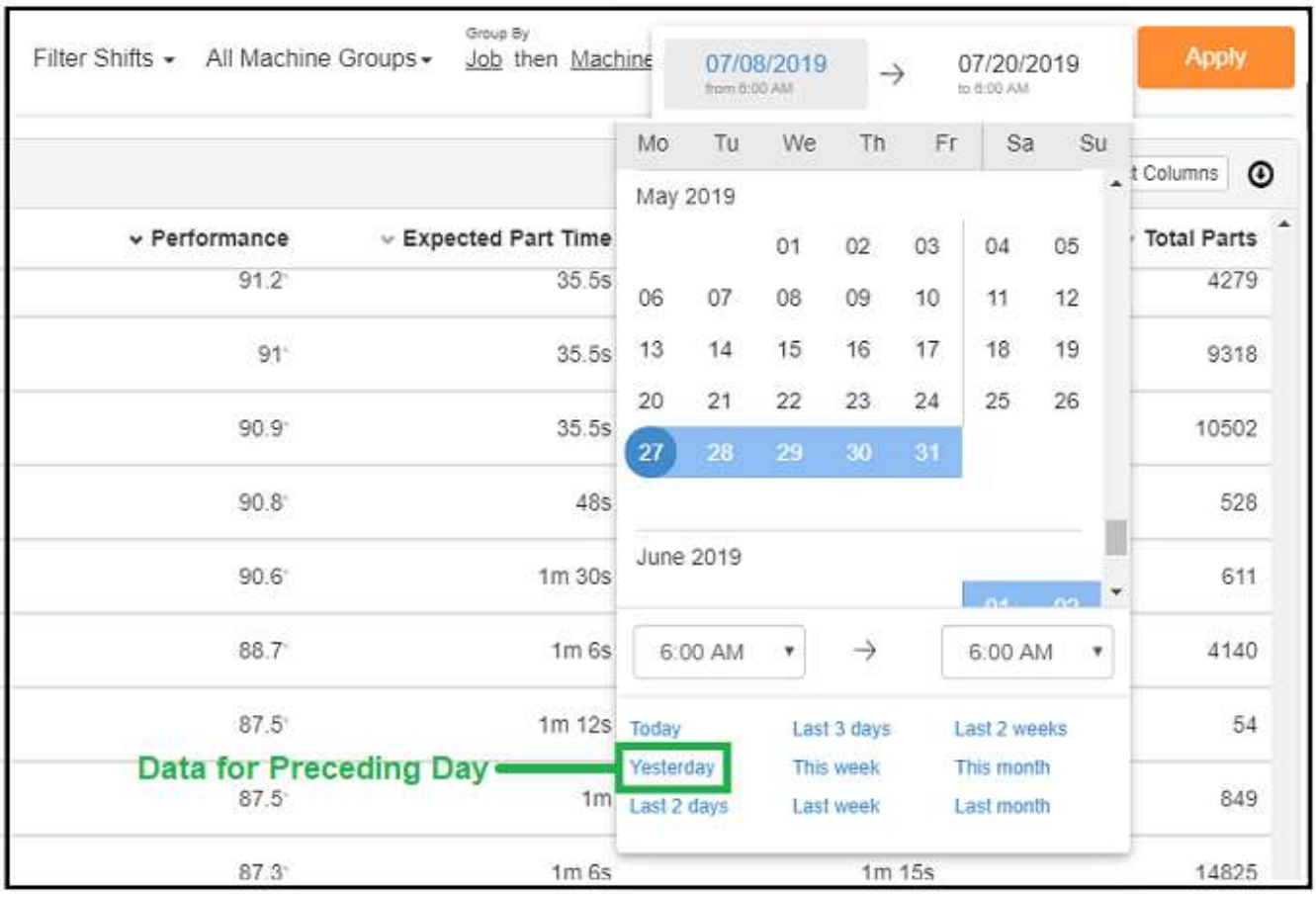
Grouping Report Results

Clicking on the **Group By/Then** links, you can select how the Production Report results are grouped and the order in which they are grouped. You can choose to group results by two of three criteria: Job, Workcenter, and Operator (if the Operator Insight feature is enabled).



Setting the Report Date Range

Clicking on either of the "from" or "to" date fields allows you to set the date range for which you want to see report data. As part of the Job standard optimization process, the MachineMetrics recommended best practice is that the Production Report be reviewed each day for the preceding day. This can be done by selecting the **Yesterday** option highlighted in the figure below.



Applying Filter/Group By/Date Range Changes

To apply any changes made to the **Filter**, **Group By**, and date range settings, click the **Apply** button. The **Apply** button is **blue** if all changes have been saved and **orange** if there are unsaved changes to these settings.

Sorting Report Data by Metric

Clicking on any metric column heading will immediately sort the report data by ascending/descending order for the selected metric. For evaluating Job standards, it is most useful to sort the report data by the ascending/descending values for the **Performance** metric to view those Jobs that are performing much faster or much slower than the parts goal. See Analyzing and Optimizing Job Standards.

Viewing Detailed Job Data

Clicking on any Job name in the report will display the page with the detailed performance report for the Job. See Analyzing and Optimizing Job Standards.

Analyzing and Optimizing Job Standards

This section provides guidelines for analyzing Job standards and recommendations for developing and implementing a Job standard optimization program and plan.

Analyzing Job Standards

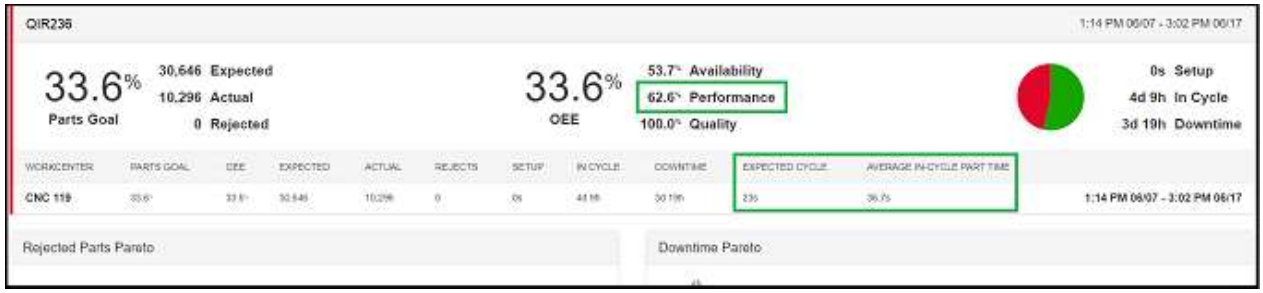
To analyze a Job standard, do the following:

1. Click on the **Performance** metric to sort the Production report by the Performance metric in ascending order.
2. Look for Jobs with **Performance** less than 85% or greater than 115%, (or whatever percentages represent your under/over-performing thresholds) and check the **Total Parts** value. Consider this example:

   
   Job_Standard_Optimization_Job_Analysis-1.png
   Note the following about this example:

   - **Job QIR236:** The CNC 119 machine is significantly under-performing at 62.7% of the Job goal and has processed over ten thousand parts. More than likely, this machine is not capable of meeting the current Job standard. Further investigation would be required to determine an achievable Job standard for this machine.
   - **Job SR438:** The CNC 115 machine is significantly under-performing at 64.8% of the Job goal and has processed 319 parts. It is likely that this Job standard needs to be adjusted, but further investigation would be required to determine whether the Job standard for this machine needs to be adjusted and what the new Job standard should be.
   - **Job ABU448:** The CNC 163 machine is performing at 80.2% of the Job goal and has processed 682 parts. With the number of parts processed, it is likely that this Job standard may need to be slightly adjusted, but this may not be a priority since it is close to optimal performance. Further investigation would be required to determine whether the Job standard for this machine needs to be adjusted and what the new Job standard should be.
   - **Job REU824:** The CNC 118 machine is performing at 82% of the Job goal, which is just slightly below the optimal 85% threshold, and it has only processed 98 parts. It is possible that when more parts are processed that this machine will meet the optimal Job performance standard. Further investigation could be done or it could wait until a larger number of parts have been processed.

3. To investigate a Job standard, click on the name of the Job to open the detailed Job production report. Consider the following production report example for Job **QIR236**:



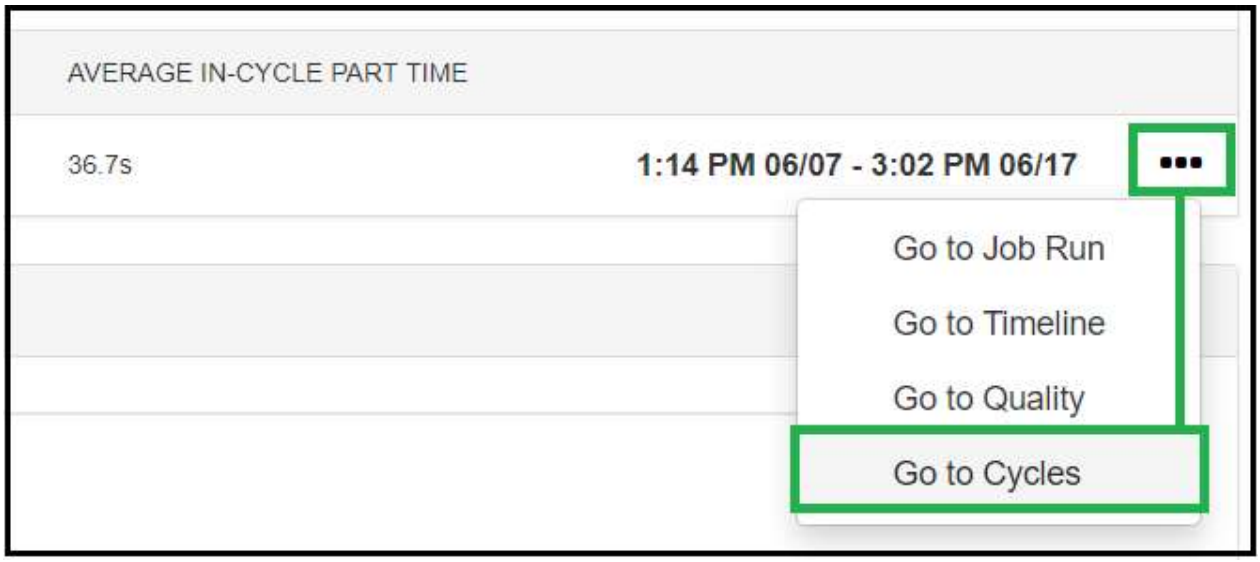
The detailed Job production report can be used to analyze many different aspects of a Job. For example, the report above shows that Job QIR236 has a significant downtime issue that should be investigated. But, when looking to optimize a Job standard, we are concerned with the **Performance** percentage (a very low 62.6% in this example) and investigating the machine cycle performance that underlies that percentage.

The remaining steps of this procedure use the above example Job QIR236, an under-performing Job. The same steps could be followed for an over-performing Job (>115% of goal).

4. To begin inspecting cycle data, click anywhere in the machine production data row of the Job production table:

5. A "Go to" menu will become available on the right end of the Job production table row:

6. Click the Go To menu icon and select **Go To Cycles**:



7. The **Cycles** report page will display for the machine. The **Cycles** page contains a **Cycles Histogram**, a **Cycles** table with the performance data for each individual machine cycle, and a **Statistics** table with the summary statistics for the machine.
8. In the Cycles table, click on the **Duration** column heading until the table values are sorted by ascending duration (shortest to longest). Note that in an over-performing Job, you would want to change this step to sort by descending duration (longest to shortest) to see how many under-performed the standard.
9. Analyze the data in the **Cycles** table, comparing the data in the **Duration** and **Expected** columns. The value in the Duration column represents the actual time the machine cycle took, while the Expected column value represents the expected cycle time, based on the "Expected" performance settings configured for the Job/machine. If the machine processes one part per cycle, these values will be equal to the Actual and Expected Part Time values for the Job/machine.

   Consider the following example of Job QIR236 on a machine that processes one part per cycle:

- In the above example, which is sorted by ascending cycle time duration, only the first/shortest cycle out of 7144 cycles (at one part per cycle) was shorter than the expected cycle time duration, and that one was significantly off of the expected value as well.
- The remaining 7,000+ cycles were all significantly slower than the Expected cycle time value of 23 seconds.

10. Review the summary statistics below the Cycle table. Consider the values in the following **Statistics** table taken from the same Job **QIR236** example in the preceding step:

- The value for **Median Cycle Time** tracks very closely with the Actual Part Time value:

- The **Standard Deviation** of 24:10.0 is large compared to the median and with only one "fast" cycle, this indicates that there are some very slow cycles in the run. These can be seen by clicking on the Duration column heading until it is sorted by descending values:

11. Determine the next course of action according to your Job Standard Optimization Process.

Developing a Job Standard Optimization Process

Job standard optimization is a continual improvement process that never truly ends. Like any such business process, to be successful it requires:

- Resources assigned to complete the process actions, in this case the actions of Job standard analysis and optimization
- A defined program and plan to manage process activities and execute process actions

Job Standard Analysis Resource Requirements

A Job standard optimization process must first include someone (perhaps more than one in larger environments) who can review and analyze the Job standards in the Production report as defined in this article. This review and analysis should be done at a defined and regularly scheduled interval, which could be daily, weekly, or another time interval depending on the characteristics of your production environment.

Job Standard Optimization Resource Requirements

When issues with a Job standard are found, there should be qualified resources assigned to complete the following actions:

- Analyze non-machine tasks and activities such as operator part loading/unloading to identify and reduce inefficiencies as much as practical.
- Analyze and identify mechanical/technical deficiencies in machine processing that may be improved.
- Determine whether new Expected values are required for the Job standard and what those values should be.

The actual processes and procedure steps required for those processes will be specific to your environment and should be defined in your Job standard optimization plan described in the following section.

Job Standard Optimization Program/Plan Requirements and Best Practices

To be successful, a Job standard optimization program should include a defined plan that contains:

- An explanation of the purpose of the program and a description of its activities
- Specific goals of the program, including the chosen Job Standard Optimization Goal
- A description of the process tasks for analyzing and optimizing Job standards

- Identification of the resources assigned and responsible for the completion of each program task
- Clearly documented procedures for completing each process task

Once developed, the plan should/must be published in a location which is known to all assigned resources for Job standard analysis and optimization.

Questions? Contact Your Customer Success Manager

This article is meant to provide guidance and the best practices as they are known to MachineMetrics for analyzing and optimizing Job standards. If you have any questions on developing a Job standard optimization program or on anything in this article, please reach out to your MachineMetrics Customer Success Manager.

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