

PSDE 4033 - Callum Thornhill

by Callum Thornhill

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Callum Thornhill

University number: 1708182

PSDE 4033

Engineering Project

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*The list of
contents
would be
more
professional if
the headings
were sub-
divided.*

Introduction and background research

The aim of this project is to solve an engineering problem involving adhesive application onto a product. The problem with the production line involves the adhesive not being applied at all times as it should, thus, leaving voids on the product which are unacceptable for the final product. The voids that have been occurring have raised serious product quality concerns and has also resulted in a lot of product being scrapped due to not meeting the required standards of our customers.

The product is a foam material which has an adhesive on one side. The product is applied to the bodywork of automobiles to improve the quality and effectiveness of respraying bodywork during paint repairs. Having voids on the product is unacceptable because the foam material must have adhesive along the whole length of product so that it may be used correctly and effectively.

To combat this issue, a sensing method must be implemented to detect voids on the product during production and alert operators that a void has been made on the product. A full explanation of what is required for the solution is provided in the specification section.

The background explanation here is good and would be improved if supported by an image. There should be more research with relevant sources in this section.

Specification

This specification is written for and has been produced by C.Thornhill, Electrical apprentice at 3M.

In this specification, the parameters will be set for a new VOID DETECTOR in the PILOT COATER area of 3M Gorseinon.

Any solutions **MUST** conform to this specification so that the final solution will be within acceptable parameters as stated by C.Thornhill.

Objectives of this project

- To provide a means of sensing voids of adhesive on the product during production
- The solution must not stop the line at any time
- To alert operators of when a void has been detected
- To utilise existing PLC's and equipment if possible before purchasing more equipment

Planning

A gantt chart has been made to outline the proposed timeline of the project and when each individual task should be completed by. This gantt chart will be followed by another chart showing the actual times the tasks took place. The proposed timeline gantt chart is shown in Figure 1. As can be seen in the chart, the tasks are listed as follows:

1. Initial meetings with quality control staff
2. Research
3. Developing solutions
4. Meetings with Keyence and quality control staff
5. Presentation to quality control staff
6. Ordering of materials to requisition of materials
7. Installation of void detector
8. Programming of PLC and testing alongside QC staff
9. Review of project

Avoid first person terms.

The gantt chart includes overlaps which means some tasks will be worked on simultaneously. For example, the first two tasks overlap a lot because these tasks will be very important in preparation for the rest of the project. I plan to research on solutions at the same time as meetings with quality control staff so that my research can remain focused on any information they may give me throughout the project. With the demands of quality control staff aside, the project will be managed and completed by myself. Once enough research has been made I will put together some solutions and make note of any good/bad points on each of them. By analysing the solutions I will be able to make a decision on a final solution.

With a final solution chosen I will begin ordering materials for the job and install the solution. When the installation is completed I will be able to test the solution and make any last changes before confirming that the solution installation has been completed successfully. Once all tasks have been completed, I will review the project and take note of my performance, the solutions performance any mistakes etc.

Solutions considered

Solution 1

The use of a flowmeter will allow me to determine whether the flow of adhesive is moving, stopped etc. By using a PLC that is already in place, I could install a flow meter and input its signals to the PLC and make a program that can respond to the behaviour of the flowmeters signals. The program could use a line running bit to know when the line is running, along with the flowmeter input to determine whether the adhesive should be flowing at that time or not. With that in place I could then create an output response to a beacon so that if the adhesive is not flowing when the line is running then the beacon will flash to alert operators of a problem. A downfall of this solution is that flowmeters are expensive.

Solution 2

The use of a photo sensor which can detect light intensity and colour would allow me to determine if the adhesive has been applied to the product material or not. With this yes/no information supplied by the sensor, the pulse can be inputted to the PLC and a behavioural response made in a program. The response would be the same as solution 1, sending an output to a beacon to alert operators of a problem. This is a cheaper option than option 1.

Final solution and implementation

Solution 2 is the chosen final solution. Figure 12 shows a rough price for installation materials. This does not include the price of a beacon and a photo sensor which worked out to be £25 for the beacon and £250 for the sensor. Installation began with the mounting of the sensor over the web material. This is shown in Figure 11. The beacon was then mounted to the location deemed the best for operators to see easily, This is shown in Figure 2. The cables were then run from the sensor to an open slot in the PLC inputs and from the beacon to an open slot in the PLC outputs. The cable to the sensor was also used to pick up a 24Vdc supply and neutral from a nearby rail. Figure 8, Figure 9 and Figure 10 show the installation location of the project.

Once all hardware was installed, the PLC program was made to create an appropriate response for the beacon in relation to the sensor input pulses to the PLC. The rungs made in the PLC program are shown in

Figure 3, Figure 4, Figure 5, Figure 6 and Figure 7. As can be seen in these rungs, I have used “run line dry” to know when the line is running and also used a manual mode bit to ensure that this only happens in auto mode. The installation only being used in auto was not something that was part of the specification but during the programming of this solution it was deemed necessary to not have this work when in manual. [Fair comment here.](#)

A lot more was added to the PLC program than was anticipated because the PLC included a lot of bits that were previously used by the older part of the line that is no longer there. This was made more awkward due to the fact that the current line still used a lot of these old bits and so it was a case of I just had to deal with it and find a way to get it to work. A timer was added for the sensor input so that a void would need to be detected for a certain amount of time before turning the beacon on. This was due to the web “tracking” back and forth slightly out of the sensors range so the timer helped determine when the adhesive was actually missing or if the web was just tracking out of the sensors range. Another timer was added to allow the program to ignore any pulses for the first 10 seconds of the line starting. This is because the line makes a void intentionally when it is started so this one needed to be ignored.

Good points made here and there are images in the PLC program appendix to support this explanation of the functions.

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Testing and results

No readings, voltages etc were taken for the project as it is unnecessary for the outcome, all that is needed is for the solution to work. Because of this, the only testing was practical testing with operators, I made adjustments as I went along to tweak its performance. The alterations I had to make have already been discussed in the previous section. The outcome of the solution was that it was a success but I'm not happy with its current location in the line. The tracking of the web isn't a problem as I have made the program to take tracking into consideration but that doesn't mean that the tracking won't get worse. I would like to move the sensor to a more stable part of the line in the future if possible. The beacon flashes when a void has been detected and remains off when the adhesive is present which is good. The program waits for 10 seconds when the line is started as it should to ignore the first void.

Overall, the installation has satisfied the specification but improvements can be made in areas to make the solution even better.

The test procedures and arguments for adjustments are all good, but the first person terms used make it less professional.

Discussion, conclusions and recommendations

The practical testing of the project was a success and many changes were made to the program during testing to get the solution to work as the specification demanded. The specification asked for a list of demands to be met. Here is an analysis of these demands and the solutions response to each one.

- To provide a means of sensing voids of adhesive on the product during production

The sensor fitted above the web detects voids by using a reference of what the adhesive should look like, the sensor then compares that with what it is currently sensing to accurately detect when a void is present or not. The sensor chosen satisfies this part of the specification.

- The solution must not stop the line at any time

The program has been designed so that the line will never stop due to void detection.

- To alert operators of when a void has been detected

The beacon fitted uses an output from the PLC which relates to an output bit in the program which responds to when a void is present. The beacon has been placed at the rewind station which I where an operator will stand next to most of the time so they will notice straight away if there is a void.

- To utilise existing PLC's and equipment if possible before purchasing more equipment

An existing PLC was used for the programming and existing power supplies used instead of purchasing and installing new equipment when not necessary. This lowered costs where purchasing was not necessary.

With each part of the specification satisfied, the project is a success on paper. However, I would like to move the sensor to a new location where the tracking of the web is a lot less than it's currently location.

The conclusion has good points and some of the best arguments. It is good practice to provide an argument to support any section. Recommendations.

Reference list and bibliography

Appendix

Figure 1



Figure 2



Figure 3

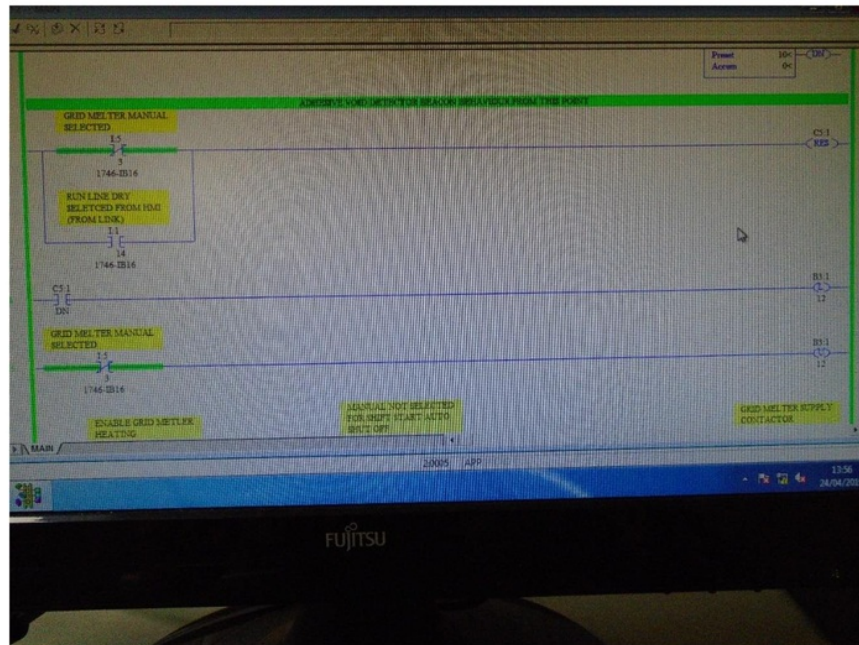


Figure 4

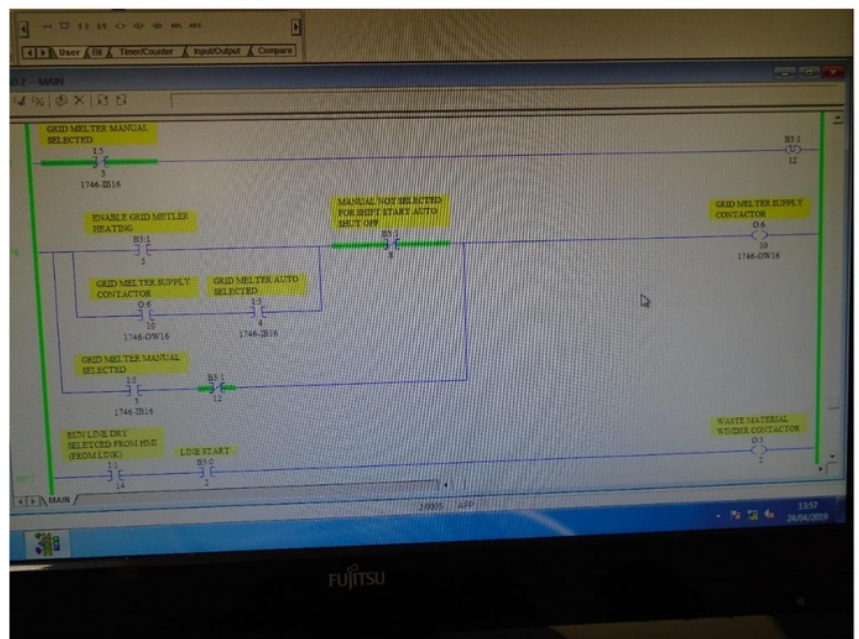


Figure 5

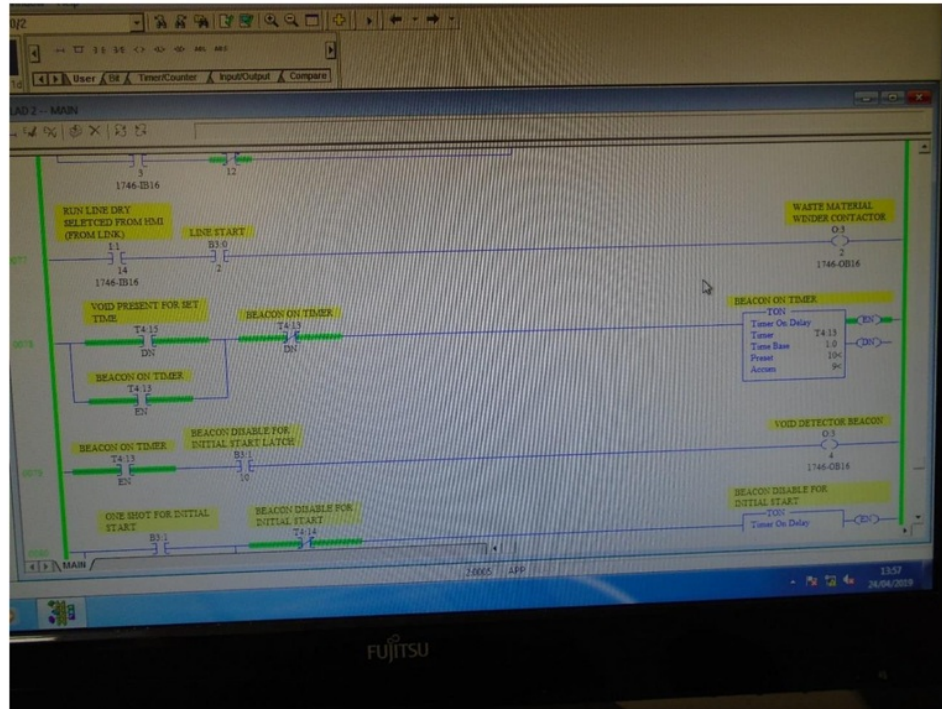


Figure 6

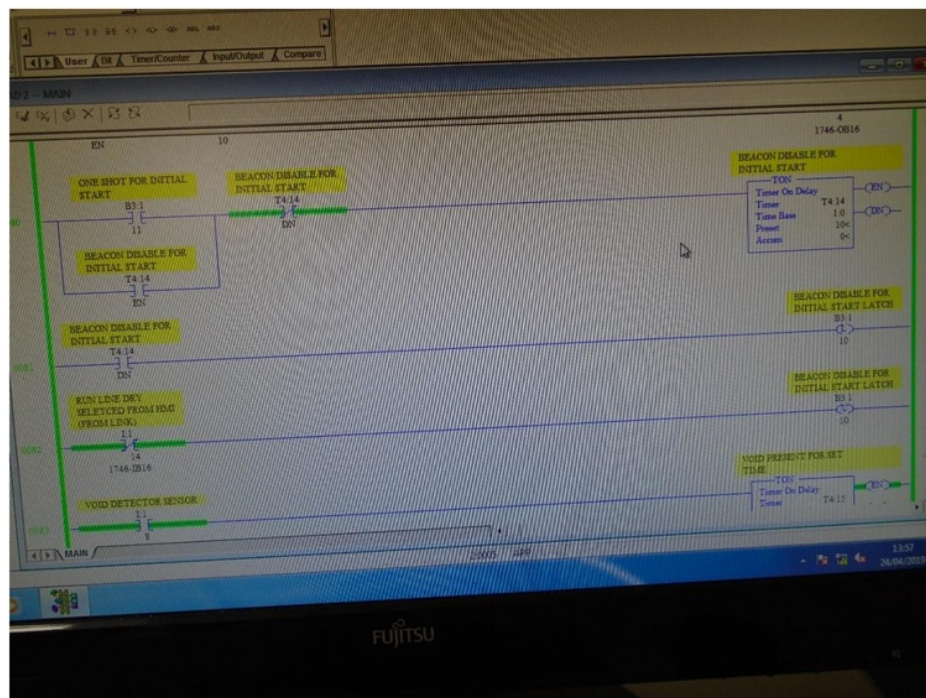


Figure 9



Figure 10

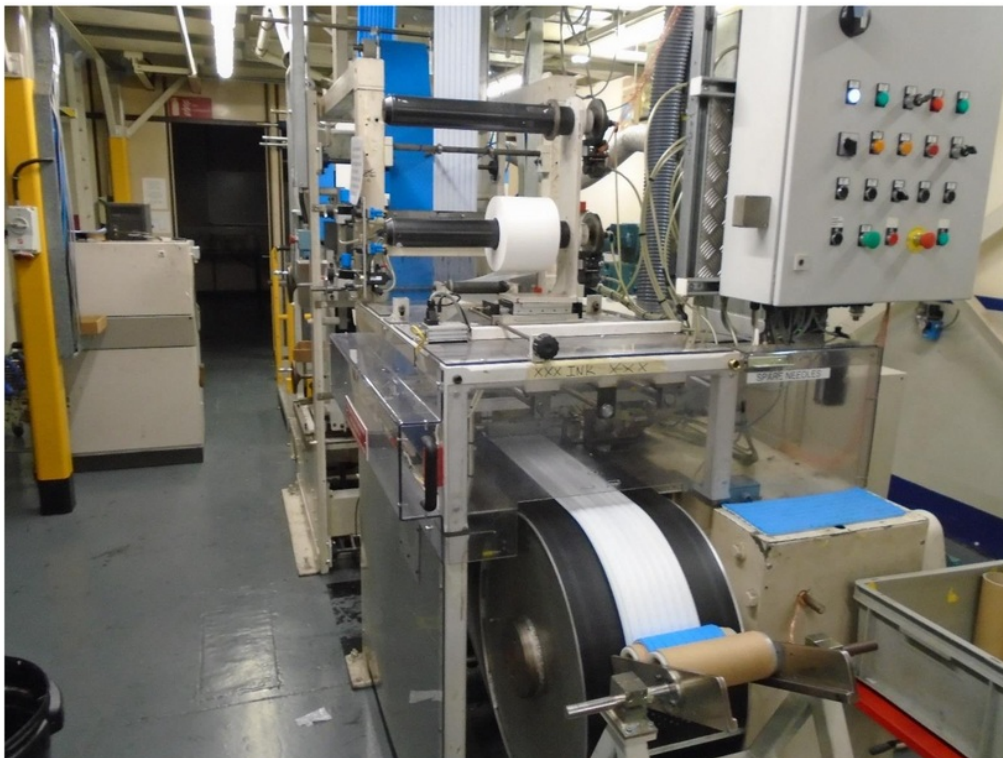


Figure 11

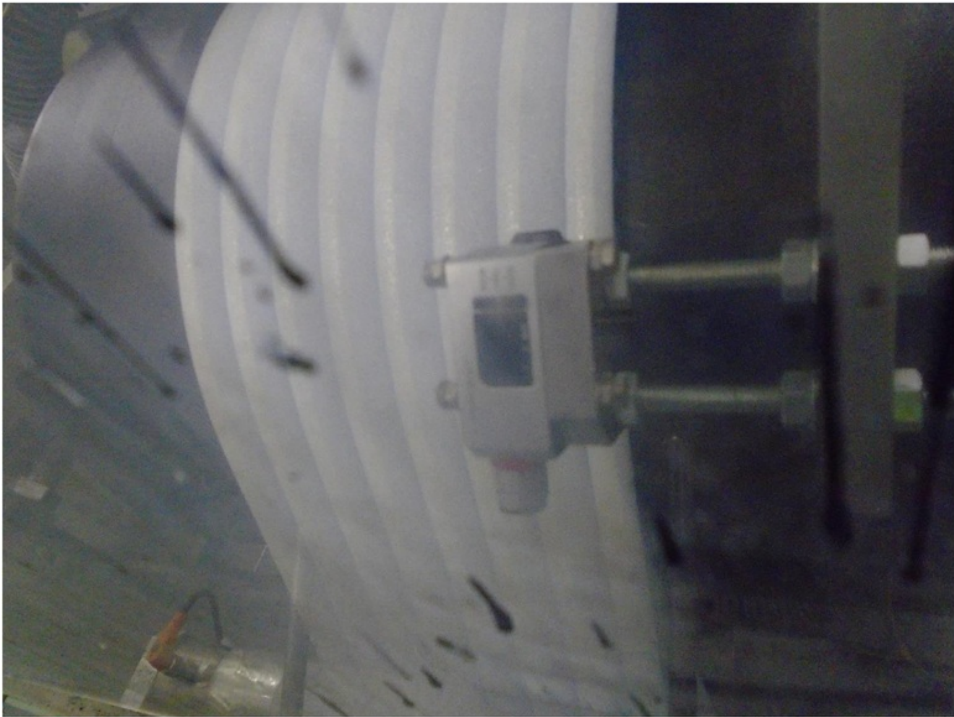


Figure 12

Schneider Electric IP64, Steel Wall Box 120mm x 300 mm x 300 mm



Price List

120 x 300 x 300	£28.29
120 x 300 x 300	£33.95

Kopex EF140 PVC Flexible Conduit Black 14mm 5m



Price List

14mm	£23.35
14mm	£28.02

RS Pro Galvanised Steel Rigid Conduit 20mm 3.75m M20 x 1.5mm



Price List

20mm	£9.488
20mm	£11.388

Omron 4PDT Non-Latching Relay Plug In, 24V dc Coil, 5 A



Price List

24V dc	£8.74
24V dc	£8.08

Lapp Lapp Oflex Classic 110 8 Core YY Control Cable, 1.5 mm², 50m, Unscreened



Price List

110	£91.02
110	£109.22

Goods total

£225.30

Delivery

Free

VAT

£45.06

Grand total

£270.36

The images are all here which support the references from the main report. The PLC program needs more explanation.

FINAL GRADE

GENERAL COMMENTS

Instructor

34/100

PAGE 1

PAGE 2

Text Comment. The list of contents would be more professional if the headings were sub-divided.

PAGE 3

Text Comment. The background explanation here is good and would be improved if supported by an image. There should be more research with relevant sources in this section.

PAGE 4

PAGE 5

Text Comment. Avoid first person terms.

PAGE 6

PAGE 7

Text Comment. The explanation is good and the images support this in the appendix.

Text Comment. Fair comment here.

Text Comment. Good points made here and there are images in the appendix to support this.

Text Comment. The PLC program needs more explanation of the functions.

PAGE 8

Text Comment. The test procedures and arguments for adjustments are all good, but the first person terms used make it less professional.

PAGE 9

Text Comment. The conclusion has good points and some of the best arguments for recommendations are in the testing section.

Text Comment. It is good practice to provide an argument to support any recommendations.

PAGE 10

PAGE 11

PAGE 12

PAGE 13

PAGE 14

PAGE 15

PAGE 16

PAGE 17

Text Comment. The images are all here which support the references from the main report. The PLC program needs more explanation.

GRADING FORM: CSG-RUBIC

CALLUM THORNHILL

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RESEARCH-INFORMED LITERATURE

Background research should include references



especially from academic sources. However there is an explanation of what the project is about. 3/10 No referencing has been used in the report to support research. 0/10

3/20

KNOWLEDGE AND UNDERSTANDING



The spec is very basic and needs more detail. 3/10 Solutions considered should include far more detail to support the arguments. There should also be refs for the solutions research. 3 /10

6/20

ANALYSIS



Testing and results would be improved if a table was used. The PLC program tests need further explanations for each network rung. However you have referenced the relevant images in the appendix. 4.5/10 The conclusion has some good points. The recommendations need to be supported by an argument. 4.5/10

9/20

PRACTICAL APPLICATION AND DEP.



The planning for the project using Gantt charts is good but does not show the predicted and actual timelines comparison. 2.5/5 Solutions considered need far more detail to support the arguments. Practical testing has been carried out on the chosen solution only. 3/10 Implementation has been completed for the chosen solution and there are images to support this. The PLC program however, needs further breakdown and explanation. 4.5/10

10/25

SKILLS FOR PROFESSIONAL PRAC.



Quality of report was poor overall and does not include a reference list. The report contains many first person terms which lowers the quality. 6/15

6/15