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The Effects of Product Recall Within the Manufacturing Industry

QUALITY MANAGEMENT IN AN OPERATIONAL ENVIRONMENT – ACEA7012

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Abstract

This report demonstrates how product recalls can have a detrimental impact on an organisation. It has been demonstrated that product recalls can liquidate a company, as this happened with Takata who's recall cost over $24 billion. It has also been shown a recall can severely affect the supply chain, as is the case with Samsung by only having one supplier for phone batteries.

Ethical issues such as poor management is an overwhelming factor to a poor product recall process. It was found that negligence from senior management could have prevented a significant amount of costs during the recall process by taking accountability.

A method developed by Ford Motor Group called the '*8D Process*' has been adopted in many organisations around the word to deal with product recalls. This processes efficiency is due to the structure from forming a team, understanding the problem, and implanting a solution.

Restoring customer confidence is very challenging during a product recall, however there are factors that will improve the customer relationship. Being reactive, taking responsibility for the problem and supplying a replacement in an urgent timescale will aid in restoring the customers confidence.

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1. Introduction

Product recalls can have damaging impacts to an organisation especially regarding costs and reputation. Procut recalls are seen through all industries and can be approached in various ways. There have been successful developments in the process of conducting a product recall to identify the problem, identify who's involved and how to overcome the problem. The 8D process has been utilised across the industries and is a successful tool to manage a product recall and the steps are discussed throughout to understand how to minimise cost and ensure customer expectations are met.

Product recalls cause the most waste financially in an organisation where many companies have lost millions due to the poor product quality and many other contributing costs. There have been many incidences where companies have been liquified as a result of product recall which is talked about throughout. While it is possible to estimate the direct costs of recall using (Filho & Buhr, 2010) model, indirect costs can make up a large share of the full recall cost.

As discussed by (Lopez, 2017) there are many affects to the supply chain due to a product recall. This however can by not being reliant on one source of goods. This can be related to managerial issues and historic legacies where an organisation has failed to adapt, whereby implementing lean procedures, there is greater chance to identify failures.

Finally, it is very difficult to restore customer confidence, however there are ways this can be dealt with. Ultimately, the consumers safety must be paramount and then managing the recall efficiently will restore some confidence by providing solutions and avoiding reoccurring incidents. When in a competitive market, they buyers have a powerful position. It is important not to rely on one customer base as losing this business leaves the company in a venerable position (Wellner & Lakotta, 2020). The need for sustainable processes is ever growing and it is discussed how companies can adapt.

2. Product Recall Process

2.1. Overview of Product Recall

It is crucial to have an effective product recall process as this will impact the organisations and customer reputations. Using successful strategies for recalling products, oftens involves companies taking accountability for the failure, which allows effective solutions to be implemented and making amends with customers.

(Das, 2009) describes a product recall as being a “request to the maker, a batch or an entire production run of product” to be returned. A product recall is conducted when there are safety concerns about the product or there has been an error in the product leading to defects or a labelling issue. Although this statement from (Das, 2009) is true, there are other factors to trigger a product recall. At times, there have been mandatory recalls by governing bodies (Cui, et al., 2022) and others are done on a voluntary basis (Michael J. Fishman, 2003). Voluntary recalls can be better approached by customers as this is a sign of the organisation accepting and acknowledging the failure by means they are likely to have a greater understanding (Cui, et al., 2022) (Michael J. Fishman, 2003).

2.2. The 8D Process

A lean approach to product recalls can be defined from the eight disciplines of problem solving (8D). This technique is well established across most industries and forms part of the quality reliability and consistency system (QRC) (Uslu Divanoğlu & Taş, 2022). This methodology is designed to find the root cause of a problem along with devising short- and long-term solutions to prevent reoccurring problems. The 8D process was founded by Ford Motor Company in the 1980’s, where they found this methodology to be very affective and was adopted as Fords primary method for problem solving (Muncut, et al., 2019). The 8D process is a detailed, team orientated approach to solving critical problems. The strength of the 8D process is from the structure, discipline, and methodology, by utilising best practices. The 8D process is required when safety or regulatory issues have been discovered, customer complaints received, or internal rejections have passed an unacceptable level (Alexa & Kis, 2016). This methodology is split into eight sections as seen in figure 1.

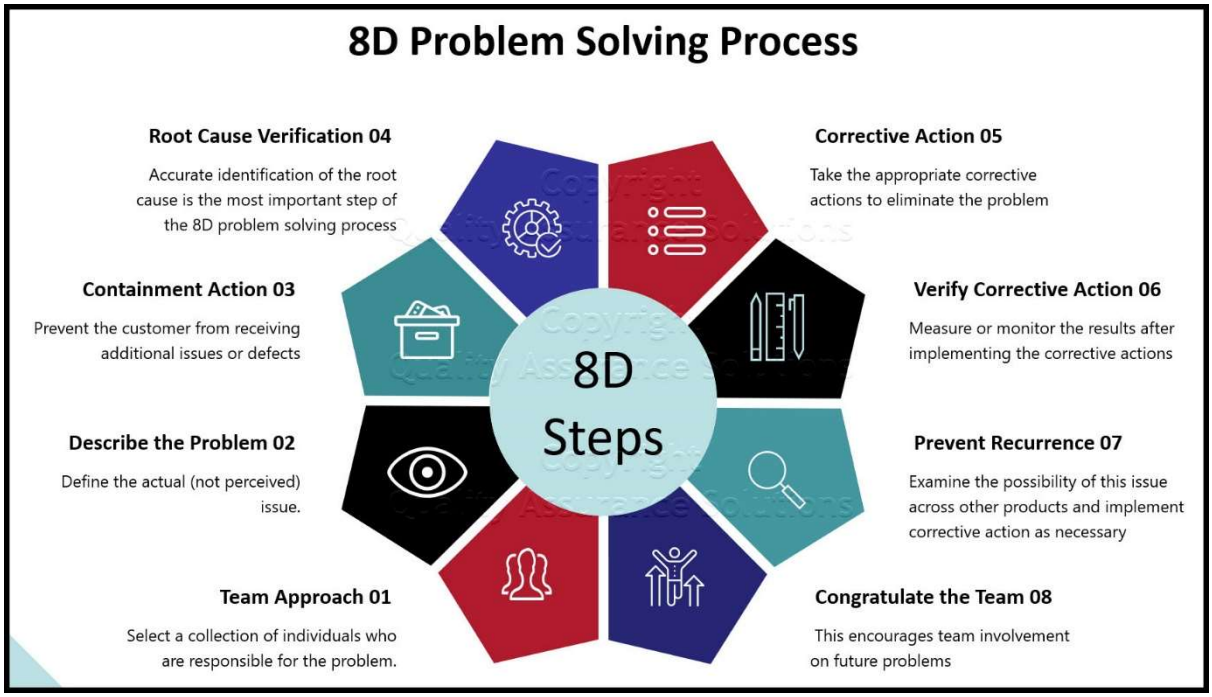

Figure 1 - Overview of the 8D Process (Solutions, 2022)

The first step is D0 which is to prepare and plan for the 8D as proper planning will always translate to a better start. By using a predefined checklist to identify the severity, the results can determine where an Emergency Response Action (ERA) is required which protects customers from further exposure to failed items (Uslu Divanoğlu & Taş, 2022).

Forming a team is the first quality step and is governed by D1. A cross Functional Team (CFT) is composed of many members from various disciplines involved. The team can vary from data driven approaches (inductive or convergent techniques) or a team who brainstorms, studies, and observes (Deductive or Divergent techniques) (S. Barosani, et al., 2017). It is important to have knowledge from all sectors.

The next step is describing the problem (D2), where the initial focus from this method is quantifying the problem from the data acquired. There are many techniques that can be used for this including inductive tools such as the 5 Why's and 'Is / Is Not' or deductive tools in the form of affinity diagram and fishbone/Ishikawa diagrams (Banica & Belu, 2019).

D3 is where the interim containment action occurs, as shown in figure 2. In this point, it dictates what the customer needs to do to assure immediate safety. It is important to verify the interim action to prevent any additional customer dissatisfaction (Muncut, et al., 2019). This action is removed once the permanent action is implemented.

In D4, the root cause analysis techniques are used to identify the cause of the failure, to provide solutions. There are various root cause analysis methods that can be utilised such as "Is" and "Is not" method, where a template can be seen in appendix A. There needs to be

verification of the root cause which is completed through data analysis. It is advised to review the process flow diagram to identify the location of the root cause (Alexa & Kis, 2016).

WALLCOLMONOY	WALL COLMONOY Ltd Corrective Action Report (8D Report)				WCL
Title:				NCR No.	
Reject Type:		Customer Name:			
Product Name:				Ref No.	
Reported Date:		Date Opened:		Last Updated:	

DØ Symptom(s):	DØ Emergency Response Action(s):

D1 Team:	Name	Position	Company	E-mail Address
Champion:				
Team Leader:				
Team Members:				

D2 Problem Description:
WHAT :
WHERE / WHEN / HOW BIG :

D3 Containment Action(s):	Date Implemented:
Rework or Sorting Action:	

Figure 2 - Wall Colmonoy 8D Process (D0-D3) (Colmonoy, 2022)

Implementing permanent correcting actions (PCA) (D5) is a direct result of the problem found in the root cause analysis. This process changes or removes part of the process which accounted to the failure. An acceptance criterion can also be established in this section which may include mandatory requirements as part of a directive compliance. The actions are aided by performing a risk assessment/failure mode affect analysis (FMEA) on the PCA choices to prioritise the movement (Rathi, et al., 2022).

Based on the prioritisation in D5, this is where to implement and validate the PCA (D6). Efficient planning is essential to successfully implementing permanent change which should include a project plan to demonstrate communication and the required steps to achieve the end goal. This allows to measure the success and conduct the lessons learnt at the end of the project (Chen & Cheng, 2010). It is key to communicate the project plan to the stakeholders, so all parties are aware when activities are taking place and when the deadlines are. To

quantify and validate the improvements, data needs to be gathered and analysed to ensure the problems have been rectified.

D7 is preventing recurrence, which takes the opportunity to preserve and share knowledge, preventing problems on similar products and processes. A review of similar products and processes should be conducted to identify problem prevention. All relevant safe working instructions and risk assessments should be updated inline with the solution. Finally, any updated FMEA's actions should be completed to bring full closure (Kumar & Adaveesh, 2017).

The final stage of this process is D8, closure, and team celebration. Within this stage, all documents would be archived which can be used for future references. A lesson learned would be conducted to make future problem solving more efficient. To have complete closure of the operation, recognition to the team and individual efforts as this solidifies the value of the 8D process, and to celebrate the closure (Uslu Divanoğlu & Taş, 2022), which has been incorporated in figure 3.

D4 Root Cause(s) and Escape Point(s):	% Contribution:
Root Cause: Escape Point:	
Verification:	
Root Cause - Escape Point -	

D5 Chosen Permanent Corrective Action(s):

D6 Implemented Permanent Corrective Action(s):	Date Implemented:

D7 Prevent Recurrence Actions:	Date Implemented:

D8 Team and Individual Recognition:	Date Closed:	Reported by:

Figure 3 - Wall Colmonoy 8D Process (D4-D8) (Colmonoy, 2022)

2.3. Ethical Issues

With this process, it is key to avoid any ethical issues. These can prevail if there is toxic workplace culture; Discrimination and harassment; Unrealistic and conflicting goals; questionable use of Technology (Sinha, 2015). On some occasions, quality failures are a result of this when major changes occur in an organisation such as organisational structure changes or change of ownership, as new processes introduced may not be fully understood by the respective teams (Wheel, 2022).

3. Costs Associated with Product Recalls and Controls

3.1. Major Costs

In most cases, product recalls heavily impact organisations, with some never recovering. An article from (Burrows, 2018) demonstrates the top ten cost affecting product recalls. This article shows how all industries are affected as the list contains companies from the automotive, pharmaceutical, food and technology industries. The article also describes how over the years from 1982, the biggest cost ranges from $100 million to $24 billion, where other many recalls can be seen in figure 4.

Figure 4 - Major Product Recall Costs (Allianz, 2022)

3.2. Case Studies

3.2.1. Takata Overview

The biggest recall to date is from Takata who manufactured air-bag inflators for many automotive suppliers. The reason for the recall was due to the inflators exploding and ejecting shrapnel-like material that was linked to at least 20 deaths. The National Highway Safety Transportation Board issues a mandatory recall which included over 37 million vehicles. This caused Takata to become bankrupt in 2017. However, the recall is still occurring as, on is likely to go on for the years ahead (Pagiavlas, et al., 2021).

3.2.2. Jaguar Land Rover Overview

From the Jaguar Land Rover (JLR) recall due to oil leaking from bearing, 1,500 brand new cars were recalled for repairs. The recall instructed customers to take the car to the issues garage. Thile the fix was taking place; customers were issued a courtesy car to avoid customer distribution. This recall cost JLR £15 million where many indirect costs such as, garage parts and labour, courtesy car, and customer claims absorbed over 60% of the recall cost (Wheel, 2022).

3.3. Calculating Costs

3.3.1. Direct Costs

It is possible to estimate the minimum direct cost of a recall by following designed by Moises Resende-Filho and Brain Buhr. The model takes into consideration the price of the recalled product and the quantity, along with the notification and transportation costs (Filho & Buhr, 2010). This can be displayed in equations 1 to 3.

$$Direct\ Cost = RC + 0.04RC + 0.1RC$$

Equation 1 - Direct Cost of Recall (Kganyago, 2018) (Filho & Buhr, 2010)

$$Direct\ Cost = Recall\ Cost + 4\%\ of\ the\ Recall\ Cost + 10\%\ of\ the\ Recall\ Cost$$

Equation 2 - Direct Cost of Recall Explained (Kganyago, 2018) (Filho & Buhr, 2010)

$$Where: Recall\ Cost = (Price\ of\ Recalled\ Product\ x\ Quantity\ of\ Recalled\ Product)$$

Equation 3 - Recall Cost

Example: The sell price of Inconel 625 is £40 per kilogram and due to contamination, 70Tonne of material had to be recalled. Thus, the minimum direct cost is as shown from equations 4 to 5.

$$Recall\ Cost = \left(\frac{£40}{kg}\ x\ 70{,}00kg\right)$$

Equation 4 - Recall Cost with Example Figures

$$Recall\ Cost = £2{,}800{,}00.00$$
$$Direct\ Cost = £2{,}800{,}000 + (0.04\ x\ £2{,}800{,}000) + (0.1\ x\ £2{,}800{,}000)$$

Equation 5 - Direct Cost of Recall with Example Figures

$$Direct\ Cost = £3{,}192{,}000.00$$

Therefore, the relative percentage costs can be calculated using Relative Change formula shown in equations 6 and 7.

$$C = \frac{x_2 - x_1}{x_1}$$

Equation 6 - Relative Change Formula (Lewis, 2019)

Where:

C = relative change

x_1 = initial value (£2,800,000)

x_2 = final value (£3,192,000)

Hence:

$$C = \left(\frac{3{,}192{,}000 - \ 2{,}800{,}000}{2{,}800{,}000}\right) x\ 100$$

Equation 7 – Relative Change Formula with Example Numbers

$$C = 14\%$$

Considering Wall Colmonoy works to an annual 5% profit, this loss would wipe all profits from the current year and the future.

3.3.2. Indirect Costs

Indirect costs depend on circumstances of a recall event which can be more damaging that direct costs, where figure 5 gives an overview of some indirect costs. These can range from fines by the regulator and lawsuits to loss in sales due to poor reputation from the event, (ArkaMukherjee & S.Chauhan, 2021). Lawsuits can be a pivotal cost during a recall. Once the decision to recall a product is made, product liability is made by the consumer who has sustained damages. However, the claimant must have sufficient evidence of the damages from the manufacture, to prove it was a manufactured design flaw or a negligence issue (Kganyago, 2018).

Indirect costs can all lead to the collapse to an organisation as with any loss in profit or sales, the organisation has to offset costs. This is mainly done through redundancies to reduce wage bills. For the personal left, this oftens leads to poor morale and employee turnover increases, loosing key skills from the organisation.

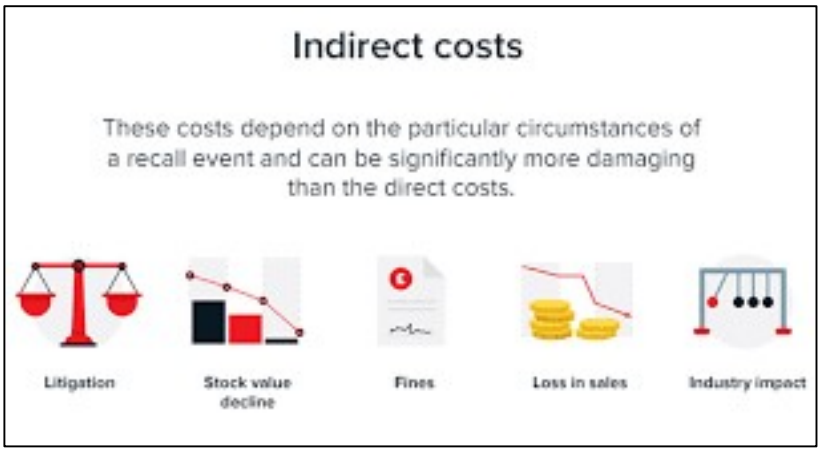

Figure 5 - Indirect Costs of a Product Recall (Kganyago, 2018)

3.4. Supply Chain Complexities

Supply chain consideration can be overlooked during the manufacturing process. Samsung are a prime example of this as in 2016, the was a recall for 2.5 million phones because several batteries that exploded, and all 2.5 million batteries were from the same batch. Evidently, Samsung parted ways from this firm. This scenario proved how there are holes within the supply chain as it is common for manufacturers to stick with one firm for its materials. As shown above, this can cause major issues if failures are missed. That's why it is best to have two or more organisations supplying the same product, which Samsung then did for its batteries and incorporates a 60-40% split between two companies (Fowler & Mozur, 2016) (Lopez, 2017). This shows that if one supplier has missed a failure, it will reduce the number of recalls needing to be made and will reduce the cost of the recall. In this case Samsung blamed the whole incident on the battery manufacturers but it is worth considering could Samsung done anything to avoid this scenario. Perhaps, regular audits to the manufacturing plant and analysing the acceptance paperwork or even spot testing a selection of batteries to validate the information being given to them. Instead of just accepting the product, there could have been a leaner process during the manufacturing and testing to help spot these failures. From a major manufacture in this industry, this shows poor ethical responsibility in the management team.

3.5. Consequences of Poor Quality

Poor quality can lead to dissatisfied customers which results in lost revenue and decreased customer loyalty. Poor quality can result in low morale and impact productivity . This also effects organisations outside its customer base. This can include waste resources and decreased efficiency, leading to higher manufacturing costs. In some cases, poor quality results in liability claims and companies can face legal action, which jeopardises the company's reputation. Finally, and most importantly, poor quality has led to unfortunate catastrophic events.

4. Restoring Customer Confidence

4.1. Approaches to Restoring Customer Confidence

To restore customer relationships during and post a product recall will depend on several factors. The first being how reactive the company was to recall a product and to supply a new product, to minimise disruption to the supply chain and the customer. By accepting liability and working with customers on solutions to provide outcomes on what went wrong, and the steps taken to ensure the same issue doesn't reoccur (Mafael, et al., 2022).

Implementing a lean approach such as a Poka Yoke solution can ensure failures either don't occur again in this process or the process identifies the failure before being released to the customer. By going over and above to demonstrate how the process has changed based on the solutions from the investigation, can have a positive impact with the customer (Heath, 2020). There are various ways this can be achieved, the first being the use of modelling software. The software can be utilised to demonstrate the changes in affect. When doing modelling scenarios, it is key to validate the data. Thus, the more data that can be gathered and compared to the model, the more confidence the customer will have.

There can be a lot of blame and avoidance from taking acceptability during a product recall, companies have even blamed customers for faulty product. A key action is to take ownership of the fault and become liable. This sooner this step is taken, the quicker solutions and new products are in place and the more likely the customer will continue to invest in the business.

From the case of faulty batteries in phones, Apple and Samsung took different approaches to the recall. Apple conducted a partial remedy which meant the customers had to send the phone to apple for a replacement battery. Although the customer didn't have to pay for this expense, the customer was without use of a phone for several days. However, Samsung offered a full remedy which meant they sent out new phones and the customer sent back the faulty phone. This meant the customer didn't go without during this period. As a result of this, Samsung retained and had new business from Apple users as the service received from Samsung was far greater to ensure the customer was able to carry out its day-to-day tasks without disruption.

Having a successful recall process relies on communication which is extremely important when a recall poses a public health or safety hazard. It is important to understand the effects on the customer and comply with any regulatory actions. When announcing a recall, the recall needs to be portrayed in a way to effectively motivate the consumer to discard or return the recalled product. An effective strategy could include offering an incentive for

complying with the recall. By reacting to the issue limits the damage caused by the media. Businesses will face public scrutiny if they do not effectively notify customers and provide solutions that ensures compliance (Byun, et al., 2020).

In 2009 Toyota went through a recall crisis where floor mats could become trapped in the accelerator pedals. An article by (Bowen & Zheng, 2015) compares how the United States media and Toyota shared news regarding the recall. It is well known that media outlets can be known for 'scaremongering' and not release all the truth to aid in its own financial gain. However, the article covers how ethical failures within Toyota's management prevented a quicker turnaround solution and were accused of loss of life. The first problem was that Toyota failed to acknowledge that problem and passed the blame onto the customers instead. Resultantly, this which costs Toyota millions of dollars was more due to the ethical issues within the organisation, where costs could have been limited by better management.

4.2. Current Practices of Powerful Buyers

With an ever-growing industry, it is important to adapt, or risk being overtaken by competitors. '*Porters 5 Forces'* is one most common model to make a competitive company, where a schematic of the process is shown in figure 6. There are five forces that the process in compiled off which include:

1. Potential entrants
2. Substitutes
3. Buyers & Customer
4. Suppliers
5. Industry Competitors

The purpose of this model is to be aware and deal with outside threats where a company can shift the balance of power in its own favour. However, when it comes to product quality, a buyer may stop purchasing a product because a better-quality product becomes available elsewhere at a more competitive price. Buyers have no loyalty to the supplier hence it is easy for the consumer to switch between companies to find the best price. If a company relies too heavily on one customer, they are vulnerable if the customer moves business elsewhere. By having a wide range of product lines becomes more appealing to the customer and are more likely to conduct more business on a range of product as long as the price is deemed competitive (Wellner & Lakotta, 2020).

Figure 6 - Porter's Five Process Model (Templates, 2019)

4.3. The Need for More Sustainable Practices

All across industries there is a new drive to become Carbon Neutral or Carbon Zero. This is a process that will take a prolonged period of time but is driven by the regulators to improve the Carbon footprint. There is a drive from consumers who only want to purchase from company's who are looking to reduce its carbon footprint, even if costs are slightly higher. By being a sustainable manufacturing process improves the image of the company and will attract new clients. The first major breakthrough in manufacturing is reducing plastic packaging, by utilising carboard packaging. This also links to reduced manufacturing costs which also increase profits. In the automotive industry there is a drive to switch to electric vehicles, with ongoing research and development into the production of Hydrogen fuelled cars to reduce the extraction of fossil fuels (Abul, 2021).

5. Conclusion

Having an efficient product recall process is critical for many reasons. Firstly, it can minimise the cost of the recall by quickly identifying the products affected and identifying a solution. It will also help in protecting the brands reputation by treating the situation with immediacy to enhance safety and satisfy customers' needs/expectations. No organisation is safe from product recalls as this can affect the supply chain which can move through many different process sectors. A product recall has significant costs and is often the last resort and is commonly executed when it is a safety critical situation. It has been shown that a product recall can costs millions and can even liquidate organisations as in many cases, it is financially impossible to recover.

Ford developed a very successful process called the 8d which covers varies the process from start to finish. The 8D tool was so successful for Ford, nearly every organisation used this process as this process had great diversity, it could be used in any industry as it covers the fundamentals to a recall. One of the key points from these processes is to take ownership of the issue. It has been found that by taking responsibility, it minimises costs and improves customer relationships. However, it can be seen that management legacy issues can indent the reputation of the organisations by not adapting to new processes and blaming the end user.

It is very difficult to retore customer relationship during and post a product recall. Although there are factors that can help retain and attract new customers. It is important to show urgency during all stages. Even after the solution is in place, it is important to show what has been done to overcome the issues and how further issues are prevented. Finally, using incentives will always have the customers interested in the product.

It is important to have a wide range of customers to prevent relying on one main source of income as this leaves the company in a vulnerable position with powerful buyers. To attract customers the quality of the product must be excellent with a competitive price. Also by adapting to sustainable processes to reduce Carbon emissions will attract new business by improving the company's reputation.

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Appendix

Appendix A

Problem Solving Worksheet

Problem Statement

	Problem Description	IS	Logically could be but IS NOT	Get Information
WHAT	Object Vehicle(s) Part Number(s)	What object has the defect?	What objects that are similar in shape, composition, form or function could have the defect but do not?	
WHAT	Defect Mechanism of Failure **Noise Factors** Piece-to-Piece Change over Time Customer Usage Cycle External Environment Neighboring System(s)	What is the defect?	What other similar defect(s) could have been observed but were not?	
WHERE	On Vehicle or Object	Where on the object is the defect observed?	Where else on the object could the defect have been observed but was not?	
WHERE	First Observed & Seen Since	Where geographically and in the process was the defective object first observed?	Where geographically and in the process could the defective object have first been observed but was not?	
WHEN	First Observed & Seen Since	When in time was the defective object first observed? When in the process was the defective object first observed? When in the life cycle of the defective object was the defect first observed?	When in time could the defective object have first been observed but was not? When in the process could the defective object have first been observed but was not? When in the defective object's life could the defect have first been observed but was not?	
WHEN	Pattern Since In Process Operating Cycle Life Cycle	What patterns of occurrence of the defect have been observed with respect to time? When during use of the defective object is the defect observed?	What patterns of occurrence could have been observed with respect to time but were not? When during use of the defective object could the defect have been observed and was not?	
HOW BIG	Magnitude	How many objects have the defect? What is the magnitude of the defect in terms of percentages, rates, patterns, trends, yield, physical dimensions, etc.? R/1000 and % in service.	How many objects could have the defect but do not? What magnitude could the defect have, but does not?	
HOW BIG	Defects per Object	How many defects are there per defective object?	How many defects could there have been per defective object but were not ?	
	Trend Hazard Plot(s)	What is the trend (increasing, decreasing, cyclical, etc.)?	What could the trend have been but was not (increasing, decreasing, cyclical, etc.)?	

Figure 7 –"Is" "Is Not" Template (Colmonoy, 2022)