Design web

Engineering Drawing and Design
ME 1110 – Engineering Practice 1

Lecture 21

FMEA -Failure Mode and Effects Analysis

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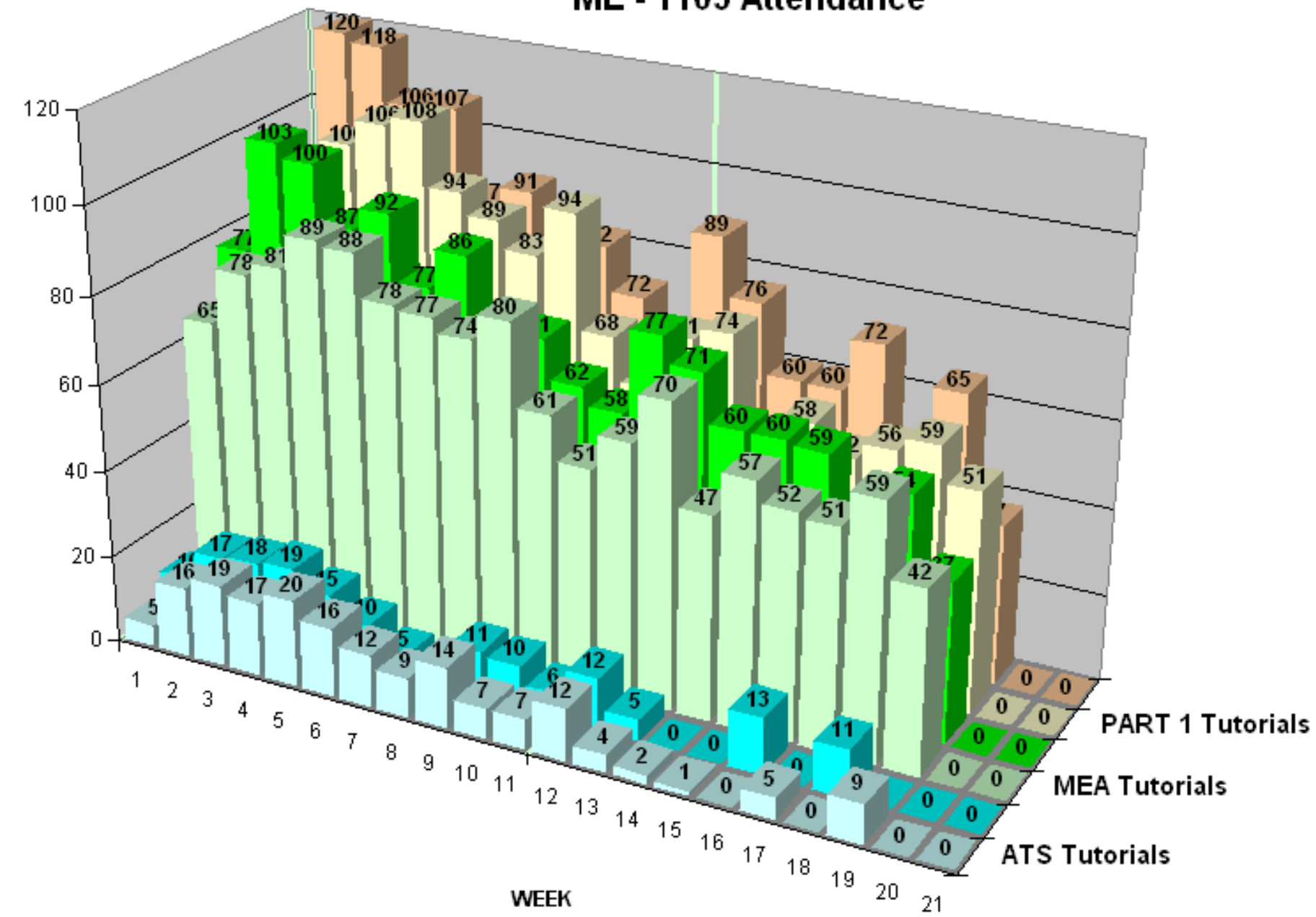
www.city-design.tk www.staff.city.ac.uk/~ra600/intro.htm

Announcements

- Written TEST - Friday 31st March 15,00
- Dr Nouri's Lecture moves to 14,00
- Testing of the paper structure:
  - » Groups A&B Thursday 23/03 10,00-12,00
  - » Groups C&D Friday 30/03 9,00-11,00

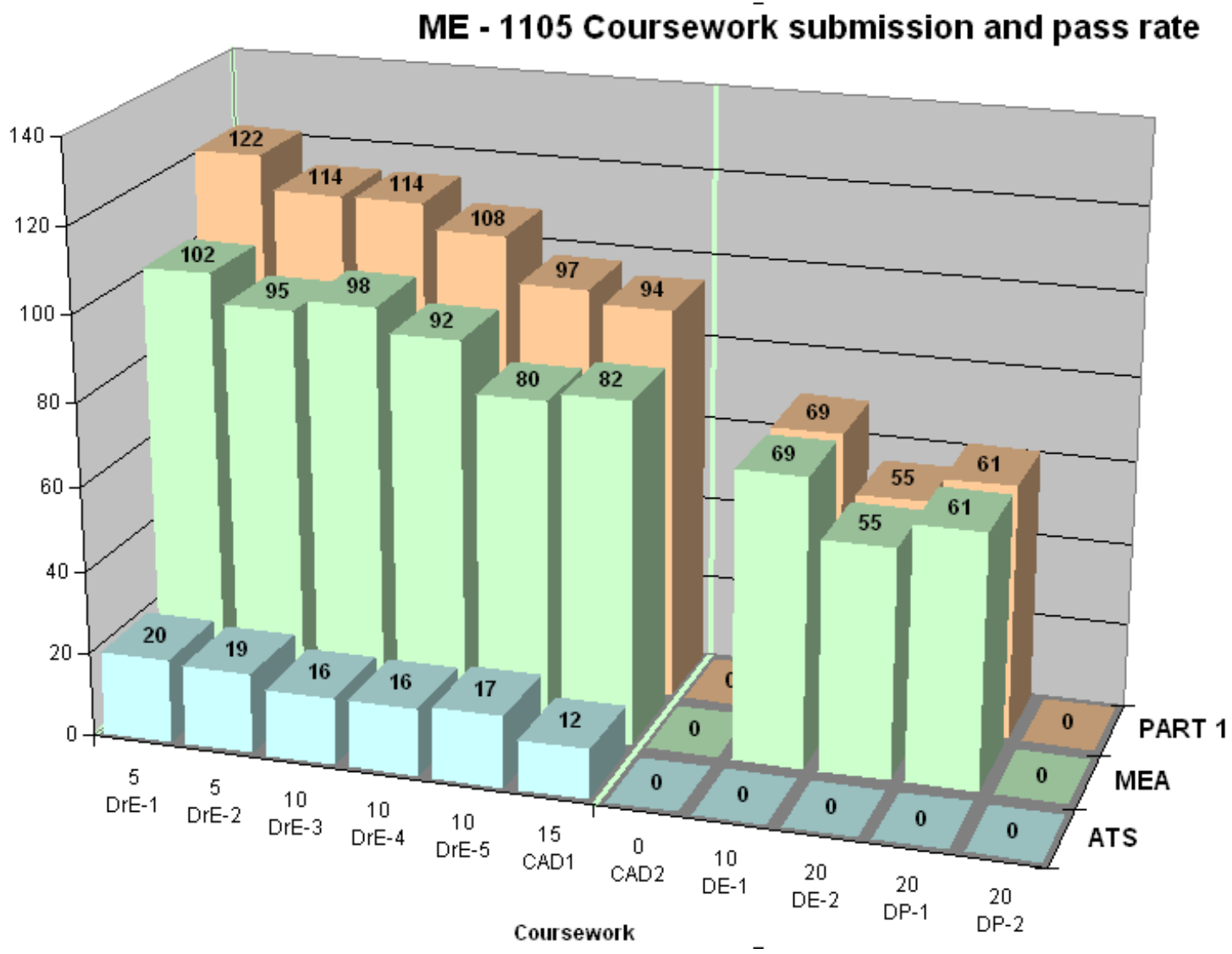
Design web

ME - 1105 Attendance



Design web

ME - 1105 Coursework submission and pass rate



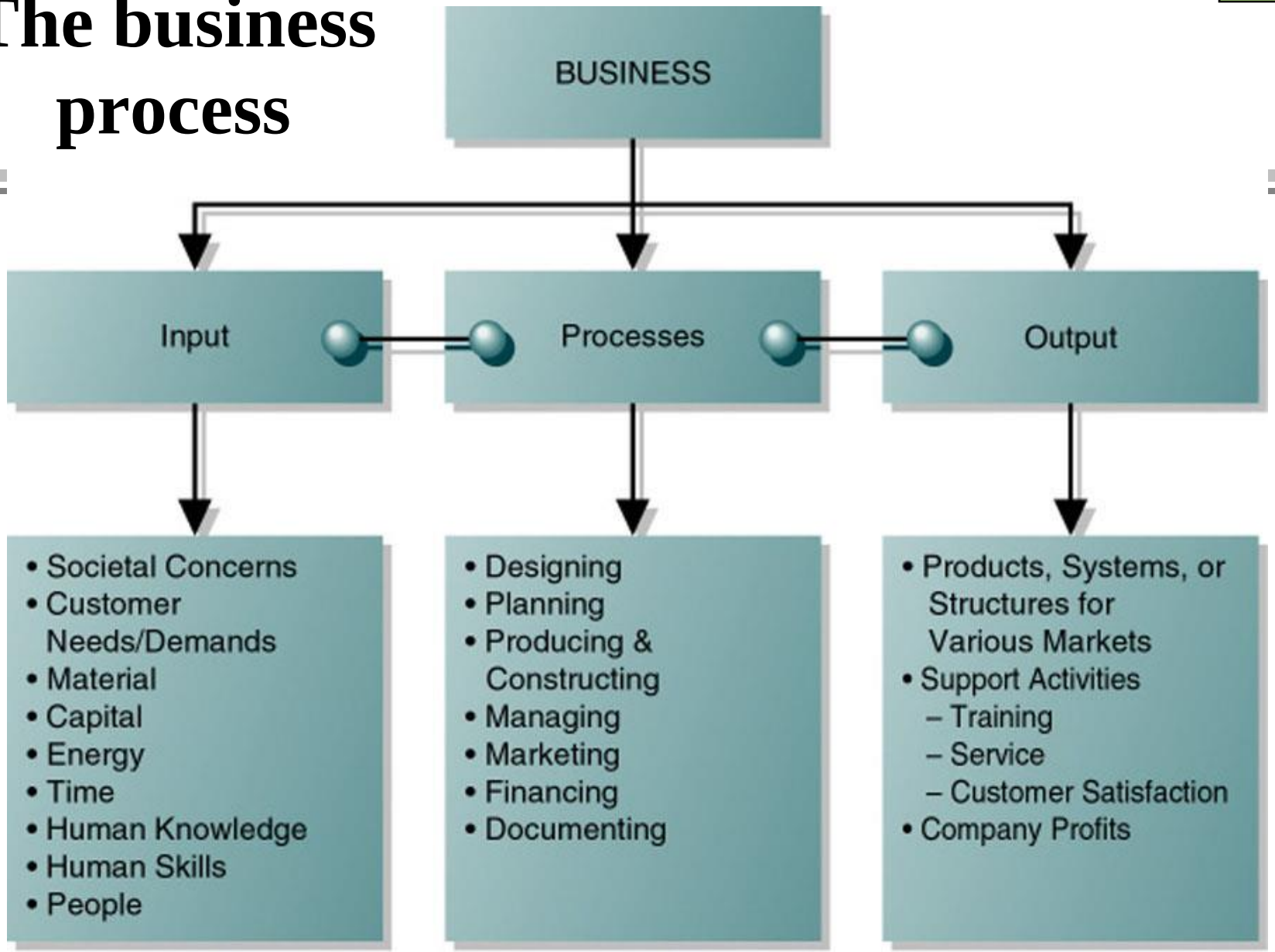
Pass marks :
MEA: 102 students
- Coursework T1 74 - 72 %
- Tests (90) 73 - 71 %
- Coursework 57 - 55 %
- Tests 1 - 1 %

ATS: 20 students
- Coursework 10 - 50 %
- Tests (17) 15 - 75 %

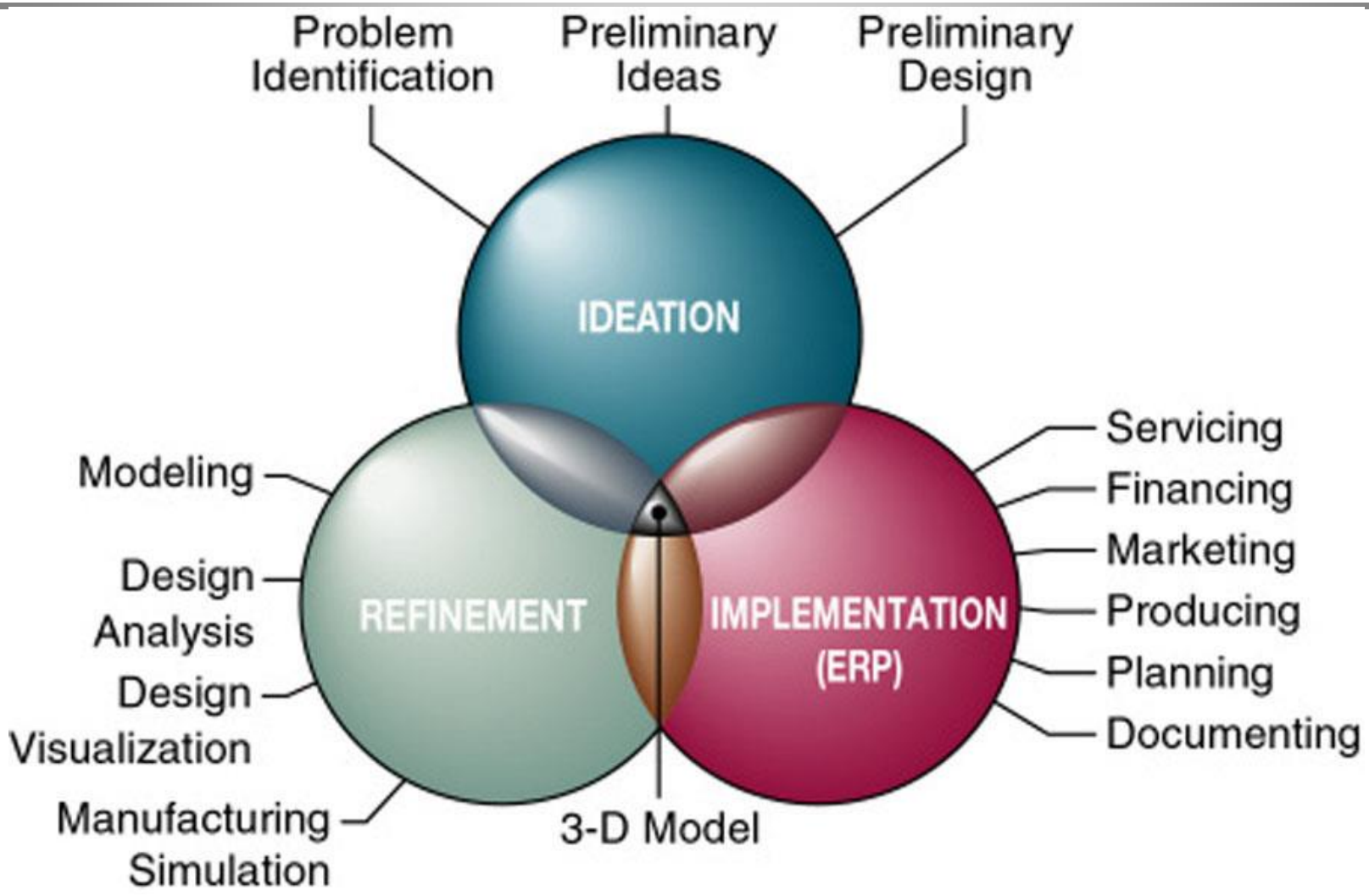
- Pass all 10 - 50%

Ahmed Kovacevic, City University London

The business process



Phases of Engineering Design



Engineering Design Process

Client Statement (Need)

Problem Definition
1. clarify objectives
2. establish user requirements
3. identify constraints
4. establish functions

Phase 1 (Concorde Window)

5. establish design specifications
6. generate alternatives

Conceptual Design

Phase 2 (Satellite hinge)

Phase 3

7. model or analyze design
8. test and evaluate design

Preliminary Design

(Car axle/Helicopter)

Phase 4

9. refine and optimize design

Detailed Design

(Paper structure)

Final Design (Fabrication Specs & Documentation)

Design Communication
10. document design

Phase 5

Produc t

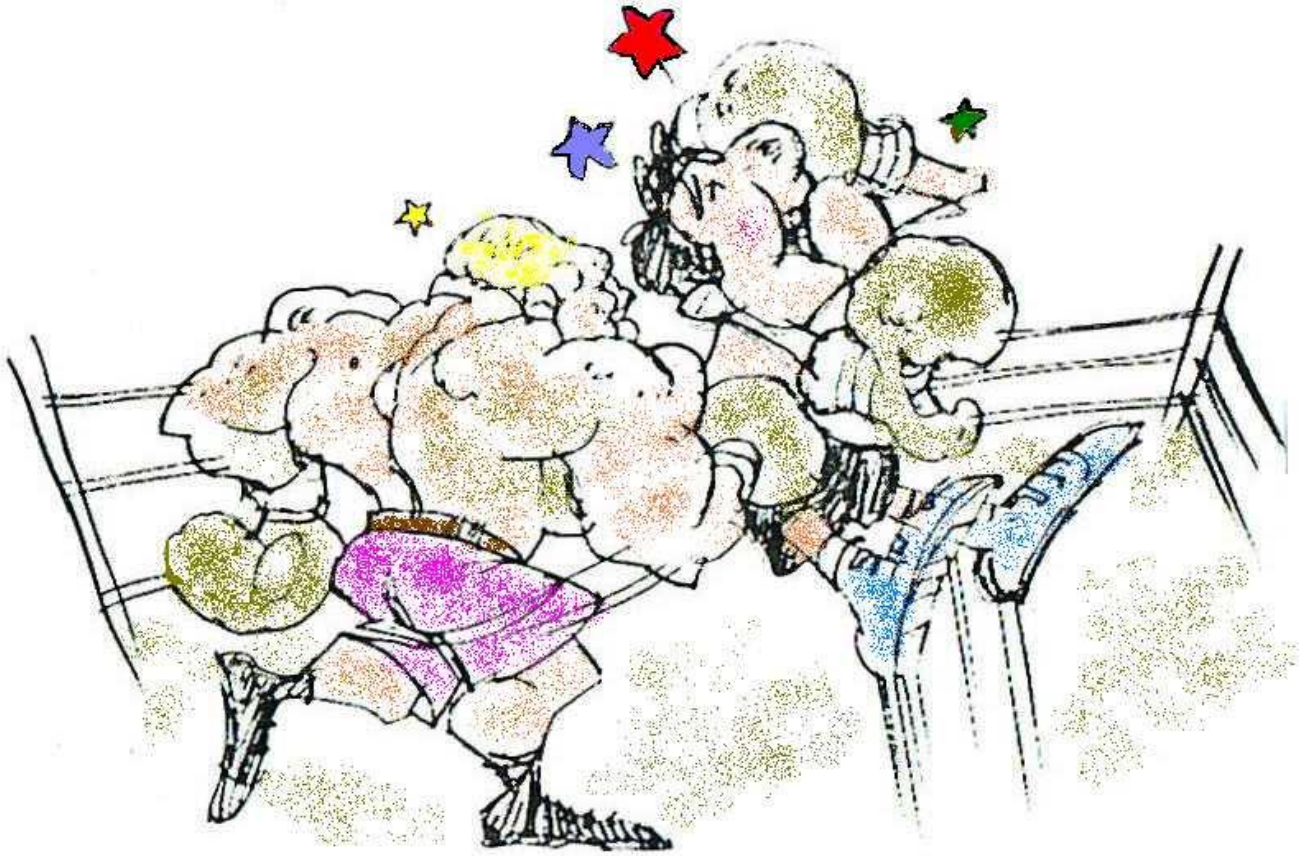
Failure Mode and Effects Analysis

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.

"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 matters?
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, colapse 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

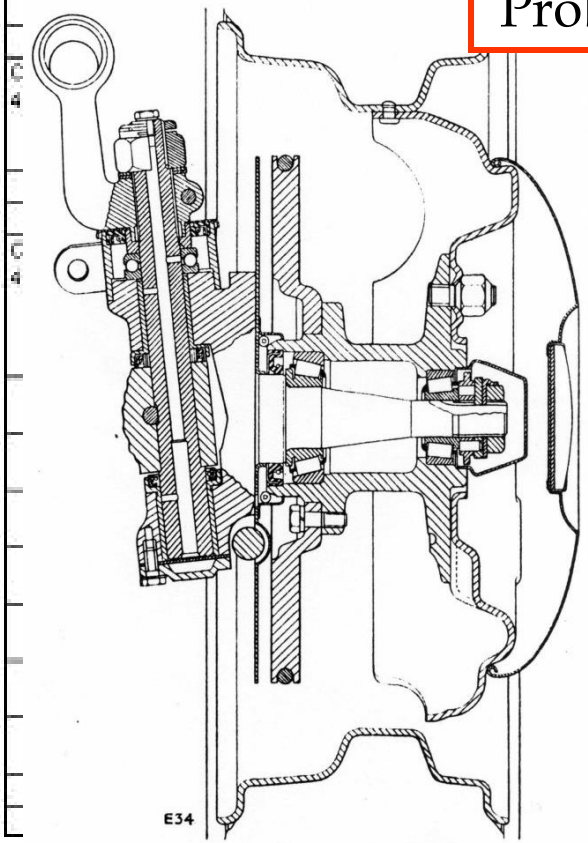
One needs to be proactive, while drawing up the FMEA, as such, much emphasis should be placed on what could happen than what has happened.

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

System	LTN2001 GPS SSU	Potential Failure Mode and Effects Analysis (Design FMEA)	Revision B
Subsystem	Receiver Card		Prepared By Robert Crow
Part Number	466230-100		FMEA Date 8/18/1992
Design Lead	J. Davies		Revision Date

Item / Function	Potential Failure Mode(s)	Potential Effect(s) of Failure	Sev	Potential Cause(s)/ Mechanism(s) of Failure	Occ	Current Design Controls	Det	RPN	Recommended Action(s)	Responsibility & Target Completion Date	Action Results: Actions Taken	New Sev	New Occ	New Det	New RPN
Circuit Block 4.1.1	Output loss from	Receiver & t data loss; loss; GPS dor	5	C1 short	1	PR-20 & HW-5	2	10	QA Proc 20-6	R. Jones, 11/30/92	Added to control plan	2	1	1	2
					2		2	20	QA Proc 20-6	R. Jones, 11/30/92	Added to control plan	2	1	1	2
					3		2	30	QA Proc 20-3	R. Jones, 11/30/92	Added to control plan	2	2	1	4
					4		2	40	Test 147	R. Jones, 11/30/92	Added to control plan	2	3	1	6
								0							0
C1				C1 open/chg val	2	None	8	16	None						0
C							8	16	None						0
								0							0
C2				C2 short	1	PR-20 & HW-5	2	8	QA Proc 20-6		ontrol				0
				C3 short	1	PR-20 & HW-5	2	8	QA Proc 20-6	B. Howell 10/15/92	Added to control plan	2	1	1	2
				C4 open/short	2	PR-20 & HW-5	2	16	QA Proc 20-6	B. Howell 10/15/92	Added to control plan	2	1	1	2
				C5 short	2	PR-20 & HW-5	2	16	QA Proc 20-6	B. Howell 10/15/92	Added to control plan	2	1	1	2
				C66 open/short	2	PR-20 & HW-5	2	16	QA Proc 20-6	B. Howell 10/15/92	Added to control plan	2	1	1	2
				C99 short	3	PR-20 & HW-5	2	24	QA Proc 20-6	B. Howell 10/15/92	Added to control plan	2	2	1	4
				FL1 short/open	5	None	2	40	100% Insp.	B. Howell 10/15/92	Added to control plan	2	2	2	8
				FL2 short/open	5	None	2	40	100% Insp.	B. Howell 10/15/92	Added to control plan	2	2	2	8
				R2open/chg val	2		2	16	None						0
				R18 open/chg val	2		2	16	None						0



Severity

Occurrence or Probability

Detection

Risk Priority Number

Agenda

Term 2					Mech, Auto, Aero	ATS
Week	Date	Lecture Topic	Lecturer	Ex. No	Tutorial exercise:	Tutorial exercise:
12	09-Jan 13-Jan	1st TEST 13/01/2006 Geary 9,00-11,00	Kovacevic Mujic, Day	Test	1st TEST - 2 hours	1st TEST - 2 hours
13	16-Jan 20-Jan	Engineer. design specification Conceptual design	Kovacevic	DE-1	Design specification - Concorde window	DESIGN PROJECT (DP) Design of Boeing 737 Airstair
14	23-Jan 27-Jan	Embodiment, Detailed design	Kovacevic	DE-2	Preliminary & Conceptual Design - Satelite hinge	
15	30-Jan 03-Feb	Machine components & struct Design Criteria & Consider.	Kovacevic			
16	06-Feb 10-Feb	Bearings - types, forces,	Kovacevic	DP-1	Mini project 1 Mech&Auto - Car axle Aero, ATE - Helicopter	
17	13-Feb 17-Feb	Shafts, Seals	Kovacevic			
18	20-Feb 24-Feb	Design of space frames Types, Forces, Deformation	Kovacevic			
19	27-Feb 03-Mar	Screw connections, Fasteners	Kovacevic	DP-2	Design project - Space frame Design, Build, Test	
20	06-Mar 10-Mar	Drives - Gears	Kovacevic			
21	13-Mar 17-Mar	Introduction to FMEA	Kovacevic	CAD-2	CAD Laboratory 2	
22	20-Mar 24-Mar	Design Communications - Presentation	Kovacevic	CAD-2	CAD Laboratory 2	
23	27-Mar 31-Mar	2nd TEST 31/3/2006 Geary 14,00-15,00	Kovacevic Mujic, Day	Prese-ntation	DP-2 Presentation - Testing	DP-2 Presentation

Part 1

Engineering Drawing and Design

2nd TEST

- ROOM: A366
- Day and Date: Friday 31st March 06
- Time: 15,00
- Duration: 1 hour