

University of Wales Trinity Saint David

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Root Cause Analysis – Technical Report

Study Skills (ACMA4039)

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2 Introduction

Risk management is a key factor in the engineering industry as it helps control health and safety guidelines in production, as well as reducing and mitigating potential problems and malfunctions in the workplace. Risk management allows for procedures to be put in place that help to prevent injury and harm to production workers in the engineering industry. This can be carried out by using tools such as Root Cause Analysis documents which helps to identify potential risks and how they can be reduced and controlled. Furthermore, risk management is used in the industry to help assess potential environmental, financial and quality risks. The following technical report discusses the findings of my research into risk management in the engineering industry and the effectiveness of Root Cause Analysis documents.

3 Literature Review

3.1 Importance of Risk Management

In all industries, it is vital to have procedures in place to help manage potential risks. However, in the engineering industry it is especially important to have these procedures in place as manufacturing processes and working with large machinery has an increased probability of causing harm to employees and mechanical failure. Risk management techniques are put in place for more than just the protection of people, but also in order to comply with legislations which are in place as well as protect assets and reduce costs, by completing risk assessments to a higher level then failures are more likely to be noticed earlier and therefore preventing expensive machinery and products from damage and costly repairs. As stated in the Management of Health and Safety at Work Regulations of 1999, by law an employer must follow three main steps for assessing risks in the workplace:

- *Identify what could cause injury or illness in your business (hazards)*
- *Decide how likely it is that someone could be harmed or how seriously (the risk)*
- *Take action to eliminate the hazard, or if this isn't possible, control the risk*

(Health and Safety Executive 2022)

This is the basic guidelines for carrying out a Risk Assessment in the workplace and helps guide employers when completing assessments in order to create a safer workplace. This ensures that employees are kept safe whilst working. Furthermore, good risk management is important to companies because it helps ensure their reputation stays positive as they are then known for being a safe, legal company. In addition to this, it also ensures projects are successful and meet the companies and consumers standards.

Something companies consider when assessing risks are the golden 3 pillars of sustainability: environmental, social and economic. This is because when assessing risks they consider what things could affect the environment, what things could have effects on the people around them such as workers and the local area, and what things could have an economic impact both positively and negatively.



Figure 1 - Diagram of Risk Assessment Process

(Howlett Health and Safety Services 2024)

Above you can see Figure 1 which is a breakdown of the 5 steps is referenced from the *Howlett Health and Safety Services* on how to effectively carry out a risk assessment which ensures that risks are well thought through and assessed.

3.2 Legislation in industry

To ensure risks are kept to a minimum and controlled as much as possible in the workplace there are lot of legislations which have been put in place for employers and businesses to follow. Legislations are put in place to force businesses to follow a set of laws which help keep employees safe and prevent malpractice. There are a range of legislations put in place with different laws aimed to help prevent problems and protect people. These laws are also important as they can also provide companies with a good reputation when they are followed and ensure that risks are managed appropriately. However, it is still the companies responsibility to put in place their own rules to control risks. For example, *COSHH does not set out specific requirements for specific circumstances. It sets out a basic system for managing risk to health. (HSG97 2004)*. COSHH is a UK law which has been put in place to control substances in the workplace. It does not state how each substance should be controlled, it states how companies should be controlling risks that could cause harm to anyone's health. Another example of legislation which has been put in place is the IMechE Code of Conduct which is to help reduce and prevent a broader range of risks in the workplace. It states companies should *quantify and limit risk in all aspects of professional work, including with those who are working under our authority (IMechE Code of Conduct 2021)*. This legislation forces companies to create a safe working environment that protects everyone as well as protecting the company itself and its reputation.

3.3 Preventive measures

Companies that prioritise risk management can use a variety of preventive measures which help control and reduce more risks in the workplace. Some examples of these measures can be the PPRR model and RCA documents. The PPRR model stands for Prevent, Prepare, Respond, Recover which is used for prevention and management of problems. The prevent section is prior to the incident, the

preparation section is once the problem is going to happen how do you prepare for it. Post incident is where the respond and recover phases take place. The response section is how you act after the incident and then recovery is how you make up for whatever happened in the incident. This covers risk management as it guides companies how to act prior, during and after risks/incidents have occurred. Another prevention process can be completing RCA reports which cover a specific process in manufacturing and break down every possible risk. It then covers the severity, occurrence frequency and detectability which allows the risk to be measured in a numerical form. It then allows you to analyse the existing prevention methods and investigate the risk after new measures have been put in place that allows you to compare both before and after in numerical form. These processes can help control and reduce risks in the workplace. In addition to this, looking in previous work incident records, it can help employers identify more unusual risks that don't happen as often or as frequently which therefore helps prevent more risks in the workplace.

4 Methodology

In order to complete this report, I carried out a lot of research into risk management as a whole as well as, in the engineering industry specifically. In addition to this, I completed a RCA document on one of the production processes in my workplace. This consisted of deep research into the correct function of the machine and how it should be operated. This then allowed me to identify when risks and problems occurred. It also allowed me to implement preventive measures and then record any changes/improvements.

5 Combined Results & Analysis of RCA

5.1 Breakdown of the RCA

Process / Function	Identified Issue	Potential Effect(s) of Failure	Severity	Classification	Potential Cause(s)/ Mechanism(s) of Failure	Occurrence	Current Controls	Detection	RPN	Recommended Action(s)	Responsibility and Target Completion Date	Action Results					
Process / Function	Describe the issue	What happens if the issue occurs	Rate the severity from 1-10	Ex: Operational Failure	List potential causes of the issue	Rate the occurrence likelihood from 1-10	List current controls in place to detect/prevent the issue	Rate the detection capability from 1-10 (the higher the score the harder to detect)	Multiply severity, occurrence, and detection	Actions recommended to mitigate the issue	Person responsible and target date for action completion	Recommended actions and results after implementing actions	Severity	Occurrence	Detection	RPN	Justification Comments

Figure 2 - RCA Table

Figure 2 shows the list of columns that should be filled out when completing an RCA. The table is split which help identify and measure each risk. Starting at the left it states the problems and the initial severity, occurrence likelihood, detection which overall provide the numerical RPN figure. The right side of the table shows the actions that have been put in place to reduce the risk, and again an RPN for after the action has been put in place. This provides us with numerical method to measure and compare risks.

5.2 Reasoning for the Justifications

When comparing the initial RPN scores to the RPN scores after preventative measures were put in place you can see the range in improvements and therefore I added a "Justification Comments" column which gave a comment on the amount the RPN had reduced by. These comments were based off the data side by side and how significant the improvement was.

5.3 Results

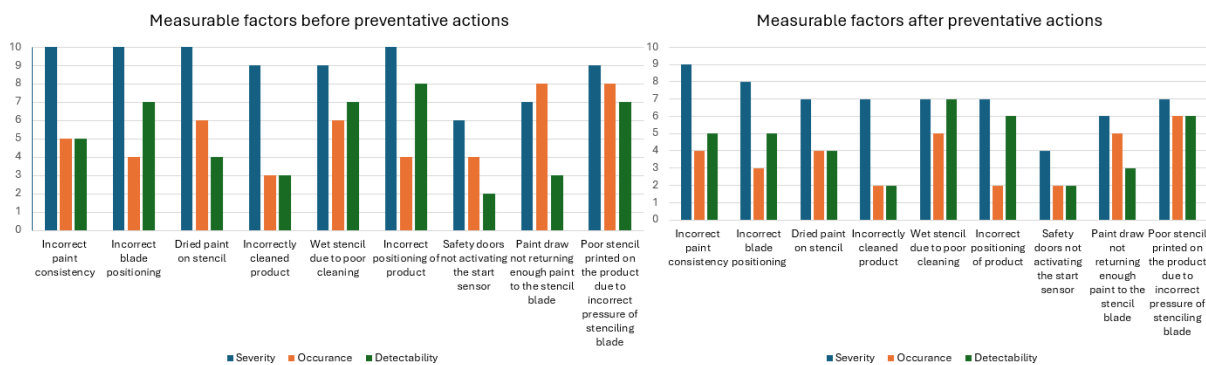


Figure 3 - Comparison of measurable data

The results of the RCA document have been broken up to display the levels of improvement before and after preventative measures have been implemented. In *Figure 3* there is a break down of each factor that was measured. Severity, Occurrence and Detectability were the three factors that were measured and by putting the two tables side by side you can see by how much each factor has improved after appropriate actions were performed.

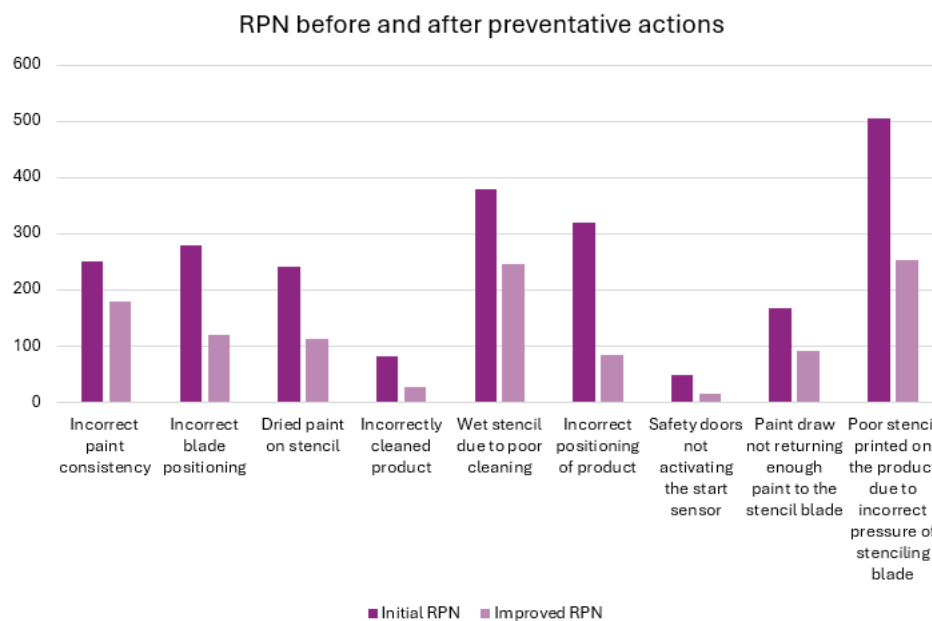


Figure 4 - RPN results

The level of improvement is easier to interpret when using the RPN values. This value is determined by multiplying the 3 broken down scores together to get an overall risk value. *Figure 4* displays a bar chart comparing the initial risk value to the risk value that was measured after preventative measures were put in place. This supports the argument that risk management is crucial in the engineering workplace as some scores came quite high initially before adequate investigation and assessments were completed.

6 Conclusion

After carrying out in depth research into risk management in the engineering workplace and completing an RCA document for a manufacturing process it is evident that risk management is vital in an engineering workplace. My findings show that risk management plays a crucial role in keeping people safe and reducing/controlling problems. This is supported both through the research that has been carried out into different ways of managing risks as well as the data that was collected from the RCA process. Furthermore, this emphasises how important risk management is and how companies need to be constantly improving, assessing and changing the preventative measures that are in place to stay on top of everchanging risks.

7 References

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(Figure 1)

8 Appendices

Item: Stenciling Machine			Responsibility: Manufacturing Engineering Department			RCA number: Page: FMEA Date (Orig):			Rev:								
Model: Production Workers			Prepared by: Dominic Jowitt														
Core Team: Production Workers																	
Process / Function	Identified Issue	Potential Effect(s) of Failure	Severity	Cause(s)	Potential Cause(s)/ Mechanism(s) of Failure	Occurrence	Current Controls	Detect	RPN	Recommended Action(s)	Responsibility and Target Completion Date	Action Results					
Process / Function	Describe the issue	What happens if the issue occurs	Rate the severity from 1-10	Ex: Operational Failure	List potential causes of the issue	Rate the occurrence likelihood from 1-10	List current controls in place to detect/prevent the issue	Rate the detector capability from 1-10 (the higher the score the harder to detect)	Multiply severity, occurrence, and detection	Actions recommended to mitigate the issue	Person responsible and target date for action completion	Recommended actions and results after implementing actions	Severity	Occurrence	Detect	RPN	Justification Comments
Stenciling machining failure	Incorrect paint consistency	If the paint is too viscous then the stencil blade will smear an insufficient amount of paint onto the product causing the stencil to be faded and dull. If the paint is too thick then the stenciling blade will push clumpy paint onto the product causing blotches and smears.	10	Operator error	Poor operator training/incorrect measurements of components required in the paint	5	Sign posting and information in the SOP of correct ratios when mixing paint.	5	250	Secondary inspection of paint mixture before input into machine	Shop floor manager/operator of machine	Add more precise measuring equipment such as measuring beakers in order to get more precise ratios when making the paint. Results show that paint was mixed more accurately in more frequent cases.	9	4	5	180	Acceptable reduction
*	Incorrect blade positioning	If the blade is in the incorrect position or has been adjusted in a way that it is not in the correct position it will press on the stencil at the incorrect angle and will not apply enough pressure. This therefore means that the paint will not be pressed into the stencil correctly and therefore an incorrect stencil will be applied to the product furthermore if the blade is adjusted into a position where it is applying too much pressure on the stencil it could tear the stencil and break it.	10	Operator error	Poor operator training or incorrect measurements for components/guides for correct positioning	4	Rough, outdated lines drawn onto machinery to indicate correct positioning. Information stated in the SOP for correct setup of machine prior to use	7	280	Staff training for the correct setup and how to detect problems	Shop floor manager/operator of machine	Add gauges which will allow for correct setup and are more accurate than previous methods of measuring the blade positioning. This has allowed employees to set up the machine more efficiently and accurately resulting in overall better stencils being printed onto products.	8	3	5	120	Good Reduction
*	Dried paint on stencil	If the operator of the machine does not clean the underside of the stencil frequently enough then paint can dry on the underside meaning that it smears other paint across the product and does not print a clear vibrant stencil up to standards on the product. Furthermore it can mean that the stencil sheet does not slide across the product as easily as there isn't enough paint being pushed through the stencil which can damage the stencil leading to unnecessary repairs.	10	Operator error	Poor operator training	6	Details guiding the process of operation in the SOP including regular cleaning intervals.	4	240	Staff training for the correct usage of the machine and how often the stencil should be cleaned.	Shop floor manager/operator of machine	Increased sign postage indicating after how many products the stencil should be cleaned. This has improved the overall stenciling process as less stencils are printed incorrectly or are smeared meaning more legible stencils are printed more frequently.	7	4	4	112	Good Reduction
*	Incorrectly cleaned product	If the product is not cleaned correctly then the stencil will not print correctly this can be because the product is dirty from transport and therefore dust or dirt will prevent the stencil from sticking to the product correctly resulting in an incomplete stencil. Or if the product is too wet from the cleaning with the white sprits then the stencil will smudge and slide across the product meaning the stencil will appear smudged and incorrect.	9	Operator error	Poor operator training and awareness	3	Information regarding product cleaning in the SOP and operator visual awareness	3	81	Staff training and secondary inspection of product prior to stenciling process.	Shop floor manager/operator of machine	Add sign posted instructions/warning for ensuring the product is cleaned correctly. This improved the overall efficiency and accuracy of the stenciling process.	7	2	2	28	Good Reduction
*	Wet stencil due to poor cleaning	When cleaning the stencil it is important to dry off the white spirit otherwise if the product is put into the stenciling machine whilst the stencil is still wet then the paint will not stick to the product correctly causing uneven incorrect stencils to be produced which are not up to standard.	9	Operator error	Poor operator training and lack of visual access to check the stencil.	6	Information in the SOP stating the correct process of using the machine and the cleaning process	7	378	Staff training and secondary inspection of product prior to stenciling process.	Shop floor manager/operator of machine	Add sign posted instructions/warning for ensuring the stencil is cleaned correctly. This improved the quality of the stenciling on the products and overall maintained the quality of the machine and the stencils.	7	5	7	245	Acceptable reduction
*	Incorrect positioning of product	If the product is incorrectly placed in the hold in the machine for example the height of the hold is too high or too low then the product will not be in the correct position to be stenciled. This is because if it is too high then it will foul with the machine or it will be too close to the stencil sheet and there will be too much friction for the product to rotate and could damage the stencil sheet. Furthermore, if the product is too low in the hold then it will not be close enough to the stencil and the paint/stencil sheet will not be able to reach the product meaning that no stencil will be printed onto the product.	10	Mechanical error	Poor operator training/incorrect set up of machine	4	Faint lines drawn onto machine to indicate correct height and information in SOP outlining the correct set up of the machine before the process begins.	8	320	Better briefing of the staff operating the machine to prevent damages.	Shop floor manager/operator of machine	Add warning signs on the machine reminding the operator to check the positioning of the product and better gauges or more visible marks on the machine to indicate the correct height for each different type of product. This resulted in less products fouling the machine and less stencils getting broken, as well as with correct product positioning lead to a more efficient and accurate stenciling process	7	2	6	84	Very Good Reduction
*	Safety doors not activating the start sensor	With repeated use of the machine and opening and closing of the doors in order to clean the stencil and apply the paint as well as adjusting the blade positioning it causes wear on the doors meaning the sometimes do not activate the start sensors for the machine to work and therefore you cannot begin the stenciling process.	6	Mechanical error	Poor operator awareness/poor maintenance of the machine.	4	The machine automatically will not start if the sensors do not sense the doors being closed.	2	48	Contacting maintenance team in order to repair doors/sensors.	Shop floor manager/operator of machine/maintenance team	By applying tape to the rear of the sensors it raised their height meaning they made better contact with the doors when they were closed and in a safe position. As well as replacing components on the doors allowed them to close better and make better contact with the sensors meaning the process happened better.	4	2	2	16	Good Reduction
*	Paint draw not returning enough paint to the stencil blade	The stenciling machine has a second blade that is supposed to drag unused paint back to the correct side of the stencil which will allow the machine to stencil again quickly with adequate paint. If this does not happen then the machine might try to stencil another product and not have enough paint meaning sections of the stencil might not be printed onto the product.	7	Mechanical error	Poor operator awareness/poor maintenance of the machine.	8	Hand scraper tool allows the operator to open the safety doors and drag the paint back into the starting position allowing the machine to function normally again.	3	168	Secondary inspection of the paint positioning on the stencil before starting each stencil	Operator of the machine	Repair the draw blade and apply the previous procedures mentioned for adjusting the main blade in order to get it in the correct position to draw paint back effectively. After completing these the machine draws back an adequate amount of paint after each stencil allowing the process to be completed more efficiently and the stencils to be more consistent.	6	5	3	90	Very Good Reduction
*	Poor stencil printed on the product due to incorrect pressure of stenciling blade	If the blade positioning is incorrect or the pushback feature is set up incorrectly then the blade could apply too little or too much pressure. This can cause the paint blade to either push too much pressure on the stencil either breaking the stencil sheet or preventing the product from rotating and therefore not producing a stencil. On the other hand, if the stencil blade is not putting enough pressure on the stenciling sheet then it will not push enough paint through the stencil and onto the product leading to no stencil being produced.	9	Operator error/ Mechanical Error	Poor operator awareness/poor or incorrect set up of the machine prior to use.	8	An automatic pushback system which lets the blade be push back a little and allows the blade to have a little give to prevent frequent stenciling sheets breaking. Information in the SOP about the correct set up of the machine and the blade positioning.	7	504	Secondary inspection of the blades positioning and the pressure being applied on the stenciling sheet.	Operator of the machine	By introducing gauges and clear, visible markings to the machine it allows the operator to easily where the blade should be positioned and therefore how much pressure the blade should be putting on the stenciling sheet. Furthermore a gauge was introduced to get the blade into the correct position without confusion or ambiguity. The outcome of these precautions lead to more accurate stencils and fewer stenciling sheets breaking.	7	6	6	252	Very Good Reduction

Personal Development Plan

Name – Dominic Jowitt

Degree – Mechanical Engineering (Part Time)

Previous Qualifications – A Levels + GCSEs

Previous Experience – N/A

Long Term Goals (5 to 10 years)

Use the information I've learnt from researching to improve and develop risk management in my workplace.

Improve writing skills to be confident in writing technical reports, RCAs, PDPs and other types of reports.

Achieve chartered engineer status

Short Term Goals (0 to 5 years)

Improve overall technical writing ability for report writing.

Gain a better understanding of RCAs and how they are helpful and should be completed.

Use PDPs to help me keep my academic goals on track to ensure I achieve good grades in my University Modules.

Achieve adequate grades in my University modules to achieve my degree.

Goal	Objective	Resources Required	Measurement	Target Date
Following the guidelines, complete a 1700-word technical report	Using the information and materials provided by my lecturer, I will get a better understanding of the formatting and information necessary to complete a good technical report.	Materials from the Lecturer, Microsoft Word, and Google Scholar.	A completed 1700-word technical report up to the required standards handed in before the deadline.	1 st December 2025
Complete an RCA for a work related problems.	Using information I already know and from some wider research, complete an RCA on hydraulic press problems.	Research materials and information from Google Scholar, as well as the RCA template provided by my lecturer.	A completed RCA with all the required information, which achieves a good mark.	1 st December 2025
Improve referencing skills and accuracy of references.	Using the resources provided by my lecturer and some online assistance	PowerPoint slides from my lecturer on how to reference material using the Harvard	More accurate references in my coursework assignments.	1 st December 2025

	improve my referencing. Use Google Scholar more frequently to get better at finding good sources for information.	Style. Google Scholar.		
Achieve a high mark in my technical report.	Use the guidance provided by my lecturer on the correct way to format and write my technical report, as well as research into technical reports and how they should be written.	Resources from my lecturer, Microsoft Word, and Google.	A mark of >70% in my technical report.	1 st December 2025