



StatusWatch

Machine Builder Guide

The Six Building Blocks of Overall Equipment Effectiveness

Overall Equipment Effectiveness (OEE) is calculated using a formula which takes into account several aspects of the equipment's process, or cycle. There is a minimum amount of data that is necessary to perform a basic OEE calculation and several pieces of optional data that can make OEE reports more detailed. The required data can be broken down into six categories: *In-Cycle Time*, *Down-Time*, *Non-Op Time*, *Part Count*, *Part Quality* and *Cycle Time*. Each of these categories is explained below with information on the types of optional data that may be collected.

In-Cycle Time

This can be generally defined as time when a piece of equipment is engaged in the tasks that it was intended to perform. If it is a welder it may be welding. If it is a lathe it may be cutting.

Optional In-Cycle States

A machine may perform a number of different tasks during the time that is considered *In-Cycle*. Examples would include: cutting, tool change, pallet change, feed hold, etc. The monitoring of these states will produce more detailed reports that show a breakdown of *In-Cycle Time* into each of these sub-states.

Down Time

If a machine is not *In-Cycle* it is usually considered to be in a *Down Time* state. This is time when the machine is not running and is not producing any parts.

Optional Down Time States

There can be a large number of different reasons for a machine to be down. The operator may be at lunch, there may be no raw material, or the machine may have a broken tool, just to name a few. Just as with the *In-Cycle Time* states, collecting more details about why the machine is down will help to produce more detailed reports.

Non-Op Time

If a machine is not *In-Cycle* but is also not in a *Down Time* state it is considered to be in *Non-Op* time. Two typical examples are scheduled preventative maintenance, and not scheduled to run. *Non-Op Time* is not a requirement for OEE. Some consider any time period that isn't *In-Cycle* to be *Down Time*.

Part Count

Part Count is the total number of parts produced by a machine.

Part Quality

Each part is considered either good or bad and this is recorded as the *Part Quality*.

Cycle Time

Cycle Time is broken down into two categories: *Ideal Cycle Time* and *Actual Cycle Time*. *Ideal Cycle Time* is the amount of time that it should take to complete a cycle if everything is operating properly and is used as a benchmark against which the *Actual Cycle Time* is compared. The *Actual Cycle Time* can be calculated from the start of a cycle to the end of that cycle or from the start of one cycle to the start of the next cycle.

StatusWatch Data Types

StatusWatch relies on data provided by the machine whenever possible to minimize the input needed from the operator. This data must be provided in a format that is recognized by StatusWatch and must be accessible via a protocol over which StatusWatch can communicate.

The format of the data varies slightly depending upon which component of OEE it is representing. NOTE: When using MTConnect the actual representation of the following types of data is flexible due to the ability to do simple manipulation of the data prior to sending to StatusWatch.

Machine State

The current machine state may be represented by a single unsigned integer that is given unique values for each of the possible states or each state may be represented by an individual bit. Whichever method is used, the integer/bit must remain constant for the duration of the state.

Part Quantity/Quality

The number of good parts and bad parts are represented by two unsigned long integers which increment each time a good or bad part is produced. When these counters reach a predefined upper limit they should reset to 0 and continue counting. Alternatively good or bad parts could be represented by two individual bits, one for good parts and one for bad parts which would toggle on for 5 seconds and then off.

Current Part/Ideal Cycle Time

The current part should be presented as an ASCII string that uniquely identifies the part. The ideal time is an unsigned long integer that represents the time in seconds that should be taken to complete the current part. Both the current part and ideal time should contain valid data anytime the machine is In-Cycle.

Other Data

Depending upon customer requirements other data may be collected by StatusWatch. The format will depend upon the type of data being monitored but could include Boolean, integer, floating point values, strings, etc.

Documentation

When the above information is provided by the machine controller, documentation should include the location/address of each piece of data and a description of its format and what it represents.

StatusWatch Connectivity Options

StatusWatch supports these connectivity options:

- OPC (OLE for Process Control)
- MTConnect

OPC describes a set of Data Access Standards based on Open Connectivity. It is aimed at the automation industry and is meant to provide a common and open means of passing data between controls and from controls to a PC. It is a key component in bringing data from a machine controller to software running in a Windows® environment. If your device can be connected to an OPC server, such as the KEPServerEX OPC Server, StatusWatch can connect to the OPC server for data collection.

Connecting machines to an OPC server is usually a trivial matter as there are many drivers available that allow an OPC server (such as KEPServerEX) to communicate to machines via common protocols like MODBUS, Profibus, etc. Modbus TCP is a widely used protocol which is easy to implement and is therefore the preferred protocol of StatusWatch. It is also important to note, that when connecting StatusWatch to an OPC server, the OPC server must reside on the same computer as the StatusWatch data collector.

Another data collection option is MTConnect. The MTConnect protocol uses XML over HTTP to provide a standardized method of communicating with many varied types of machines made by different machine builders. The MTConnect Bridge software is a companion product to StatusWatch that allows StatusWatch to easily communicate with MTConnect enabled devices via the MTConnect Agent. The MTConnect Agent software acts as a data concentrator for multiple machines. More information can be found at <http://www.mtconnect.org/> regarding how to make your machines MTConnect compliant as well as setting up the MTConnect agent.

As previously mentioned, the actual data types (integer, Boolean, etc) of the data being collected is less important when working with MTConnect because the MTConnect Bridge allows for simple scripting which can be used to manipulate the “raw” data into a form that StatusWatch can effectively log and report on.