1809806

by Richard Harrison

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1. Executive Summary

This project involves the upgrading of a production line to use SCADA monitoring software to monitor, track and record a lines progress and offer management a utility with which to view the line running in real time and keep better track of its progress. The project did not end up going to plan with support for the project trailing off and the programme having to be constructed on a personal laptop outside of work hours using the software originally suggested but having to do it from home. After much trial and error, trying various different solutions and having to self-teach the software and how to use it, a usable programme was created and tested using a web-based vision client. However, the system could not be built outside of the software programmes for the SCADA HMI and the Siemens PLC programme because the company stopped providing support for the project and the buying of parts, upgrading of machines and enlistment of specialist contractors for help in the building of the project could not be done since funding disappeared along with support.

Throughout the creation of the PLC and HMI programmes, multiple sources were consulted, and the programme was very much self-taught. Because the project had to take a rapid turn to be done outside of work there was a large amount of difficulty in getting the system to work because there was no support, and a large amount of time was spent troubleshooting and figuring out different ways in which the project could still be done. As a result, the end product was not what the was specified for but if the funding was given, the project could be completed because in the end, the HMI + PLC programmes were ready and tested.

Paragraphs should be fully justified text as required in the brief

Line spacing should be 1.5

Your summary reads like a complaint against your company. instead, you should have focused on the good things you have achieved. You don't seem happy that you had to self learn things, yet this is the most important and valuable part of the experience of an independent project.

2. Introduction

The project detailed within this report is to be used by management (to streamline planning), production (to increase running efficiencies) and engineering (as a monitoring aid) to evaluate the concept of using a SCADA monitoring system to determine whether it is worthwhile implementing it on all production lines. Once built, the system will be put through various functionality tests as well as a trial over a set time period to determine whether it is effective for each of the tree Spelling aforementioned parties. The budget for the project is £40,000.

This report contains the design of the system as well as a record of its implementation, a conclusion and analysis of its final state. Finally, overall management techniques will be evaluated as a whole and the finished product will be compared to what the project set out to achieve to begin with. Commenting on deviations from the original plan and highlighting and potential areas for improvement or further development.

1.5 line spacing would have allowed your tutor room for comments between the lines.

3. Acknowledgements

Dylan Jones (engineering manager): Agreeing and allowing the SCADA project to take place.

Christopher McLaren (previous company employee): Aided in acquiring Beckhoff software for testing the SCADA HMI on personal computer.

Lee Headington (Head of finance for Dunbia Cross-hands): Clearing the project budget

Reiser customer support: Providing a method of allowing SCADA to communicate with their machinery and providing a translation document so SCADA can understand their machines I/O.

SF customer support: Confirming that the SF conveyors on the line can be monitored by SCADA using the conveyors outfeed run signal.

Sealpac customer support: Providing a quotation for the required upgrade to the Sealpac A8's current firmware to allow its PLC to communicate with SCADA.

Ceia metal detectors customer support: E-mailing a quote for the board upgrade, allowing the machine to communicate with SCADA and give a run signal.

Marel customer support: Providing diagrams on the WPL9000 machines spare external run signal outputs for external equipment.

Ravenwood customer support: Confirming that no monitoring will be needed when the machine is already controlled by the Marel WPL9000.

Clarification:

During the implementation phase of this project, I have had very little to no help from the company. The engineering manager controlled all aspects regarding parts for the project, hardware (such as a company laptop) or software to go with it for the purposes of creating and developing the HMI, as well as the promise of having another engineer allocated to aid me. None of these promises have been upheld and I have been forced to make do with what I can achieve using my own means in my own time. As a result, I have only been able to create a "proof of concept" of the HMI on my personal laptop and at my own expense.

This clarification does not belong here and is entirely unncessary as stated earlier since the most immportant and valuable experience of a projec is doing things yourself.

4. Design

This has been explained already

For the duration of the design aspect of the project, any and all support promised during the initial planning stage fell apart. Because of this, only certain aspects of the design phase could be completed such as the initial design of the electrical panel, drawings for its implementation and a SCADA HMI demo style screen which can be used to demonstrate how the system would have worked if the project had been supported to the end. Shown below is what was possible given the circumstances that arose.

4.1 Planning the SCADA panel

Given the situation described above, very limited progress was possible but the project was taken as far as it could possibly have been given the circumstances. Also, given the circumstances, various unforeseen challenges arose particularly regarding testing the HMI once it was built. Given that there would be no physical system with which to test it with. However, steps were taken to ensure what resulted was as close as possible to what is promised in the FDS. Sown below in figure 1 is a logic diagram showing how the system layout was planned.

Spelling

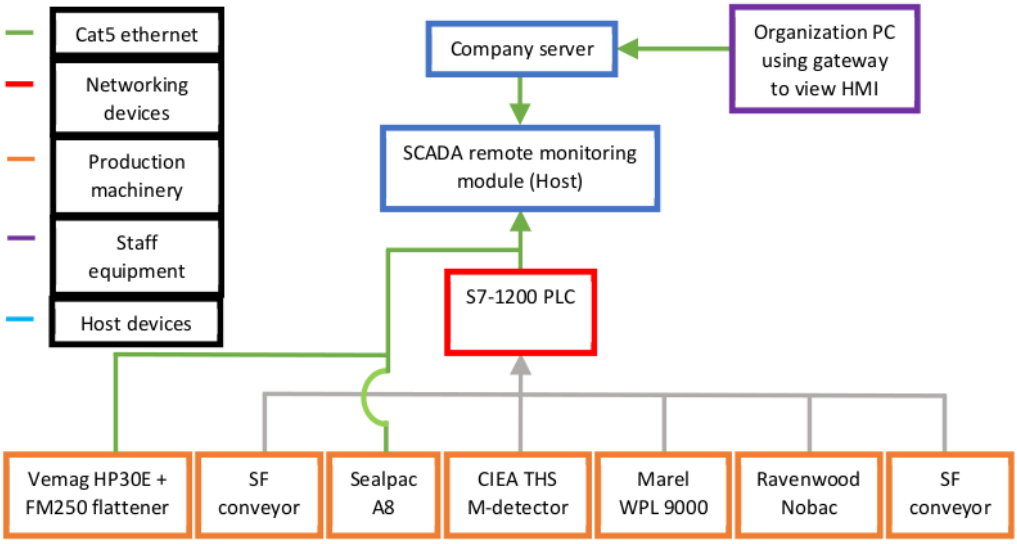


Figure 1 - SCADA system logic diagram

In order for the SCADA panel to be built, wiring diagrams were needed (shown here in figures 42 + 43) which will follow the IEC standards 60204-1. Part of which states that *AC +DC power circuits use black cables, Blue is for DC control circuits and earthing uses green + yellow cables* - (GT Engineering, 2023). A basic layout of the panel needed to be planned to take into account the dimensions and placement of each individual component. (Shown here in figure 41) The dimensions were taken using datasheets for each component and included in the diagram of the panel layout so the required panel dimensions could be determined. See table of SCADA panel components + datasheet links for more information.

use quotation marks

page number

All citations should be done using the Harvard reference with quoted information
This table is therefore unnecessary

Panel component:	Datasheet URL:
Single pole isolator	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://docs.rs-online.com/14cf/0900766b813340f0.pdf
DIN rail terminals	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://docs.rs-online.com/4f64/A700000008879755.pdf
DC PSU unit	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://docs.rs-online.com/47d4/0900766b816bf834.pdf
MCB	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://docs.rs-online.com/679a/A700000007707789.pdf
PLC unit	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://docs.rs-online.com/7d6e/0900766b81639d60.pdf
PLC I/O module	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://docs.rs-online.com/8e6f/0900766b81251619.pdf
Ethernet switch	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://docs.rs-online.com/c94b/A700000006798441.pdf
Trunking	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://docs.rs-online.com/e6dc/A700000008700190.pdf
Cable markers	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://docs.rs-online.com/ee17/0900766b815420fb.pdf
RJ45 connectors	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://docs.rs-online.com/85af/A700000008747198.pdf
DIN rail	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://docs.rs-online.com/ee43/A700000007356992.pdf
Cable glands	chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://docs.rs-online.com/a6ab/0900766b815fce6b.pdf

Table 1 - SCADA panel components + datasheet links

4.2 Using Siemens TIA software

It was determined that the best way forward considering the situation was to try and get Siemens TIA software on my personal laptop so work could progress. This is because the programme could be developed at home and tested on the college PLCs since they are directly connected to the college PLCs. This would give the best opportunities for testing full functionality since the PLCs have I/O boards which can be configured to mimic the I/O that would be present if the system were connected to the production line in the workplace. However, when installing the software onto the laptop it ran into errors. This caused a partial corruption within the laptops operating system, and it would no longer boot up. It is suspectedly because of the AMD chipset on the laptop. As a result, the laptop would no-longer boot into windows outside of safe mode and in order to repair it I had to revert to an older windows 11 update. Because of this, the option of using Siemens TIA was put on hold so as to not put all the files and work on the personal laptop at risk and pursue the possibility of using SCADA ignition.

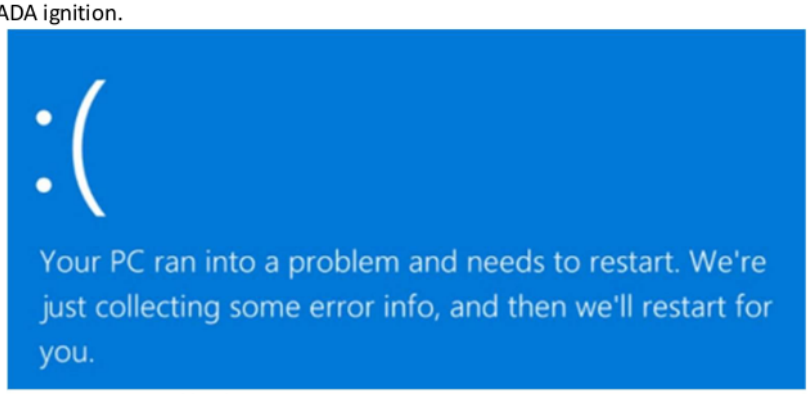


Figure 2 - Error resembling boot-up

See #TIA_software_download

This information should be in the log book. You should not be telling a story but rather, you should be focussing on what you produced

4.3 Using SCADA on personal laptop

In order to develop the SCADA HMI screen on a personal laptop since one was not provided, an account was created with Inductive automation so their Ignition software could be downloaded. The path using Ignition was continued due to the fact that they allow an unlimited amount of time for trialling the programme before testing it on an actual production line and their own servers can be used to trial programmes. This meant installing Designer. *Launching a Designer allows the user to make changes to a Gateway* - (Ignition 8.1, 2023), Vision client (This allows the user to view their HMI as if through a web-browser) which would be invaluable for testing the screen if the programme cannot be tested using the college PLCs. and Perspective workstation (*Which allows the user to run their clients as full desktop applications desig dedicated workstations* - (Ignition 8.1, 2023)) then learning how to use them in my own time. Since the workplace was no longer supporting me, I could not rely on a SCADA engineer or the new engineer (Tomos) to aid me. Therefore, in order to learn how to use the software I used ignitions "user manual", support information and watched various U-tube tutorials on how to create a HMI screen.

Write in the third person

Spelling

This reads as a journal written in the first person.

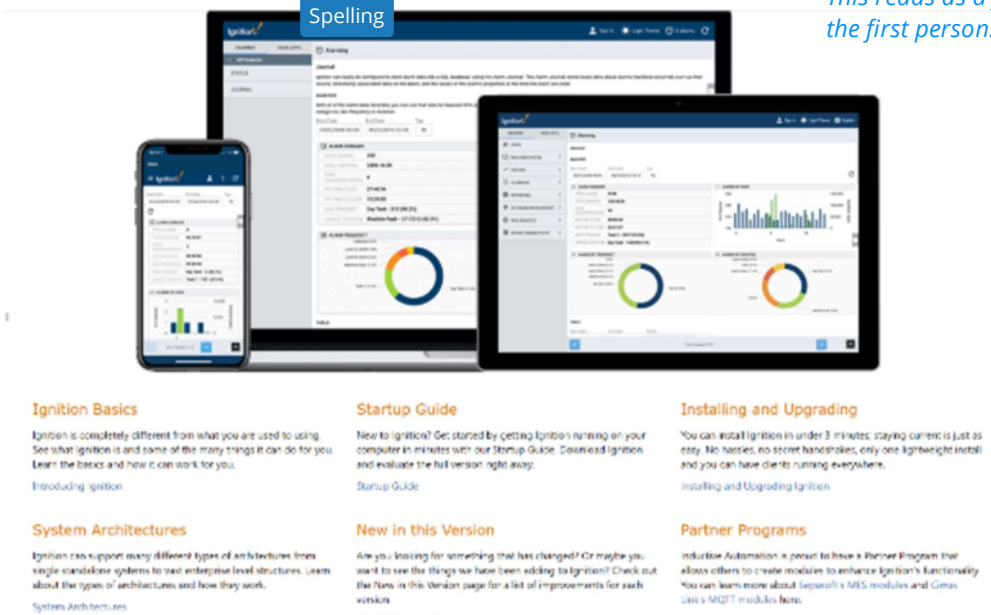


Figure 3 - Ignition 8.1 user manual

Unnecessary image, it would be better to explain what it means and Harvard reference its contents.

These belong in the citation list and information from them cited here in the text.

The table below is an accumulation of different sources used to gain knowledge on how to construct the HMI. These are also in the appendix.

Source:	URL:
Ignition 8.1 user manual (figure 3)	https://docs.inductiveautomation.com/
Installing and Upgrading Ignition	https://docs.inductiveautomation.com/display/DOC81/Installing+and+Upgrading+Ignition
Startup guide	https://docs.inductiveautomation.com/display/DOC81/Startup+Guide
Vision client launcher	https://docs.inductiveautomation.com/display/DOC81/Vision+Client+Launcher
Perspective workstation	https://docs.inductiveautomation.com/display/DOC81/Perspective+Workstation
Designer launcher	https://docs.inductiveautomation.com/display/DOC81/Designer+Launcher
Vision	https://docs.inductiveautomation.com/display/DOC81/Vision
Perspective	https://docs.inductiveautomation.com/display/DOC81/Perspective
OPC UA	https://docs.inductiveautomation.com/display/DOC81/OPC+UA
Tag historian	https://docs.inductiveautomation.com/display/DOC81/Tag+Historian
Ignition 8.1 quick start demo	https://www.youtube.com/watch?v=hR3b1563x4M&t=774s
Ignition 8 demonstration	https://www.youtube.com/watch?v=0SrEJuONDyc
Ignition SCADA - PLC - How to Create Ignition SCADA PLC Desktop Screen For Client & Supervisor	https://www.youtube.com/watch?v=8h03PEfWFdE&list=PLP8klkm0vzQRxOK_36nM0JRVIKEDIAYTI
What is ignition	https://inductiveuniversity.com/videos/what-is-ignition/7.9

Table 2 - Table of sources used when learning to use SCADA

4.3 Creating the HMI screen

Of the three programmes required by ignition, Ignition designer was used to create the SCADA HMI. In order to do this using, the personal laptop a localhost designer session was created and to make the process easier, the quick-start option was used. *With quick-start, Ignition creates an internal SQLite database. This is ideal for testing and demonstrations* - (InductiveAutomation, 2023) This made the process of getting into designing the screen much faster and easier. See figure 4.

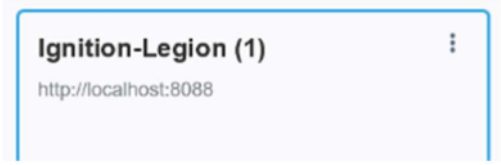


Figure 4 - Designer launcher localhost startup

It is not necessary to instruct your reader how to create a screen, this is a major project report not a user instruction manual.

From there, a main window can be created (see figure 5) and construction of the main HMI screen could begin.

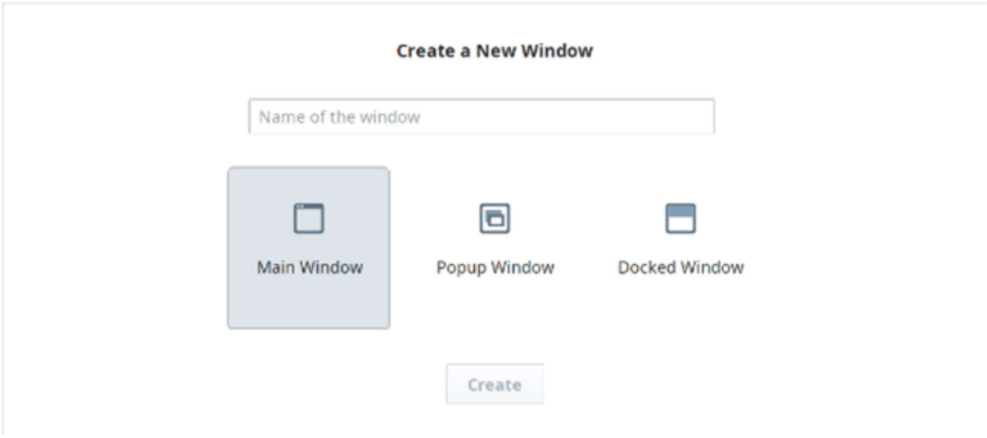


Figure 5 - Ignition creation window

This main screen will comprise of visual "birds-eye" representations of each machine on the production line with an indicator of their current state (Running or stopped) which is required in the original Functional Design Specification. In order to create the icons of each machine, polygons were placed onto the screen. The number of corners of the item and its shape can be adapted and with the use of other tools to change its colour, transparency, size and precise position means replicas of each machine could be created easily using multiple shapes. Each was labelled to increase the user-friendliness of the screen. See figure 6.

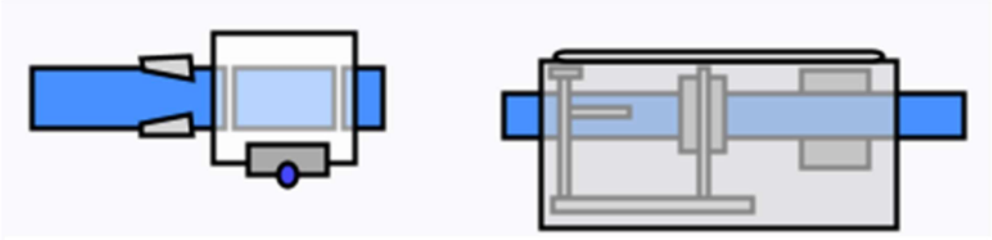


Figure 6 - Machine replicas being constructed

In order to create the running indicators for each machine, a multi-state indicator was used. This indicator was then set to have two states (1 and 0). State 1 being green “Running” and state 0 being red “Stopped”. This process was then repeated for each machine. See figure 7



Figure 7 - multi-state indicator insert

In order for the multi-state indicators to work the need to have tags assigned to them so they would change when the machine stops or starts. Since the machines would not end up being connected when testing would be done the tags would have to be changed manually to see if the indicator then changed on the HMI. To set this up, the tag needed to be enabled, set to boolean type and its deadband mode set to absolute. See figure 8

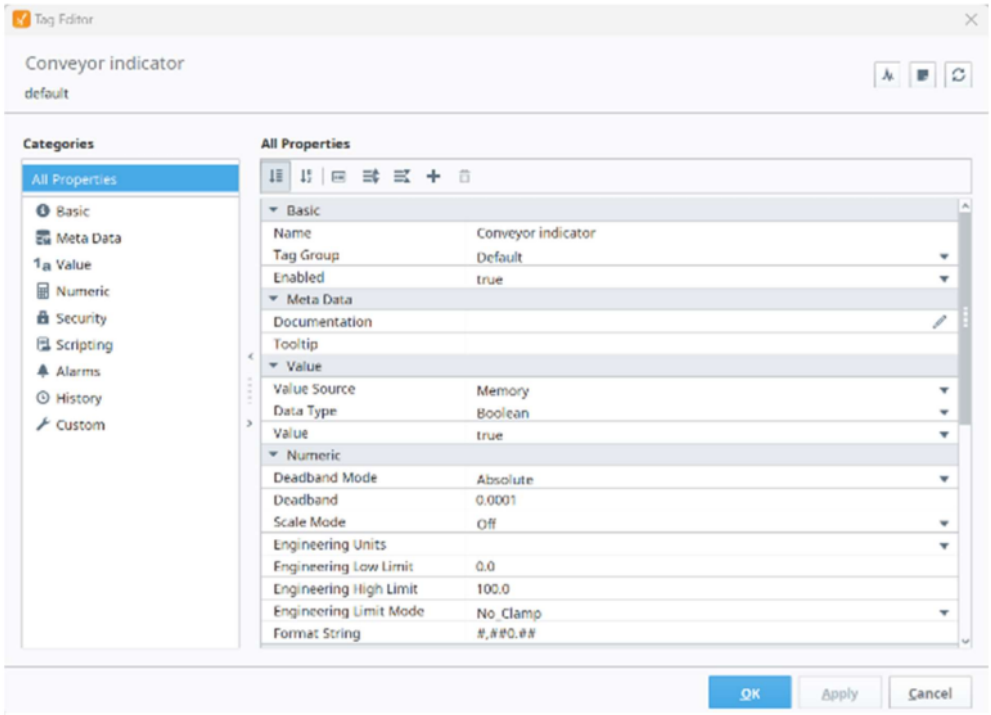


Figure 8 - Tag editor

This process was then repeated for each machine that would have been connected to SCADA and tag history was enabled to let the program record the tags states over time. This will be needed for when the history page is created. A separate tag was created for use in creating the history table, with an integer datatype of 50 for simulating data based on a 50-packs per minute run rate. See figure 9

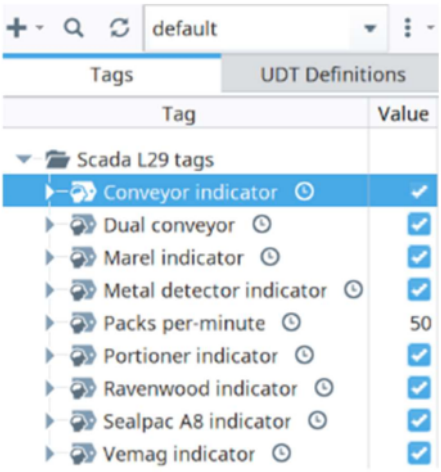


Figure 9 - Default tag table within SCADA

Next, the history tab was created. To start, a pushbutton was pasted onto the screen and a new page was created within the screen. Then on component scripting, under handlers and “actions” the button could be configured to open the new page when the button is pressed by selecting the navigation tab, “open/swap” and selecting “popup history”. See figure 10

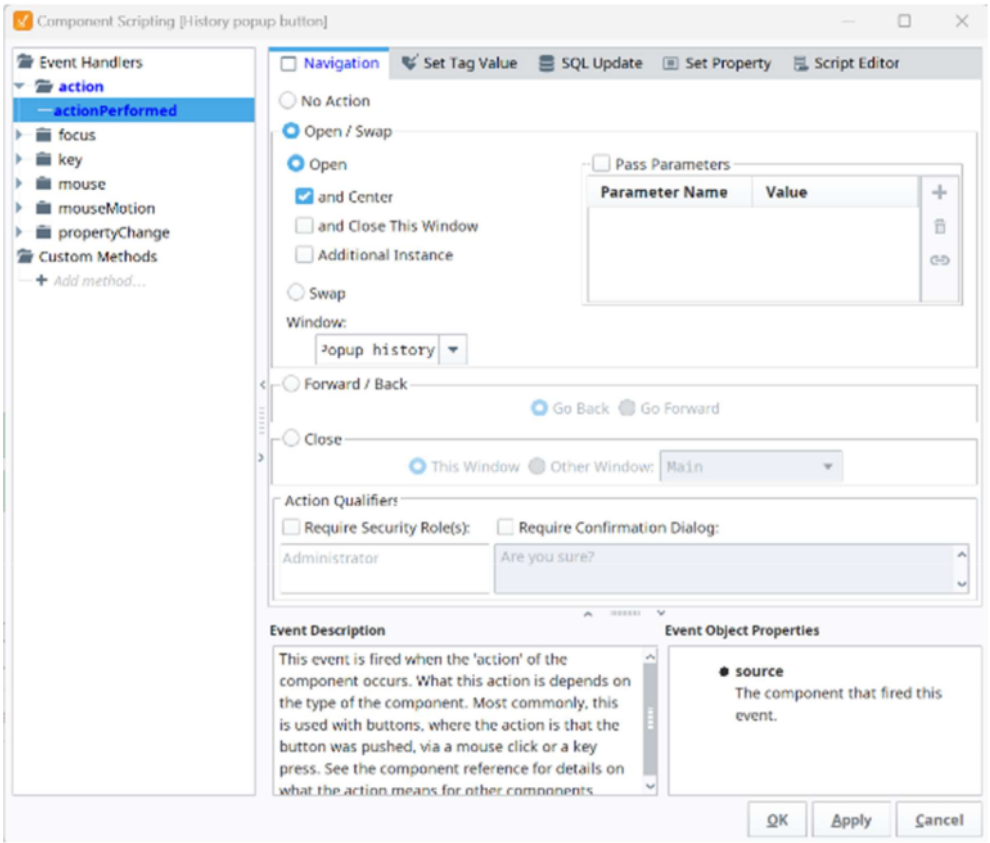


Figure 10 - Component scripting

In order to display data on the history tab, a table will be needed to pool data in and a graph will be needed to display the data in a usable way (Specified for in the Functional design specification). This can be done by inserting it from the components tab. It then shows in the project browser under "Root container". See figure 11.

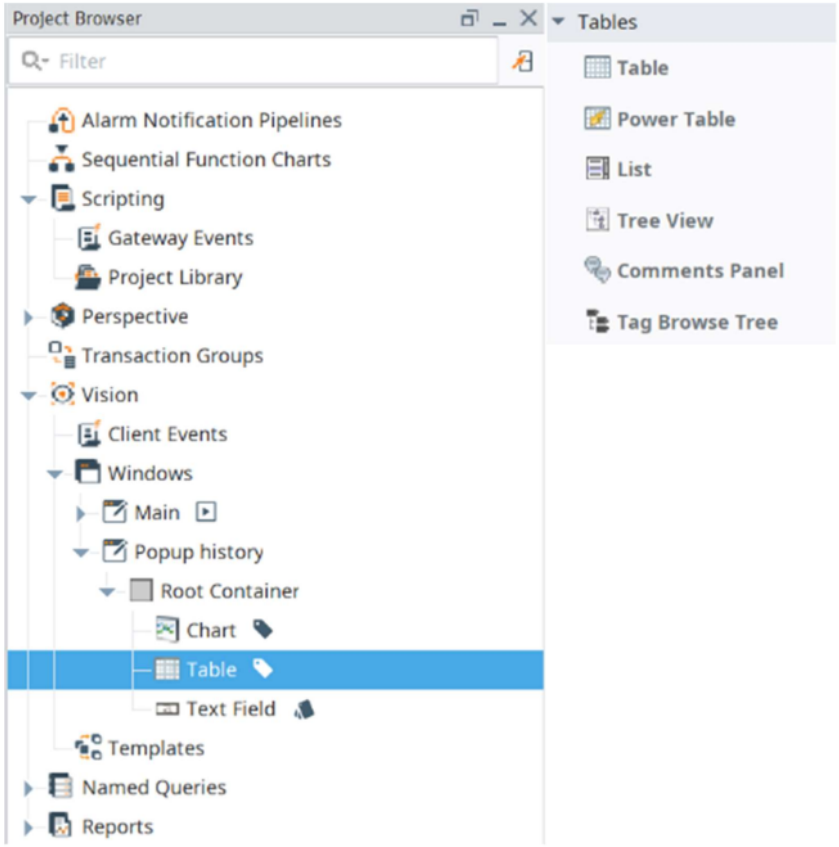


Figure 11 - Creating a table to store tag history

By double-clicking the table, the “table customizer” can be opened. This allows the user to create sections and assign tags to each section, label columns and control what type of table it is. For the t_stamp column, this is the time-stamp column. Therefore, the date format was set to HH:mm:ss for Hours/ Minutes/ Seconds for the purpose of showing total runtimes for the line (specified for in the FDS). Each column (1 per machine) was set to show the date followed by the time it had been running. (Resets every 24Hrs). The remaining options were left at their default settings since only time is needed for monitoring. See figure 12



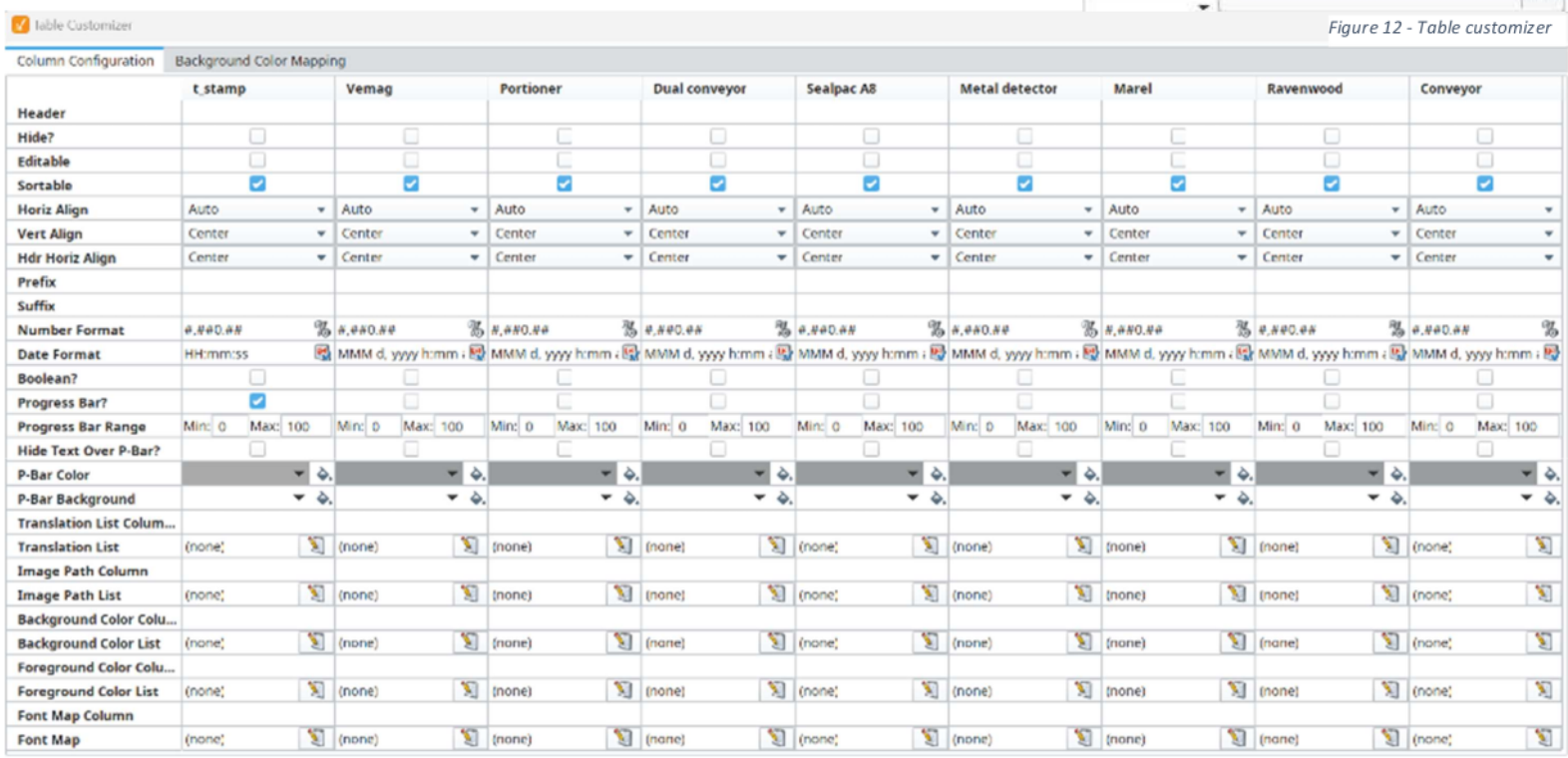


Figure 12 - Table customizer

To finish the history tab, the table needs to be created. This is done in a similar way to the table. By inserting it from the components tab. The chart customizer is set to its default dataset. See figures 13 + 14

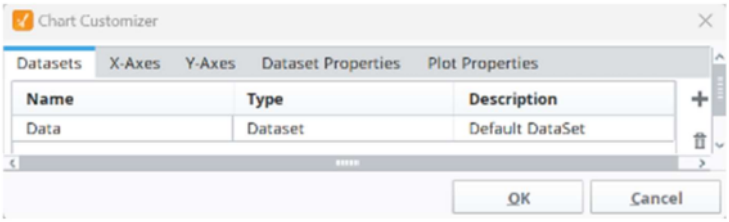


Figure 13 - Chart customizer

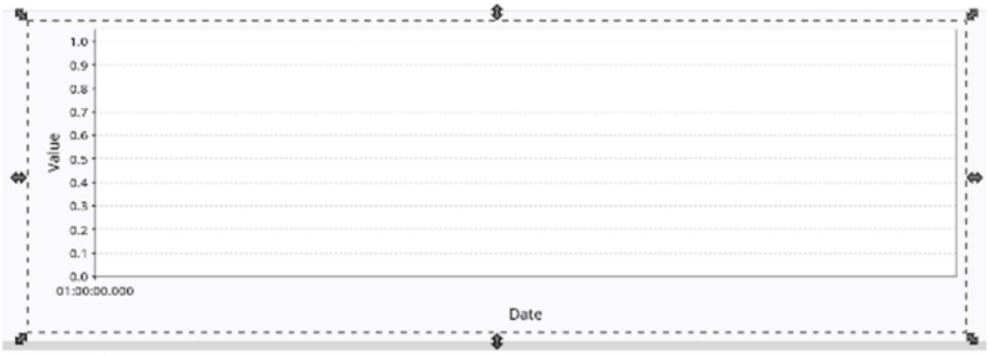


Figure 14 - Chart

It is pleasing to see how you have taught yourself how to do this but this belongs in a log-book.

4.4 Completed HMI screens

Figure 15 shows the completed HMI main screen ready for testing on the vision client launcher.

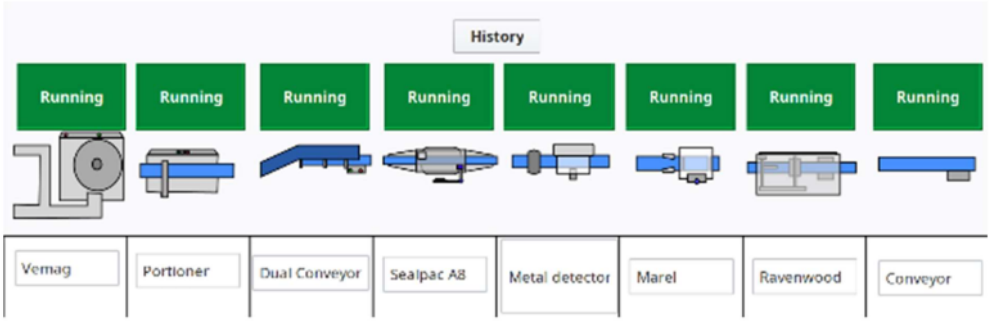


Figure 15 - Completed main screen

Figure 16 shows the history tab HMI screen fully completed.

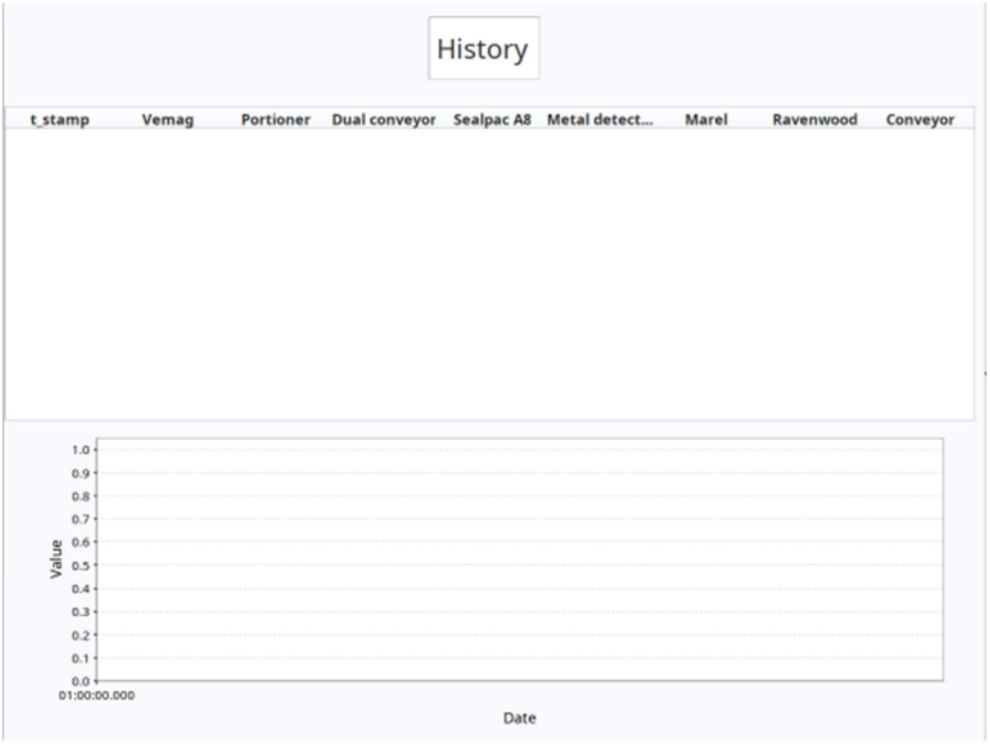


Figure 16 - Completed History tab

4.5 Beckhoff solution

4.5.1 installing Beckhoff Twin CAT

Given the situation of not having a PLC readily available to test on, the decision was made to use Beckhoff Twin CAT PLC software. For the primary reason that the software can run a virtual PLC on a PC or laptop. This would allow the SCADA HMI to be fully tested without the need for a physical PLC. See figure 17

Beckhoff states that " ..... " (2023, page?)

Twin CAT Simulation Manager is a tool for the configuration of a simulator which integrates itself in the Twin CAT system software. Supporting the creation of a virtual machine. Which recreates data relative to a real PLC relative to its runtime performance. The Twin CAT Simulation Managers task is to break and restore links, for example between a PLC variable and IO port. When simulating, the link is remade for a simulation environment. - (Beckhoff, 2023) Incorrectly cited, this is not the Harvard Method

Beckhoff software, in particular Twin CAT open control software is the heart of Beckhoff PC-based controllers. - (Beckhoff, 2023)

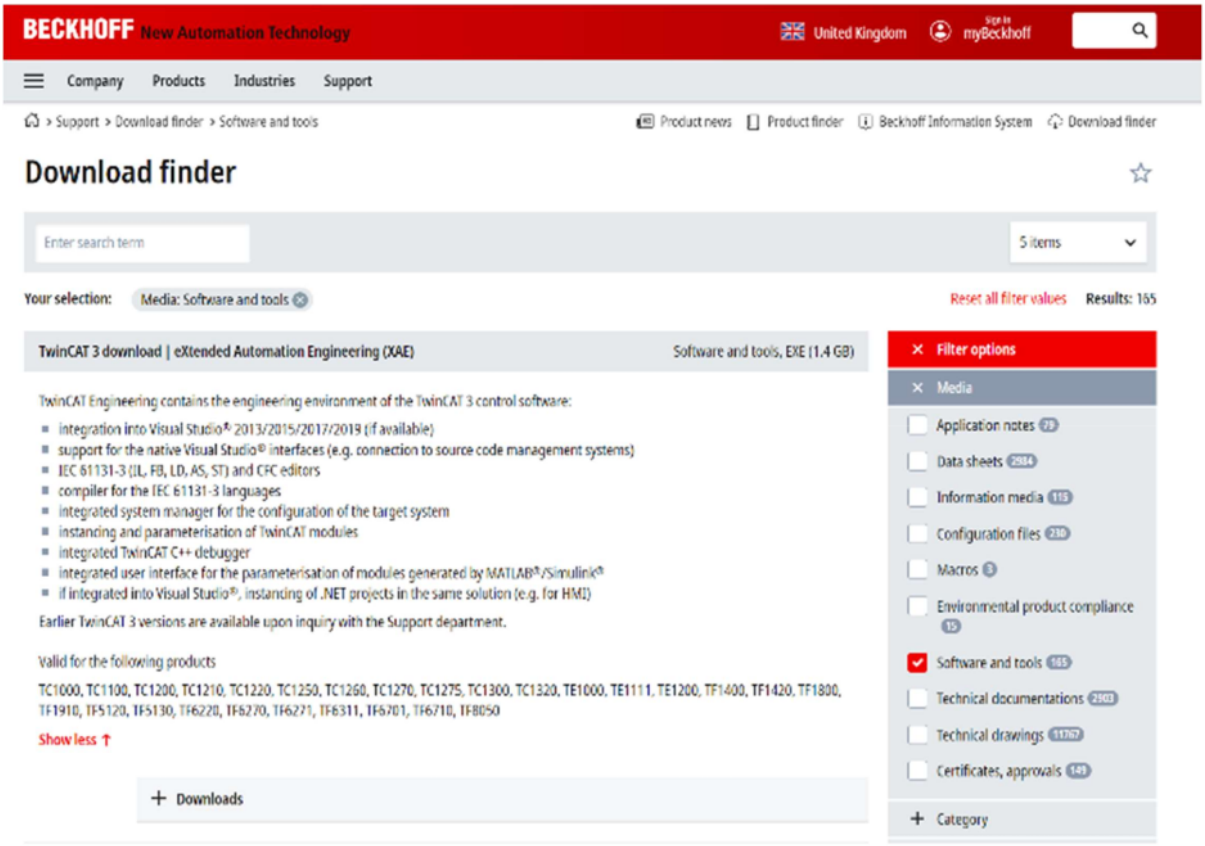


Figure 17 - TwinCAT software download (Beckhoff, 2023)

4.5.2 Creating the Beckhoff PLC programme

This portion of the project was done with support from an associate. An engineer (Christopher McLaren) who had previously worked in my workplace but had since left the business who had previous experience working with this software. I sought out his help because although I had used TIA software in the past and Beckhoff would be similar, it would be easier to have support if issues arose.

Write in the third person

To begin, the correct PLC settings and module (Twin CAT PLC server) had to be selected in order for the programme to work on the laptop. This section is mostly necessary for testing the History tab within the SCADA program. See figure 18

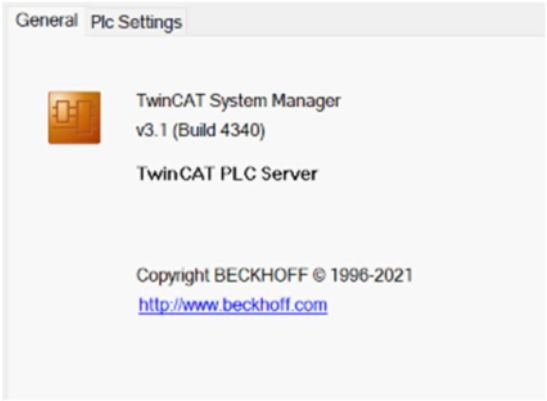
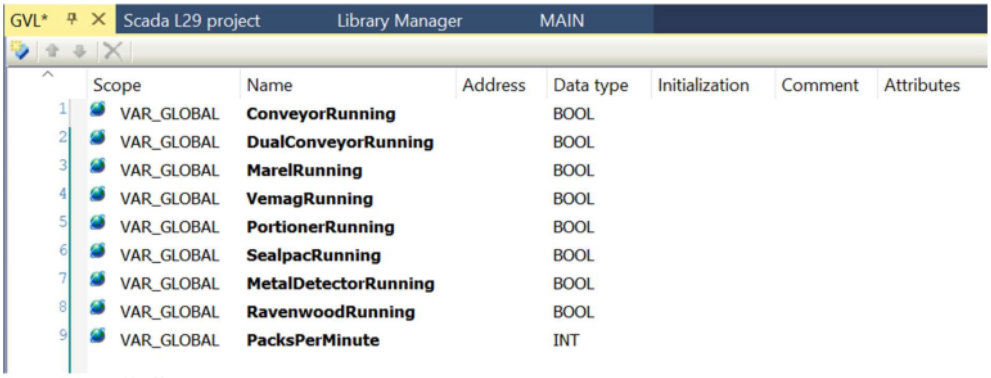


Figure 18 - PLC local server being created

Next, a global variable list (GVL) was created to hold the tags for each machine (Bool datatype) and one tag for "packsPerMinute" as an Integer. See figure 19



	Scope	Name	Address	Data type	Initialization	Comment	Attributes
1	VAR_GLOBAL	**ConveyorRunning**		BOOL			
2	VAR_GLOBAL	**DualConveyorRunning**		BOOL			
3	VAR_GLOBAL	**MarelRunning**		BOOL			
4	VAR_GLOBAL	**VemagRunning**		BOOL			
5	VAR_GLOBAL	**PortionerRunning**		BOOL			
6	VAR_GLOBAL	**SealpacRunning**		BOOL			
7	VAR_GLOBAL	**MetalDetectorRunning**		BOOL			
8	VAR_GLOBAL	**RavenwoodRunning**		BOOL			
9	VAR_GLOBAL	**PacksPerMinute**		INT			

Figure 19 - Beckhoff programme GVL

Next the main part of the programme was created. This would allow the PLC to output a signal to the SCADA ignition programme and within the history tab, data will appear on the chart and produce a visual representation of the data. The chart requires a live stream of varying data to produce results. Otherwise, it will not work. Basic SCL script was used for this section and over time was simplified into what is now shown in figure 20

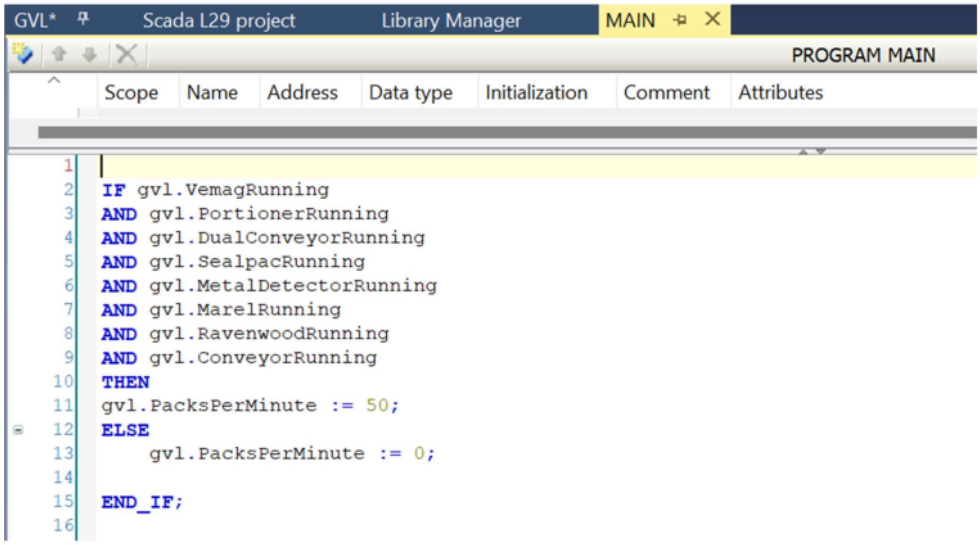


Figure 20 - Beckhoff SCL programme

4.5.3 Error running Beckhoff PLC simulator

As shown in figure 40 the software runs into a “Hyper-V” error when attempting to simulate the PLC. After trying various methods and researching the error as well as contacting Christopher McLaren for support, it was found that the issue lied somewhere within the laptops operating system and a conflict in its Hyper-V software. Disabling the software and restarting the laptop made no difference. The error still occurred. Meaning the laptop was missing an addon or subscript which the Beckhoff programme needed to simulate the PLC. In the end this issue could not be corrected.

4.6 OpenVPN solution

Since the Beckhoff software could not simulate the PLC and run the programme on the laptop, the laptop needed to be able to communicate with the Siemens PLCs in the college which could then run a recreated version of the Beckhoff programme. The room with the PLCs operates within its own VPN so as to not clash with the college network. Therefore, the VPN service used in the classroom would be needed on the laptop, so the SCADA can communicate with the PLC. See figure 21

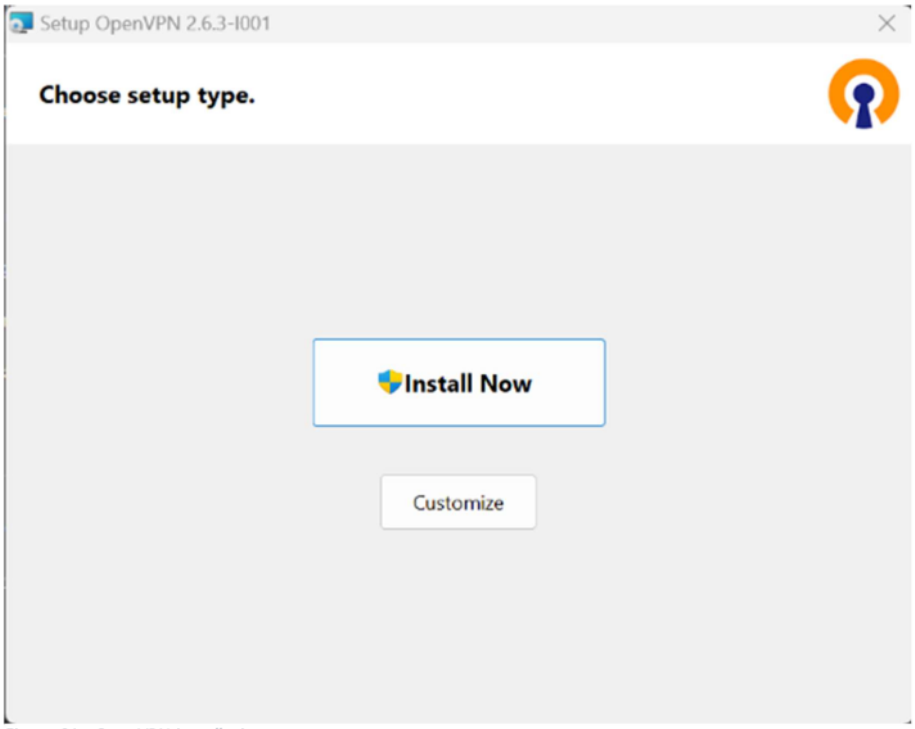


Figure 21 - OpenVPN installation

The OpenVPN software starts automatically and is used through the system-tray (Figure 22)



Figure 22 - GUI launcher in system tray

4.7 Recreating the Beckhoff programme on college S7-1200 PLC

The process of recreating the Beckhoff programme within Siemens TIA would not be too difficult given the two different software-suites are fairly similar in how they work. Disclaimer, TIA was used at this point because Beckhoff was not available on the college PCs and would not work with their Siemens PLCs, also Siemens TIA portal was readily available on the college PCs which were already connected to the PLCs. To begin, a new programme was created in TIA and the correct PLC unit had to be selected for the PLC in the classroom (S7-1200 CPU 1214C [DC/DC/DC]). See figure 49.

Next, the PLC tags were created the same was as done in the Beckhoff programme with all the line machines with Bool datatypes and the last being a PacksPerMinute (Integer type). See figure 50.

Unlike the Beckhoff programme, which uses a global variable list TIA uses an additional datablock. This hold tags which are more or less exactly the same as in the PLC tag table. See figure 51.

Finally, the SCL section was recreated. This is the exact same structure as what was used in the Beckhoff software recreated in TIA. See figure 52.

The programme was then compiled to check for errors. None of which appeared.

4.8 OpenVPN software errors

Better planning would avoid this lack of time

Due to a lack of time until the finish deadline was reached, I was unable to diagnose and fix the fault which was occurring within the OpenVPN software and stopping it from being able to connect to the college VPN. It was unknown whether the fault could be fixed in time. I therefore decided to utilise my remaining time to make the SCADA ignition programme testable within its own web-utility which had the best chance of working given it works in conjunction with the Ignition software and was supplied with it. See figure 23

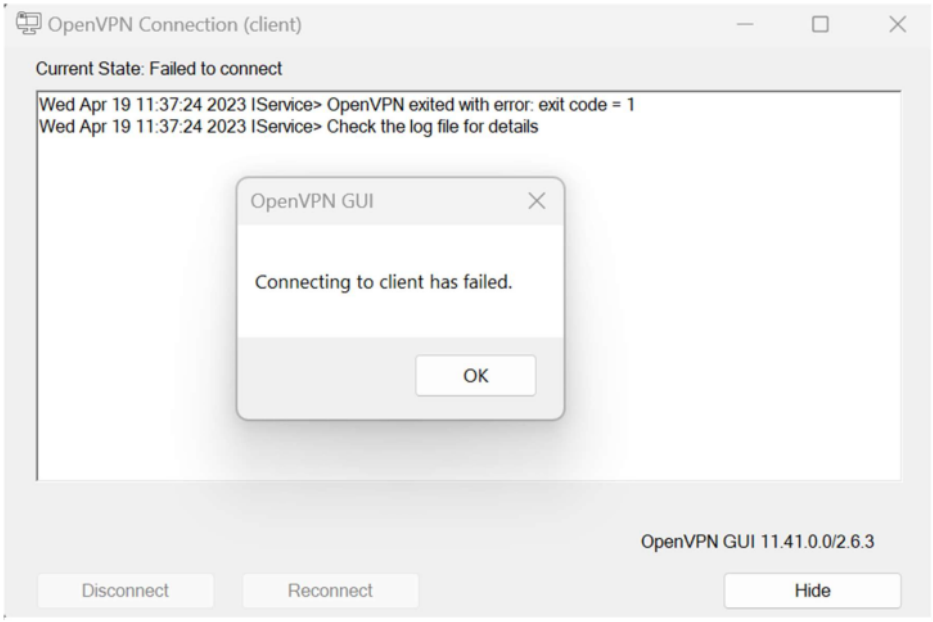


Figure 23 - OpenVPN start error

4.9 Adjusting SCADA programme

Because of the Beckhoff PLC simulation error and the failure of the OpenVPN server software, another solution had to be found to supply the chart in SCADA with data. Without which, there will be no live data for the chart to represent. Therefore, sample data from the Ignition servers was used. The ignition software has sample tags (from the sample_SQLite_Database) which supply varying types of data from IgnitionAutomation servers to the chart and simulate inputs for testing purposes. Allowing the graph to output a line similar to how it would if connected to the production line using the 50 packs per minute tag mentioned earlier. See figure 24

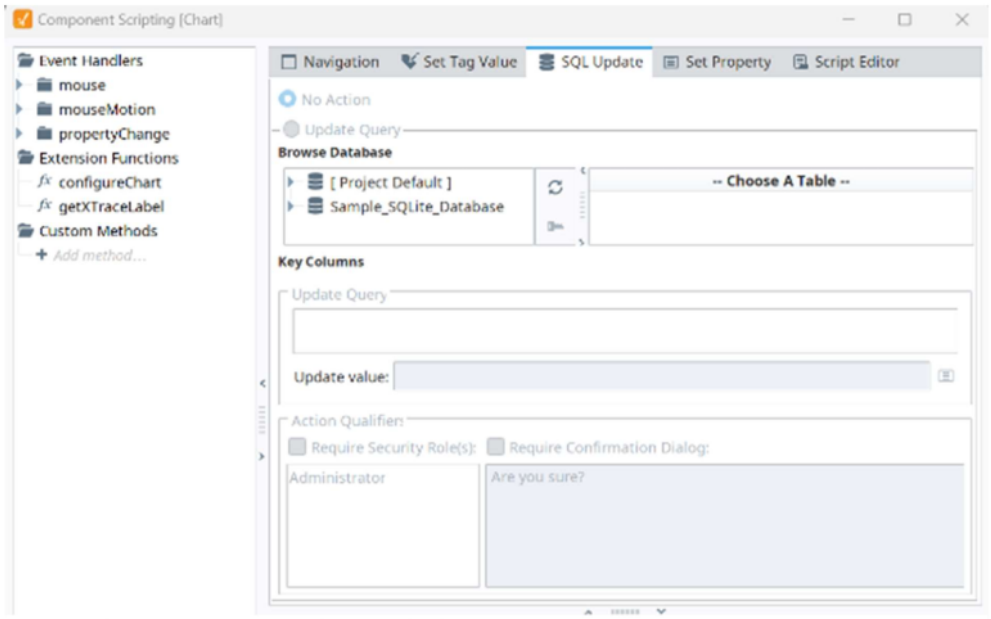


Figure 24 - Chart scripting + using sample_SQLite_database tags

With the SCADA programme as it is and the circumstances that arose during the design and implementation phase of the project, this is as far as the project progressed. The programme is finished and ready to be implemented into the system which has not been built. This marks as far as the project can be taken without the help of the company in supplying parts for building the electrical panel and allowing contractors to upgrade the machines software.

This is quite understandable but better planning and time management could have resulted in a better outcome.

5. Implementation and Management

Due to the company mothballing the project and no longer supporting its progress within the workplace, nothing was purchased for the project, and it is unknown whether anything ever will be. Therefore, the necessary parts, components and software was never obtained, and true costs can only be speculated upon. It is unknown whether there would have been any unforeseen costs if the project had gone ahead, however it is likely to have had unforeseen costs. As a buffer in case this did happen, there is £8,621.11 of additional budget remaining before additional funds would be needed.

Predicted costing	Actual costing
Scada Module + software package: £6362.12	
SCADA contractor/installation engineer: £3k	
Ethernet cable (500m): £718.53	
Communications cable (4 core 304m): £503.82	
S7-1200 PLC: £210	
PLC software: £821	
Siemens engineer to create program: £2k	
Electrical panel/cupboard for PLC: £300	
MCB for panel: £56.84	
Isolator (10A): £37.78	
Panel DC power supply: £73.60	
Rj45 connectors: £15.30	
Vemag software upgrade: £8k (Includes contractor costs)	
Sealpac software + module upgrade package: £7k (includes contractor costs)	
Ceia M-detector Communications board: £1.5k (Includes contractor costs)	
8-core data cable (100m): £303.90	
Junction box (IP65 rated): £3.78	
Din rail (2M): £6.64	
Din rail terminals (10 pack): £5.69	
Cable glands (5 per bag need 10): £7.76	
Cable markers: £7.86	
Ethernet switch: £244	
Total: £31,378.89	Total: £

Table 3 - Cost spreadsheet

Had the project gone ahead, the milestones outlined in assignment 1 FDS to be achieved along with their completion deadlines are shown below:

1. (To complete by Feb 6th, 2023) Build panel to house main system components such as SCADA unit and PLC and fit in void.
2. (To complete by Feb 9th, 2023) Necessary upgrades to existing machines to be finished and software updated.
3. (To complete by Feb 25th, 2023) PLC + SCADA programming completed, and HMI screen created.
4. (To complete by Mar 6th, 2023) Install communications from machines to panel, install ethernet + create gateway.
5. (To complete by Mar 11th, 2023) Complete testing of the system including Panel, HMI + gateway.

However, given the circumstances only point three was completed and point was five partially completed (Panel + gateway could not be tested since they were not built). As seen in figure 25 below.

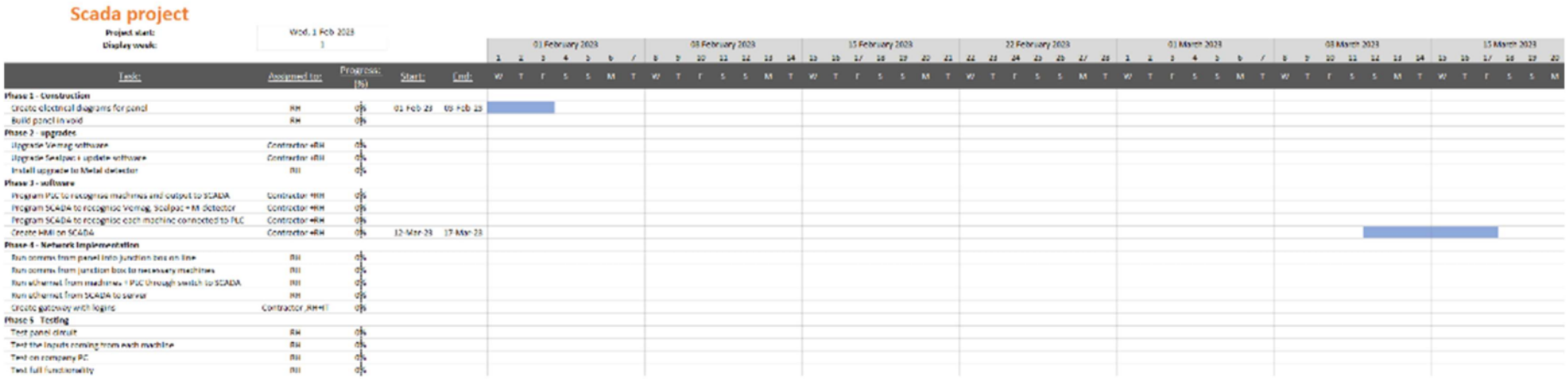
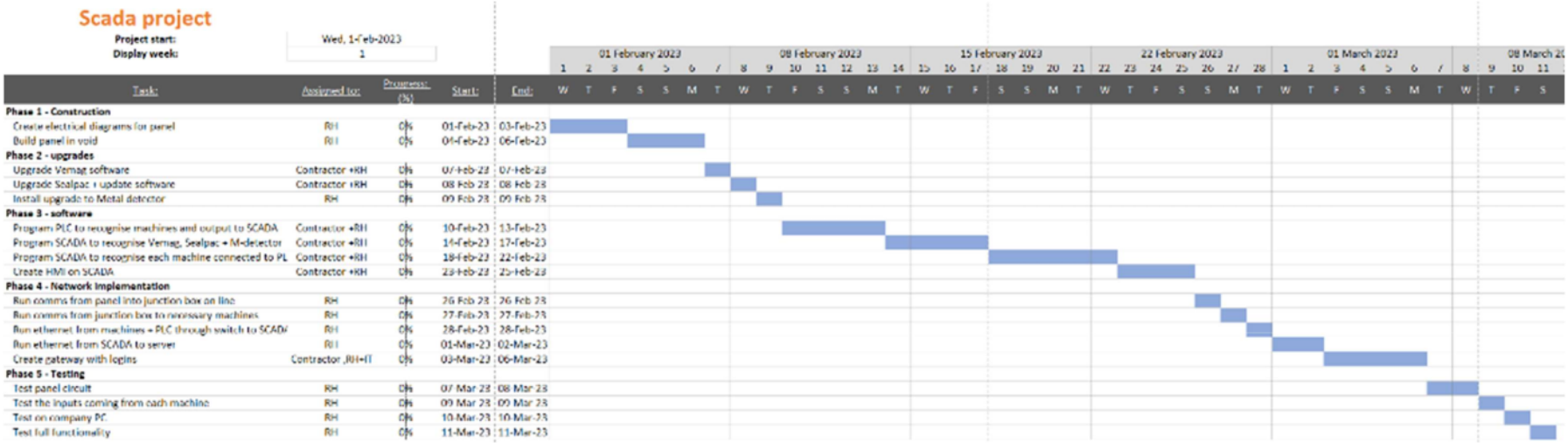


Figure 25 - Gantt chart of what got completed

It would have been better to have adjusted the FDS and plans to produce something achievable. However, you have achieved much in your understanding and skills in developing a SCADA system and I am sure this will stand you in good stead for your next project. In the real world, projects often get shelved or delayed but you have shown great determination in achieving what you have.

Shown below in figure 26 is the original Gantt chart project timeline plan for reference against the one above showing what was actually completed.



Task:	Assigned to:	Progress: (%)	Start:	End:
Phase 1 - Construction				
Create electrical diagrams for panel	RH	0%	01-Feb-23	03-Feb-23
Build panel in void	RH	0%	01-Feb-23	06-Feb-23
Phase 2 - upgrades				
Upgrade Vemag software	Contractor +RH	0%	07-Feb-23	07-Feb-23
Upgrade Sealpac + update software	Contractor +RH	0%	08 Feb 23	08 Feb 23
Install upgrade to Metal detector	RH	0%	09 Feb 23	09 Feb 23
Phase 3 - software				
Program PLC to recognise machines and output to SCADA	Contractor +RH	0%	10-Feb-23	13-Feb-23
Program SCADA to recognise Vemag, Sealpac + M-detector	Contractor +RH	0%	14-Feb-23	17-Feb-23
Program SCADA to recognise each machine connected to PL	Contractor +RH	0%	18-Feb-23	22-Feb-23
Create HMI on SCADA	Contractor +RH	0%	23-Feb-23	25-Feb-23
Phase 4 - Network implamentation				
Run comms from panel into junction box on line	RH	0%	26 Feb 23	26 Feb 23
Run comms from junction box to necessary machines	RH	0%	27-Feb-23	27-Feb-23
Run ethernet from machines + PLC through switch to SCADA	RH	0%	28-Feb-23	28-Feb-23
Run ethernet from SCADA to server	RH	0%	01-Mar-23	02-Mar-23
Create gateway with logins	Contractor ,RH+IT	0%	03-Mar-23	06-Mar-23
Phase 5 - Testing				
Test panel circuit	RH	0%	07 Mar 23	08 Mar 23
Test the inputs coming from each machine	RH	0%	09 Mar 23	09 Mar 23
Test on company PC	RH	0%	10-Mar-23	10-Mar-23
Test full functionality	RH	0%	11-Mar-23	11-Mar-23

Figure 26 - Original project planned timeline

5.1 Hindrances and contingencies

You didn't need to keep saying this.

Throughout the implementation of the project the one massive drawback and hinderance has been that support for the project has disappeared. Therefore, in order to get the most out of the project certain measures have had to be put into place. A large part of the project was always the creation of the SCADA HMI and programming of the PLC which would handle the bulk of the I/O from the machines. Therefore, this primary area of the project was focused on given it was the area in which progress could be made without company support. This way, if support did re-appear, the project could move along quickly before minds were changed again. However, no support did re-appear but if it does in the future, the programme is ready, and a plan can be adapted from the original if given a new timeframe.

Because of the lack of support and the need for the development of the programme to carry on, the decision was made to continue work in my own time using whatever resources I could get my hands on. This created a variety of challenges that would not have appeared if the original plan had gone ahead.

Write in the third person

Solution: To begin with, in order to address the fact, I had to continue work at home, the plan was to get Siemens TIA portal on my personal laptop, so the programme could be made there.

Problem: However, the software crashed the laptop while installing and caused it to boot-loop, blue-screening each time and corrupt the operating system. To fix this, I reverted the laptop to an older windows version and re-updated it.

Solution: I decided the only solution was to get the SCADA software proposed for use in the workplace on the laptop and using another PLC software such as Beckhoff to simulate a PLC on the laptop.

Problem: SCADA and Beckhoff software was installed, however once the programs were created it was found that the Beckhoff software ran into a compatibility error when trying to simulate the PLC and would not run.

Solution: The only solution was to go back to Siemens TIA, with the exception of running that on a college PC (already connected to the appropriate PLCs) and use a VPN to connect the laptop to the college classroom network.

Problem: Next, the VPN service would not work, and time became short.

Solution: At this point an attempt was briefly made to connect the laptop directly to the PLC pre-loaded with the PLC programme and run from there but due to various complications this would take too long to correctly set up.

Solution: Therefore, I decided to go with the Ignition vision client that came with the designer software for the SCADA programme. With testing tags provided, this would allow me to test the SCADA programme through a web-browser. The PLC programme was in a working state since it had no errors when compiled in TIA, but without the HMI connected, I would not be able to test its functionality.

This is an unnecessary list of what went wrong. All project suffers form setbacks. Instead, you should have focussed on the end product.

One of the biggest hindrances that was constantly apparent throughout the work that I was able to do on the project was the very little support available to me with regards to issues that arose while working on the project at home. This meant for each issue faced, countless hours were spent trying to solve the issue (the longest being recovering the laptop after the failed TIA install). The second biggest being that with the exception of TIA portal I have had no previous experience with the software used (Ignition, Beckhoff OpenVPN etc). This has meant spending a large amount of time learning how to use the software from various sources, forums, acquaintances and U-tube video tutorials. However, this has given me the opportunity to hone my skills in teaching myself. One benefit of having to do this by myself is that the company has no claim to the programme I have created.

This is a good thing and self-learning is the most valuable part of the project.

5.2 Constraints outlined in Project definition, Research + quality planning

The constraints outlined in the first assignment all had solutions planned for which would have been implemented if the project had gone ahead. The first being compatibility with such a system. Plans were made to update the firmware of certain machines, load translation files into the PLC that would have been in the panel for communications with the Vemag grinder and install a communications add-on board to the metal detector.

The second constraint outlined the need for adaptability, since the machine at the start of the line changes occasionally depending upon the product being run. However, the SCADA module can be set up to have a separate HMI with a different starting machine if needed and have the ability to change which machine is currently being used. This functionality can be implemented at a later date.

The third constraint was the planned moving of the production line. The line did move with a good amount of time for the project to be implemented. However, lack of support turned out to be the deciding factor.

The final constraint regards the line not requiring the SCADA system to run. This would not have been an issue given the design of the system to be more of an add-on to the existing line.

5.3 Handling of contractors

Had the project gone ahead, as per company guidelines, contractors would have to fill in Sign-in and Permit-to-work forms when coming on-site and would be given appropriate PPE for use on the production floor which abides by company guidelines. Work permits would have to have been signed after each day by the contractor and the engineer attending or once the work has been completed to confirm it is satisfactory.

5.4 Pre-work assessments + records

Before starting work, the area would be visually inspected and if necessary, the machine or panel locked off and tested for dead before work was done. Work done along with parts used would be booked out/recorded within Piranha. The software used for recording work and parts stock levels.

5.5 Documentation + diagram records

Any electrical, mechanical diagrams or software manuals would be stored electronically on the company server under the sub-directory of the machine it corresponds to. For example, Sealpac software information would be stored under Sealpac and information/diagrams on the SCADA panel would be recorded in a new file designated “SCADA”.

6. Testing and Results

Because the project was not built and only the HMI was completed on a laptop, not all the tests specified in the FDS were possible. All tests that could be done were completed. Furthermore, in order to do the tests without machines the tags states were manually changed to simulate the machines running and stopping/going into fault, so once the tag is changed the appropriate response should be seen on the HMI then changed state.

However, the functionality of the HMI could be tested through the web-client viewer software that came with the HMI designer software.

Table 4, page 32 shows the testing table filled in as best as possible. The FDS mentions the additional requirement that the representation of the line shown on the HMI must be a schematic or block diagram version of the line. As shown in figure 30 (see appendix) this has been done. In order to perform the four tests marked in **red**, the panel would need to be built and machines connected as originally planned.

FDS item no:	Test description	Expected outcome	Actual outcome	Pass/Fail	Evidence/Reference
4.1.1	Stop + start multiple machines	HMI shows machine status changing. History shows status changing	Machine status changes for each machine	Pass	See Appendix figures 29 - 37
4.1.2	Stop + start each machine in turn	HMI must show machine green when running and red when stopped/fault	Each machine shows green when running + red when stopped	Pass	See Appendix figure 29 -37
4.1.3	Run each machine individually	Each machine should be able to run individually	**Unable to perform**	**N/A**	**Unavailable**
4.1.4	Using PC, log into HMI through gateway	Can access the HMI and view the line	**Unable to perform**	**N/A**	**Unavailable**
4.1.5	Wash down line	Cat5 junction boxes must be dry inside	**Unable to perform**	**N/A**	**Unavailable**
4.1.6	Turn off SCADA system	Line must run as normal	**Unable to perform**	**N/A**	**Unavailable**
4.1.7	Create a fault on each machine	Each machine must show a fault	Each machine in turn shows stopped/fault	Pass	See Appendix figure 29 - 37
4.1.8	Create various faults on the line	HMI must have a page recording recent faults	History tab records runtime data +machine status	Pass	See Appendix figure 39

Table 4 - FDS test table

7. Evaluation of Project Outcomes

The project has not turned out as originally planned. Not because of changes that had to be made because it would not work, but because it could no longer be done in the workplace and there was no possible way of fully completing it at home with the resources available to me.

The original plan would have finished with a fully built and working system where the SCADA unit sits in a panel in the roofing void, monitoring the status of the line and recording its run-times and status. Hosting a gateway for users to log in from a company PC and view the line in real-time. The reality of what was actually achieved is very different, although capable of reaching that point if support for the project re-emerges. The state of the project currently consists of a HMI screen and PLC programme ready to be loaded into a panel which does not exist. In short, two sets of completed software programmes ready and waiting for hardware that is likely never to manifest. The failed support of the project being the key reason why the project has turned out in this fashion.

In terms of evaluating the outcomes from the perspective of cost drivers and the design process, the cost drivers are seemingly irrelevant because in the end nothing was spent towards it. The situation that arose did dramatically change the design process from what was originally planned. Having to do all the work from home meant the design methods had to be mostly redone with the exception of keeping the original idea of using the SCADA ignition 8.1 software as the main basis for the HMI and using a S7-1200 PLC to handle bulk I/O. With regards to the FDS in assignment 1, the constraints were all originally covered by the plan. However, they do not apply to how the project turned out. The constraints mentioned in the FDS regard machine compatibility with the HMI, communications upgrades modules and the possibility of the line moving. Plans to resolve these constraints were planned and prepared for. However, once the project had to be finished outside of work, the situation changed, and those factors were no longer relevant.

From the point of working without the company's support, the constraints changed to being able to get the software needed, making sure that it would work for the project in the way it was needed and making sure the hardware needed was available for use. I recognise that, the project lead (myself) is primarily responsible for the project's success.

As for continuous improvement, the project outcome can be improved upon. The main area being re-securing support for the project and completing it as initially intended. Following that, the HMI could be expanded upon to offer additional detail on the line or more functionality like automatic email/SMS to personnel such as engineering when the line stops due to a fault. The system could also be expanded across more lines or to incorporate the whole factory's production lines. Promoting the idea of industry 4.0.

Had the project gone ahead as planned, the benefits of equality, diversity and inclusion are apparent. All parties involved would be equal in their parts played within the project and all parties should feel included and given the opportunity to learn about and take part in the project if they wished to do so.

Getting the project proposal signed by your company as part of assignment 1, may have given earlier warning that they had no intention of allowing you to complete the project. Lesson learnt!

8. Conclusions and Recommendations

To conclude, the project did no go as initially planned and if it was to be redone, more care would be taken to ensure the support was there for the project to go ahead as a definite. However, given the setbacks and the situation that the project found itself in, it still progressed in terms of programme development and is at the point where no more work can be done to further its development outside of actually getting parts ordered, contractors on site, machine upgrades installed, the panel built, and communications installed.

Recommendations for the projects further development include:

Securing support for the actual implementation of the project onto the production line.

The HMI could be developed further to allow for increased functionality and control of the running of the machines. So, if a machine goes into fault the system can halt all the machines before it automatically which would reduce wasted energy and product. Additionally, the HMI can be programmed to send emails or SMS messages to managers or engineers when the line has a fault. Decreasing downtime.

The Cat5 junction boxes could be upgraded to be quick-disconnect-able, so if a machine needs to be moved it can be done more efficiently and save time.

An additional HMI screen could be added to the start of the line for the line leader to use to help keep track of run-times and plan better. With a buzzer or indicator lamp that activates when an error occurs.

The first machine changes periodically throughout the year and the HMI could have a set of screen programmes specifically for each machine ready to be loaded in when that machine is moved onto the line.

If the system proves to be beneficial, it can be expanded to cover more lines across the factory later on.

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[Accessed 28 10 2022].

10. Appendix



Features



Screen courtesy of Wunderlich-Malec

Real-Time Status & Control

Securely display, analyze, and manage what's happening in your facility right now — Ignition makes it easy through the combination of real-time status and control functionality, SQL database integration, the Vision Module's powerful graphical capabilities and solid security support.

Instantly Launch Unlimited Clients

With the Ignition Vision Module, you can launch an unlimited number of rich runtime clients to as many HMIs, industrial panels, PCs, and laptops as you need.

Plant-Floor Proven

The Ignition Vision Module is perfect for plant-floor, standalone HMIs, and desktop screens. It's fast, reliable and proven, after more than 10 years of plant-floor use and countless installations around the world.

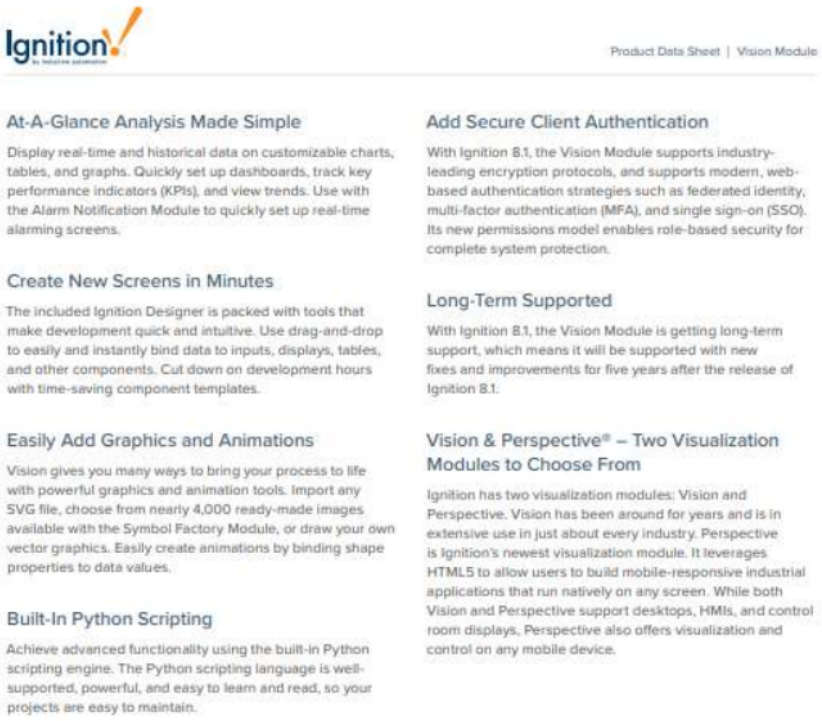
Easily Interface with PLCs and Databases

With Ignition, you can easily connect to any major type of PLC or database and integrate that data into your SCADA system. With powerful, easy-to-use property binding capabilities, the Vision Module lets you create applications that display database information to any screen and write data directly to any database.

inductive automation

inductiveautomation.com 1-800-266-7798

Figure 27 - Vision module unlimited PDF part 1 (Inductive Automation, 2023)



Ignition

Product Data Sheet | Vision Module

At-A-Glance Analysis Made Simple

Display real-time and historical data on customizable charts, tables, and graphs. Quickly set up dashboards, track key performance indicators (KPIs), and view trends. Use with the Alarm Notification Module to quickly set up real-time alarming screens.

Create New Screens in Minutes

The included Ignition Designer is packed with tools that make development quick and intuitive. Use drag-and-drop to easily and instantly bind data to inputs, displays, tables, and other components. Cut down on development hours with time-saving component templates.

Easily Add Graphics and Animations

Vision gives you many ways to bring your process to life with powerful graphics and animation tools. Import any SVG file, choose from nearly 4,000 ready-made images available with the Symbol Factory Module, or draw your own vector graphics. Easily create animations by binding shape properties to data values.

Built-In Python Scripting

Achieve advanced functionality using the built-in Python scripting engine. The Python scripting language is well-supported, powerful, and easy to learn and read, so your projects are easy to maintain.

Add Secure Client Authentication

With Ignition 8.1, the Vision Module supports industry-leading encryption protocols, and supports modern, web-based authentication strategies such as federated identity, multi-factor authentication (MFA), and single sign-on (SSO). Its new permissions model enables role-based security for complete system protection.

Long-Term Supported

With Ignition 8.1, the Vision Module is getting long-term support, which means it will be supported with new fixes and improvements for five years after the release of Ignition 8.1.

Vision & Perspective® – Two Visualization Modules to Choose From

Ignition has two visualization modules: Vision and Perspective. Vision has been around for years and is in extensive use in just about every industry. Perspective is Ignition's newest visualization module. It leverages HTML5 to allow users to build mobile-responsive industrial applications that run natively on any screen. While both Vision and Perspective support desktops, HMIs, and control room displays, Perspective also offers visualization and control on any mobile device.

You were asked not to include datasheets, instead, you should have read them and extracted information and cited it as a source.



Module Specs and Requirements

Requirements	Supported Operating Systems	Supported Databases
Ignition 8.1.23	Windows Server 2016/2019	Microsoft® SQL Server
Dual-core processor	Windows 10	Oracle
4 GB RAM	macOS (10.16+)	MySQL
10 GB free HD space	Linux (support for popular distributions, tested with Ubuntu 18.04)	MariaDB
(Requirements vary by usage)		PostgreSQL
		Any database with a JDBC driver

To learn more about Ignition, visit us at ***inductiveautomation.com***

Figure 28 - Vision module unlimited PDF part 2 (Inductive Automation, 2023)

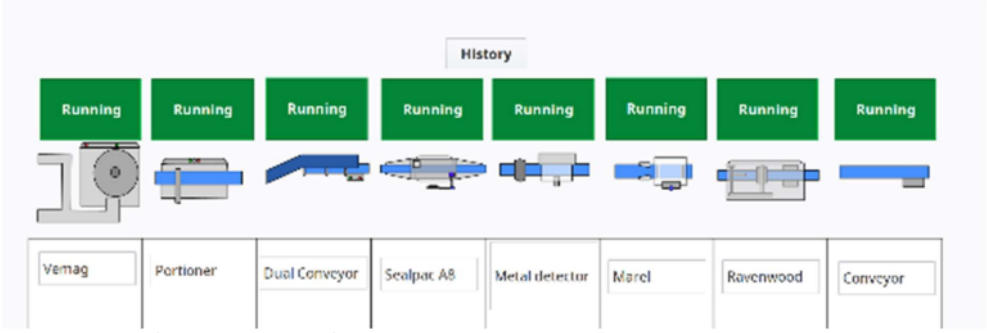


Figure 30 - Testing line running in vision client



Figure 29 - Testing, Vemag stopped/fault



Figure 31 - Testing, portioner stopped/fault

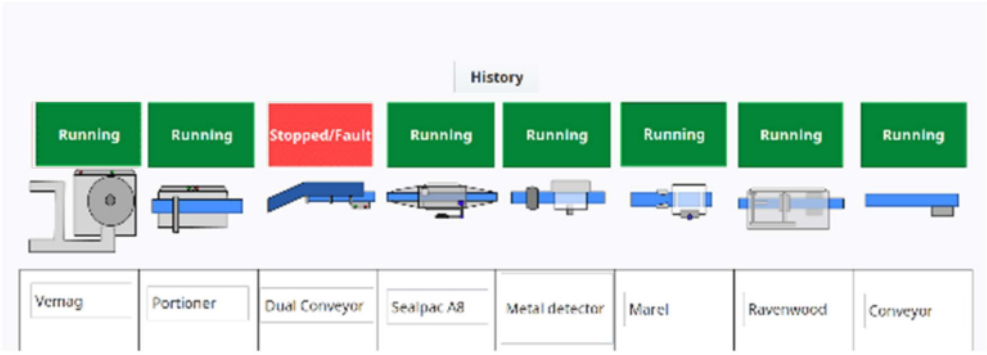


Figure 33 - Testing, Dual conveyor stopped/fault

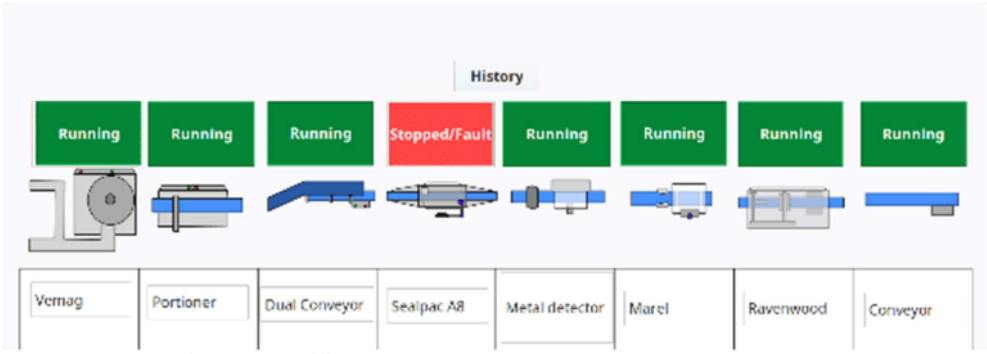


Figure 32 - Testing, Sealpac A8 stopped/fault

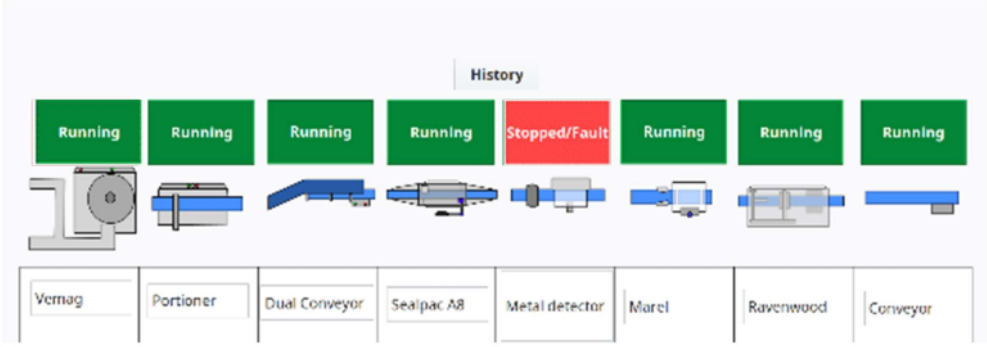


Figure 34 - Testing, M-detector stopped/fault



Figure 36 - Testing, Marel stopped/fault



Figure 35 - Testing, Ravenwood stopped/fault



Figure 37 - Testing, Conveyor stopped/fault

Predicted costing	Actual costing
Scada Module + software package: £6362.12	
SCADA contractor/installation engineer: £3k	
Ethernet cable (500m): £718.53	
Communications cable (4 core 304m): £503.82	
S7-1200 PLC: £210	
PLC software: £821	
Siemens engineer to create program: £2k	
Electrical panel/cupboard for PLC: £300	
MCB for panel: £56.84	
Isolator (10A): £37.78	
Panel DC power supply: £73.60	
Rj45 connectors: £15.30	
Vemag software upgrade: £8k (Includes contractor costs)	
Sealpac software + module upgrade package: £7k (includes contractor costs)	
Ceia M-detector Communications board: £1.5k (Includes contractor costs)	
8-core data cable (100m): £303.90	
Junction box (IP65 rated): £3.78	
Din rail (2M): £6.64	
Din rail terminals (10 pack): £5.69	
Cable glands (5 per bag need 10): £7.76	
Cable markers: £7.86	
Ethernet switch: £244	
Total: £31,378.89	Total: £ 0 (project not funded/supported)

Figure 38 - Final costing spreadsheet

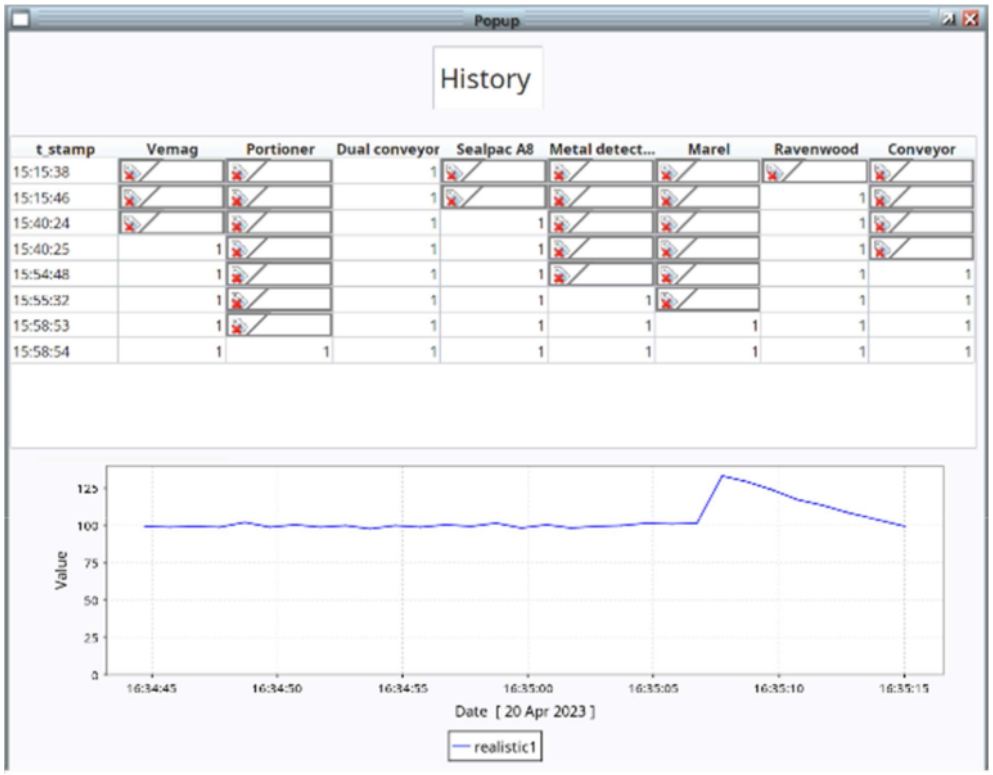


Figure 39 - Testing, History tab, state table + chart functionality

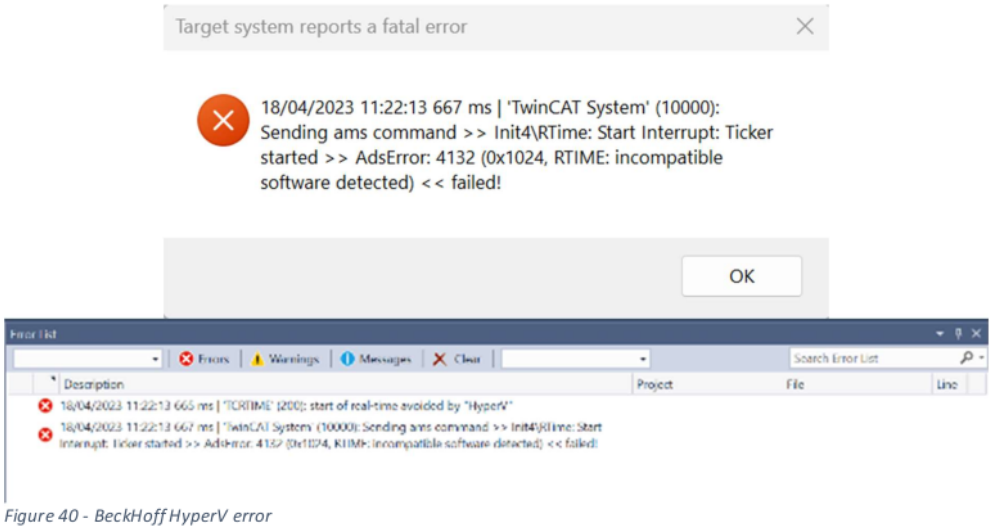


Figure 40 - BeckHoff HyperV error

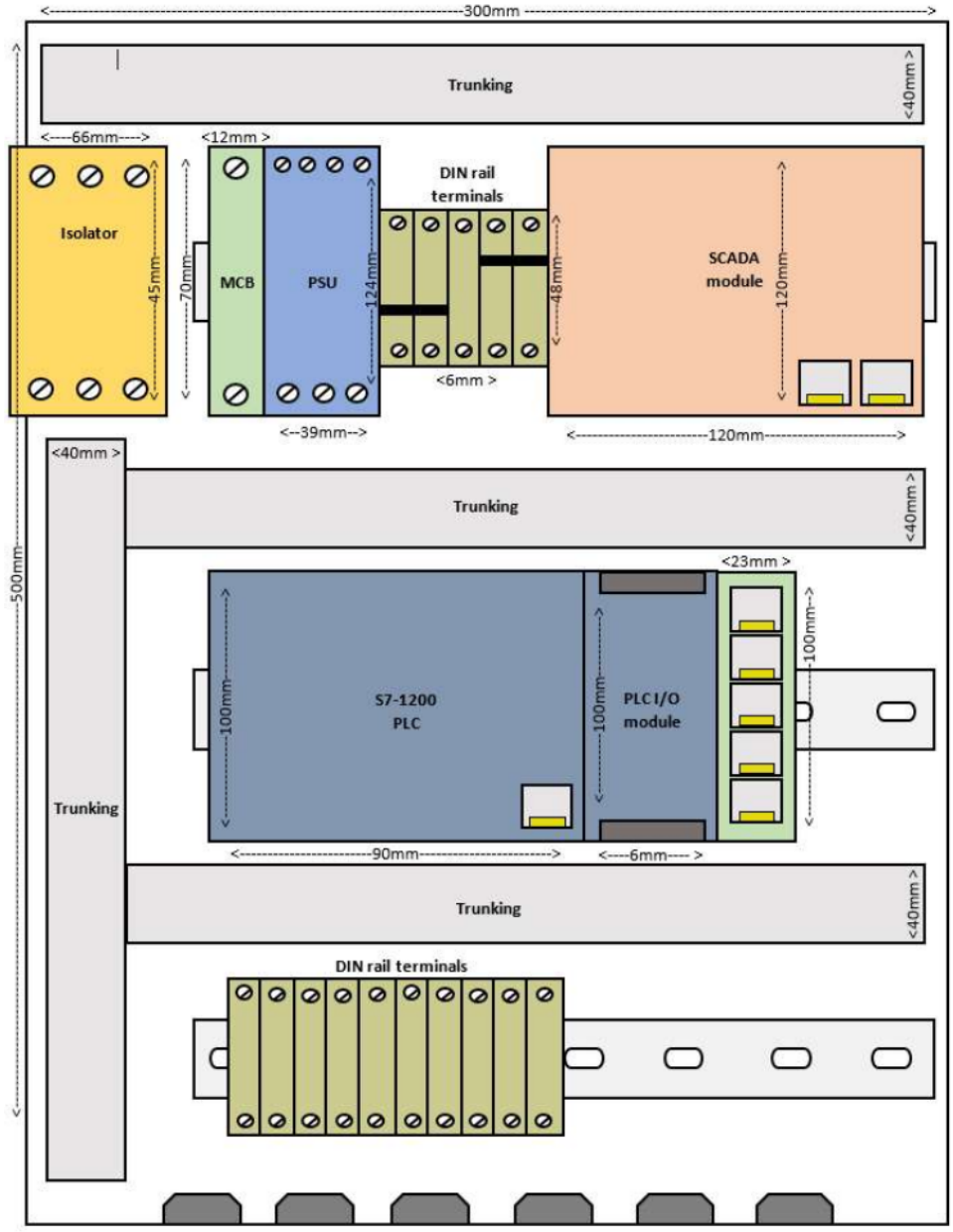


Figure 41 - Panel layout with measurements

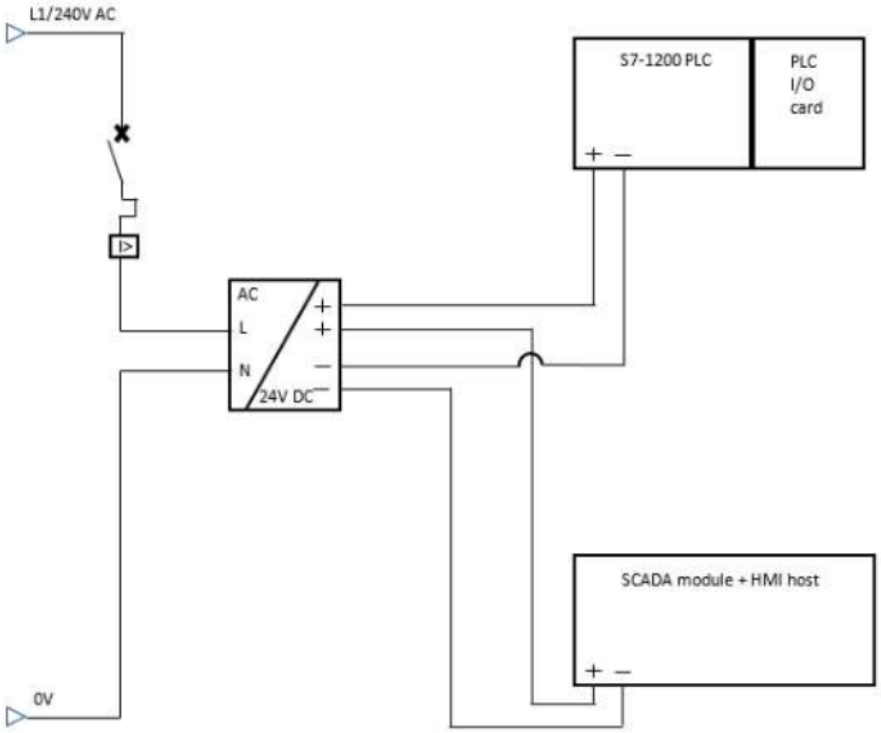


Figure 42 - SCADA panel power delivery

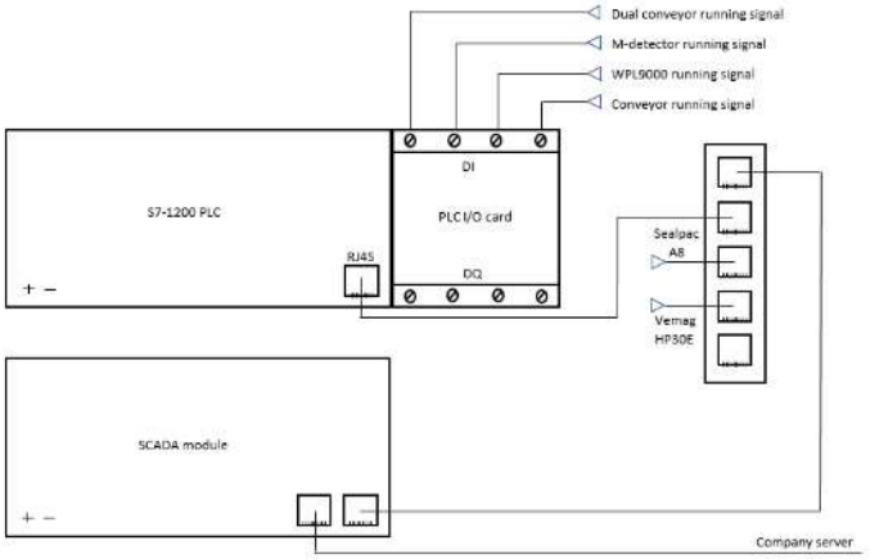


Figure 43 - SCADA panel communications + Cat5 runs

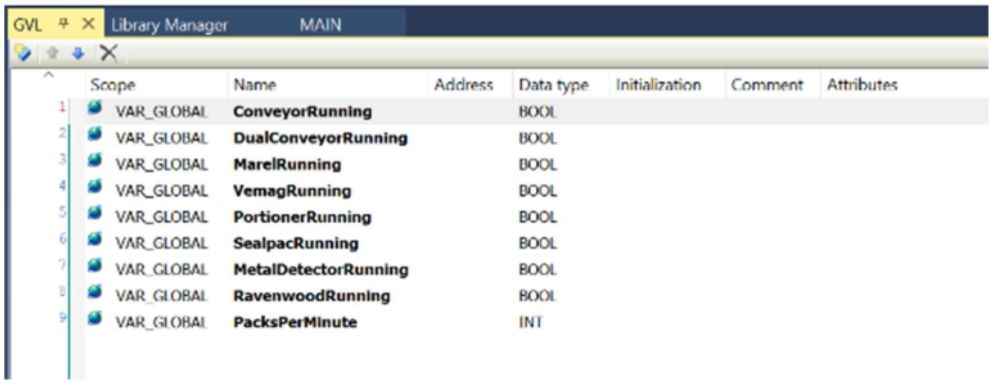


Figure 44 - Beckhoff global variable list

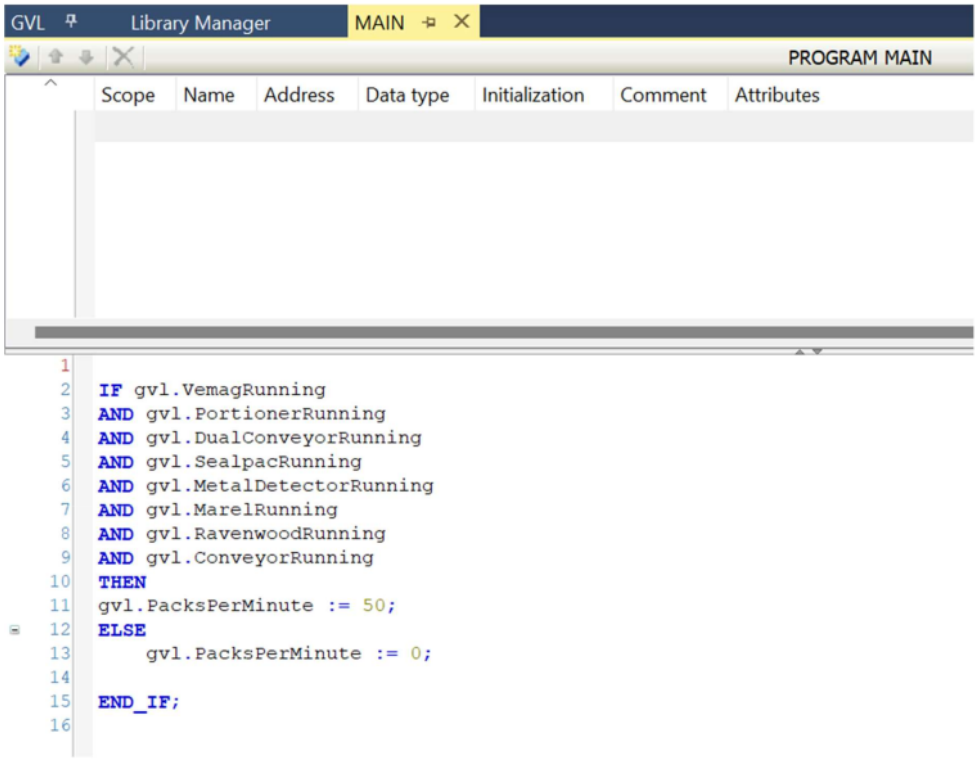


Figure 45 - SCL programme for simulating PLC with appropriate I/O

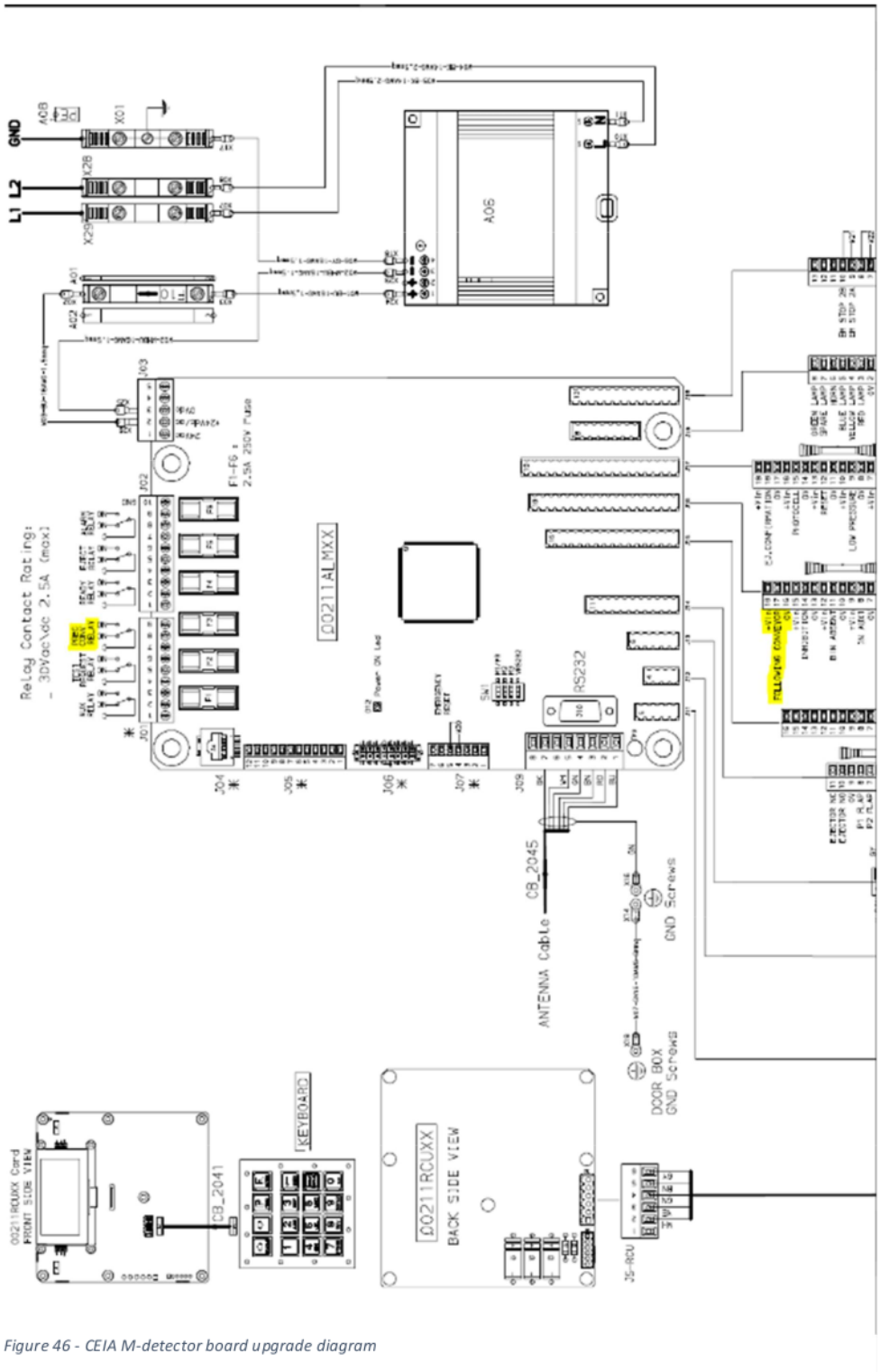


Figure 46 - CEIA M-detector board upgrade diagram

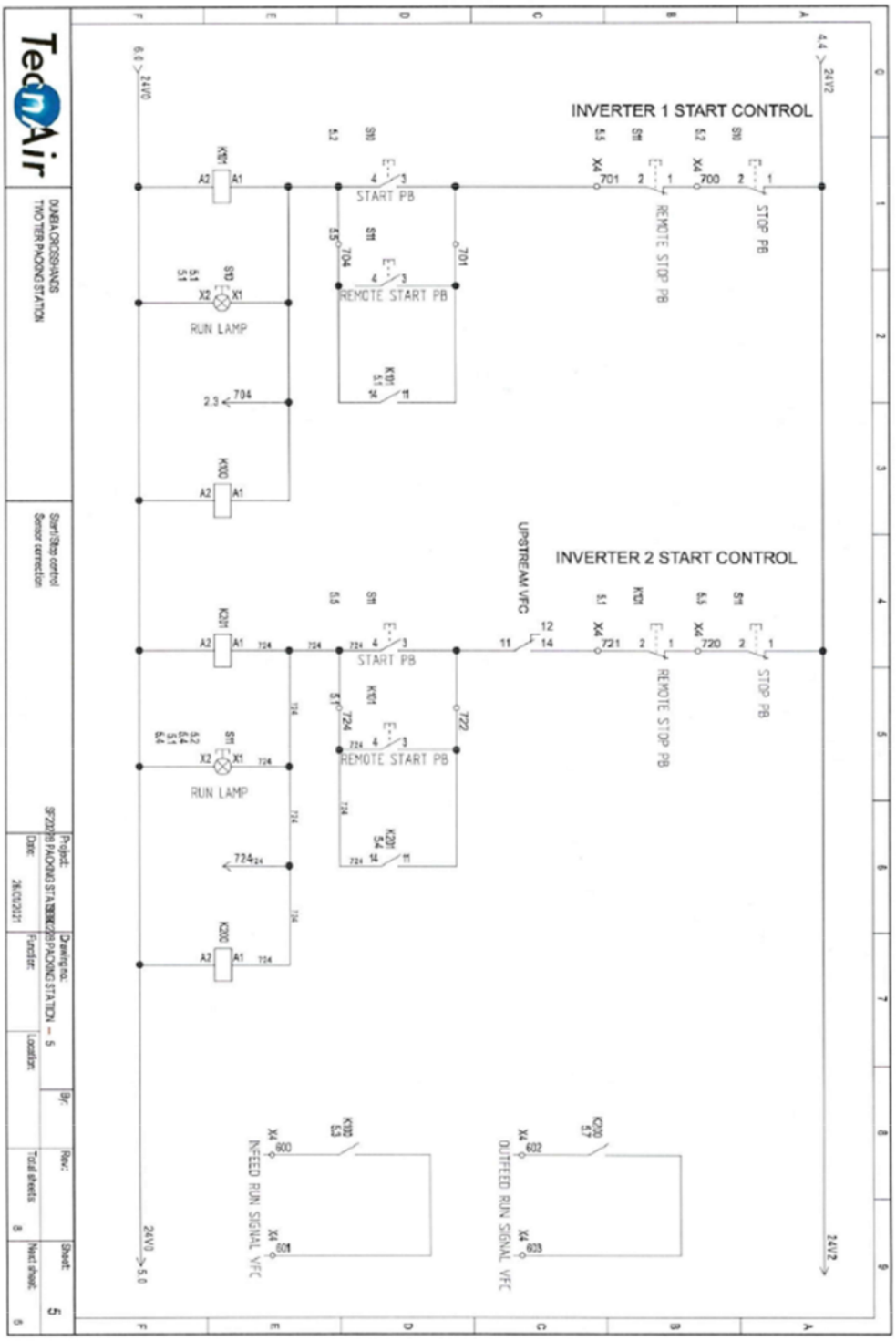


Figure 47 - SF conveyor outfeed run signal location

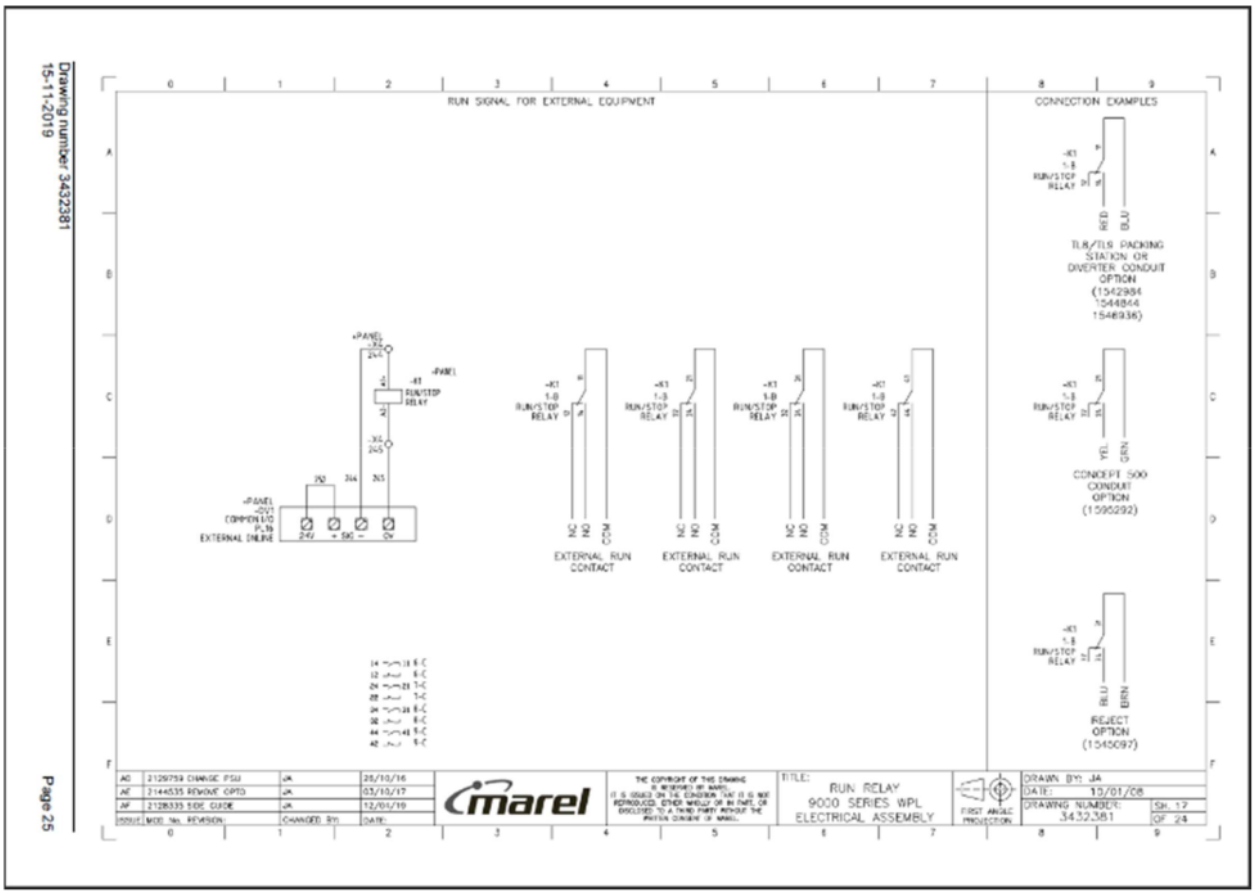


Figure 48 - Diagram of external run relays for WPL9000

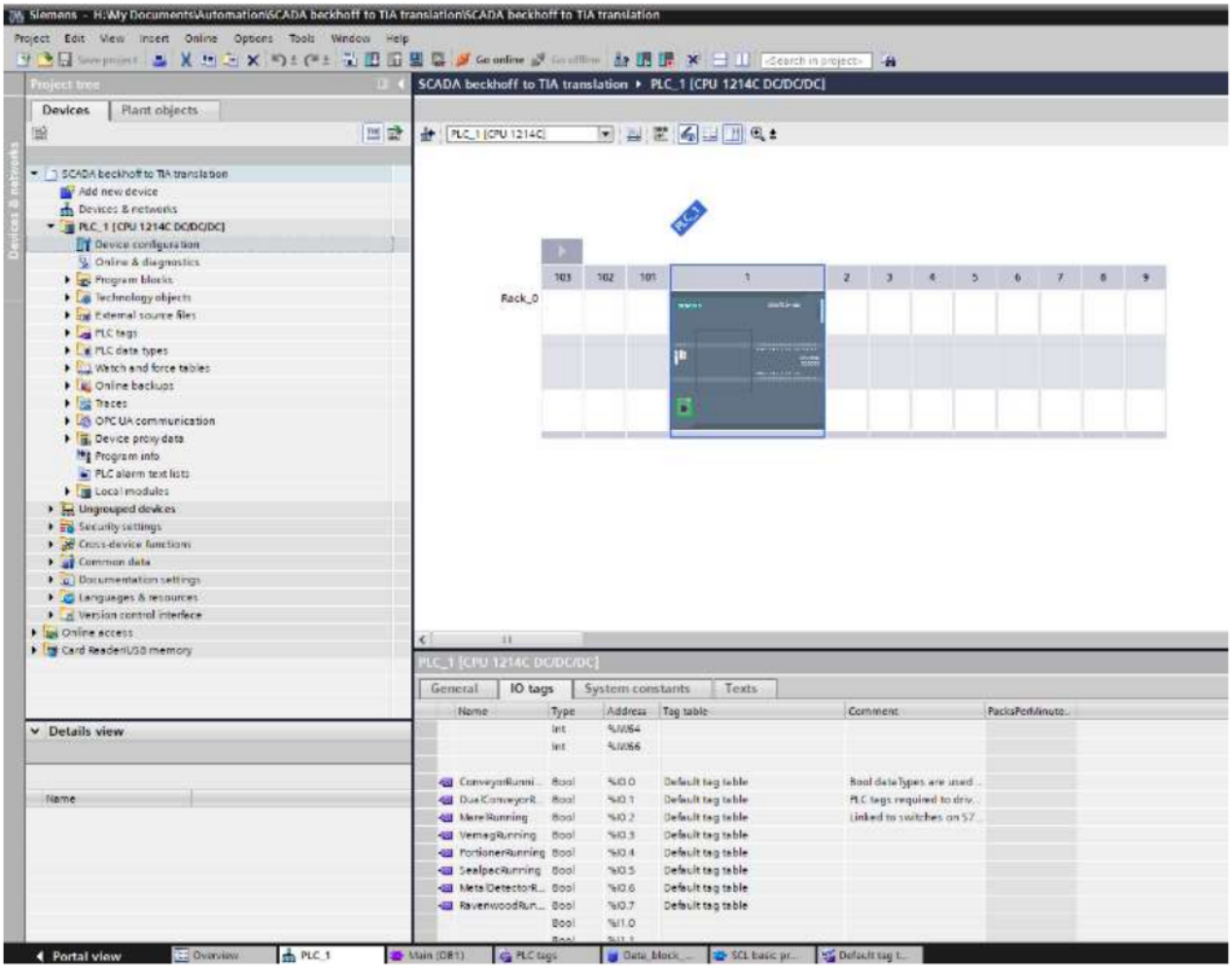


Figure 49 - Siemens PLC used in college ready to input program

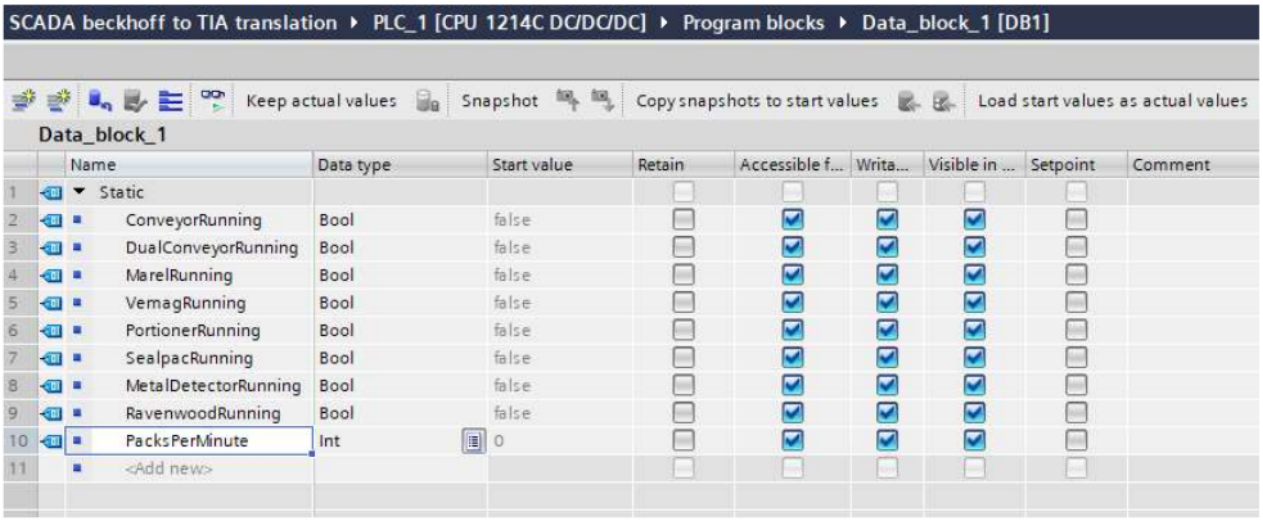


Figure 50 - PLC data block

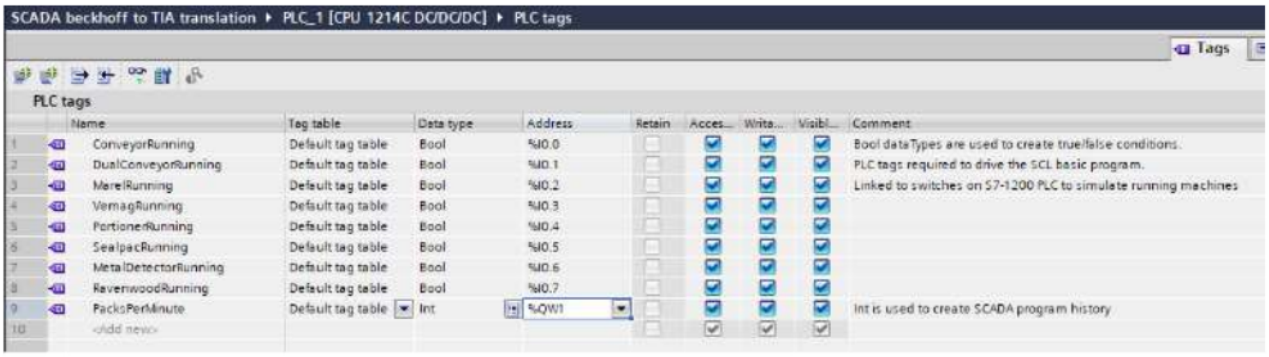


Figure 51 - Siemens PLC tags

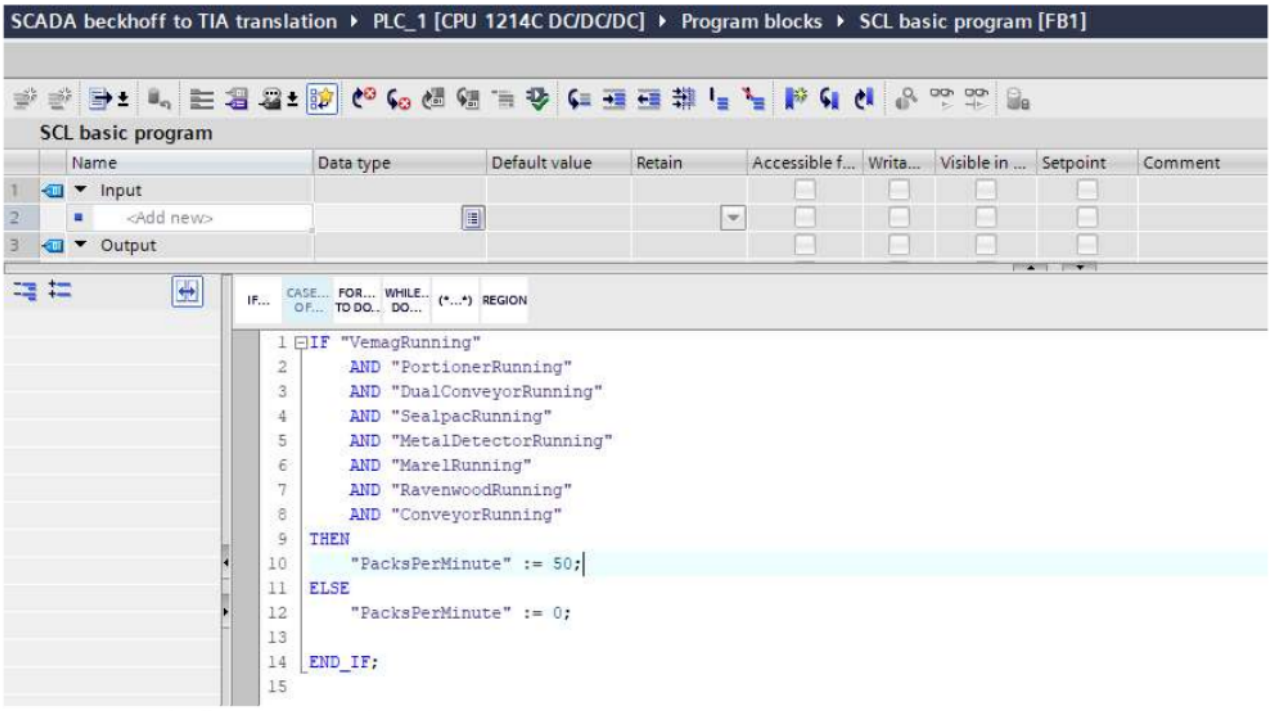


Figure 52 - Basic BeckHoff SCL program remade in Siemens TIA

Scada project

Project start: Wed, 1-Feb-2023
Display week: 1

Task:	Assigned to:	Progress: (%)	Start:	End:
Phase 1 - Construction				
Create electrical diagrams for panel	RH	0%	01-Feb-23	03-Feb-23
Build panel in void	RH	0%	04-Feb-23	06-Feb-23
Phase 2 - upgrades				
Upgrade Vemag software	Contractor +RH	0%	07-Feb-23	07-Feb-23
Upgrade Sealpac + update software	Contractor +RH	0%	08 Feb 23	08 Feb 23
Install upgrade to Metal detector	RH	0%	09 Feb 23	09 Feb 23
Phase 3 - software				
Program PLC to recognise machines and output to SCADA	Contractor +RH	0%	10-Feb-23	13-Feb-23
Program SCADA to recognise Vemag, Sealpac + M-detector	Contractor +RH	0%	14-Feb-23	17-Feb-23
Program SCADA to recognise each machine connected to PL	Contractor +RH	0%	18-Feb-23	22-Feb-23
Create HMI on SCADA	Contractor +RH	0%	23-Feb-23	25-Feb-23
Phase 4 - Network implemantation				
Run comms from panel into junction box on line	RH	0%	26 Feb 23	26 Feb 23
Run comms from junction box to necessary machines	RH	0%	27-Feb-23	27-Feb-23
Run ethernet from machines + PLC through switch to SCADA	RH	0%	28-Feb-23	28-Feb-23
Run ethernet from SCADA to server	RH	0%	01-Mar-23	02-Mar-23
Create gateway with logins	Contractor ,RH+IT	0%	03-Mar-23	06-Mar-23
Phase 5 - Testing				
Test panel circuit	RH	0%	07 Mar 23	08 Mar 23
Test the inputs coming from each machine	RH	0%	09 Mar 23	09 Mar 23
Test on company PC	RH	0%	10-Mar-23	10-Mar-23
Test full functionality	RH	0%	11-Mar-23	11-Mar-23

Scada project

Project start: Wed, 1-Feb-2023
Display week: 1

Task:	Assigned to:	Progress: (%)	Start:	End:
Phase 1 - Construction				
Create electrical diagrams for panel	RH	0%	01-Feb-23	03-Feb-23
Build panel in void	RH	0%		
Phase 2 - upgrades				
Upgrade Vemag software	Contractor +RH	0%		
Upgrade Sealpac + update software	Contractor +RH	0%		
Install upgrade to Metal detector	RH	0%		
Phase 3 - software				
Program PLC to recognise machines and output to SCADA	Contractor +RH	0%		
Program SCADA to recognise Vemag, Sealpac + M-detector	Contractor +RH	0%		
Program SCADA to recognise each machine connected to PLC	Contractor +RH	0%		
Create HMI on SCADA	Contractor +RH	0%	12-Mar-23	17-Mar-23
Phase 4 - Network implementation				
Run comms from panel into junction box on line	RH	0%		
Run comms from junction box to necessary machines	RH	0%		
Run ethernet from machines + PLC through switch to SCADA	RH	0%		
Run ethernet from SCADA to server	RH	0%		
Create gateway with logins	Contractor ,RH+IT	0%		
Phase 5 - Testing				
Test panel circuit	RH	0%		
Test the inputs coming from each machine	RH	0%		
Test on company PC	RH	0%		
Test full functionality	RH	0%		

Figure 53 - Original planned Gannt chart + Actual Gantt chart showing slippages

SGEL6000

Independent Project

Logbook

Richard Harrison

SCADA system line implementation

2022-2023

Summary of Entries

Log Entry	Date	Brief Description of Activity	Duration (hrs)	Accumulated time (hrs)
1	23/09/22	First draft of proposal	12	12
2	30/09/22	Further discussed project with manager	13.5	25.5
3	07/09/22	Determining how to make machines SCADA-ready	14.5	40
4	14/09/22	Inquiring into SCADA implementation with manufacturers	12	52
5	21/10/22	Discussed project solutions with manufacturers	15	67
6	28/10/22	Developed FDS + literature review further	10.5	77.5
7	04/11/22	Talked with SF conveyors about their panels	11	88.5
8	11/11/22	Contacted Marel and Ravenwood again	12.5	101
9	18/11/22	Discussed lines moving within the company	13	114
10	25/11/22	Talked to Marel about machine modification	14.5	128.5
11	02/12/22	Checked void for place to mount SCADA panel	11	139.5
12	09/12/22	Looked into parts required for SCADA panel	13	152.5
13	16/12/22	Received SCADA translation document from Reiser	12	164.5
14	23/12/22	Looked into SF conveyor modifications	11.5	176
15	30/12/22	Discussed line move timeline with projects manager	9.5	185.5
16	27/01/23	Ordered SCADA panel parts	10.5	196
17	03/02/23	Created power supply diagram	12	208
18	10/02/23	Discussed adaption to SCADA solution	11	219
19	17/02/23	Organised for overtime to develop program	10.5	229.5
20	24/02/23	Overtime for project + requested company laptop	12	241.5
21	03/03/23	Checked laptop request with manager	9	250.5
22	10/03/23	Began installing software on personal laptop	13	263.5
23	17/03/23	Began constructing HMI on personal laptop	12	275.5
24	24/03/23	Finished HMI + Beckhoff program	14.5	290
25	31/03/23	Tested HMI within SCADA web-program	10	300
26	07/04/23	Compiled testing findings	9	309

Log Entry Sheet

Only entries from the design and implementation phase were required.

Log Number	1
Date	23/09/22
Duration (hrs)	12
Accumulated time (hrs)	12

Record of activities and achievements
1. Created first draft of project proposal for workplace manager and tutor to look over. 2. Collected information on further documents needed.

Plans for next week
1. Planned to meet with the workplace manager when next available to discuss the proposal draft. 2. Need to clarify what PLCs are in each machine to check compatibility and whether the manufacturer will allow slight changes to the program to allow for the SCADA implementation.

Signed_____ Signed_____

L21 SCADA system

DRAFT 1

SCADA integration project for production line 21

Course: BSC degree electrical and electronic engineering

Sponsor company: Dunbia (Division of Dawn Meats)

Contacts: Richard Harrison (engineer/Student), Dylan John (Maintenance Manager), Simon Grove (Projects manager)

Project type: Industry (Production line integration)

Project intellectual property: Company controlled

Project citizenship restriction: No.

Project Scope + aims:

When a machine on the production line goes into error, machines before and after carry on working. This creates build-ups of product, along with machines that need to be stopped manually before the issue with the faulty machine can be fixed. Once fixed, the build-up of product needs to be distributed down the line before proper production can resume. Leading to production time lost for every stoppage. Also, machines that are still running while the line is inactive waste power and reduce efficiencies. Also currently, production run-rates are recorded on boards at the start of each line and are not as accurate as they could be and there can be a delay between the machine breaking down and the relevant personnel being notified.

Installing a SCADA LAN (Local Area Network) system will resolve this, by allowing all the machines on the line to communicate with each other through one device known as an RTU or PLC. Therefore, if one stops, they all stop. This would reduce build-ups when a fault occurs, allow production staff to either resolve the issue with the troublesome machine faster and engineering + other relevant parties to be notified if needed through automated messaging (email/SMS) of line status changes. Meaning increased up-time, reduced downtime and increased efficiency levels for both production and power usage. The system will integrate with on-site servers to allow certain company users with access to log-in via a gateway and view a HMI screen with a representation of the line. Meaning real-time monitoring of the status of the line and relative data such as total run-time, downtime, efficiencies and percentage of product done. Including showing whichever machine is in fault (shown as RED), machines before the faulty machine should show ORANGE (standby/manually stopped) and machines after should remain GREEN (can continue running or also go into standby to reduce wasted power depending on user preference). Meaning better planning, greater knowledge of what goes on and increased accuracy in the recording of line statistics.

The HMI of the line should resemble a schematic-type drawing of the line, clearly representing each machine. Basic machines such as conveyors and complex machines such as the Sealpac A8 can be monitored by an RTU (Remote terminal unit). This can monitor the status of basic control equipment such as relays, valves etc used by basic (non-PLC driven) equipment, while more complex machines can be connected via their on-board PLC through Cat5 (ethernet) for monitoring purposes and limited remote control if needed. The use of an RTU for this system would mean very little modification to existing machinery and the production line itself. Meaning little downtime for installation since most of the work would be done upstairs in the void and in creating the HMI.

In addition, care can be taken to ensure the system is expandable to implement more lines in the future if the need arises.

Figure 54 - project proposal draft part 1

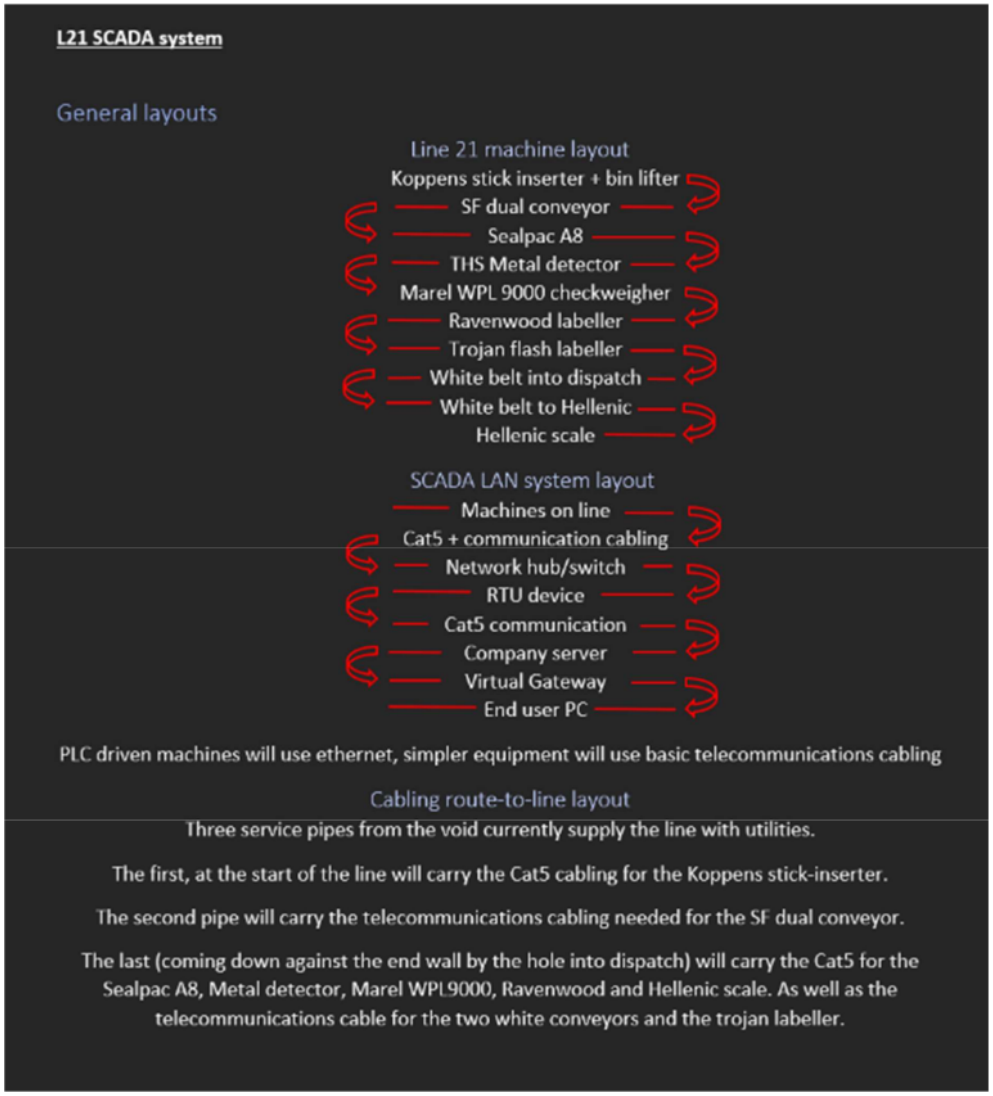


Figure 55 - Project proposal draft part 2

Log Entry Sheet

Log Number	2
Date	30/09/22
Duration (hrs)	13.5
Accumulated time (hrs)	25.5

Record of activities and achievements

1. Brainstormed other methods of further improving upon the proposed system and thought about piggy-backing the existing I/O of the machines using logic modules.
2. Met with the workplace manager and discussed the project and got confirmation that it can be done. During the discussion additional points were made in that when a machine goes into fault the system must show what the fault is on the SCADA HMI/gateway in the offices along with a catalogue of faults that have occurred, their times, total downtime, runtime etc.
3. Discussed how the system could be expanded and built upon afterwards if required.
4. Took down information from each machine on the line and determined what information was still needed from the manufacturer to make sure the machine can be made ready for SCADA.
5. Condensed proposal into a single page.

Plans for next week

1. Need to discuss a bypass with the manager. If production needs to run only a section of the line for specific reasons that can be done easily.
2. Need to talk with another engineer who is in the process of renewing and refurbishing conveyor panels within the factory so the refurbished panels are ready for the necessary equipment for SCADA elsewhere if the system is expanded at a later date.
3. Begin calling up manufacturers to see how the machines can be made ready for SCADA
4. Inquire about the system using https://inductiveautomation.com
5. Enquire about budget for SCADA system

Signed_____ Signed_____

Log Entry Sheet

Log Number	3
Date	07/10/22
Duration (hrs)	14.5
Accumulated time (hrs)	40

Record of activities and achievements
1. Enquired what would be needed to make certain machines SCADA-ready. 2. Talked with the tutor about improving the proposal. 3. Planned out deadlines for parts of the documentation.

Plans for next week
1. Need to discuss a bypass with the manager. If production needs to run only a section of the line for specific reasons that can be done easily. 2. Need to talk with another engineer who is in the process of renewing and refurbishing conveyor panels within the factory so the refurbished panels are ready for the necessary equipment for SCADA elsewhere if the system is expanded at a later date. 3. Inquire about the system using https://inductiveautomation.com 4. Enquire about budget for SCADA system 5. Continue calling up manufacturers to determine requirements for SCADA.

Signed_____ Signed_____

L21 SCADA system

SGEE6000 Independent project

Project proposal

Richard Harrison

SCADA integration project for production line 21

07/10/2022

Budget: £40000

Contacts/parties involved: Richard Harrison (engineer/Student), Dylan John (Maintenance Manager), Simon Grove (Projects manager)

Project Description

This project is based in a meat processing and packaging factory. When a machine on the production line goes into error, machines before and after carry on working. This creates build-ups of product, along with machines that need to be stopped manually before the issue with the faulty machine can be fixed. Once fixed, the build-up of product needs to be distributed down the line before proper production can resume. Leading to production time lost for every stoppage. Also, machines that are still running while the line is inactive waste power and reduce efficiencies while production run-rates, are recorded on boards at the start of each line and are not as accurate as they could be. Furthermore, there can be a delay between the machine breaking down and the relevant personnel being notified.

A SCADA LAN (Local Area Network) system could be used to resolve this, by allowing all the machines on the line to communicate with each other through one device such as an RTU or PLC. Therefore, if one stops, they all would stop. This would reduce build-ups when a fault occurs allowing production staff to resolve the issue with the troublesome machine faster while engineering + other relevant parties can be notified if needed, through automated messaging (email/SMS) of line status changes. This would increase up-time, reduce downtime and increase efficiency levels for both production and power usage. The system must integrate with on-site servers to allow certain company users to view a HMI screen with a representation of the line. This would provide real-time monitoring of the status of the line and relative data such as total run-time, downtime, efficiencies and percentage of product done. This must include the showing of whichever machine is in fault (shown as RED). Machines before the faulty machine should show ORANGE (standby/manually stopped) and machines after should remain GREEN (can continue running or also go into standby to reduce wasted power depending on user preference). The result would be better planning, greater knowledge of what goes on and increased accuracy in the recording of line statistics.

In addition, care must be taken to ensure the system is expandable to implement more lines in the future if the need arises.

Completion date

31st March 2023

Approval signatures

Student Signature: _____ Date: _____

Industrial Supervisor Signature: _____ Date: _____

Academic Tutor Signature: _____ Date: _____

Figure 56 - Project proposal

Log Entry Sheet

Log Number	4
Date	14/10/22
Duration (hrs)	12
Accumulated time (hrs)	52

Record of activities and achievements

1. Finished sending enquiries to each machine manufacturer regarding implementation with SCADA.
2. Produced project requirements, Testing and Project background + definition + constraints documents.
3. Reproduced project aims and objectives to manager for review.

Plans for next week

1. Need to discuss a bypass with the manager. If production needs to run only a section of the line for specific reasons that can be done easily.
2. Need to talk with another engineer who is in the process of renewing and refurbishing conveyor panels within the factory so the refurbished panels are ready for the necessary equipment for SCADA elsewhere if the system is expanded at a later date.
3. Enquire about the budget for SCADA system and required parts.

Signed_____ Signed_____

Testing Plan (Factory acceptance test)

Testing criteria MUST:

Check operation of HMI and gateway through server.

1. Using a laptop, login to the HMI system through the company gateway using a moderator login. (Ability to move HMI parts)
2. Login as an operator and test the HMI functionality. Can the current machine state be seen (for each machine), is the appropriate information shown (run-rates, percentage, downtime as a total).
3. Check **for each machine,** when each of its three states occurs, the appropriate colours show on the HMI and that when the machine is re-enabled the rest of the line starts again automatically.
4. For each machine in turn, check that when it is stopped the machines before it all go into idle and the following machines carry on running for the set time. (Both for real and on the HMI).
5. Can parts of the line be started individually? I.e., Can the second half (for labelling) be run while the first half stays idle or off?
6. Disable the system and make sure the line can still run manually.
7. Stop any machine and make sure the following machines run until the timer runs out.
8. Create three faults on each machine and test to see if that specific fault description appears on the HMI.
9. The faults tested should be recorded on a separate screen on the HMI.

Extra testing for COULD requirements shown in FDS

1. Can (using the moderator login) the first two machines be changed.
2. Does the HMI screen on the production floor mirror the gateway?
3. Does the buzzer sound when a fault occurs?

Figure 57 - Testing plan draft

Log Entry Sheet

Log Number	5
Date	21/10/22
Duration (hrs)	15
Accumulated time (hrs)	67

Record of activities and achievements

1. Received replies from Reiser, THS and Sealpac machine manufacturers and talked about various issues and potential solutions with parts of the project regarding their machines. Reiser supplied a translation document that will allow SCADA to translate and use their machines information.
2. Awaiting replies from Marel, Ravenwood and SF conveyors.
3. Discussed potential SCADA suppliers with the manager.
4. Discusses bypass options with the manager. Allowing production to only run a section of the line if needed.

Plans for next week

1. If no reply has been received regarding enquiries into Marel, Ravenwood and SF conveyors, will need to contact each again.
2. Discuss SCADA suppliers with the manager.
3. Discuss bypasses with the manager.

Signed_____ Signed_____

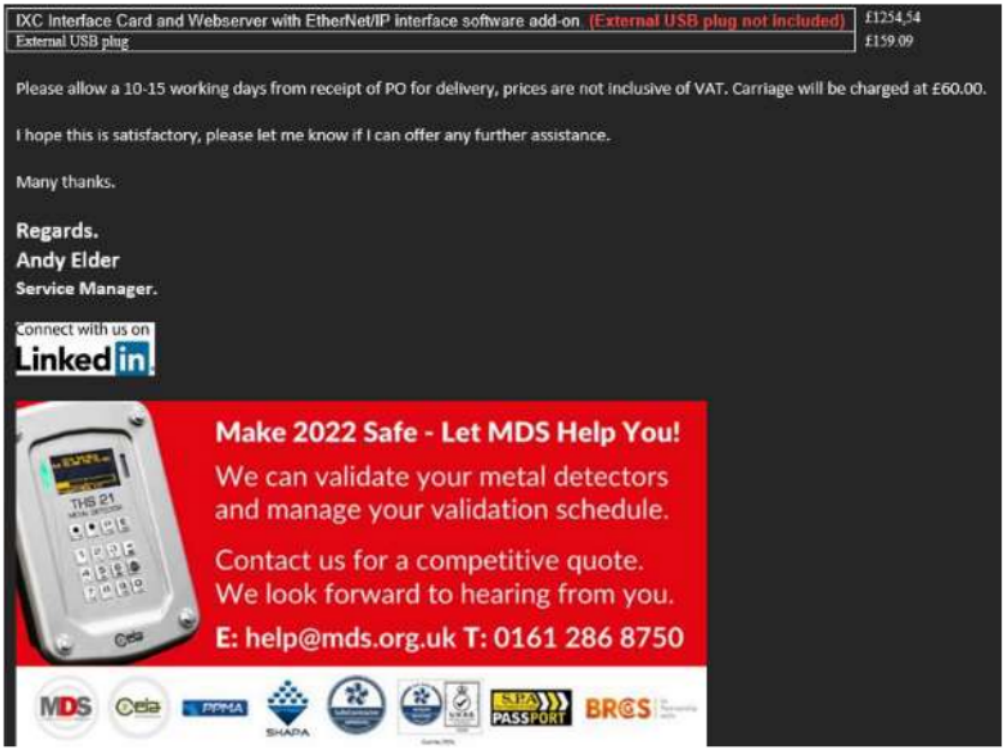
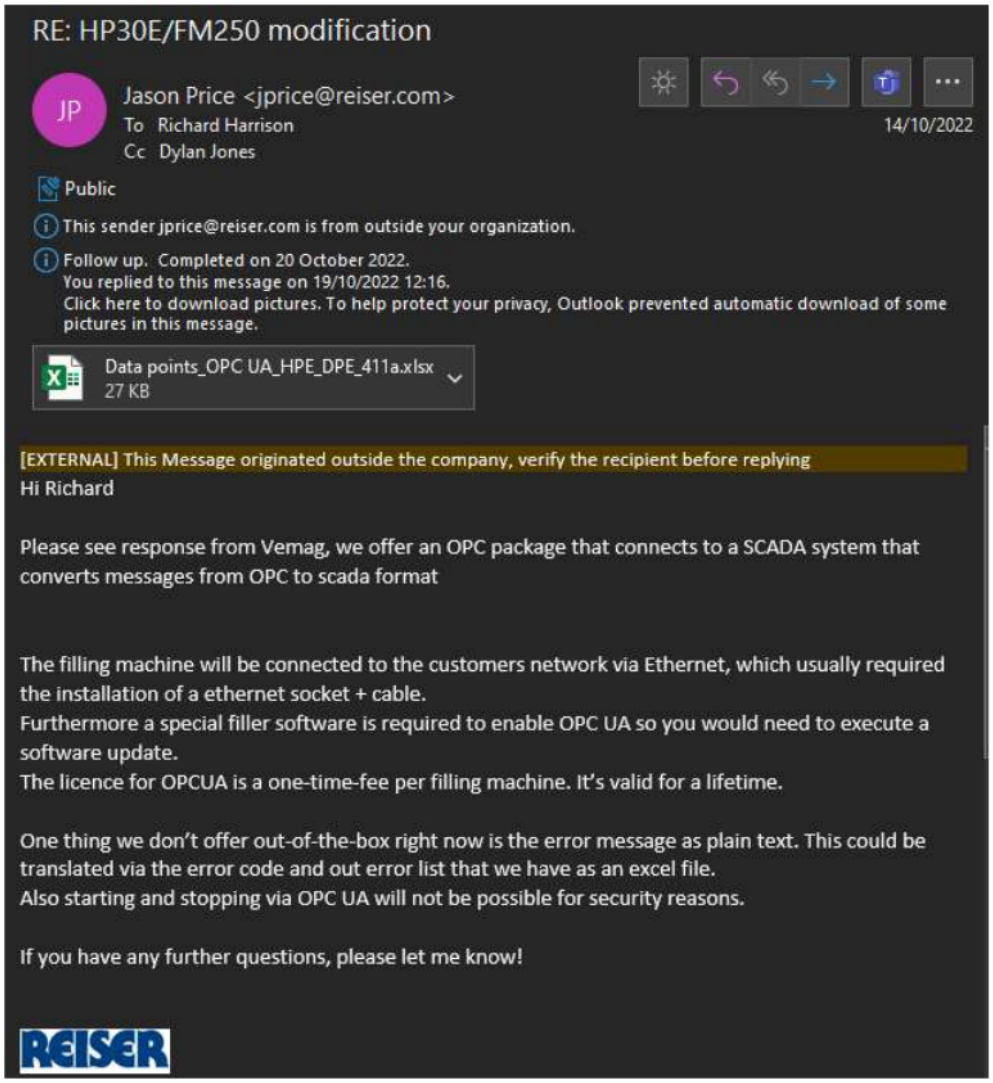


Figure 58 - Quote from CEIA metal detectors


RE: HP30E/FM250 modification

JP

Jason Price <jprice@reiser.com>
To Richard Harrison
Cc Dylan Jones

14/10/2022

Public

This sender jprice@reiser.com is from outside your organization.

Follow up. Completed on 20 October 2022.
You replied to this message on 19/10/2022 12:16.
Click here to download pictures. To help protect your privacy, Outlook prevented automatic download of some pictures in this message.

Data points_OPC UA_HPE_DPE_411a.xlsx
27 KB

[EXTERNAL] This Message originated outside the company, verify the recipient before replying

Hi Richard

Please see response from Vemag, we offer an OPC package that connects to a SCADA system that converts messages from OPC to scada format

The filling machine will be connected to the customers network via Ethernet, which usually required the installation of a ethernet socket + cable.
Furthermore a special filler software is required to enable OPC UA so you would need to execute a software update.
The licence for OPCUA is a one-time-fee per filling machine. It's valid for a lifetime.

One thing we don't offer out-of-the-box right now is the error message as plain text. This could be translated via the error code and out error list that we have as an excel file.
Also starting and stopping via OPC UA will not be possible for security reasons.

If you have any further questions, please let me know!

REISER

Figure 59 - Reiser response regarding HP30E SCADA implementation

Log Entry Sheet

Log Number	6
Date	28/10/22
Duration (hrs)	10.5
Accumulated time (hrs)	77.5

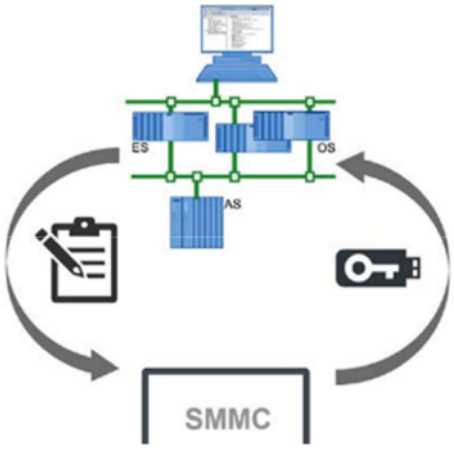
Record of activities and achievements
1. Looked back over Functional Design Specification 2. Researched other potential solutions for the project other than SCADA that would provide the same outcome for literature review.

Plans for next week
1. If no reply has been received regarding enquiries into Marel, Ravenwood and SF conveyors, will need to contact each again. 2. Discuss SCADA suppliers with the manager. 3. Discuss bypasses with the manager.

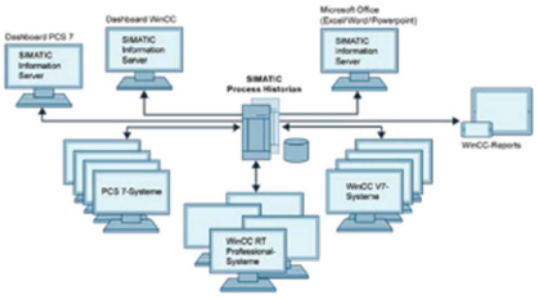
Signed_____ Signed_____

Process plants must be continuously kept up to date, especially due to their long operating life. This also applies first and foremost to process control technology. With Version 9.1 of SIMATIC PCS 7, efficient upgrade strategies can be implemented safely.

Systematically inventoried and always up-to-date
Plant performance always results from the interaction of the entire plant equipment. It is therefore important to know the status of the hardware and software used. But how do you keep track of hundreds of devices? With the SIMATIC Management Console (SMMC) integrated in SIMATIC PCS 7 and our Update Services, you get a detailed and up-to-date picture of the status of your automation infrastructure (software and hardware). This improves the proactive life-cycle management of your existing SIMATIC PCS 7 plant. The SMMC enables a convenient inventory of the installed base and a simplified comparison with the latest software and hardware updates. In interaction with the new web-based SIMATIC PCS myExpert application, this information is standardized, clearly displayed and monitored - even across multiple plants. Microsoft Windows updates are also managed via SMMC. Benefit from an even more comprehensive overview of available updates, obsolescence or the lifecycle status of individual assets. All Microsoft Defender events from all PCS 7 stations in a plant also converge in the SMMC.



Generating added value from data - with the right IT solution
Another lever for more efficient plant management in future lies in previously unused process data, tags, alarms and batch data at runtime and from the past. With SIMATIC PCS 7 Process Historian (PH), this information can be archived and evaluated centrally and in real time. In addition to standard database interfaces such as ODBC, OLE DB and ADO.NET, data can now also be processed via OPC UA. This enables simple and standardized integration of third-party systems. The archive data is visualized via the Information Server (IS). Based on Microsoft Reporting Services, individual and target group-specific reports can be created very intuitively using interactive dashboards.



Accessing and evaluating the volume of historical data for plant optimization requires a high-performance archiving, reporting and backup system. With SIMATIC DCS/SCADA Infrastructure, Siemens offers you a comprehensive IT solution consisting of hardware, software and customized services. Leave nothing to chance when it comes to data archiving, visualization and backup. For example, the right disaster recovery strategy plays a central role in resuming production after a failure and preventing data loss.

Figure 60 - Siemens PDF showcasing the advantages of PCS7 (Siemens, 2023)

Log Entry Sheet

Log Number	7
Date	04/11/22
Duration (hrs)	11
Accumulated time (hrs)	88.5

Record of activities and achievements
1. Spoke more with SF conveyors about their electrical panels supplied by another party and Sealpac responded with a quote for the work that would be needed to allow the Sealpac to communicate with SCADA. 2. Talked to the manager about the project and how it will be affected by lines being moved around in the company.

Plans for next week
1. Carry on with FDS work for project documentation. 2. Contact Ravenwood again. 3. Contact Marel again.

Signed_____ Signed_____

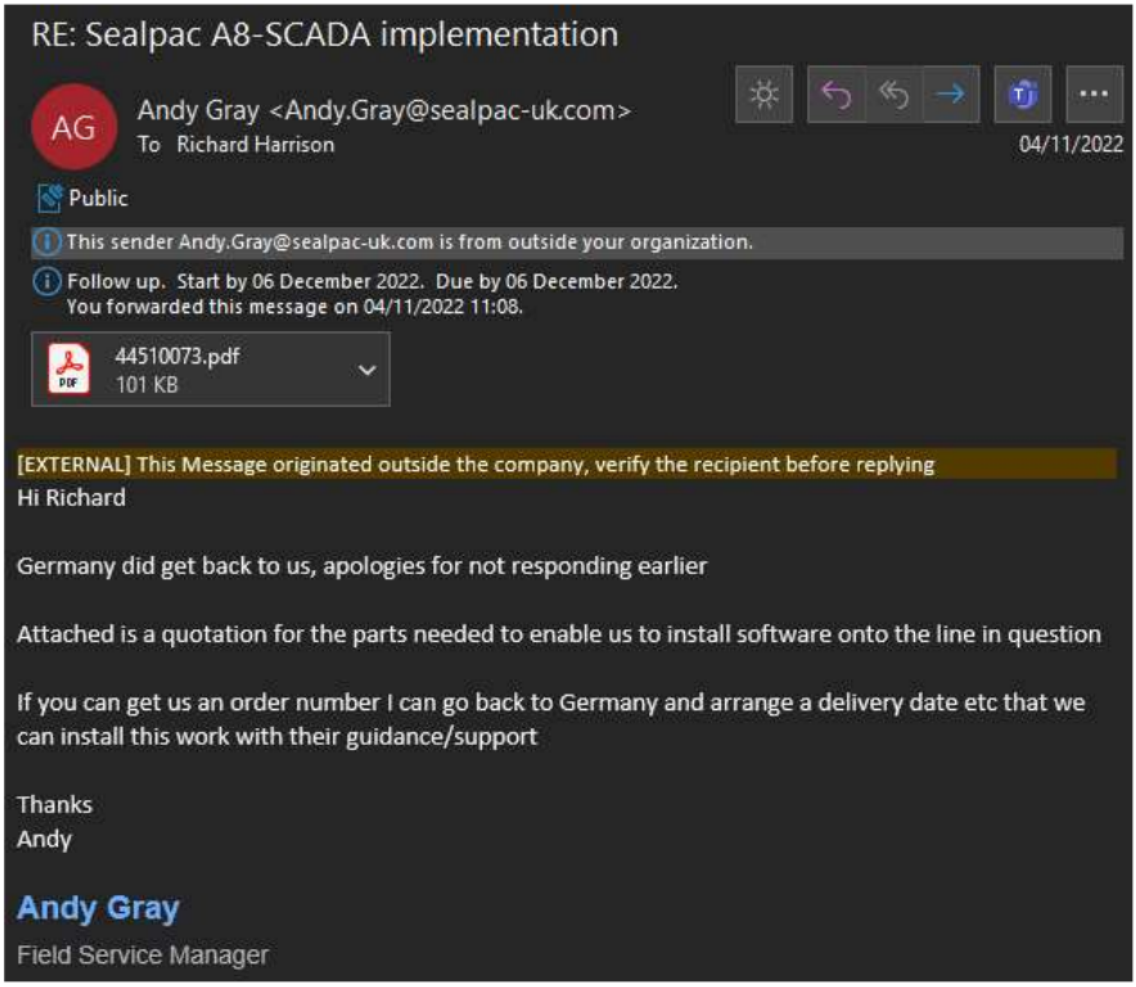


Figure 61 - Response from Sealpac

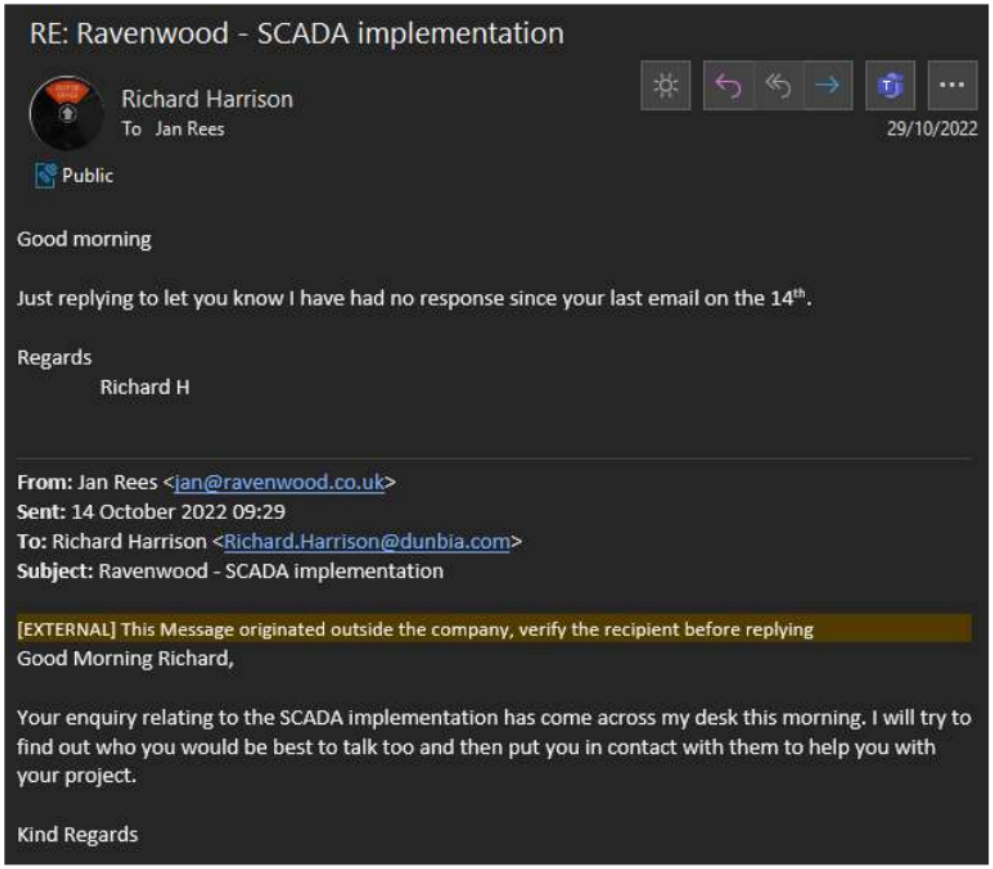
Log Entry Sheet

Log Number	8
Date	11/11/22
Duration (hrs)	12.5
Accumulated time (hrs)	101

Record of activities and achievements
1. Contacted Ravenwood again regarding the project 2. Contacted Marel again regarding the project 3. Looked back over project documentation

Plans for next week
1. Act on replies from Marel and Ravenwood 2. Adjust documentation considering machine control

Signed_____ Signed_____



RE: Ravenwood - SCADA implementation

Richard Harrison
To Jan Rees

29/10/2022

Public

Good morning

Just replying to let you know I have had no response since your last email on the 14th.

Regards
Richard H

From: Jan Rees <jan@ravenwood.co.uk>
Sent: 14 October 2022 09:29
To: Richard Harrison <Richard.Harrison@dunbia.com>
Subject: Ravenwood - SCADA implementation

[EXTERNAL] This Message originated outside the company, verify the recipient before replying
Good Morning Richard,

Your enquiry relating to the SCADA implementation has come across my desk this morning. I will try to find out who you would be best to talk too and then put you in contact with them to help you with your project.

Kind Regards

Figure 62 - Follow-up email to Ravenwood

Log Entry Sheet

Log Number	9
Date	18/11/22
Duration (hrs)	13
Accumulated time (hrs)	114

Record of activities and achievements
1. Gave further details to SF conveyors regarding the panels fitted to their conveyors in the factory. 2. Talked with the Projects manager within the company regarding the line my project is going to be implemented on. Got assurance that while the line may be moved it will still be within the factory with its original setup.

Plans for next week
1. Get back to the project manager and see if he can be brought more on-board with the project. What are the timelines for the lines moving and can I implement my project when the line moves? 2. Tie up with Ravenwood and Marel.

Signed_____ Signed_____

Log Entry Sheet

Log Number	10
Date	25/11/22
Duration (hrs)	14.5
Accumulated time (hrs)	128.5

Record of activities and achievements

1. Discussed with Marel engineer how the WPL9000 could be implemented into such a system. It was suggested that there were extra relays within the system that could be used.
2. Investigated machine panel and drawings for external run relays that the Marel engineer talked about

Plans for next week

1. Supply machine drawings with project assignment
2. Look into other machines connectivity to SCADA
3. Get back to the project manager and see if he can be brought more on-board with the project. What are the timelines for the lines moving and can I implement my project when the line moves?
4. Tie up with Ravenwood and Marel.

Signed_____ Signed_____

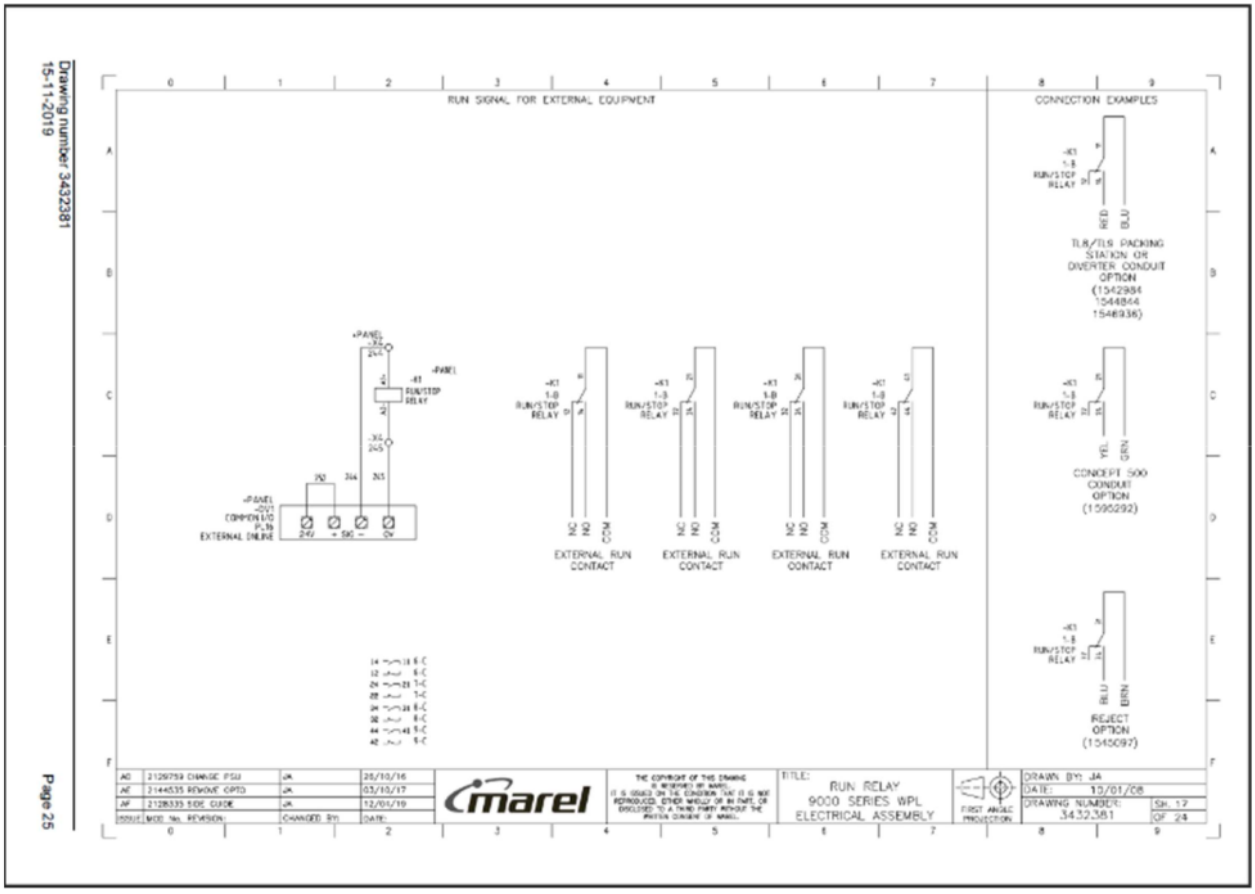


Figure 63 - Diagram of external run relays for WPL9000

Log Entry Sheet

Log Number	11
Date	02/12/22
Duration (hrs)	11
Accumulated time (hrs)	139.5

Record of activities and achievements

1. Added machine drawings for the metal detector upgrade
2. Attempted to contact Ravenwood.
3. Checked along the void space for mounting points and power for the panel to house the SCADA and PLC units.
4. The Project manager is currently busy with organising the move of all lines within the factory. Line that the project will be done on will need to be moved before the project can begin.
5. Got confirmation that the run relays in the SF conveyor panels can be used from SFEngineering.

Plans for next week

1. Supply machine drawings with project assignment
2. Look into other machines connectivity to SCADA
3. Get back to the project manager and see if he can be brought more on-board with the project. What are the timelines for the lines moving and can I implement my project when the line moves?

Signed_____ Signed_____

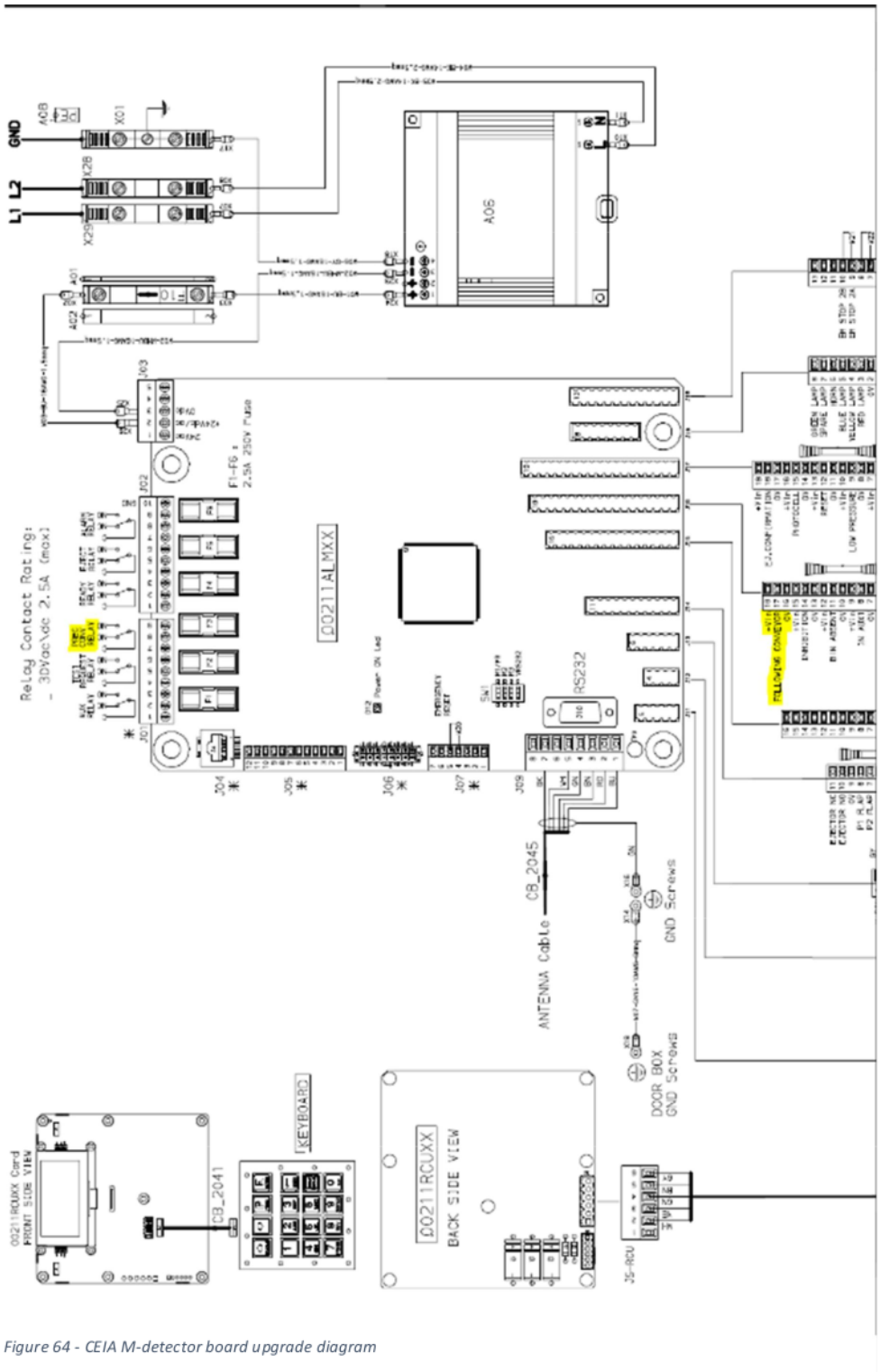
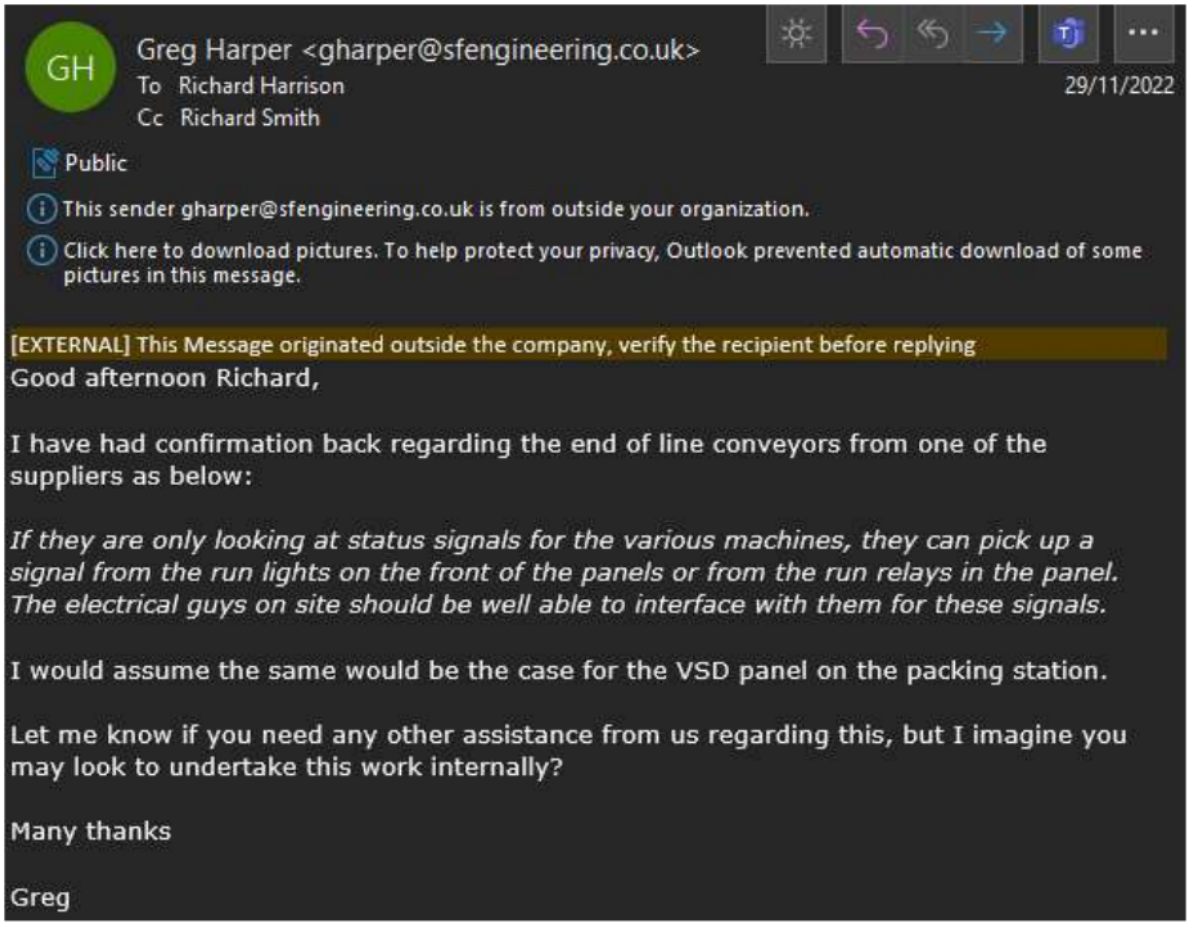


Figure 64 - CEIA M-detector board upgrade diagram



GH

Greg Harper <gharper@sfengineering.co.uk>

To Richard Harrison

Cc Richard Smith

29/11/2022

Public

This sender gharper@sfengineering.co.uk is from outside your organization.

Click here to download pictures. To help protect your privacy, Outlook prevented automatic download of some pictures in this message.

[EXTERNAL] This Message originated outside the company, verify the recipient before replying

Good afternoon Richard,

I have had confirmation back regarding the end of line conveyors from one of the suppliers as below:

If they are only looking at status signals for the various machines, they can pick up a signal from the run lights on the front of the panels or from the run relays in the panel. The electrical guys on site should be well able to interface with them for these signals.

I would assume the same would be the case for the VSD panel on the packing station.

Let me know if you need any other assistance from us regarding this, but I imagine you may look to undertake this work internally?

Many thanks

Greg

Figure 65 - Confirmation from SF Engineering

Log Entry Sheet

Log Number	12
Date	09/12/22
Duration (hrs)	13
Accumulated time (hrs)	152.5

Record of activities and achievements

1. Looked into the equipment and parts required to build the necessary panel for the SCADA and PLC unit and cross-referenced those parts with stock in the company stores to see what parts were already on site and available to use.

Plans for next week

1. Supply machine drawings with project assignment
2. Look into other machines connectivity to SCADA
3. Get back to the project manager and see if he can be brought more on-board with the project. What are the timelines for the lines moving and can I implement my project when the line moves?

Signed_____ Signed_____

Log Entry Sheet

Log Number	13
Date	16/12/22
Duration (hrs)	12
Accumulated time (hrs)	164.5

Record of activities and achievements

1. Talked to Reiser (meat processing machine manufacturer) about the line in question and the error translations for their machine to be used by SCADA so the system can process the input from the machine.
2. Inspected SCADA translation document and added it to documentation appendix.

Plans for next week

1. Supply machine drawings with project assignment
2. Look into other machines connectivity to SCADA
3. Get back to the project manager and see if he can be brought more on-board with the project. What are the timelines for the lines moving and can I implement my project when the line moves?

Signed_____ Signed_____

OPC UA Data points filling machine			Currently supported data types: DINT, UDINT, REAL and STRING.		
Data Point	**Display Name for UA Client**	**Datatype**	**Meaning**	**Read right**	**Write righ**
Article No.	ArticleNo.Data	DINT	Article No. / Item No. Item number of the current recipe. Program change via article number is possible.	X	X
Program name	ProgramName.Data	STRING	Name of the currently loaded recipe / program	X	
Accesslevel	SCADA.sAccessLevel	DINT	The user key can be used to block access to certain functions. -1: program lock (changing programs, entering weight corrections, calibration tube test) 0: Experienced user (setting up and changing programs) 1: Professional user (option) 2: Service (machine configuration)	X	X
Analog output 1	SCADA.sAnalogOut1X10	DINT	This function sets the tempo of an external drive. Adjustable range from 0 - 100 corresponds to 0 - 10 volts. If "-1" is selected, the tempo will be synchronized between master and slave machine. The tempo corresponds to a voltage value (e.g., 10% = 1V) (e.g., feed belt).	X	
Analog output 2	SCADA.sAnalogOut2X10	DINT	See analog output 1	X	
Back suction	SCADA.sBackSuctionX10	DINT	Back suction [g * 10]	X	X
Calibre	SCADA.sCalibre	DINT	Durchmesser der Wurst [mm]	X	
Clipp time	SCADA.sClipTime	DINT	time for clipp (ClippLage: negative = leading) [ms]	X	X
Corrected weight	SCADA.sCorrectedWeight	DINT	Current corrected weight (in grams X10)	X	
Tempo Crimperbelt	SCADA.sCrimperBeltSpeed	DINT	Crimper belt speed [%] Application: CC215	X	
Daily Idle time	SCADA.sDailyIdleTimeSec	UDINT	Day idle time [sec] of the machine. The machine is ready but does not produce. This counter is reset daily at 0:00 am (as soon as the date changes on the machine).	X	
Daily production Runtime	SCADA.sDailyProductionRunTimeSec	UDINT	Daily production run time [sec] of the machine. This counter is reset daily at 0:00 am (as soon as the date changes on the machine).	X	
Daily-Quantity Counter	SCADA.sDailyQuantityCounter	UDINT	Daily quantity counter [g]. This counter is reset daily at 0:00 am (as soon as the date changes on the machine).	X	
Daily-Piece Counter	SCADA.sDailyStrokeCounter	UDINT	Daily piece counter. This counter is reset daily at 0:00 am (as soon as the date changes on the machine).	X	
Efficiency	SCADA.sEfficiency	REAL	Efficiency of the Doublescrew, determined by setpoint / corrected weight	X	
Activating the OPC UA server for 60 seconds	SCADA.sEnabled	DINT	Activating the OPC UA server for 60 seconds. 0: The OPC UA server is disabled (unless sPermanentlyEnabled = 1) 1: The OPC UA server is active and all other variables can be read out. If sEnabled is set to 1, this variable will remain at 1 for 60 seconds and then automatically reset to 0.	X	X
ErrorCode	SCADA.sErrorCode	DINT	The error number of the current error.	X	
Tempo feed belt	SCADA.sFeedBeltSpeedX10	DINT	Tempo feed belt in relation to the crimper belt [%] Application: CC215plus	X	
Tempo of alginate pump (HPCoex)	SCADA.sFillerB_Speed	DINT	Tempo of the alginate pump Application: CC215	X	
Gel output	SCADA.sGelOutput	DINT	Alginate consumption (gel output) in relation to sausage [%] provided that a clean gel calibration and a clean weight correction were performed.	X	
Gel thickness	SCADA.sGelThickness	DINT	Gel thickness [µm] of alginate, application: CC215	X	
Error active	SCADA.sIsErrorActive	DINT	0: There is currently no error that would hinder production. 1: The machine currently has an error that causes production to stop.	X	
Hopper filling status	SCADA.sIsHopperEmpty	DINT	0: hopper is filled. 1: hopper needs to be filled.	X	
Machine is idle	SCADA.sIsMachineIdle	DINT	0: The machine is either not ready or it is being produced. 1: The machine is ready, but it is not being produced.	X	
Machine is in production	SCADA.sIsMachineInProduction	DINT	0: The machine is not producing right now. 1: The machine is currently producing.	X	
Warning active	SCADA.sIsWarningActive	DINT	0 if there is no warning active. Switches periodically between 0 and 1 if there is an active warning	X	
LifeBit	SCADA.sLifeBit	DINT	Switches between 0 and 1 each second whenever the machine is turned on.	X	
Tempo of the main drive	SCADA.sMainSpeedX10	DINT	Main Speed in [%], 0%: minimum speed 100%: maximum speed	X	X
Operating mode	SCADA.sOpMode	DINT	Numerical represantation of the operating mode of the recipe (continuous, LPG, etc.)	X	
Break time	SCADA.sPauseTime	DINT	The pause time between the portions in clocked mode	X	X
Permanent activation of the OPC UA server	SCADA.sPermanentlyEnabled	DINT	Permanent activation of the OPC UA server. 0: The OPC UA server is permanently disabled (unless sEnabled = 1) 1: The OPC UA server is permanently active and all other variables can be read out. Even after a restart of the machine, the OPC UA server is immediately active and all variables can be read immediately.	X	X
Portions per minute	SCADA.sPortionsPerMinuteX100	UDINT	Number of portions per minute. This value is not a setpoint specification, but only a display parameter. In continuous or pressure control mode, no value for portions per minute can be determined. Decimal places: 2.	X	
Portion delay	SCADA.sPortionDelay	DINT	Current portion delay [ms] of the recipe if set	X	
Portion delay mode	SCADA.sPortionDelayMode		Numerical representation of the Delay mode that is set in the recipe. 0: Off 1: Time 3: Signal S-M 4: Coex	X	
Portions per minute Setpoint	SCADA.sPPMX10	DINT	Portions per minute	X	X

Figure 66 - Vemag fault list to SCADA translation (part 1)

Soft start mode	SCADA.sSoftStart	DINT	0: Soft start - off 1: Soft start - all Portions 2: Soft start - first Portion 3: Soft start - on (continuous mode) 4: LPG-Mode 1 5: Ramp adaption for LPG-Mode	X	
Special Control mode	SCADA.sSpecialControl	DINT	0: OFF 1 :FILL 2: BREAK 3: LIFTING TABLE 4: EMPTY CASING 5: CONTINUOUS 6: VACUUM PROTECTION 7: START COMMAND 8: READY 9: HANGING HOOK 10: INFEED STOP 11: NOT READY 12: PLANNED HOOK 13: DEV2_REF_READY 14: PORTION END	X	
Program number	SCADA.sProgramNo	DINT	Number of the currently loaded recipe / program	X	X
Sausage Length	SCADA.sSausageLength	DINT	Sausage length [mm]	X	
Start-Stop-Mode	SCADA.sStartStopMode	DINT	0: Knee 1 1: Knee 2 >=2: Remote modes	X	
Piece Counter	SCADA.sStrokeCounter	UDINT	Piece counter that can never be reset.	X	
System time	SCADA.sSystemTime	DINT	Provides the machine's system time in 3 bytes; representing second, minute, hour (starting from the least significant bit).	X	
Tempo Transportbelt	SCADA.sTransportBeltSpeedX10	DINT	Tempo Transportbelt in relation to the crimper band [%] Application: CC215	X	
Vane Cell	SCADA.sVaneCell	DINT	Numerical representation of the vane cell that is currently used. X: number of chambers, -1 if no vane cell	X	
Weigth Correction	SCADA.sWeightCorrectionX10	STRING	Way [cm3] at the main drive per portion	X	X
Weight sample	SCADA.sWeightedSampleX10	DINT	Last weight sample of the scale 877	X	
Nominal weight	SCADA.sWeightX10	DINT	Current nominal weight	X	X

Figure 67 - Vemag fault list to SCADA translation (part 2)

Log Entry Sheet

Log Number	14
Date	23/12/22
Duration (hrs)	11.5
Accumulated time (hrs)	176

Record of activities and achievements

1. Found circuit diagrams for the two SF conveyors on the production line and determined the best place to take the run signal for the PLC.
2. Added drawings to project documentation appendix.

Plans for next week

1. Get back to the project manager and see if he can be brought more on-board with the project. What are the timelines for the lines moving and can I implement my project when the line moves?

Signed_____ Signed_____

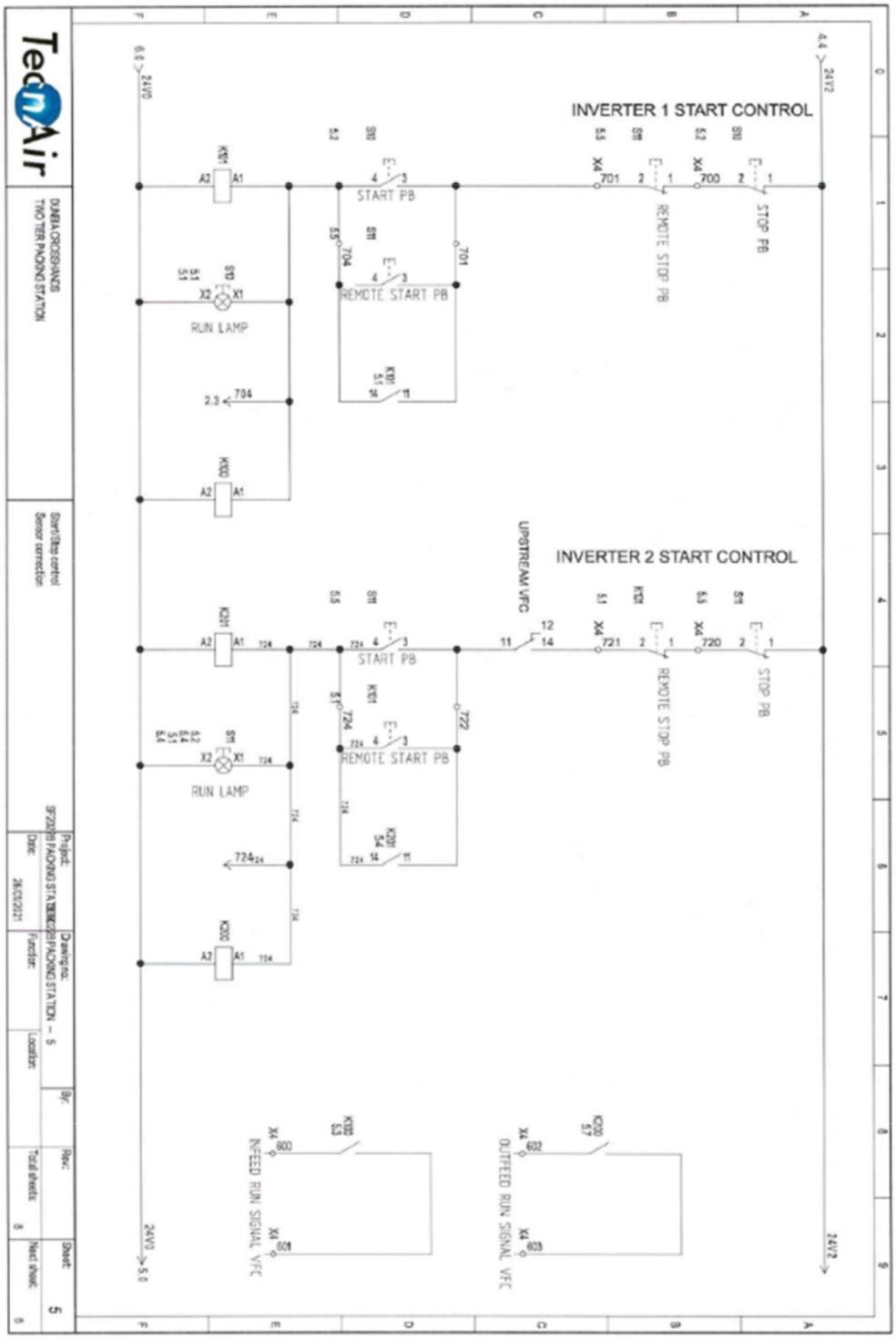


Figure 68 - SF conveyor outfeed run signal location

Log Entry Sheet

Log Number	15
Date	30/12/22
Duration (hrs)	9.5
Accumulated time (hrs)	185.5

Record of activities and achievements
1. Checked with the project manager about the timeline for line move. Still unknown 2. Assignment writeup work

Plans for next week
1. Get back to the project manager about the timelines for the lines moving and can I implement my project when the line moves?

Signed_____ Signed_____

Log Entry Sheet

Log Number	16
Date	27/01/23
Duration (hrs)	10.5
Accumulated time (hrs)	196

Record of activities and achievements

1. Sent list of parts to be ordered for the SCADA panel to engineering manager. He wants them to be directed to him.

Plans for next week

1. Have panel housing made
2. Have meeting with manager and speak about getting in contractors to install necessary software upgrades ahead of time, get more details on SCADA module (including dimensions) and PLC + look at documenting the system as it is created so if faults occur within the system, they can be diagnosed easier

Signed_____ Signed_____

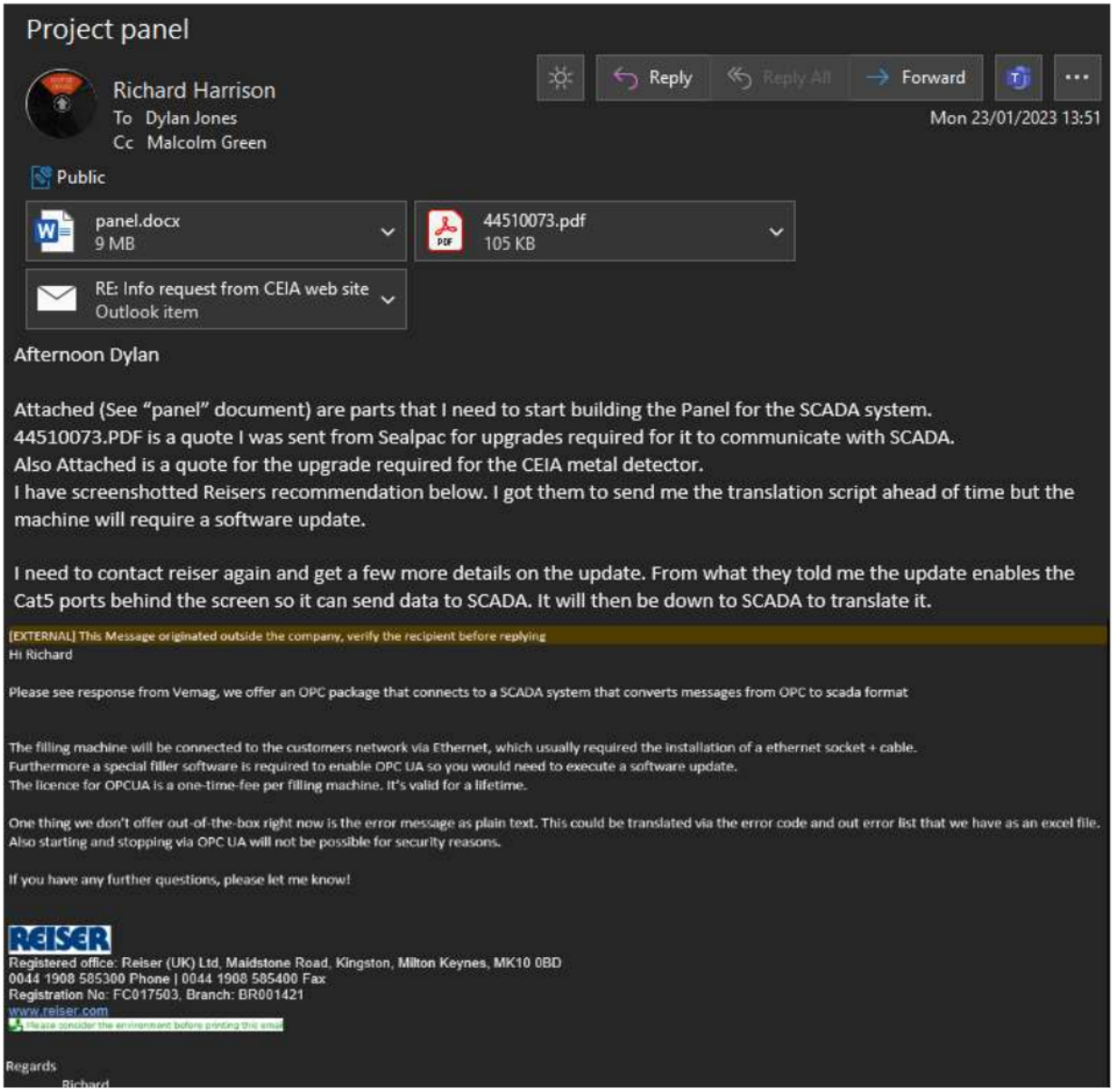


Figure 69 - Email requesting parts in order to build panel

Log Entry Sheet

Log Number	17
Date	03/02/23
Duration (hrs)	12
Accumulated time (hrs)	208

Record of activities and achievements

1. Spoke with the manager but could not have a meeting as he was busy.
2. Line in question was not moved like planned and was delayed until mid-February.
3. Made an initial plan for power delivery/supply to the SCADA panel.
4. Have been assured that funding for the project is still safe regardless of bigger projects currently being done in work.

Plans for next week

1. Have panel housing made
2. Have meeting with manager and speak about getting in contractors to install necessary software upgrades ahead of time, get more details on SCADA module (including dimensions) and PLC + look at documenting the system as it is created so if faults occur within the system, they can be diagnosed easier.
3. Get concrete date for line move

Signed_____ Signed_____

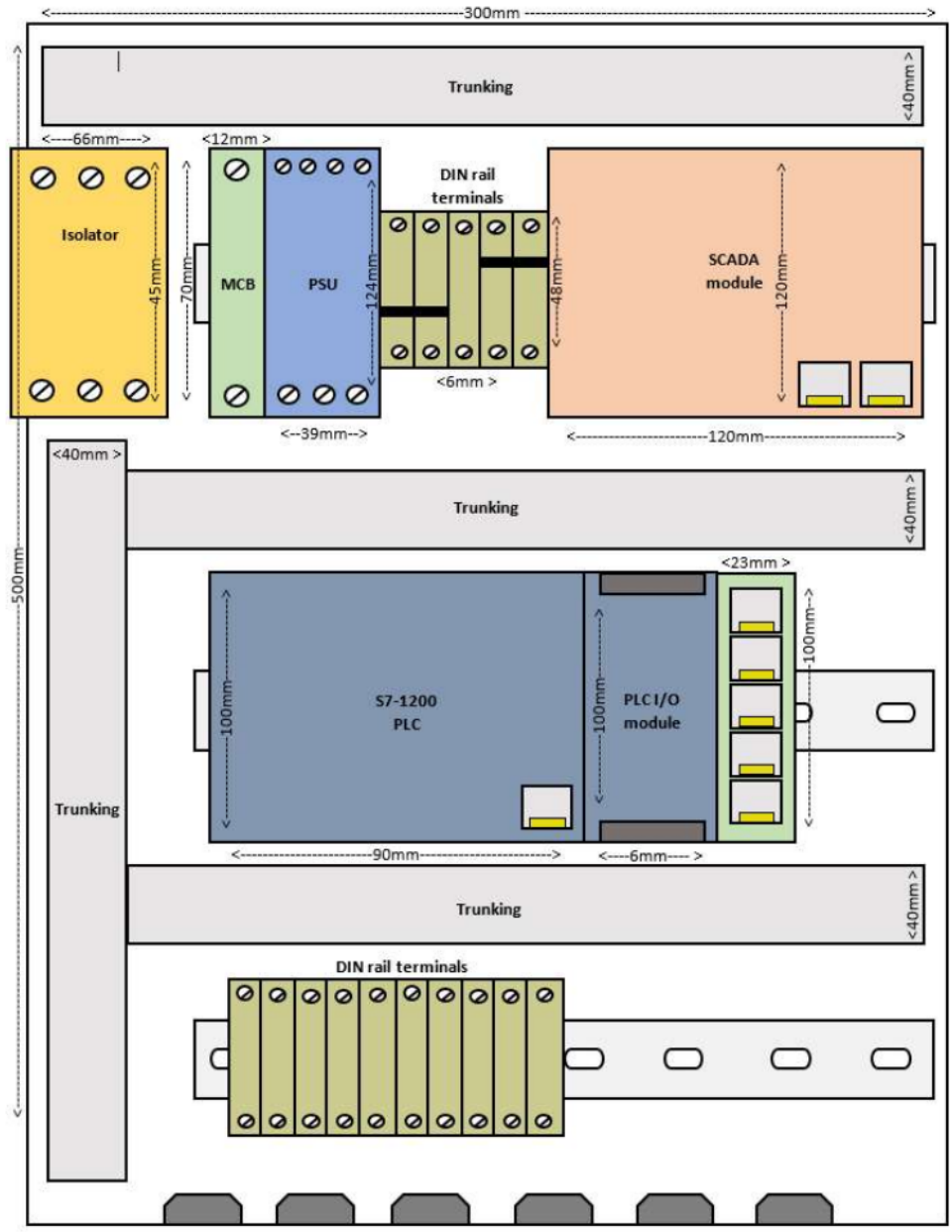


Figure 70 - Panel layout with measurements

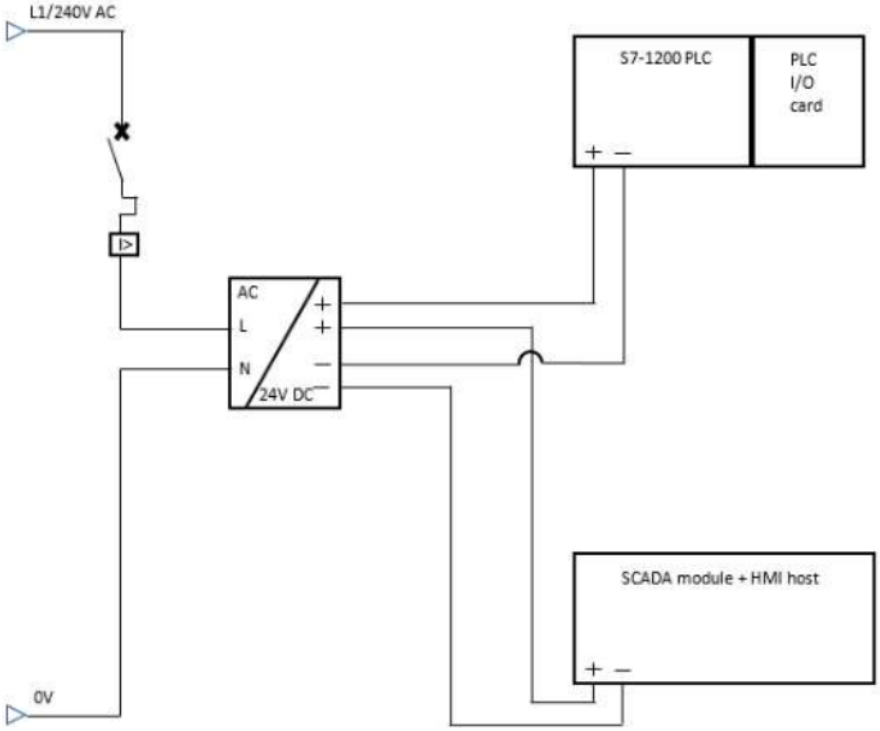


Figure 72 - SCADA panel power delivery

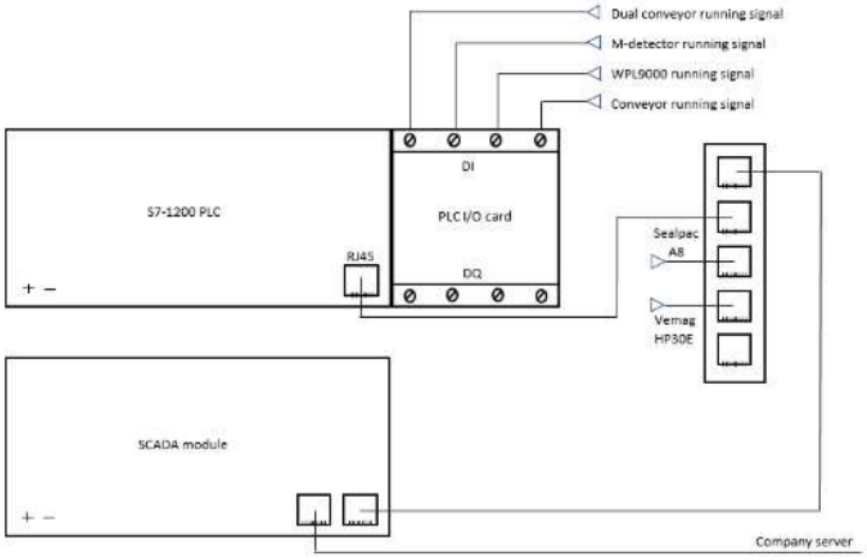


Figure 71 - SCADA panel communications + Cat5 runs

Log Entry Sheet

Log Number	18
Date	10/02/23
Duration (hrs)	11
Accumulated time (hrs)	219

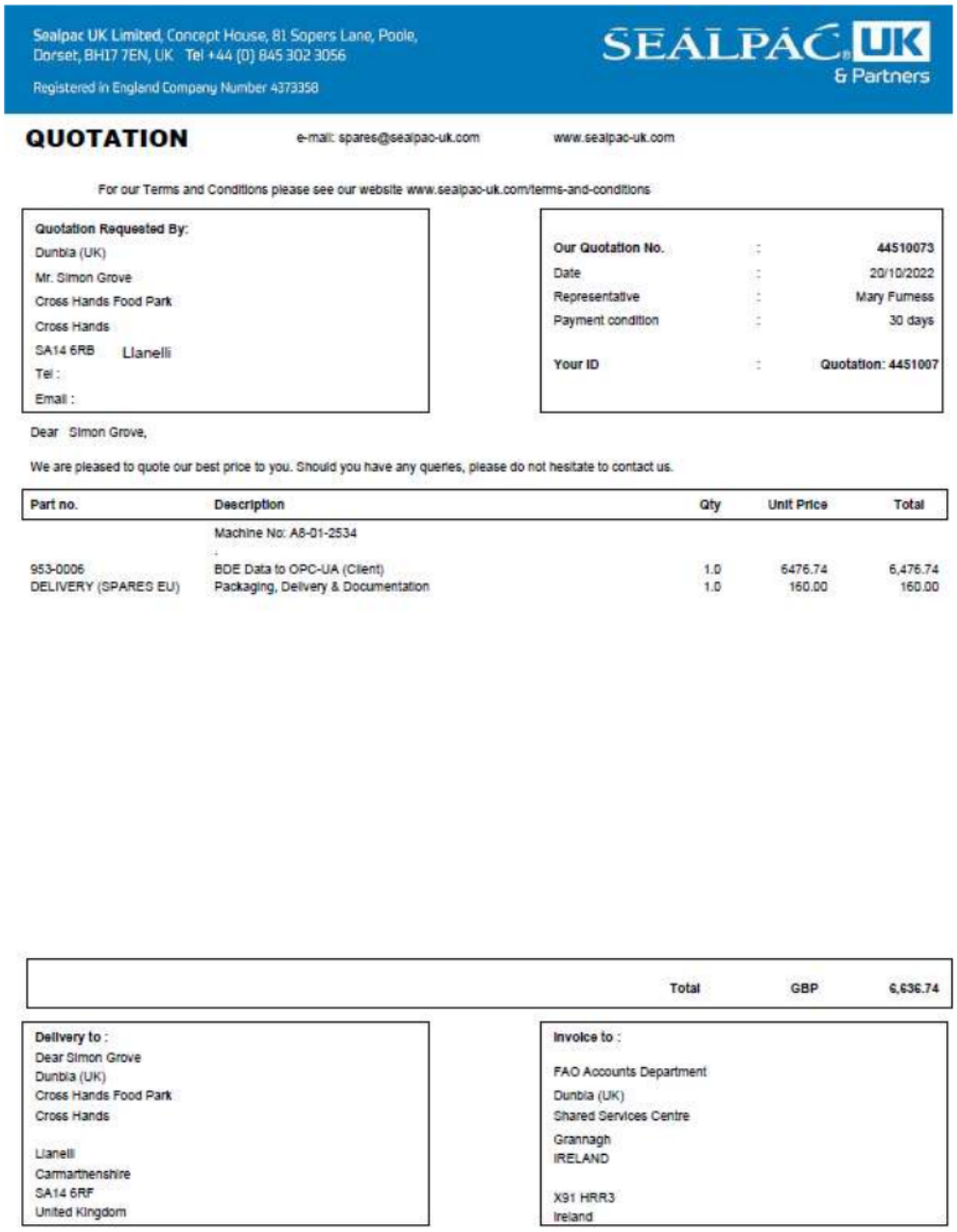
Record of activities and achievements

1. I had a meeting with the manager and spoke about getting in contractors to install necessary software upgrades ahead of time, get more details on SCADA module (including dimensions) and PLC + look at documenting the system as it is created so if faults occur within the system, they can be diagnosed easier. Quote shown below from Sealpac OEM addressed to Simon Grove (Head of projects).
2. Met with new engineer (Tomos) who has a background working with SCADA systems and will be assisting with the project.
3. Adjustments to original solution were proposed in meeting where instead of using a dedicated SCADA module, the software will be hosted on a server, but PLCs will still be used to pool I/O data.
4. No request has been made by manager to purchase a panel to mount parts inside since previous entry.

Plans for next week

1. Speak with the manager about getting in contractors to install necessary software upgrades ahead of time.
2. Speak with a new engineer about the project in more detail.
3. Discuss in more detail the proposed adoption of the SCADA solution.

Signed_____ Signed_____



Sealpac UK Limited, Concept House, 81 Sopers Lane, Poole,
Dorset, BH17 7EN, UK Tel +44 (0) 845 302 3056

Registered in England Company Number 4373358

SEALPAC UK & Partners

QUOTATION

e-mail: spares@sealpac-uk.com www.sealpac-uk.com

For our Terms and Conditions please see our website www.sealpac-uk.com/terms-and-conditions

Quotation Requested By:
Dunbia (UK)
Mr. Simon Grove
Cross Hands Food Park
Cross Hands
SA14 6RB Llanelli
Tel :
Email :

Our Quotation No.	:	**44510073**
Date	:	20/10/2022
Representative	:	Mary Furniss
Payment condition	:	30 days
Your ID	:	**Quotation: 4451007**

Dear Simon Grove,

We are pleased to quote our best price to you. Should you have any queries, please do not hesitate to contact us.

Part no.	Description	Qty	Unit Price	Total
	Machine No: A8-01-2534			
953-0006	BDE Data to OPC-UA (Client)	1.0	6476.74	6,476.74
DELIVERY (SPARES EU)	Packaging, Delivery & Documentation	1.0	160.00	160.00

Total	**GBP**	**6,636.74**

Delivery to :
Dear Simon Grove
Dunbia (UK)
Cross Hands Food Park
Cross Hands

Llanelli
Carmarthenshire
SA14 6RF
United Kingdom

Invoice to :

FAO Accounts Department
Dunbia (UK)
Shared Services Centre
Grannagh
IRELAND

X91 HRR3
Ireland

Figure 73 - Sealpac software + installation quote

Log Entry Sheet

Log Number	19
Date	17/02/2023
Duration (hrs)	10.5
Accumulated time (hrs)	229.5

Record of activities and achievements

1. Met new engineer (Tomos) and briefly discussed the project. Talked about how he has experience working with such systems.
2. Discussed using Inductive Automation SCADA software (called ignition) with new engineer + manager.
3. Organised to come in on overtime to develop a program for the project, speak to IT about a server to host a cloud service to accumulate and store data collected by SCADA and found out that the InductiveAutomation software is the SCADA software adopted by DAWN GROUP.
4. Still no word on panel housing. Manager has not looked at parts list email I sent.

Plans for next week

1. Download + install SCADA software on laptop.
2. Begin developing the SCADA program with the help of new engineer (Tomos)
3. Contact IT regarding the server.
4. Once the new parameters for the project are determined for definite, make changes to Gannt chart + keep a copy of the original. FDS needs to be changed with a copy of the original also.

Signed_____ Signed_____



Figure 74 - Introduction to ignition SCADA software (InductiveAutomation, 2023)

Log Entry Sheet

Log Number	20
Date	24/02/23
Duration (hrs)	12
Accumulated time (hrs)	241.5

Record of activities and achievements

1. Came in on overtime and spoke to IT about the project to try and get more progress. Discussed using a server to store data on runtimes, the SCADA software and how to acquire a company laptop since they cannot allow the software to be installed on a personal computer.
2. Asked the manager to request a laptop from IT since they need a formal request from the department manager before they can issue a laptop. (IT states once a request is made it will only take a day or so to put the required software on the laptop so I can use it)
3. Could not make further progress since I was told to help with breakdowns. (Not what I came in to do)
4. Still no word on parts requested for panel.

Plans for next week

1. Begin developing the SCADA program with the help of new engineer (Tomos)
2. Once the new parameters for the project are determined for definite, make changes to Gannt chart + keep a copy of the original. FDS needs to be changed with a copy of the original also.

Signed_____ Signed_____

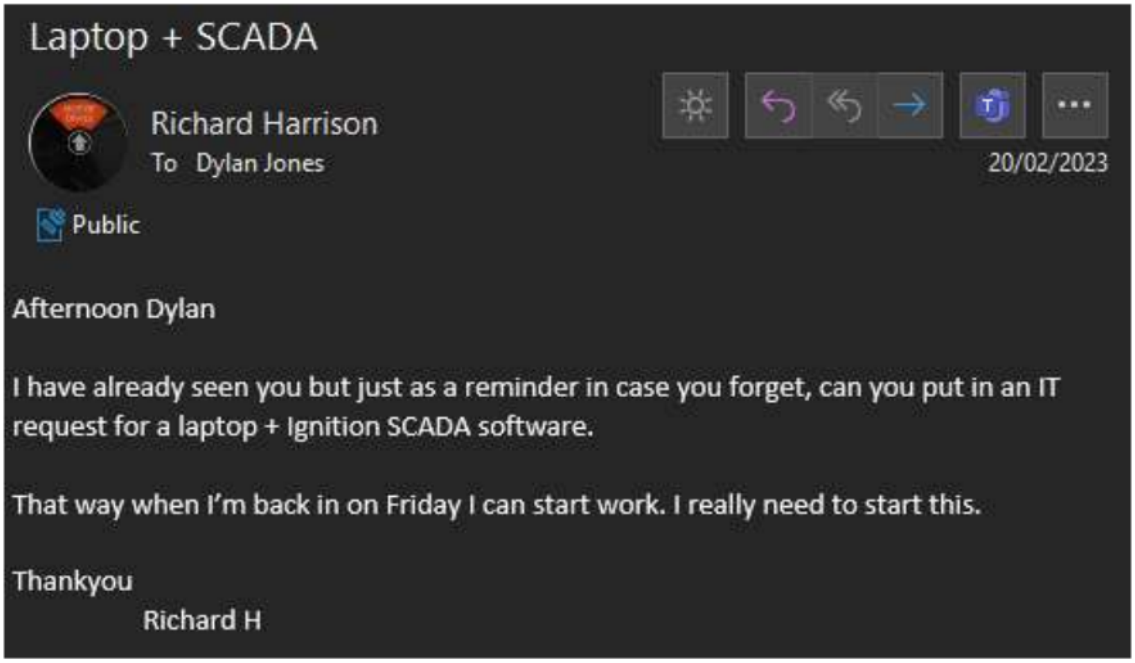


Figure 75 - Email requesting laptop

Log Entry Sheet

Log Number	21
Date	03/03/23
Duration (hrs)	9
Accumulated time (hrs)	250.5

Record of activities and achievements

1. Checked with the manager about a request for a laptop since I cannot begin on the software without it. (He said he has not submitted a request yet)
2. Brainstormed the very real possibility of constructing the HMI at home for testing purposes and what would be needed to do so.
3. College tutor suggested using Siemens TIA to test the HMI if needed. Began installing software on personal laptop in case this approach would be needed.

Plans for next week

1. Begin developing the SCADA program with the help of new engineer (Tomos)
2. Once the new parameters for the project are determined for definite, make changes to Gannt chart + keep a copy of the original. FDS needs to be changed with a copy of the original also.

Signed_____ Signed_____

Delivery Release TIA Portal V17

Entry | Associated product(s)

Information about TIA Portal V17: Your gateway to automation in the digital enterprise

TIA Portal V17 offers a large variety of new functions for existing products

- SIMATIC STEP 7 V17 > 109784439
- SIMATIC STEP 7 Safety V17 > 109783085
- SIMATIC WinCC V17 > 109795525
- SIMATIC WinCC Unified V17 > 109792165
- SINAMICS Startdrive V17 > 109795276
- SIMOTION SCOUT TIA V5.4 SP3 > 109801441
- SIMOCODE ES V17 > 109793079
- SIRIUS Soft Starter ES V17 > 109793077
- SIRIUS Safety ES V17 > 109793091

An overview of the new functions is available here: PDF TIA Portal V17 new functions (9.0 MB)

Overview of products and options in TIA Portal V17

Figure 76 - TIA portal Simatic WinCC V17 (Siemens, 2023)

Log Entry Sheet

Log Number	22
Date	10/03/23
Duration (hrs)	13
Accumulated time (hrs)	263.5

Record of activities and achievements

1. Still no word from the manager or indication that a request for a laptop has even been put in.
2. Began installing software on my personal laptop in my own time to learn how to create the HMI and develop a demonstrative program. (However, since this is on a personal laptop, testing will be limited). For reference, “Legion” refers to the laptop name.
3. Siemens TIA software suggested by tutor crashed personal; laptop and caused it to consistently blue screen on boot. To resolve the issue, had to revert to a previous version of windows dated before the install of the TIA software to get the laptop working again.

Plans for next week

1. Begin developing the SCADA program with no help from company what-so-ever. Will need to use guides from SCADA software distributor, video tutorials, previous work colleagues that have since left the company. for advice.

Signed_____ Signed_____

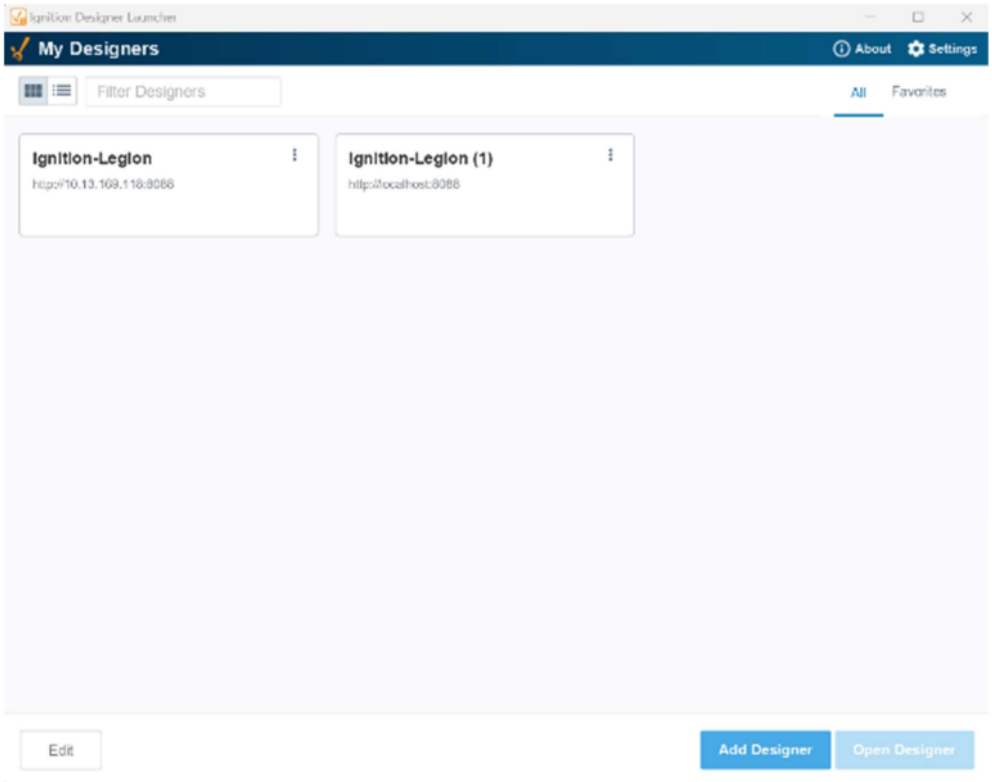


Figure 77 - Ignition launch window

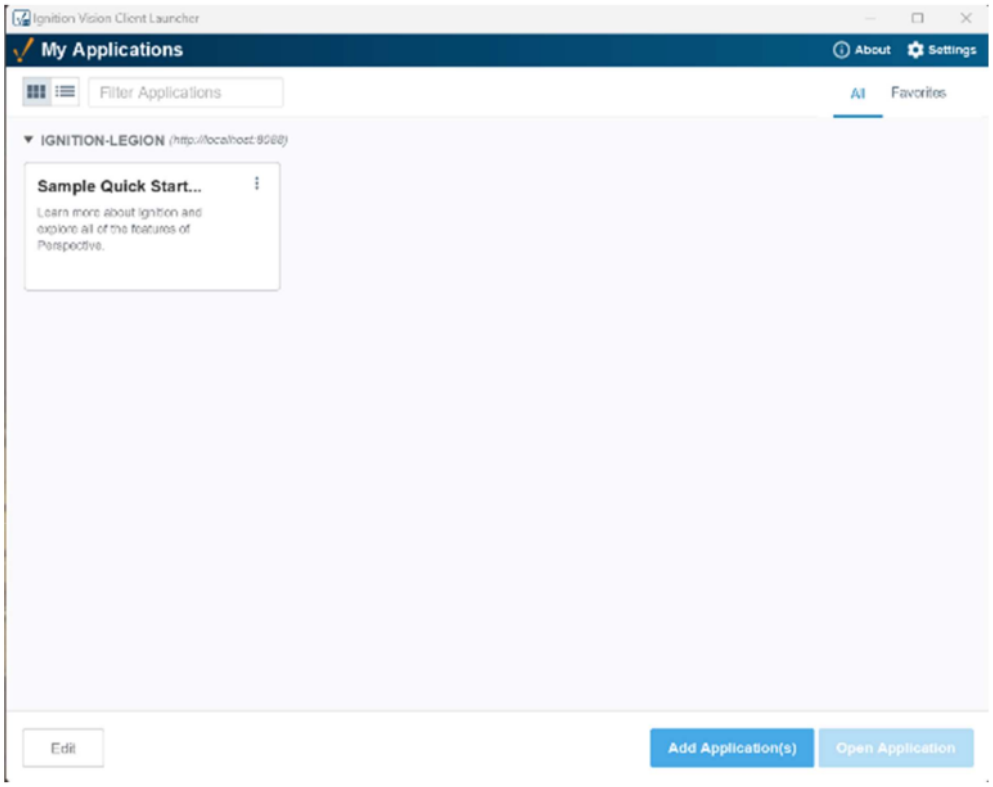


Figure 78 - Vision client

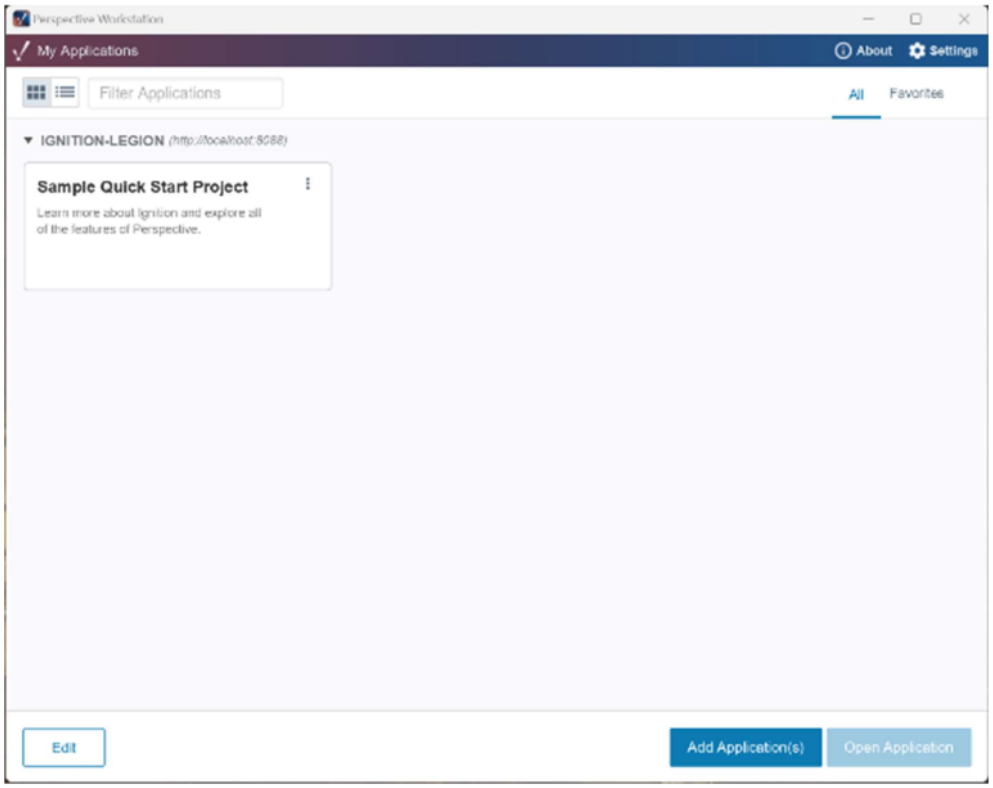


Figure 79 - Perspective workstation

Log Entry Sheet

Log Number	23
Date	17/03/23
Duration (hrs)	12
Accumulated time (hrs)	275.5

Record of activities and achievements

1. Consulted with a previous work colleague (Christopher McLaren) who showed that the SCADA software can be tested by installing Beckhoff PLC software that runs a PLC simulation on a personal laptop while SCADA runs the program on a server in a web-browser. Meaning testing of the HMI in full is possible.
2. Began constructing HMI within SCADA software using simple tags to replicate I/O from machines that would be on the line, creating visual representations of a top-down aspect of each machine in turn in order it appears on the line.

Plans for next week

1. Finish building SCADA program
2. Create script in Beckhoff for simulating a PLC on personal laptop to test HMI.

Signed_____ Signed_____

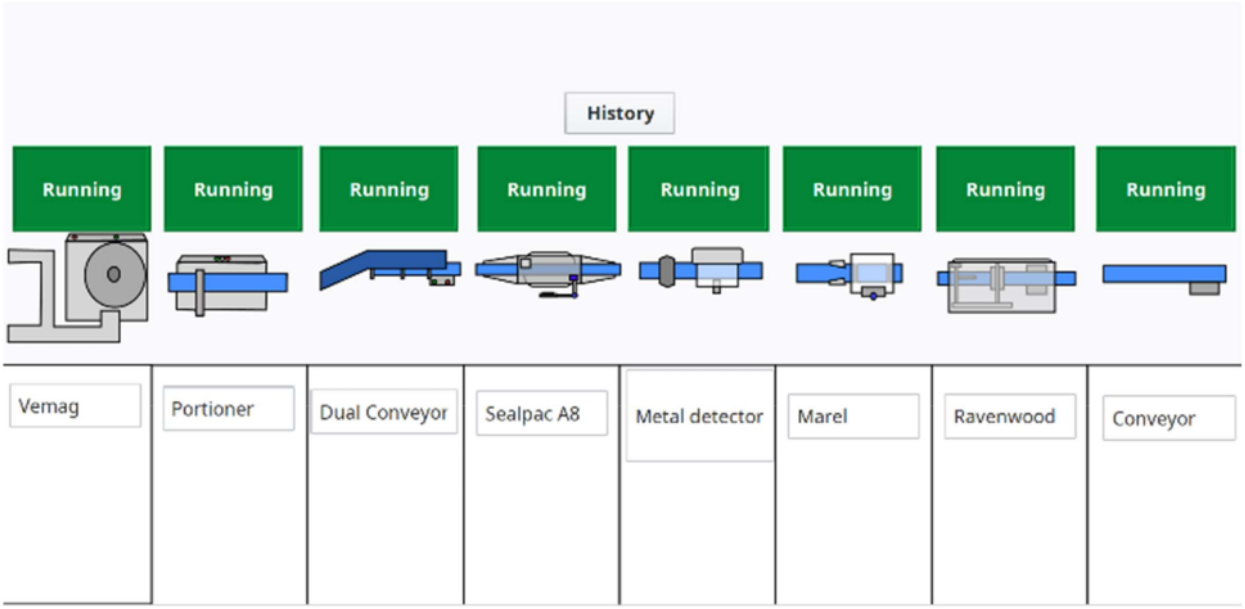


Figure 80 - SCADA HMI under construction

Log Entry Sheet

Log Number	24
Date	24/03/23
Duration (hrs)	14.5
Accumulated time (hrs)	290

Record of activities and achievements

1. Finished creating the HMI screen and created a separate window for compiling run-time history.
2. Created and tested history tab using a variable tag within the SCADA programming software.
3. Created Beckhoff PLC program to test the HMI using SCL script and data blocks to store the machine tags which can be used to connect with the SCADA program. Learned various methods of condensing the SCL programme down to make it easier to read and keep track of.

Plans for next week

1. Test completed HMI using Beckhoff PLC simulator.

Signed_____ Signed_____

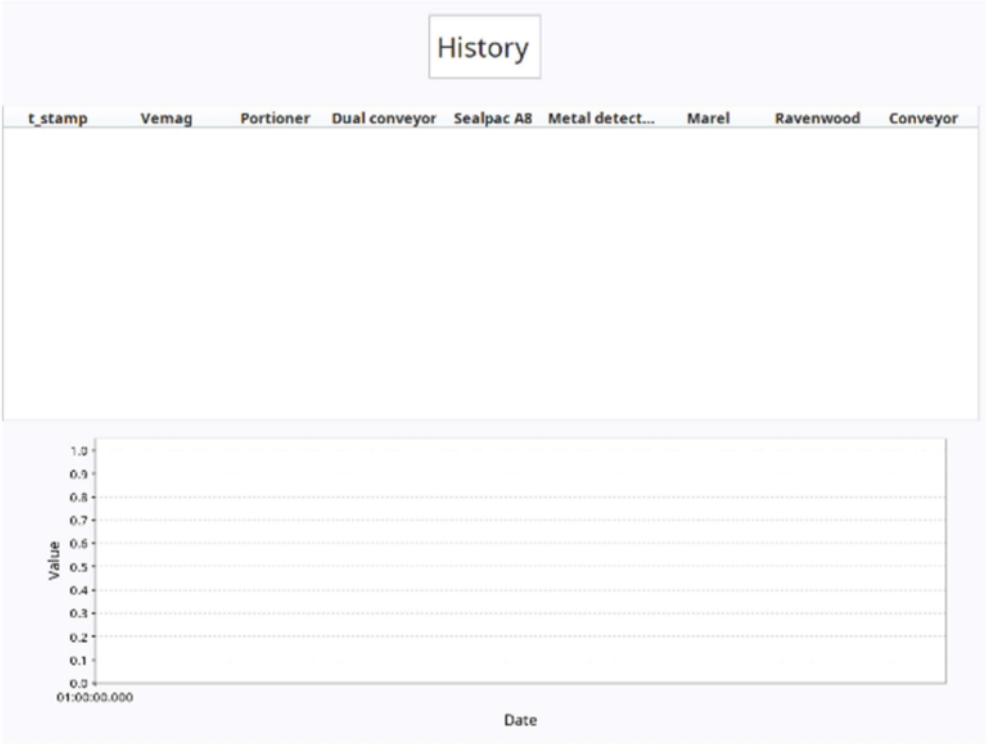


Figure 82 - History page within HMI

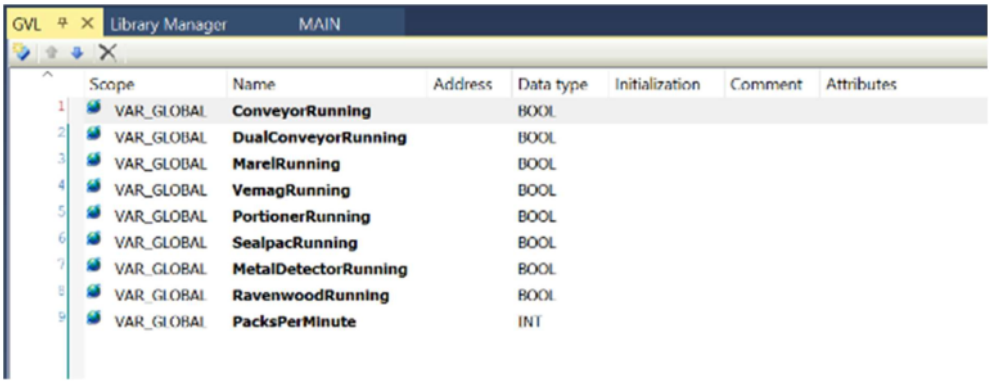
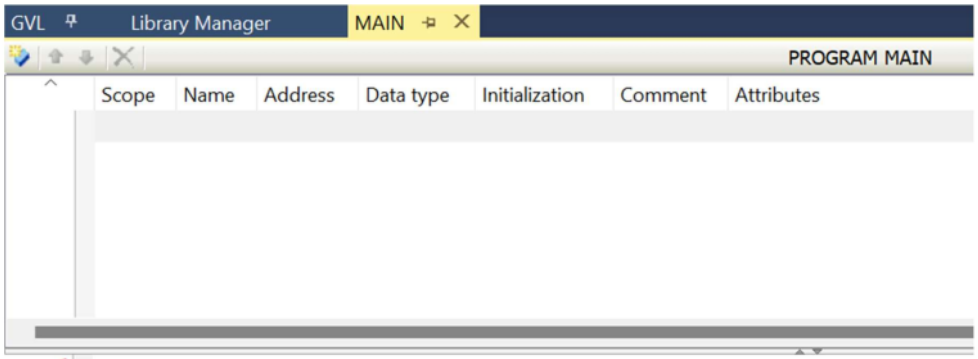


Figure 81 - Beckhoff global variable list




```
1
2   IF gvl.VemagRunning
3   AND gvl.PortionerRunning
4   AND gvl.DualConveyorRunning
5   AND gvl.SealpacRunning
6   AND gvl.MetalDetectorRunning
7   AND gvl.MarelRunning
8   AND gvl.RavenwoodRunning
9   AND gvl.ConveyorRunning
10  THEN
11  gvl.PacksPerMinute := 50;
12  ELSE
13      gvl.PacksPerMinute := 0;
14
15  END_IF;
16
```

Figure 83 - SCL programme for simulating PLC with appropriate I/O

Log Entry Sheet

Log Number	25
Date	31/03/23
Duration (hrs)	10
Accumulated time (hrs)	300

Record of activities and achievements

1. Beckhoff PLC simulation runs into an error when starting the program. After investigation, the issue is due to the software crashing because of how windows 11 operating system is structured on personal laptop. Possibly not compatible with the operating system.
2. Re-created programme on S7-1200 siemens PLC using TIA software in college to test HMI.
3. Tested HMI within the browser which is more limited.

Plans for next week

1. Install OpenVPN software so personal laptop can connect to college PLCs.
2. Connect PC to PLC once programme is loaded to test HMI using PLC toggles as I/O for the production line machines that would be connected in the workplace.
3. Write-up testing findings

Signed_____ Signed_____

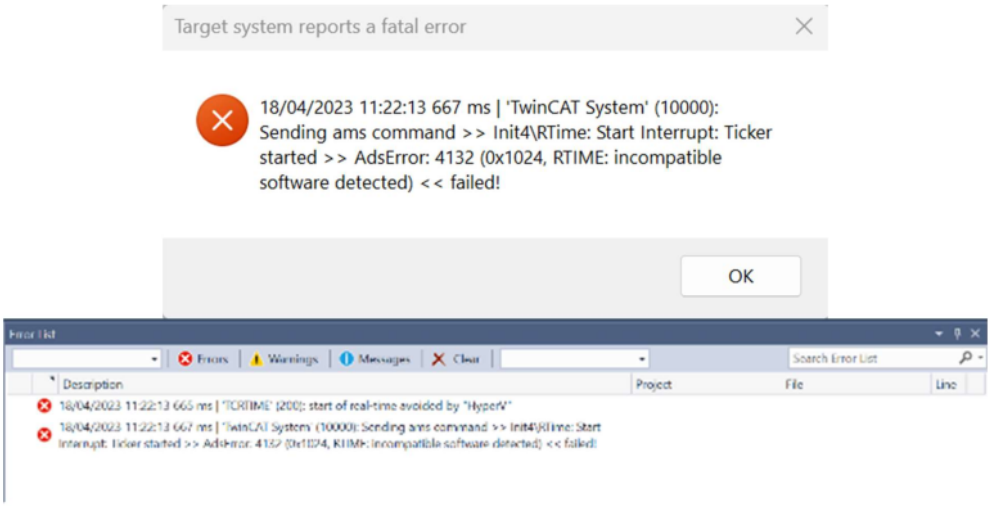


Figure 85 - BeckHoff HyperV error

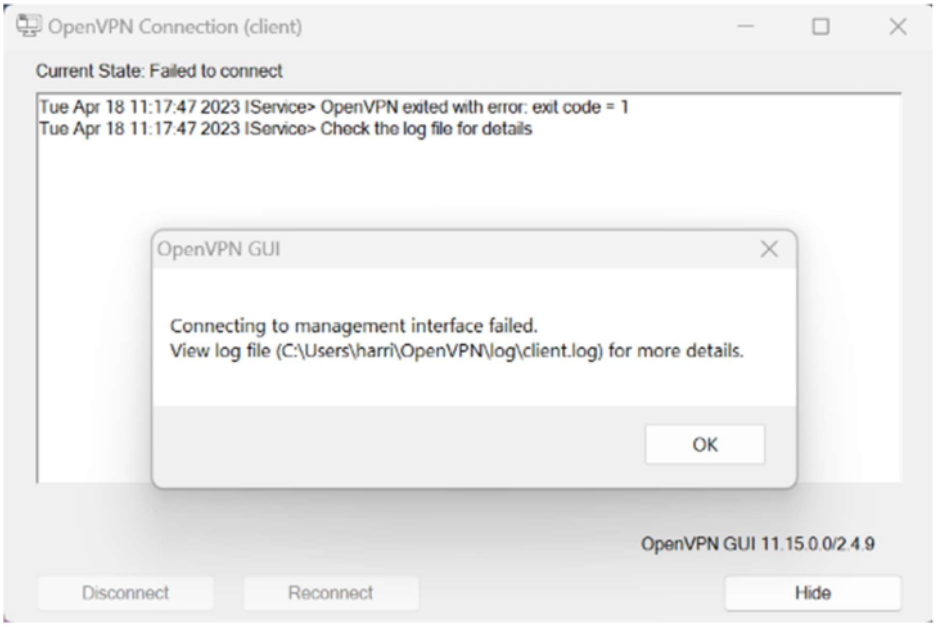


Figure 84 - openVPN error

Log Entry Sheet

Log Number	26
Date	07/04/23
Duration (hrs)	9
Accumulated time (hrs)	309

Record of activities and achievements

1. Installed OpenVPN software used by the college to allow laptop to communicate with PLC so testing could be done. Issues with the VPN software and lack of time prevented me from being able to test the software on the PLC. Will have to make do with testing on web-browser using Inductive Automation test servers.
2. Compiled findings from the limited testing that I was able to do given the circumstances.
3. Write-up project report.

Plans for next week

Signed_____ Signed_____

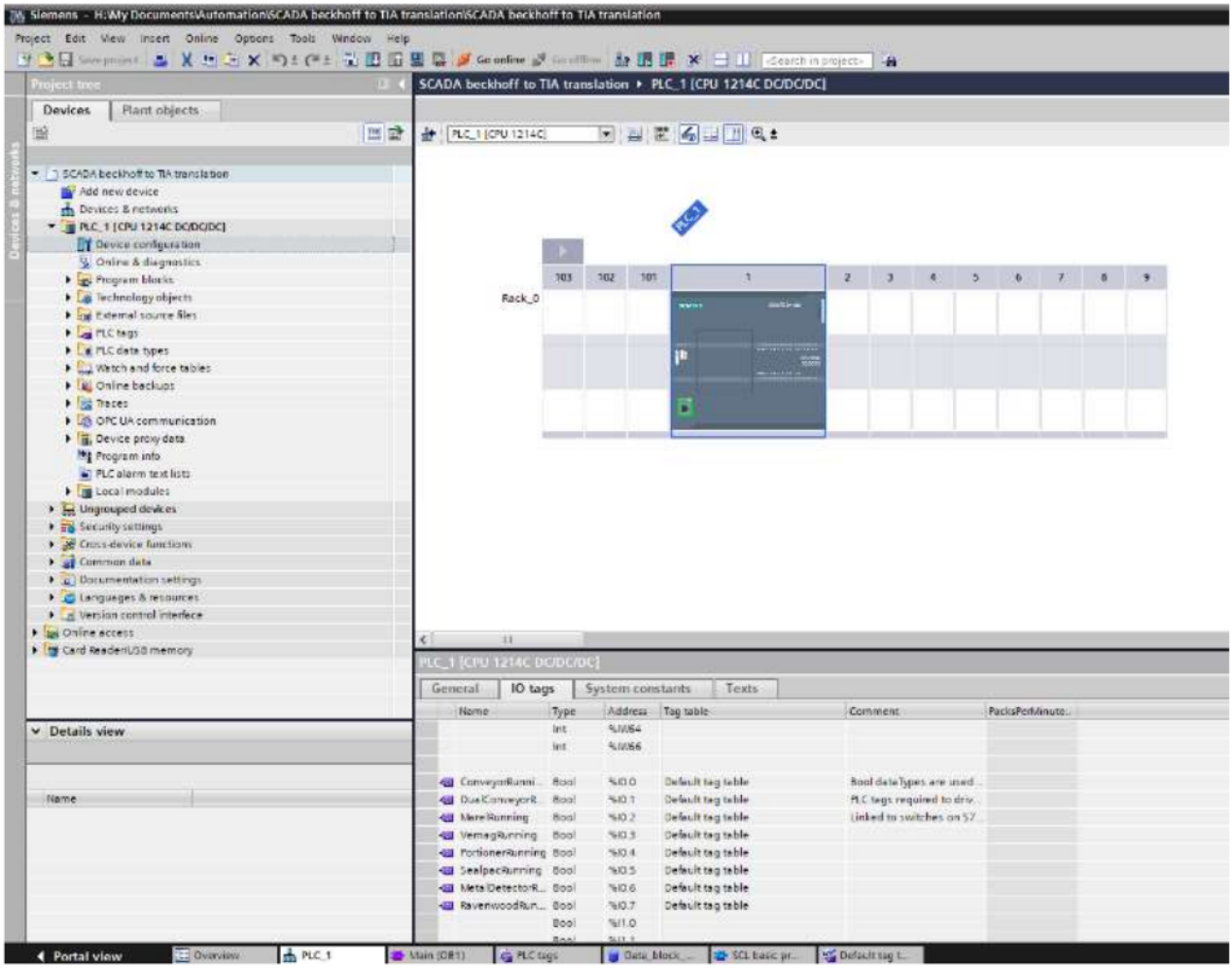


Figure 87 - Siemens PLC used in college ready to input program

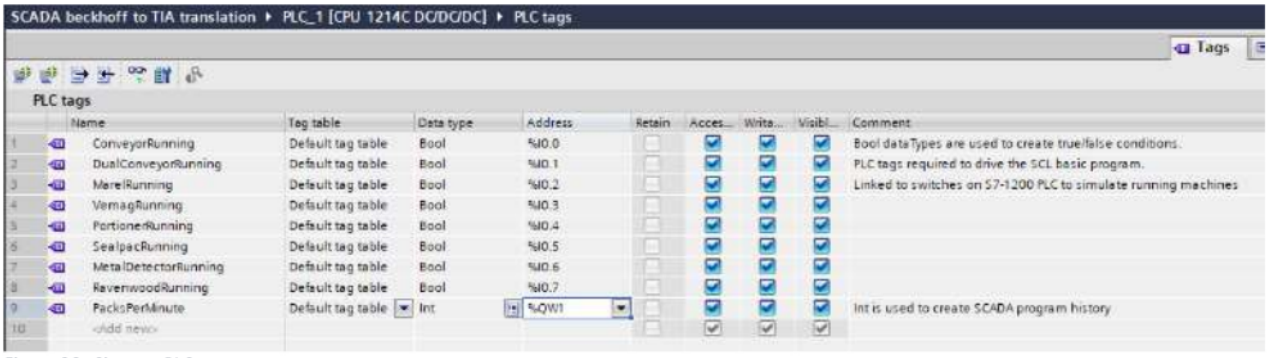


Figure 86 - Siemens PLC tags

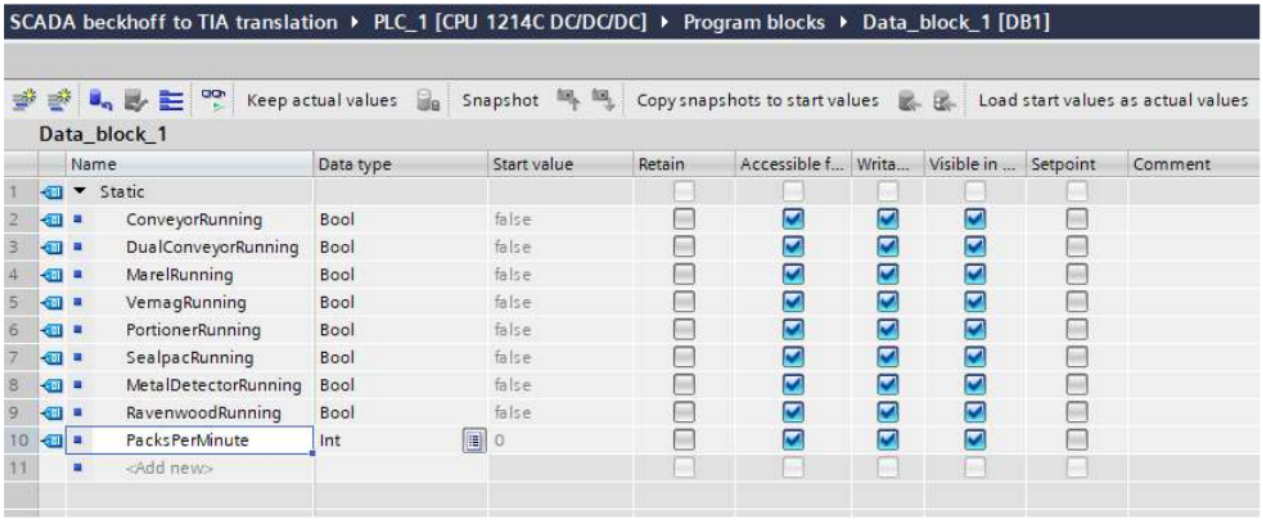


Figure 88 - PLC data block

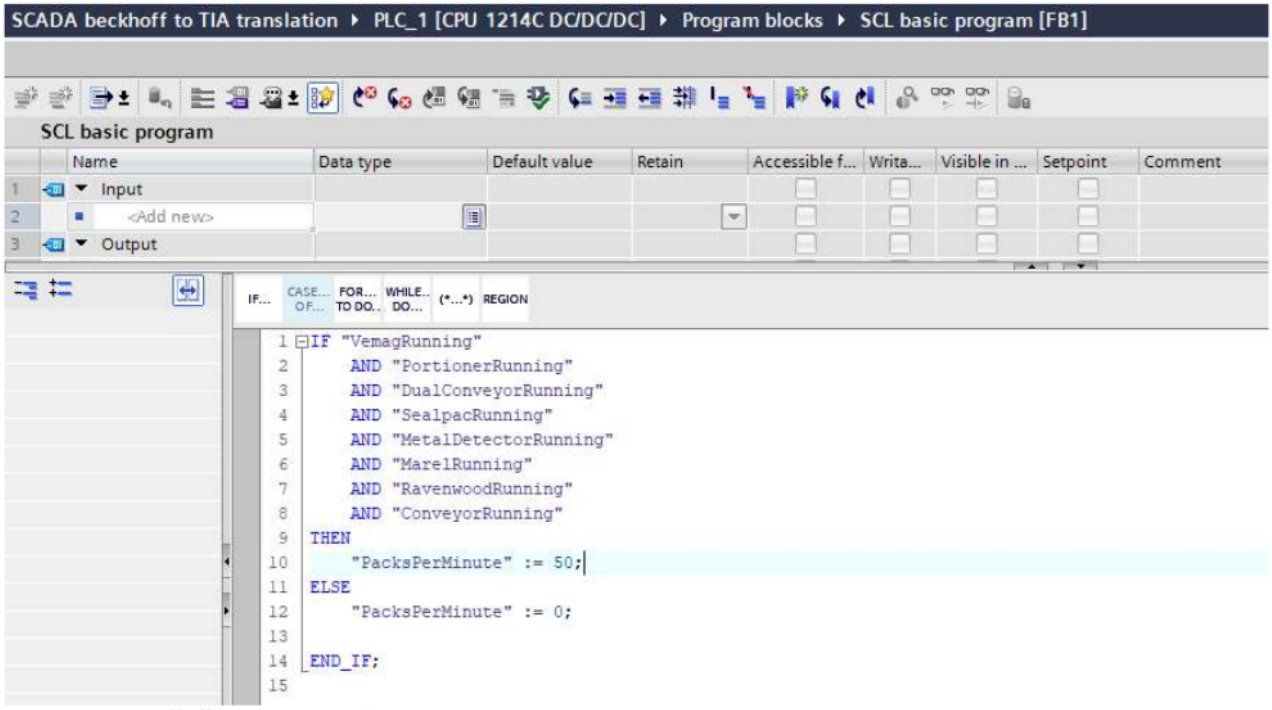


Figure 89 - Basic Beckhoff SCL program remade in Siemens TIA

1809806

GRADEMARK REPORT

FINAL GRADE

56/100

GENERAL COMMENTS

Instructor

PAGE 1

Text Comment. date submitted?

PAGE 2

QM

Good Structure

Report is structured exactly as stated in the assignment brief.

PAGE 3

PAGE 4

PAGE 5

PAGE 6

QM

Paragraphs should be fully justified text as required in the brief

QM

Line spacing should be 1.5

This allows the marker to put comments in between your lines

Text Comment. Your summary reads like a complaint against your company. instead, you should have focused on the good things you have achieved. You don't seem happy that you had to self learn things, yet this is the most important and valuable part of the experience of an independent project.

PAGE 7

QM

Spelling

Spelling error

Text Comment. 1.5 line spacing would have allowed your tutor room for comments between the lines.

PAGE 8

Text Comment. This clarification does not belong here and is entirely unncessary as stated earlier since the most immportant and valuable experience of a projec is doing things yourself.

PAGE 9

Text Comment. This has been explained already

QM

Spelling

Spelling error

Text Comment. use quotation marks

Text Comment. page number

PAGE 10

Text Comment. All citations should be done using the Harvard reference with quoted information

Text Comment. This table is therefore unnecessary

PAGE 11

Text Comment. This information should be in the log book. You should not be telling a story but rather, you should be focussing on what you produced

PAGE 12

QM

Write in the third person

Don't refer to your self as I, me, my or others as you etc. Avoid personal references. If absolutely necessary, refer to self as "the author".

Text Comment. This reads as a journal written in the first person.

QM

Spelling

Spelling error

Text Comment. Unnecessary image, it would be better to explain what it means and Harvard reference its contents.

PAGE 13

Text Comment. These belong in the citation list and information from them cited here in the text.

PAGE 14

Text Comment. It is not necessary to instruct your reader how to create a screen, this is a major project report not a user instruction manual.

PAGE 15

PAGE 16

PAGE 17

PAGE 18

PAGE 19

PAGE 20

Text Comment. It is pleasing to see how you have taught yourself how to do this but this belongs in a log-book.

PAGE 21

PAGE 22

Text Comment. Beckhoff states that " ..... " (2023, page?)

QM

Incorrectly cited, this is not the Harvard Method

PAGE 23

QM

Write in the third person

Don't refer to your self as I, me, my or others as you etc. Avoid personal references. If absolutely necessary, refer to self as "the author".

PAGE 24

Text Comment. lay

PAGE 25

PAGE 26

Text Comment. Better planning would avoid this lack of time

PAGE 27

Text Comment. This is quite understandable but better planning and time management could have resulted in a better outcome.

PAGE 28

PAGE 29

Text Comment. It would have been better to have adjusted the FDS and plans to produce something achievable. However, you have achieved much in your understanding and skills in developing a SCADA system and I am sure this will stand you in good stead for your next project. In the real world, projects often get shelved or delayed but you have shown great determination in achieving what you have.

PAGE 30

PAGE 31

Text Comment. You didn't need to keep saying this.

QM

Write in the third person

Don't refer to your self as I, me, my or others as you etc. Avoid personal references. If absolutely necessary, refer to self as "the author".

Text Comment. This is an unnecessary list of what went wrong. All project suffers form setbacks. Instead, you should have focussed on the end product.

PAGE 32

Text Comment. This is a good thing and self-learning is the most valuable part of the project.

PAGE 33

PAGE 34

PAGE 35

PAGE 36

Text Comment. Getting the project proposal signed by your company as part of assignment 1, may have given earlier warning that they had no intention of allowing you to complete the project. Lesson learnt!

PAGE 37

PAGE 38

PAGE 39

PAGE 40

Text Comment. You were asked not to include datasheets, instead, you should have read them and extracted information and cited it as a source.

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PAGE 57

PAGE 58

Text Comment. Only entries from the design and implementation phase were required.

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PAGE 114

GRADING FORM: NEW CSG-RUBRIC

RICHARD HARRISON	**56**

1. ENGAGEMENT WITH LITERATURE

	Section 3: Judicial use and critical evaluation of technical literature in the design of the project There is very good evidence of use of literature in the learning, configurating and programming of the software (4/5) Section 8: Extent of reading, range of credible sources and use of Harvard method There is a wide range of sources used which are listed correctly but not always cited correctly. Your main report contains table of URLs which are not required and your quotation should use quote marks. You have also included some datasheets in your appendix which are unnecessary. (3/5)	**7**

2. KNOWLEDGE AND UNDERSTANDING



Sections 3 and 4: Advanced knowledge and critical understanding demonstrated in the design and implementation of the project.
There is good evidence of advanced knowledge through self-learning (6/10)

6

3. COGNITIVE AND INTELLECTUAL



Section 5: Testing and analysis of results.
For what you were able to test, there is some evidence in the way of screen shots and a partly completed testing table for what could be achieved. (5/10)
Section 5: Critical evaluation of the project outcomes.
Good critical evaluation of your project outcomes. However, your report reveals your frustration with your company whereas you should have focussed on what you have achieved rather than blaming your company. Perhaps your FDS should have been revisited sooner and adjustments made to the outcomes. (6/10)
Section 6: Conclusions and recommendations
Good conclusions and recommendations. However, this section contains too much blame on others and should be written more positively. (5/10)

16

4. PRACTICAL APPLICATION

Section 4: Deployment method, use of material, tools, equipment and techniques in the construction of the project.
With what you could achieve, there is good evidence of correct methods and techniques. (6/10)
Section 4: Quality of the final product or system.
Although the practical aspects of panel building could not be assessed, the SCADA software appears to be of a good quality. (5/10)
Sections 5, 6 and appendix: Management of the design process including use of plans, costing spreadsheet and log book.
Better planning and contingencies would have produced a better set of outcomes. Practical issues would have been foreseen if you had ensured company approval and commitment to the project in assignment 1. You appear to have been waiting for others and have left important software developments to the last minute. However, there is good evidence in the log-book. (5/10)

16

5. TRANSFERABLE SKILLS

Section 1: Acknowledgements, executive summary and introduction.
All sections are present but contain far too much blaming of others for their lack of support. (2/5)
All Sections: Presentation quality of the report, diagrams, charts, tables, figure numbering, page and section numbering etc.
Report is well structured, tables and figures are number correctly. However, presentation could be a better if you had adhered to the style required in

11

the brief (full justified text, 1.5 line spaced). Some of your information belongs in the appendix or the log-book. (2/5)
All Sections: Quality of the writing style, use of punctuation and grammar.
Generally, writing style is OK but report reads like a journal with personal references and explanation of the problems encountered. However, it should be focussed on what was achieved rather than constantly complaining of who let you down. You should also learn to write in the third person. (2/5)
Word count limit not exceeded (5/5)