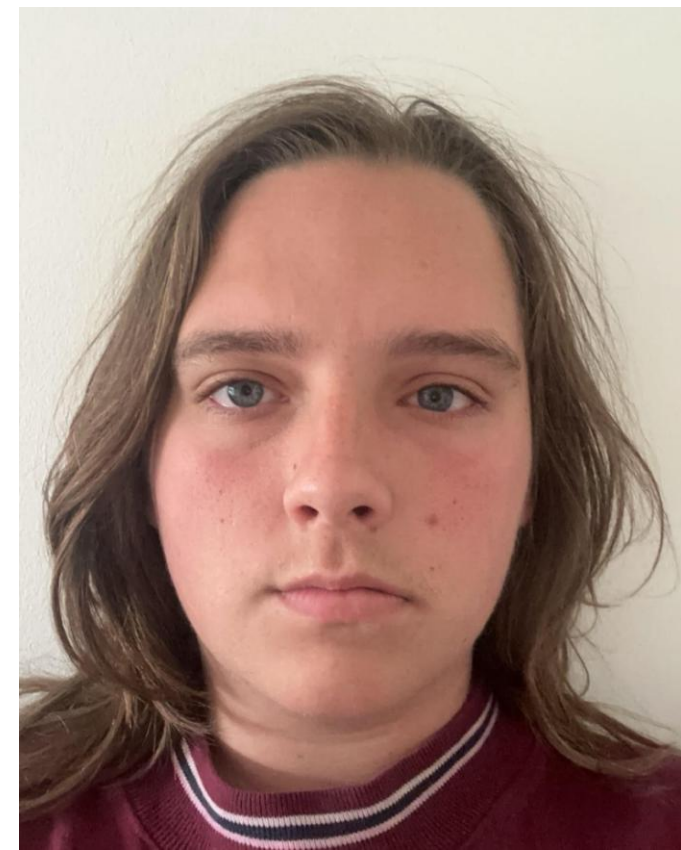




The Development of The Prevention of Failures

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Introduction

The prevention of failure and safety is a vital part when it comes to all aspects of engineering as if the correct precautions are not met it can lead to catastrophic disasters. The main way to prevent failure is using FMEA. As technology develops, so does the need for improved safety protocols. It is not just for regulation purposes but crucial for development within the engineering industry. This lecture was done by Ryan James.

What is FMEA

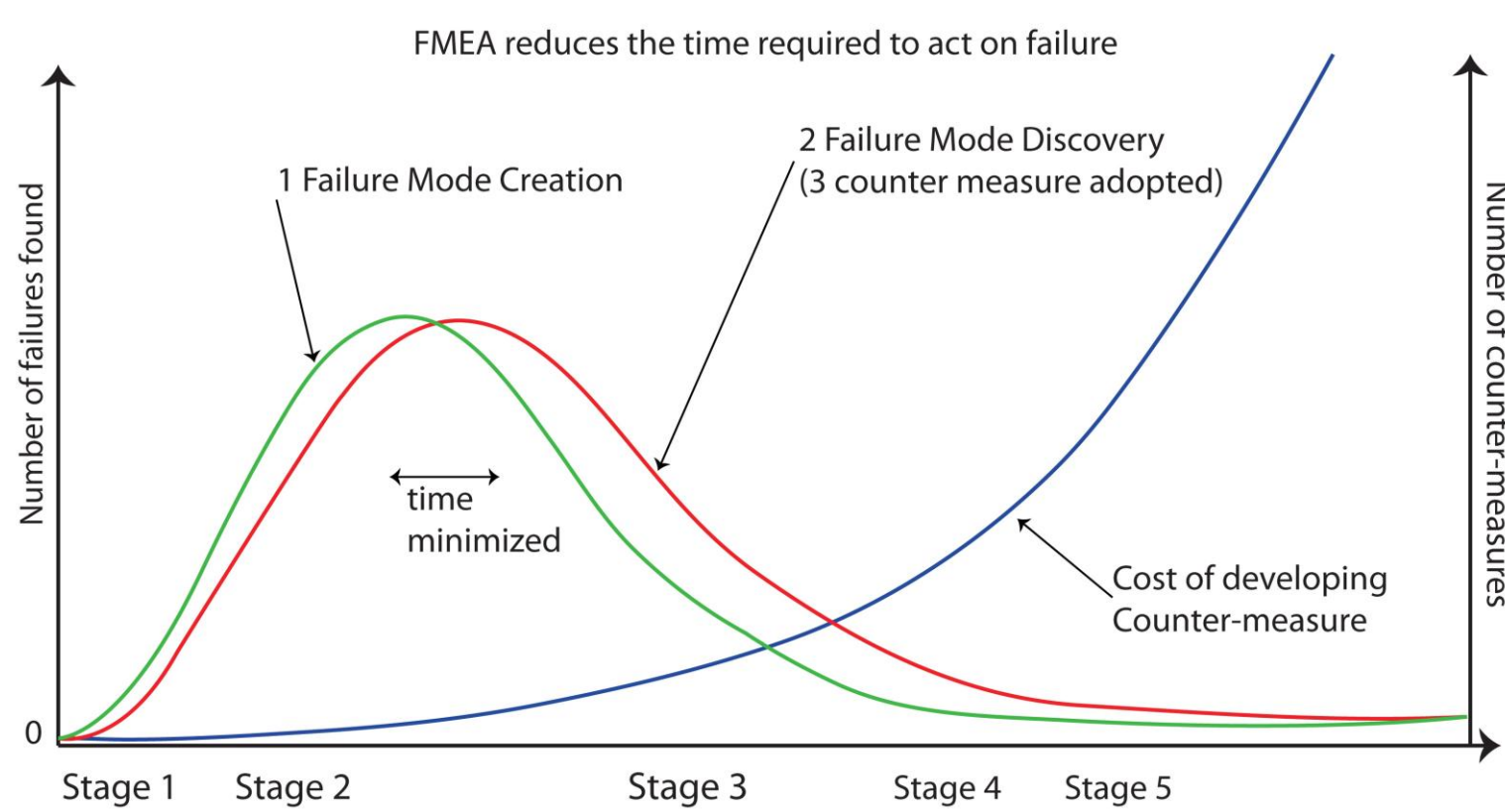
FMEA (Failure Mode and Effects Analysis) is one of the most important aspects of presenting failure. Originally developed by the American military at the end of the 1940s and was adopted by NASA in the late 1950s. It is a ‘step-by-step approach to identify and prioritise failures in design, manufacturing or assembly processes’ (ASQ, n.d.). This is a system that requires engineers to use a table and point out every aspect that could go wrong. They will then list down the potential outcome of that failure, evaluate the risks priority by putting a ranking from 1-10 and the actions recommended to fix and avoid the situation. This makes the process efficient and improves the safety of everyone involved.

An example of a fully developed FMEA table with all the steps needed (Created by Peter Sebelius, 2020 - [FMEA vs ISO 14971 - Medical Device HQ 1](#))

Part	Function	Failure mode	Local effect	System end effect	Po	S	Pd	RPN	Risk mitigation	Status	R-Po	R-S	R-Pd	R-RPN
Internal high voltage cord	Connect power inlet to power supply. Transfer current.	Loosen	Cable is not attached to power supply. Loss of power to power supply.	Complete loss of function.	3	10	10	300	Additional restriction on cable shall be applied and length controlled in such a way that no conducting parts can be reached by loose cord.	Done	2	10	10	200
Roller pump motor	Drive roller pump head.	Breakage	Roller pump head rotation stop.	Complete loss of function.	2	10	8	160	Implement alarm that alerts user of pump stop.	Done	4	6	2	48
Pump segment tubing	Lead fluid through pump.	Crumbling	Particles from tubing are released.	Partly degraded function as filters are filled with particles.	5	6	8	240	Select tubing material with safety margin on wear and tear. Long term testing to confirm longevity.	Pending	TBD	TBD	TBD	TBD

Types of FMEAs

There are 2 main types of FMEAs that both have vital roles when it comes to the prevention of failure and the safety of everybody. The 2 types are Design FMEA and Process FMEA. Design FMEA is ‘An analytical methodology used in the product design and development phase to improve product quality’ (John Hartwell, 2022). This means that all design safety requirements need to be met before the product bis produced and manufactured. Process FMEA is the same concept but conducted when the product is being produced. This requires that all safety requirements must be met while the product is being manufactured. This can save companies incredible amounts of money as it leaves less room for broken and failed products.



A graph showing the time required to act on a failure when companies use and don’t use FMEA. (Quality-One <http://quality-one.com/fmea/fmea-training/>)

Types of Failures

There are multiple types of failures that could lead to unusable products and disasters. One of those failure types is failure conditions. Failure Conditions are defined as ‘effects on an aircraft and its occupants, both direct and consequential, caused or contributed by one or more failures, considering relevant adverse operational conditions’ (De Florio, 2016). There are 4 classes based on severity. These are:

- Minor,
- Major,
- Hazardous and
- Catastrophic.



Challenger Crash in 1986. (CNN - [1986: Space Shuttle Challenger explosion | CNN](#))

This is the type of failure that caused the challenger to explode in 1986.

Another type of failure is failure in part Design. Failure in part design is when a product has a poor design process leading to recalls of the item or disasters. A poor design process consists of the item not being designed to a high standard and not always following Process FMEA.

Modern day failure preventions

With the development of Artificial Intelligence and robots within a workplace, there are less and less human errors within the design and processing stage of a products development. There are many negatives to the AI integration like the loss of jobs for many qualified engineers across the world. The introduction to more and more safety laws every year also allows for less failure as more precautions must be followed.

Conclusion

The key takeaways I have taken from this lecture is that safety is a number one priority and as an engineer it is my duty to ensure that everyone is following them. The lecture had a big impact on my understanding of safety and how to use an FMEA table and its importance.

References

- **ASQ** - [What is FMEA? Failure Mode & Effects Analysis | ASQ](#)
- **John Hartwell** - [DFMEA - Complete Guide to the Design FMEA | IQASystem](#)
- **De Florio** - [Failure Condition - an overview | ScienceDirect Topics](#)