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Factory Automation Overview

Factory automation is an exciting new feature available in LYNQ 2019. Factory Automation extends the existing manual data collection features in LYNQ, with automated data collection to determine equipment effectiveness (OEE).

Including:

- Up/Downtime (including downtime reason)
- Operational completion (Quantity)
- Operational scrap (including scrap reason)

With over 140 industrial drivers to the most common PLC/IO devices including Allen Bradley, GE, Honeywell, Mitsubishi, Siemens and more. LYNQ provides the platform to digitalise your factory by connecting machines, measuring equipment and other devices to read data without manual inputs.

LYNQ’s factory automation provides controlled management of machine data including error handling; live or controlled data posting to ERP/PLM systems; data collection from multiple geographical facilities; data historian.

It is important to note that this feature guide does not cover the setup and maintenance requirements for the PLC or IO device and/or the OPC server. Configuration of these hardware and software devices will be completed by a recommended industrial engineer.

Within this feature guide, you will learn:

- System requirements to support factory automation
- How to enable factory automation
- How to create automated devices
- How to configure signals and processors
- How to monitor a live automated environment
- How to resolve dataflow errors
- How to setup alerts for monitoring automation errors
- How to troubleshoot failures
System Requirements

Factory automation is entirely dependent on the infrastructure illustrated in the Factory Automation Topology Diagram. You must have LYNQ implemented to utilise factory automation.

Machines that will be configured as automated devices in LYNQ must already be connected to a PLC or IO device and communicating with the OPC Server.

Factory Automation Topology Diagram

To automate your equipment you must have a device license which differs to the manual resource seat license. To check whether you have sufficient automated device licenses, click on Help, Change Product License from the LYNQ home page.

LYNQ System Requirements
The Concept of Automation

Factory automation in LYNQ has a simple concept. The Data Flow Diagram illustrates the overall factory automation solution. The orange columns (Infrastructure) illustrate the flow of data between the various hardware and software components before reaching LYNQ. The green columns (LYNQ) illustrate the flow of data once the data has reached LYNQ.

Data Flow Diagram

![Data Flow Diagram]

It is important that all these aspects of the factory automation solution are understood and configured correctly. To successfully adopt automation in your factory, you will require a resource, such as an Industrial Engineer that is sufficiently skilled to maintain your factory network including PLC/IO devices and the OPC Server hardware and software. Note: LYNQ can only take responsibility for the support and maintenance of its own software.

Typically automation relies on a user selecting a task in the workbench to indicate which job/product is running when the automated devices are sending good and bad quality data. This is because the automated device generally does not have any concept of which job/product it is running. Human interaction with the Workbench is not required for status (uptime/downtime) data collection.
Enabling Factory Automation

By default factory automation is disabled. The followings steps explain how to turn on automation within LYNQ.

LYNQ must understand which database is configured to store data logged by the OPC Server.

Configure the Factory Automation Database:

1. Logon to LYNQ as an administrator
2. Select Settings from the home page
3. Select Settings
4. Navigate to the Database Settings section
5. Enter the factory automation database name in the Automation row
6. Select Save

Enable Factory Automation:

1. Logon to LYNQ as an administrator
2. Select Settings from the home page
3. Select Advanced Settings
4. Select General
5. Check the Enable automation option
6. Set the Automation polling interval (secs) as required
7. Set the Data buffer interval (secs) as required
Configuring Automated Devices

Automated devices are configured under Resource Management, Seat Maintenance, Equipment Maintenance. Devices that you choose to automate, must be imported into LYNQ using the standard Import Equipment function first. Once the equipment is imported, you will be able to configure the automated device settings in Equipment Maintenance.

To enable equipment for automation:

1. Select Resource Management/Seat Maintenance
2. Select the Equipment record and click Edit
3. Check the Automation tick box
4. For informational purposes only, enter the manufacturer’s details, IP Address of the automated device, the OPC Agent and the IP Address of the OPC Server.
5. Click Save

Equipment Maintenance

Against each Automated Device within LYNQ, you must configure both:

1. Signals
2. Processors

This is explained in the following sections
Signals

Signals are configured to listen for any change in values for a unique OPC tag as defined in the OPC server. You must create a signal in LYNQ for each unique OPC Tag. OPC tags can be configured to read good parts count, scrap parts count and the actual state of the device.

Quantity and Scrap Signals support the configuration of default values for:

- Location
- Warehouse
- Bin Number
- Serial Number
- Lot Number
- Scrap Reason (Scrap Signal Only)
- 5 User Defined Values

In order to capture scrap for 5 different reasons codes, the OPC Server must be configured to store 5 separate tags and distinct counters. LYNQ must be setup with 5 separate Scrap Signals each with a unique Scrap Reason code.

Other Non-OEE related data such as pressure, temperature, spindle speed, etc may be recorded and stored within the LYNQ Factory Automation SQL Database. LYNQ signal processing will ignore this data but the data can be used for custom reporting (i.e Power BI, Microsoft SQL Server Reporting Services). You can then provide visibility of this data in LYNQ via the Webhook functionality.
Status Signals

To configure a signal for Status:

1. Select Resource Management/Seat Maintenance
2. Select the Equipment record and click Edit
3. Select the Automation Tab
4. Select Signals
5. Select New
6. Select Status
7. Enter a description and the OPC Tag unique identifier
8. Select Add

To map the signal data to the relevant status in LYNQ:

1) Enter the OPC Tag value
2) Select the correct Status
3) Enter a description
4) Click OK.
5) Click Save
**Quantity Signals**

**OPC Tag**
The OPC Tag is written to the factory automation logging database along with all other values captured by the PLC/IO device. The data is stored in the Lync_ME_FA_InputData table.

To configure a signal for **Quantity**:

1. Select Resource Management/Seat Maintenance
2. Select the Equipment record and click Edit
3. Select the Automation Tab
4. Select Signals
5. Select New
6. Select Quantity
7. Enter a description and the OPC Tag unique identifier
8. Specify any default values for the Quantity Signal
9. Click Save
Scrap Signals

To configure a signal for Scrap:

1. Select Resource Management/Seat Maintenance
2. Select the Equipment record and click Edit
3. Select the Automation Tab
4. Select Signals
5. Select New
6. Select Quantity
7. Enter a description and the OPC Tag unique identifier
8. Specify any default values for the Scrap Signal
9. Click Save

### New Signal Listener - DRILL / DRIL01, Scrap

**General**
- **Active?**
- **Description**
- **Data**
- **OPC Tag**

**Details**
- **Location**
- **Warehouse**
- **Bin Number**
- **Serial Number**
- **Lot Number**
- **User Defined Field 1**
- **User Defined Field 2**
- **User Defined Field 3**
- **User Defined Field 4**
- **User Defined Field 5**
Processors

Processors are used to convert signal data into meaningful transactional data in LYNQ. Within the processor settings, you may also apply specific business rules to enable certain actions to be performed after the transaction has been created. It is important to note that Processors can also be used independently of Factory Automation with LYNQ RestAPI.

LYNQ is shipped with pre-defined Processors for:

- Quantity
- Scrap
- Status

You may however add your own processors if required from the Equipment Maintenance Processor screen.
Processor Options

Activated
By default all statuses are activated. You only need to deactivate a status if you want to stop the processor from processing data for that particular status type.

LYNQ Rest API
Refer to the Rest API feature guide to understand how to communicate with the processor outside of LYNQ.

New Processors
Use the New option to create your own custom processor.

Actions
You can view which actions were triggered from the Factory Automation screen.

Against a Processor for Quantity and Scrap you can define a multiplication factor. Multiplication factors can be static (i.e. defined against the Processor) or dynamically assigned (i.e. defined in the Routing Operation, Stock Code or Custom Form Fields etc).

Multiplicators are typically used to indicate the number of units produced per operation cycle recorded with the PLC (i.e. multi-die forms when one punch of press creates multiple units)

Quantity Process Settings for Multiplier

Status Processor settings can be configured to perform certain actions once a transaction has been generated.

<table>
<thead>
<tr>
<th>Tab Name</th>
<th>Sub Name</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statues</td>
<td>Active</td>
<td>The process is active for the type of status</td>
</tr>
<tr>
<td></td>
<td>Reset Accounting</td>
<td>Whether the Accounting Date should be reset after the transaction is created</td>
</tr>
<tr>
<td></td>
<td>Date</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reset Clocked In</td>
<td>Whether the Clocked In Date should be reset after the transaction is created</td>
</tr>
<tr>
<td></td>
<td>Stop</td>
<td>Whether all active tasks should be stopped after the transaction is created</td>
</tr>
<tr>
<td></td>
<td>Process</td>
<td>Whether additional data should be created after the transaction is created. This behaviour works the same as the Process Data function within On Screen Elements.</td>
</tr>
<tr>
<td></td>
<td>Swap Status</td>
<td>Whether the status of the resource should be swapped after the transaction is created</td>
</tr>
</tbody>
</table>
Status Processor

To configure a processor for Status:

1. Select Resource Management/Seat Maintenance
2. Select the Equipment record and click Edit
3. Select the Automation Tab
4. Select Processor
5. Select Enable
6. Select the Equipment Status Processor

To configure which seats are associated to the processor:

1. Select Seats
2. Select Add
3. Select the Automated Resource
4. Click OK
5. Click Save
Quantity Processor

To configure a processor for **Quantity**:

1. Select Resource Management/Seat Maintenance
2. Select the Equipment record and click Edit
3. Select the Automation Tab
4. Select Processor
5. Select Enable
6. Select the Quantity Status Processor
7. Select OK
8. Select the Quantity Processor and select Edit
9. Select Active to enable to processor
10. Select whether the processor will process other data
11. Enter any multiplication factors

To configure which seats are associated to the processor:

1. Select Seats
2. Select Add
3. Select the Automated Resource
4. Click OK
5. Click Save
Scrap Processor

To configure a processor for Scrap:

1. Select Resource Management/Seat Maintenance
2. Select the Equipment record and click Edit
3. Select the Automation Tab
4. Select Processor
5. Select Enable
6. Select the Quantity Status Processor
7. Select OK
8. Select the Quantity Processor and select Edit
9. Select Active to enable to processor
10. Select whether the processor will process other data
11. Enter any multiplication factors

To configure which seats are associated to the processor:

1. Select Seats
2. Select Add
3. Select the Automated Resource
4. Click OK
5. Click Save
Testing Signals

You may at any time use the simulate option to test that quantity/scrap signals and processors are configured correctly. Note: running this option will generate transactions but these can be deleted afterwards.

Before testing a Signal, start a task in the workbench for the automated device you wish to test.

1. Select Resource Management/Seat Maintenance
2. Select the Equipment record and click Edit
3. Select the Automation Tab
4. Select Signals
5. Select Start in the Simulate column
6. Select Monitor
7. Select Start

![Signal Table]

Once started you will see the counter increase

![Signal Table]

As the counter is increasing click on the Monitor Tab and press Start. You will now see the simulated transactions appear one after the other. Expand the row to show the transaction detail.

If everything has been configured correctly you will see the quantity or scrap reported against the Job.

Note: The simulator will stop automatically if you move away from the Monitor Tab. The Monitor will operate for a maximum of 20 minutes (page life cycle time).
Monitoring Live Data

The actual live data coming from the factory floor can be visualised in the Monitor. The Monitor is optimised for mobile devices and is a useful tool for troubleshooting physical dataflow issues between multipie layers of the automated solution. (Machine, PLC, Network, OPC Server, LYNQ).

The monitor displays information relating to the quantity, scrap and status signals that are active in LYNQ.

To start the monitor:

1. Select Resource Management/Seat Maintenance
2. Select the Equipment record and click Edit
3. Select the Automation Tab
4. Select Monitor
5. Select Start

Expand the row to view the detail captured for the OPC Tag

To pause the monitor:

1. Select Resource Management/Seat Maintenance
2. Select the Equipment record and click Edit
3. Select the Automation Tab
4. Select Monitor
5. Select Pause

To clear the monitor:

1. Select Resource Management/Seat Maintenance
2. Select the Equipment record and click Edit
3. Select the Automation Tab
4. Select Monitor
5. Select Clear
Monitoring Live Data

The Automation Status Indicator on the Equipment Status screen and on the Workbench screen provides another useful tool for monitoring the health of an automated device.

The Automation Status Indicator has 5 different status meanings:

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Color/Image Code</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finger</td>
<td></td>
<td>Factory Automation is disabled but Manual Data Collection is enabled</td>
</tr>
<tr>
<td>WiFi Grey with Diagonal Line</td>
<td></td>
<td>Device is not activated for Automation and Manual Data Collection is disabled</td>
</tr>
<tr>
<td>WiFi Grey</td>
<td></td>
<td>Device is activated for Automation but no data has been received</td>
</tr>
<tr>
<td>WiFi Green</td>
<td></td>
<td>Device is activated for Automation and valid data has been received on the accounting day</td>
</tr>
<tr>
<td>WiFi Red</td>
<td></td>
<td>Device is activated for Automation and unresolved invalid data has been received on the accounting day</td>
</tr>
</tbody>
</table>
Error Handling

There may be occasions where data received from an automated device is not visible in the workbench or in reports and/or dashboard screens in LYNQ. If you are seeing the data on the Monitor but cannot report on the data in LYNQ you should use the Factory Automation screen to investigate the reasons for this problem.

Similar to the process flow in the Transaction Review Screen, Factory Automation data must pass through stages before the data becomes a valid transaction that can be seen in the Transaction Review Screen and in turn in other LYNQ dashboard and reporting screens.

Data from Automated Devices must pass through these flow states:

- Pending Accept
- Accepted
- Posted
- Trx visible in Trx Review
- Trx ready for approval
- Visible in Workbench
- Visible in Dashboards
- Visible in Reports

Factory Automation Screen

There are in total 6 flows states in LYNQ.

<table>
<thead>
<tr>
<th>Flow State</th>
<th>Type</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invalid</td>
<td>Invalid data received or no Job running (Qty)</td>
<td></td>
</tr>
<tr>
<td>Pending Accept</td>
<td>Waiting for the Processor to run based on Data Buffer Interval</td>
<td></td>
</tr>
<tr>
<td>Accepted</td>
<td>Data accepted but not processed by the LYNQ Platform Service (Service must be started, service polls every 1 minute)</td>
<td></td>
</tr>
<tr>
<td>Accept Error</td>
<td>Internal Acceptance error due to data integrity issues</td>
<td></td>
</tr>
<tr>
<td>Posted</td>
<td>Transaction successfully generated</td>
<td></td>
</tr>
<tr>
<td>Instant Accept</td>
<td>Transaction was generated via the Workbench</td>
<td></td>
</tr>
</tbody>
</table>

The Factory Automation screen groups these different flow states into a simplified view of the flow status for quick troubleshooting purposes.
Error Handling

The Factory Automation Screen has 3 filters:

- In progress
- Errors
- Trx Generated

Relationship of filter to flow state value

<table>
<thead>
<tr>
<th>Relationship</th>
<th>Flow State</th>
<th>Flow Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invalid</td>
<td>Errors</td>
<td></td>
</tr>
<tr>
<td>Pending Accept</td>
<td>In Progress</td>
<td></td>
</tr>
<tr>
<td>Accepted</td>
<td>In Progress</td>
<td></td>
</tr>
<tr>
<td>Accept Error</td>
<td>Errors</td>
<td></td>
</tr>
<tr>
<td>Posted</td>
<td>Trx Generated</td>
<td></td>
</tr>
<tr>
<td>Instant Accept</td>
<td>Trx Generated</td>
<td></td>
</tr>
</tbody>
</table>

Transactions displayed on the Factory Automation Screen with a status of **Error** should be investigated promptly.

Errors will happen if:

1. Data received includes invalid data (i.e. string value received instead of a numerical value for good quantity/scrap quantity).
2. No Job/Operation running at the time when the Quantity/Scrap processor created the transaction. When this happens, the data cannot be processed correctly as LYNQ doesn’t know which Job/Product to process the data against.
3. Internal data acceptance issues due to violation of key constraints.

You should also investigate transactions in the status of **In Progress** if these transactions have been in this status longer than the data buffer interval.

In Progress will happen if:

1. The processor is still waiting to process the data based on the Data Buffer Interval Setting (Advanced Settings/General).

Some of these issues will resolve themselves, however there may be times when you need to resolve error data to allow the LYNQ transaction to be generated.
Correcting Invalid Errors

Transactions with a flow state of Invalid should be corrected to ensure data flow in LYNQ completes successfully. Corrections can only be applied to quantity of scrap transactions. Status transactions cannot be corrected as correction requires changes of time-based calculations in the past. Invalid status transactions are shown for visualisation purposes only.

Invalid errors happen when the Factory Automation Processor cannot generate the final transaction for the data received from the automated device. This typically happens when the equipment was not running a Job at the time of the record creation.

Double clicking on the record will show a blank Task value.

To edit correct these Transactions, complete these steps:

1. Select Workforce
2. Select Factory Automation
3. Filter the screen to show the correct date range
4. Filter the screen to show only records where event type = Quantity
5. Filter the screen to show only records where Flow State = Error
6. Double Click on the Transaction that does not have a Job No
7. Using the Task Lookup [...] select a Job/Task
8. Select Save
9. Select the Checkbox in the Row Data (first column) and select Resolve

The Flow Status will change to Pending Accept and the next time the processor runs the transaction should update to a Flow Status of Trx Generated.

When a record in the Factory Automation screen is updated to Trx Generated the data will be visible in the standard LYNQ screens.

If you are experiencing high volumes of Invalid Errors see the following Alerts Section.
Correcting Accept Errors

Contact the LYNQ Support Team if you receive any transactions with a flow state of Accept Error. Accept Errors will occur if the transaction cannot be generated due to internal data integrity issues. LYNQ will investigate these issues with you to determine the root cause.
Alerts

LYNQ can be configured to alert you when errors are logged during the data flow process to help you promptly react to problems.

As an example, to configure an alert to notify recipients every hour when 5 or more errors have been logged:

1. Select Factory
2. Select Alert Maintenance
3. Select New
4. In the Name field enter Factory Automation Errors
5. In the Description field enter Factory Automation Errors
6. In the Measurement field select Equipment Factory Automation Errors
7. In the Condition field enter 0 and then 5
8. In the Execution Schedule field select Every 1 Hour
9. Select the Recipient Group for this alert
10. Select the Measured resources
11. Select whether the alert should create
   a. Product Issue
   b. Message Alert
   c. Email Alert
12. Select whether the Alert can be repeated.
13. Check the Active field

Alert Maintenance Settings

After 5 errors have been generated, the Alert will create a Production Issue and will send a message.
# Troubleshooting

The overall Factory Automation solution will have various points for failure. Investing in redundant network infrastructure will ensure higher availability of the Factory Automation solution.

It is important to understand when Factory Automation is not working, where to start troubleshooting. Troubleshooting can take place at the infrastructure layer and at the LYNQ application layer.

Use the table below as a guide for troubleshooting purposes:

<table>
<thead>
<tr>
<th>Troubleshoot</th>
<th>Issue</th>
<th>Troubleshooting Steps</th>
<th>Layer</th>
</tr>
</thead>
</table>
| No Data in Monitor         | Check that you have correctly configured the automated device seat in LYNQ. (i.e. Equipment has been imported, Equipment has been activated for Automation) | • Check there are no communication issues between the automated device/PLC/OPC Server or other underlying network issues  
• Check there are no communication issues between OPC server and the LYNQ Web Server  
• Check the Signals are activated in LYNQ with the correct Tag Values and Status Codes | LYNQ Application      |
| Data in Monitor but no Transactions in LYNQ | Check the Processors are Enabled in LYNQ and that the correct seats have been associated to the Processor  
Check the Factory Automation screen to see if there are any flow status errors. Resolve these where appropriate | LYNQ Application      |