

Overall Equipment Effectiveness

Before delving into detail about OEE it is worth having a basic understanding of one of the most striking characteristics of Adroit: the extensible object model at the heart of its SCADA server. The objects in the server are called *agents* in Adroit terminology, and range in type from simple Boolean, Integer, Real types, through conventional SCADA types like Digital, Analog, right up to rich data types that, on their own, implement complete sub-systems such as Alarm Management and Overall Equipment Effectiveness.

An Adroit agent or data type is implemented as an independent DLL that need only conform to a defined *signature*, essentially a name format (t_XXX.DLL), plus a defined set of exported *create, get, set, delete...* functions (or *methods*). Internally each agent contains a number of properties which act as primitive storage *slots* that can be of type Boolean, Integer, Real, or String. The way these various data types are implemented is by creating different agent type DLLs that contain different compositions of slots. The data types exhibit different behaviours by having custom processing (*overridden* implementations) for the 'get' and 'set' methods on their different constituent slots.

The result has been that with successive versions of Adroit over the years, it has been possible to add new, rich data types to the Adroit SCADA server, and is primarily what we mean by describing the object model as being *extensible*.

The Overall Equipment Effectiveness agent is a prime example of this - a rich data type that has fairly recently come into being:



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What is OEE

Overall Equipment Effectiveness (OEE) is a measure of how effectively an item of equipment, a group of equipment items, or even an entire plant or factory is being utilised.

Specifically, it is the percentage determined by the cumulative impact of the following three factors:

- **Availability** The percentage of the actual running time of the monitored item. So this factor is decreased by the activities that cause unplanned downtime
- **Performance** The percentage of how often the monitored equipment item performs at optimum speed. So this factor is decreased by the all the factors preventing the equipment from running at optimal speed
- **Quality** The percentage of good quality items produced by the monitored equipment. So this factor is decreased by the amount of waste or bad quality and scrapped items

$$\text{OEE\%} = \text{Availability\%} \times \text{Performance\%} \times \text{Quality\%}$$

OEE in Adroit

The dialog or form below, showing numerous OEE slots or properties, represents a single OEE agent instance in Adroit. A complete plant or section of plant will typically have several OEE agents – one for each equipment item, and possibly one the overall plant or plant section.

KPI/OEE data:

| Day | Shift | Type | Available time | Runtime | Downtime | Total 1 | Total 2 | KPI | Target KPI | Percent KPI | On count | Off count | Capacity | Quality |
|------------|-------|------|----------------|---------|----------|---------|---------|-------|------------|-------------|----------|-----------|----------|---------|
| 2010/04/11 | 2 | 0 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 21.50 | 30.00 | 71.66 | 0 | 0 | 59.00 | 1.00 |
| 2010/04/11 | 1 | 0 | 8.00 | 8.00 | 0.00 | 235.78 | 0.00 | 29.47 | 30.00 | 98.24 | 0 | 0 | 59.00 | 1.00 |
| 2010/04/10 | 3 | 0 | 8.00 | 8.00 | 0.00 | 236.00 | 0.00 | 29.50 | 30.00 | 98.33 | 0 | 0 | 59.00 | 1.00 |
| 2010/04/10 | 2 | 0 | 8.00 | 8.00 | 0.00 | 236.05 | 0.00 | 29.51 | 30.00 | 98.36 | 0 | 0 | 59.00 | 1.00 |
| 2010/04/10 | 1 | 0 | 8.00 | 8.00 | 0.00 | 235.98 | 0.00 | 29.50 | 30.00 | 98.32 | 0 | 0 | 59.00 | 1.00 |
| 2010/04/09 | 3 | 0 | 8.00 | 8.00 | 0.00 | 235.98 | 0.00 | 29.50 | 30.00 | 98.32 | 0 | 0 | 59.00 | 1.00 |
| 2010/04/09 | 2 | 0 | 1.22 | 1.22 | 0.00 | 26.02 | 0.00 | 29.56 | 30.00 | 98.53 | 0 | 0 | 59.00 | 1.00 |

OEE Configuration Dialog

The advanced configuration dialog shown below, allows you to designate other Adroit tags as parameters in an OEE agent. Alternatively OEE parameters can be directly acquired from a PLC if they are available there.

Advanced OEE options:

Optional tag references:

Available tag: ...

Running tag: ...

Input1 tag: ...

Input2 tag: ...

Reject count tag: ...

Product tag: ...

Batch ID tag: ...

Setpoints:

| | Target value: | Low alarm: | Low-low alarm: |
|-------------------|-------------------------------------|-----------------------------------|-----------------------------------|
| KPI: | <input type="text" value="30.00"/> | <input type="text" value="0.00"/> | <input type="text" value="0.00"/> |
| Quality (%): | <input type="text" value="100.00"/> | <input type="text" value="0.00"/> | <input type="text" value="0.00"/> |
| Performance (%): | <input type="text" value="100.00"/> | <input type="text" value="0.00"/> | <input type="text" value="0.00"/> |
| Availability (%): | <input type="text" value="100.00"/> | <input type="text" value="0.00"/> | <input type="text" value="0.00"/> |
| OEE (%): | <input type="text" value="100.00"/> | <input type="text" value="0.00"/> | <input type="text" value="0.00"/> |

SQL connection string: ...

SQL sample rate (mins):

Buttons: OK, Cancel, Update, Refresh, Help

Advanced Configuration Dialog

From the configuration dialogs you can see that an OEE agent may be used to measure a specific KPI, as well as calculate the OEE.

KPIs are typically the variation of some production value over time, or of one production value versus another production value. Therefore an OEE agent can measure two variables:

- the 1st of these production values (Input1)
- the 2nd production value (Input2), used as a divisor of the first value

If the 2nd value is not specified, then the 1st value is simply divided by time. In this way it is possible to measure production figures, such as ton/hr, kWh/ton, total produced, actual run-hours, etc.

By using OEE agents in tandem with instance(s) of another agent type *Shift*, the measured KPI can either compare actual performance with benchmark figures or compare today's performance with the previous day or the previous day's shifts.

Something else that can be seen on the advanced configuration dialog is a SQL connection string. This is used to specify a SQL database to which the various KPIs and OEE parameters are logged away for data warehousing purposes.

Since OEE is calculated during the time that the monitored equipment is available for production, the *available* slot should only be ON when the machine/process is supposed to be running. To this end instances of another agent type *Scheduler* can be created that are configured with the applicable off times for the monitored equipment - such as maintenance/lunch/tea times etc.

Conclusion

A brief period of even the most cursory research into the topic of OEE will convince you that there is a lot more to it than it has been possible to describe in this short data sheet. But what we have been able to do is touch on some of the ways in which Adroit's flexible, extensible object model has been elegantly put to work implementing a key component in this very important lean manufacturing and production strategy.

To discover more about OEE and appreciate many of the other great benefits to be gained from Adroit Smart SCADA, download the installer from <http://adroit-europe.com/SmartSCADA.cshtml>