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ME 1110 – Engineering Practice 1

Engineering Drawing and Design - Lecture 19

Failure Mode and Effects Analysis
FMEA

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www.staff.city.ac.uk/~ra600/intro.htm

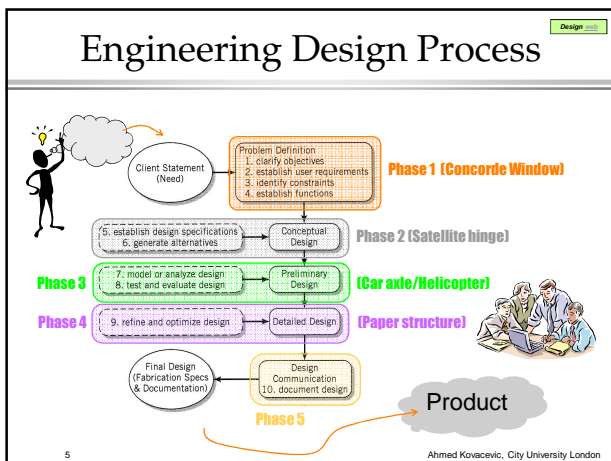
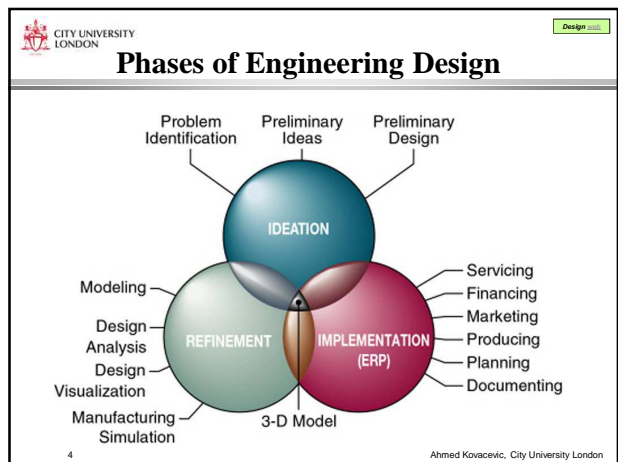
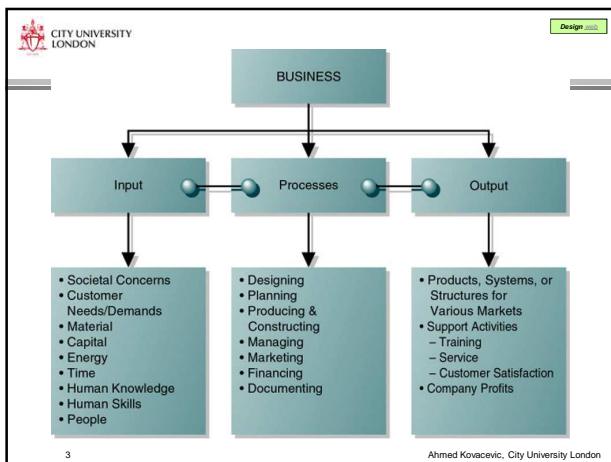
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Objectives for today

- Learn FMEA – one of the methods for assessing potential failure and their effects

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Failure Mode and Effects Analysis

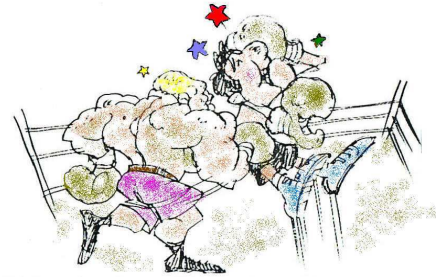
A failure mode is any event, which causes a functional failure of a machine or a system!

Failure effects describe what happens when a failure mode occurs

The best way to address all failure modes and to estimate their effects is to list all functions and to analyse how each of these can fail and what causes will it make.

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"A problem well-defined is half solved."



"Not solving the root cause of a problem is like putting an amateur in the boxing ring...if he is hit, his hands go where it hurts, and his opponent will hit him somewhere else." Adapted from Demosthenes

MOVIES

FMEA in Design and Maintenance

Any Design and/or Maintenance process shall ensure that all of the following seven questions are answered satisfactorily in the sequence shown below:

1. **FUNCTIONS** - What are the functions and associated desired standards of performance of the asset in its present operating context?
2. **FUNCTIONAL FAILURES** - In what ways can it fail to fulfil its functions?
3. **FAILURE MODES** - What causes each functional failure?
4. **FAILURE EFFECTS** - What happens when each failure occurs?
5. **FAILURE CONSEQUENCES** - In what way does each failure matter?
6. **PROACTIVE TASKS** and **TASK INTERVALS** - What should be done to predict or prevent each failure?
7. **DEFAULT ACTIONS** - What should be done if a suitable proactive task cannot be found?

Categories of failure modes

Failure modes can be classified in to three groups:

1. When capability falls below desired performance
 - » Deterioration
 - » Lubrication failure
 - » Dirt
 - » Disassembly
 - » 'Capability reducing ' human errors.
2. When desired performance rises above initial capability
 - » Sustained, deliberate overloading
 - » Sustained, unintentional overloading
 - » Sudden, unintentional overloading
 - » Incorrect process material.
3. When the asset is not capable of doing what is wanted from the outset.

How detailed?

Failure modes should be defined in enough detail for it to be possible to select a suitable failure management policy.

- Too little detail and/or too few failure modes lead to superficial and sometimes dangerous analyses.
- Too many failure modes and/or too much detail causes the entire RCM process to take much longer than it needs to.

The effects of failure

While describing the effects of a failure, the followings should be recorded:

- What **evidence** that the failure has happened/occurred?
 - » Warning signals, smell, noise, leak, fire, smoke ...
- In what way it poses a **threat to** safety or the environment?
 - » Cause explosion, fire, leak if hazardous chemicals, collapse of structure ...
- In what way it **affects** production or operation?
 - » How does it affects production or process
- What **physical damage** is caused by the failure?
 - » Effects on other parts and processes, cost ...
- What **must be done** to prevent or to repair the failure?
 - » Replace components or subsystems, lubricate on time

Sources of information about Modes and effects

One needs to be proactive, while drawing up the FMEA, as such, much emphasis should be placed on what could happen than what has happened.

The common sources of information with a brief review of their main advantages and disadvantages are:

- » The manufacturer or vendor of the equipment
- » Other users of the same equipment
- » Technical history records
- » The people who operate and maintain the equipment

Potential Failure Modes and Effects Analysis (Design FMEA)														
Item / Function / Module	Potential Failure Modes	Potential Effects of Failure	Potential Causes / Mechanisms of Failure	Potential Consequences of Failure	Current Design Controls	Recommended Actions	Responsibility & Target Completion Date	Action Taken	Review Date					
Circuit Breaker H.1.1	Output loss from release	Release	C1 short	2	PR-20 & HV-5	1	QA Proc. 20.6	R. Jones, 11/03/92	Added to control plan	2	1	1	3	
				2		2	QA Proc. 20.6	R. Jones, 11/03/92	Added to control plan	2	1	1	3	
				3		3	QA Proc. 20.3	R. Jones, 11/03/92	Added to control plan	2	2	1	4	
				4		4	Test 107	R. Jones, 11/03/92	Added to control plan	2	3	1	5	
				5		5							9	
				6		6	None							9
				7		7	None							9
				8		8	None							9
				9		9	QA Proc. 20.6		control					9
				10		10								9
				11		11	QA Proc. 20.6	D. Howell, 10/15/92	Added to control plan	2	1	1	2	
				12		12	QA Proc. 20.6	B. Howell, 10/15/92	Added to control plan	2	1	1	2	
				13		13	QA Proc. 20.6	B. Howell, 10/15/92	Added to control plan	2	1	1	2	
				14		14	QA Proc. 20.6	D. Howell, 10/15/92	Added to control plan	2	1	1	2	
				15		15	QA Proc. 20.6	B. Howell, 10/15/92	Added to control plan	2	2	1	4	
			16		16	100% Insp.	B. Howell, 10/15/92	Added to control plan	2	2	2	8		
			17		17	100% Insp.	B. Howell, 10/15/92	Added to control plan	2	2	2	8		
			18		18	None							9	
			19		19	None							9	