PROJECT PROPOSAL

Institute of Technology Tralee

Quality Management, Tools and Techniques in Practice

Automated Verification of Raw Material. (Scrap reduction)

Student: **Bertie Harte**

ID Number: [redacted]

Date: **12/09/2019**

Project carried out at: [redacted]

Workplace project sponsor: [redacted]

Role: [redacted]

1 Introduction/Description of the Problem or Issue

Bulk raw material in the form of printed circuit boards is manually loaded at the beginning of a multi-stage, high speed process. For cleanliness and housekeeping all packaging is removed prior to issuing the material to the production floor, thus external reference to part numbers is unavailable to the operators loading the material.

As a result there is a risk that mixed material may be loaded to the equipment, especially where there are significant visual similarities between the bare circuit boards.

While operator training and best practice guidelines instruct on a visual check of the material numbers, the impact of human error is a point of failure. There is a risk of performance and financial losses due to the scrappage of incorrectly processed material.

The equipment currently on the production line is not technically capable of detecting the differences in raw material – an engineering change may be required to raw material to address the risks.

2 Aim

The aim of this project is to eliminate the acceptance of incorrect material into the first transformative process of a production line. In this case a Laser Etch machine.

3 Objectives

The objectives of the project are:

- To assess the risk(s) at the process.
- Analyse the current impact (if any) of identified risk(s).
- Determine if practical solutions exist to reduce or eliminate the risk(s).
- Research alternative solutions to determine if these can be applied.
- Design and develop solutions to bring about improvements.
- Implement any solutions developed.
- Measure the effects of any changes.
- Document the methods used, technologies required (if any) and define how lesson learned can be further utilised.
- Distribute the project findings within the organisation.

4 DELIVERABLES AND NON DELIVERABLES

Deliverable 1:

The core deliverable for this project is to prevent the generation of scrap by active interruption of the process. This project entails designing and developing a low cost automated vision system to alert for incorrect material in a production process. The system will automatically inspect each individual printed circuit board loaded and generate a go / no-go signal in response to the production process loaded on the first

transformative process step. A single machine trial will be conducted on a high-speed production line in the [redacted] plant.

Deliverable 2:

Integration into an existing process.

Development of the hardware and software will be conducted as a standalone system. Once satisfied that the solution is working it will be migrated to the equipment for live testing. Detailed design specifications will be included. It is important that the solution be easily integrated into the existing equipment and if necessary as easily removed. The stability of the current process must not be compromised by any aspect of the project.

Deliverable 3:

The use of an intelligent system as an aid to the operators must be highlighted. The use of any system is not a criticism of the current work methods, but rather an acknowledgement that human error can occur and this solution is a safety net. With this in mind the system will be passive good – active bad. Where no failure is detected the machine will function as normal. The alert / alarms will only be generated when a failure occurs. Thus the system will appear to be a passive system, which should encourage operator acceptance.

Deliverable 4:

In the event of a system failure, either hardware or software, the system default must be OFF allowing the existing equipment to operate as normal.

5 Definitions

Printed Circuit board: A laminated panel with conductive elements, onto which electrical devices are soldered to create an electronics assembly.

Laser Etch: A transformative process where a barcode or text code is etched onto a printed circuit board using a low power C02 laser.

Vision System: A closed loop system that utilises image acquisition (cameras) and processing (software) to determine a good/bad output to control a process.

Embedded system: A low cost microcontroller running a small program, utilised when interfacing equipment where direct connections may not be supported.

Python: A programming language.

Library: A set of files that may be required by a computer program.

SMEMA: A machine communication protocol, allows transmission of signals between connected equipment.

6 Why I/we am/are well placed to do this project?

I have over 20 years' experience in manufacturing. I have prior experience and knowledge of process studies and improvement projects. My interests extend to using software based solutions to reduce or eliminate the impacts of human errors on production processes. I am sympathetic to the pressures and demands that high-speed / high-volume process place on operations staff, and believe that where possible robust automated solutions should be developed to assist staff.

I am equally conscious of the demands to deliver cost reduction and performance improvements directly through scrap reductions. Ideally scrap should not be generated – well designed and implemented solutions should be used to automatically stop processes where an error has been detected – detection should occur as early in a process as possible and be preventative rather that reactive. Automated detection systems are my preference.

7 Expected Benefits arising out of the project

- Detecting incorrect material before the laser etch will prevent scrap from occurring. This will directly reduce scrap costs. Automating the detection process removes an existing error-prone task from the operators, allowing them to remain focused on other production activities.
- The use of vision systems in industry is not uncommon, however they tend to be at the higher end of processes and are specialised, expensive and complicated, thus they are not widely used outside of specific key areas. The use of a low cost solution may encourage future research, development and deployment of similar systems as production aids – augmenting the existing systems and procedures.
- Knowledge of emerging technologies and potential applications in industry is informative. As technology changes, industry should regularly update itself on ways to work smarter. Using technologies to close process gaps or offset human-errors.
- This project is a process improvement – it augments an existing process, but adds an extra layer of automated verification.
- Other students may begin to understand how vision systems can be used to accurately evaluate repetitive tasks. Students may also understand that such systems need not be complicated and/or expensive. Additionally using low cost micro-controllers to connect machines may open additional improvement options.

8 Stakeholders in the project

- Bertie Harte: Project owner & solutions developer.
- Dr David Gorman. Project Supervisor, Tralee I.T.

[redacted]

9 Ethics statement

As there have been existing errors made, the expectation from production is that this proposal will absolutely work. While valid, the underlying methods as to why any human errors occur need to be addressed. However, these are many and varied and

outside of the scope of this project. A key concern for this project is that it is a trial using technologies that may prove to be unfit for this purpose, so the results while valuable may not yield any improvement in this specific application.

Operator involvement is a key component, as they will be the persons reacting to any failures. It is prudent to inform the support staff of the aims and objectives, and to reassure that this isn't taking anything from them, merely adding an additional automated layer to act as a protection. If the end-users are aware that this is an aid, they are more likely to report problems they encounter in a positive manner. It is also likely that additional features and ideas may come from the operator group, so regular communication will be required.

The project sponsor from [redacted] He is supportive of the aims of the project. There is no confidential information, so no agreements are required.

10 Risk Assessment

- Skills shortages: Many aspects of this project require an understanding of equipment functions, low level programming and micro-controller integration.
- I possess the skills to complete all tasks, however all documentation must be complete, robust and structured before project handover, so that others can understand the technical aspects – in the event of others continuing the development at a later stage. The project supervisor will also act as a document reviewer – to ensure that the documentation is up to standard.
- Regular document updates and review must occur as the project progress from design to offline testing to inline testing and prior to handover.
- This project is within the electronics manufacturing industry – specifically [redacted]. As I work for the company the interaction will be regular. I will be liaising with production operators (many) for the initial process maps and a planned Q&A session. My manager, also the project sponsor will be given regular updates and where required may authorise additional time resources to keep the project on track. The quality and production heads will also be regularly informed of project status – but have no direct involvement in the project timeline.

11 Research in the workplace

- Process mapping of the current system.
- Activity studies of operator handling of raw material during process steps.
- Operator focus groups to assess perception of risks.
- Analysis of scrap reports for previous occurrences – to get a baseline.
- Process mapping of any changes to the existing process.

12 Research (Literature Review)

Much of the technical aspects of this project have previously been researched. Python programing is a powerful tool for automating vision processing. Thus, many industry articles and discussions exist on its suitability for low level solutions.

The principle sources for preliminary research and occasionally for peer discussion were conducted on the websites listed below. *(Articles and fora accessed are indexed below the main link).*

Research gate.

- Image and Vision Computing.
- A survey on industrial vision systems applications and tools.
- Industrial Application of Machine Vision.
- Introduction to Computer Vision in Python.

Machine learning mastery.

- A gentle introduction to Computer Vision.

Stack overflow.

- Stack overflow opencv-python.

Semester 1 Project Plan

Week no.	***Task***	***Who (team projects)***	***Start date/Finish date***	***Duration (5 day working week)***
1-2	Research project areas which might be suitable and discuss with Project coordinator.	Bertie Harte (BH), Dr David Gorman (DG)	Sept 11th 2019 / Sept 20th 2019	1.5 weeks
2	Start writing up proposal	BH	Sept 13th 2019 / Sept 20th 2019	1 week
2	Hand up proposal through Blackboard (Friday)	BH	Sept 20th 2019	1 day
4	Start project (after approval)	BH	Sept 30th 2019	
4	Meeting 1: Workplace meeting	BH , Production operators (OP)	Sept 30th 2019 / Oct 4th 2019	1 week
4	Project Charter and timing plan to be handed up (Friday)	BH	Oct 4th 2019	1 day
5	Study 1: Process Mapping activity / Review current quality data.	BH , Production operators (OP)	Oct 7th 2019 / Oct 11th 2019	1 week
6	Study 2: Time study / activity mapping	BH , Production operators (OP)	Oct 14th 2019 / Oct 18th 2019	1 week
7	Meeting 2: Workplace meeting – discuss findings and improvement plan.	BH, OP, [redacted]	Oct 21st 2019	1 day
7 - 8	Software / Hardware development & testing.	BH	Oct 21st 2019 – Nov 1st 2019	2 weeks
9	Installation and live testing.	BH	Nov 5th 2019 – Nov 6th 2019	2 days
9	Meeting 3: Workplace meeting – solution rollout.	[redacted]	Nov 7th 2019	1 day
9-11	Monitoring, documentation finalised, review quality data	BH	Nov 7th 2019 – Nov 22nd 2019	2.5 weeks
12	Final Presentation	BH	Nov 29th 2019	1 day
13	Project Reflection	BH	Dec 6th 2019	1 day

Semester 2 Project Plan

Week no.	***Task***	***Who?***	***Start date/Finish date***	***Duration***
1-7	Review project performance, document before / after performance metrics. Interview [redacted] staff for feedback.	BH	13th Jan 2020 – 6th Mar 2020	7 weeks
7	Draft of final report (Friday)	BH	6th Mar 2020	1 day
7-11	Finalise report contents, structure, references.	BH	9th Mar 2020 – 17th Apr 2020	5 weeks
11	Final Report (Friday)	BH	17th Apr 2020	1 day
12	Final Presentation	BH	24th Apr 2020	1 day

Assessment of the Project Proposal (20% of overall mark)

For college use only:

	Element	**% allocation**	**Student mark %**
1.	Clear aims and objectives with clearly stated deliverables for each semester.	15%	
2.	Demonstrates confidence in the area through background knowledge of the topic and has confirmation of the support of their company where relevant. Has addressed all risk areas.	15%	
3.	Project plan showing how the student or team is going to achieve the aims and objectives within the academic time frame giving a schedule of activities and a breakdown of tasks for each semester.	20%	
4.	Has adequately addressed the headings of the proposal	50%	
	TOTAL	**100%**	

Proposal accepted: _____ *Yes*
_____ *No*
_____ *Conditional*

If conditional, please state conditions here.

Project supervisor for student: _____
Date: _____