

# Engineering Drawing and Design

## ME 1110 – Engineering Practice 1

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### Lecture 21

## FMEA -Failure Mode and Effects Analysis

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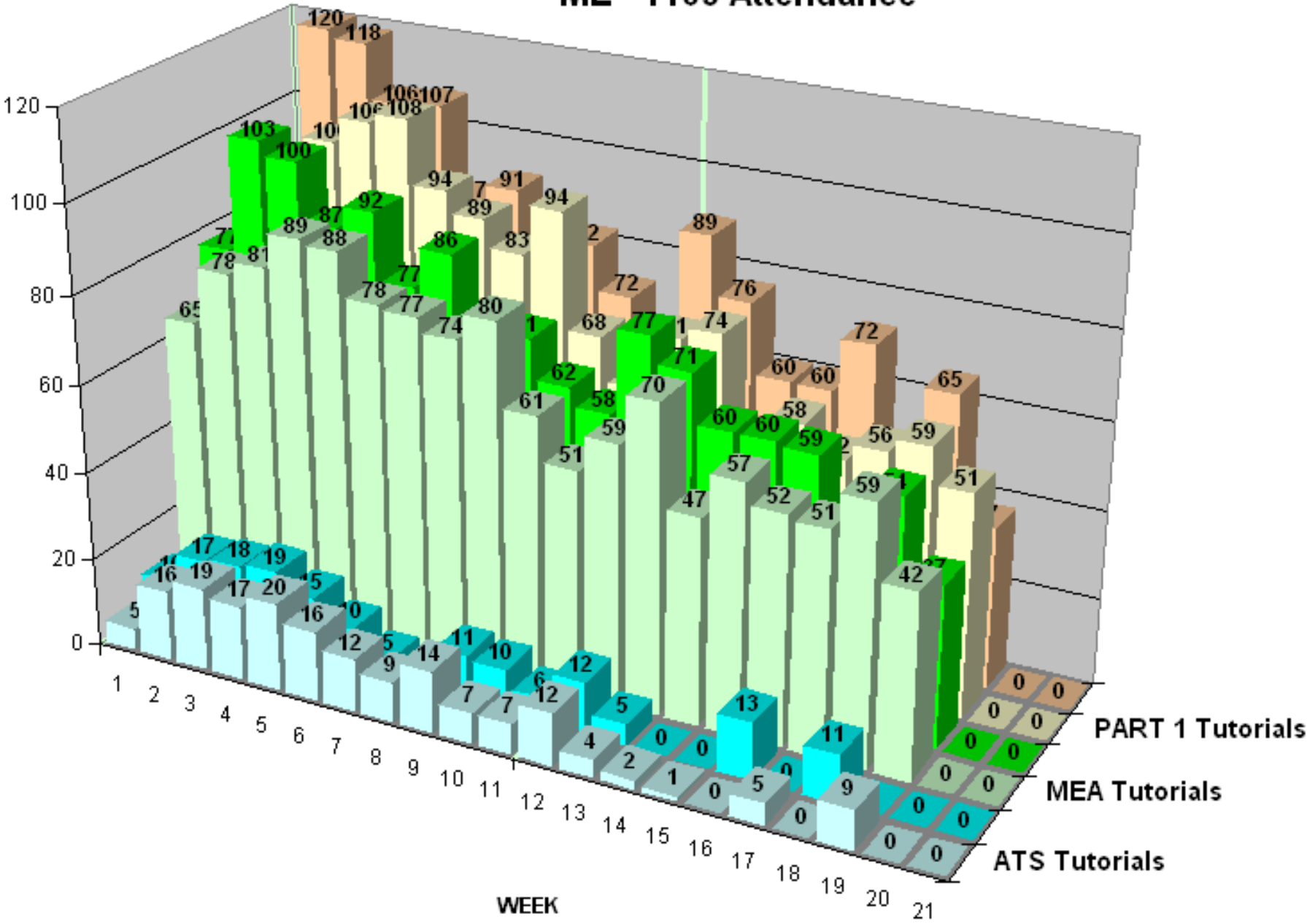
[www.staff.city.ac.uk/~ra600/intro.htm](http://www.staff.city.ac.uk/~ra600/intro.htm)

# Announcements

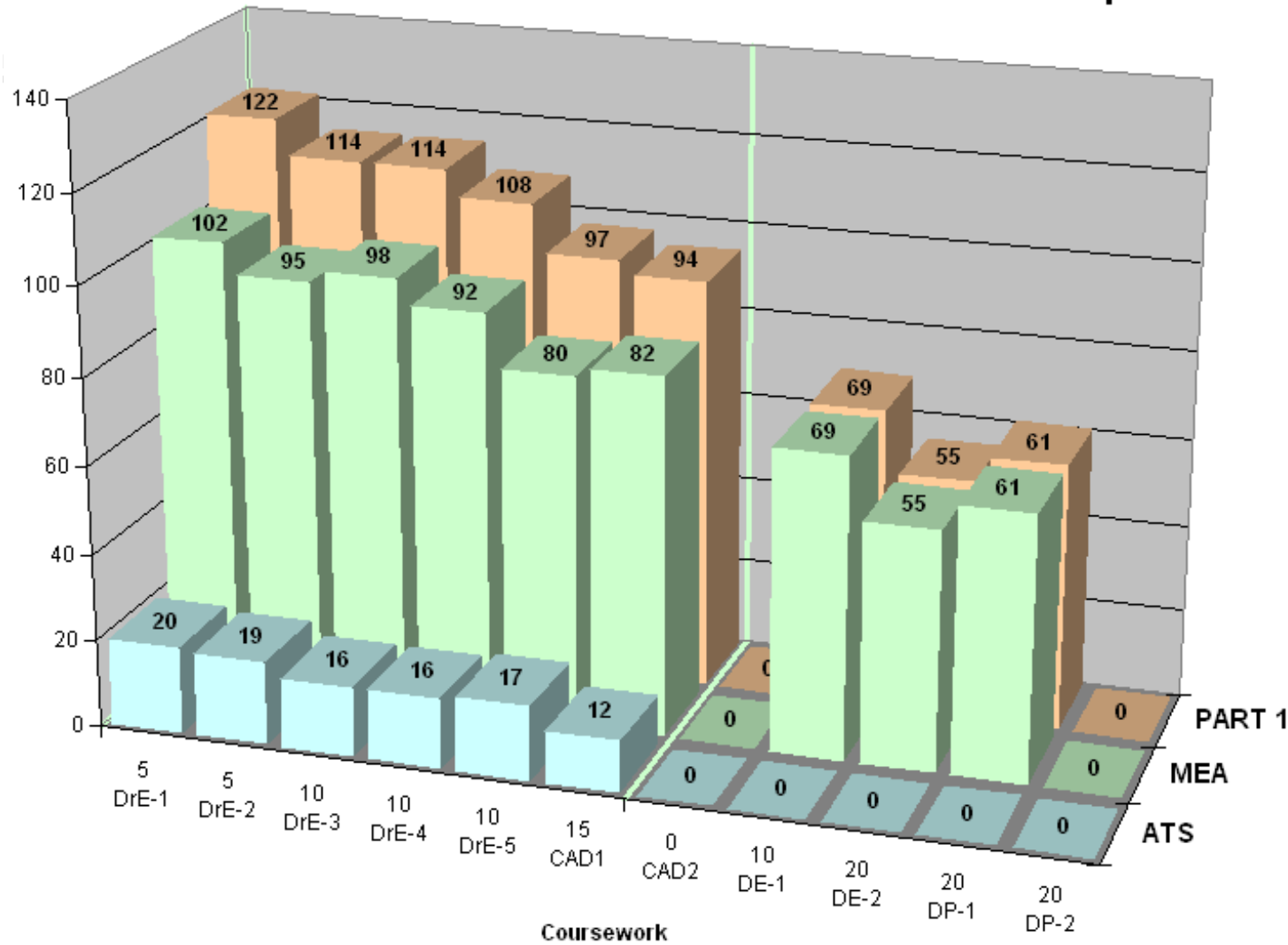
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- Written TEST - Friday 31<sup>st</sup> March 15,00
- Dr Nouri's Lecture moves to 14,00
- Testing of the paper structure:
  - » Groups A&B Thursday 23/03 10,00-12,00
  - » Groups C&D Friday 30/03 9,00-11,00

### ME - 1105 Attendance



### ME - 1105 Coursework submission and pass rate



**Pass marks :**

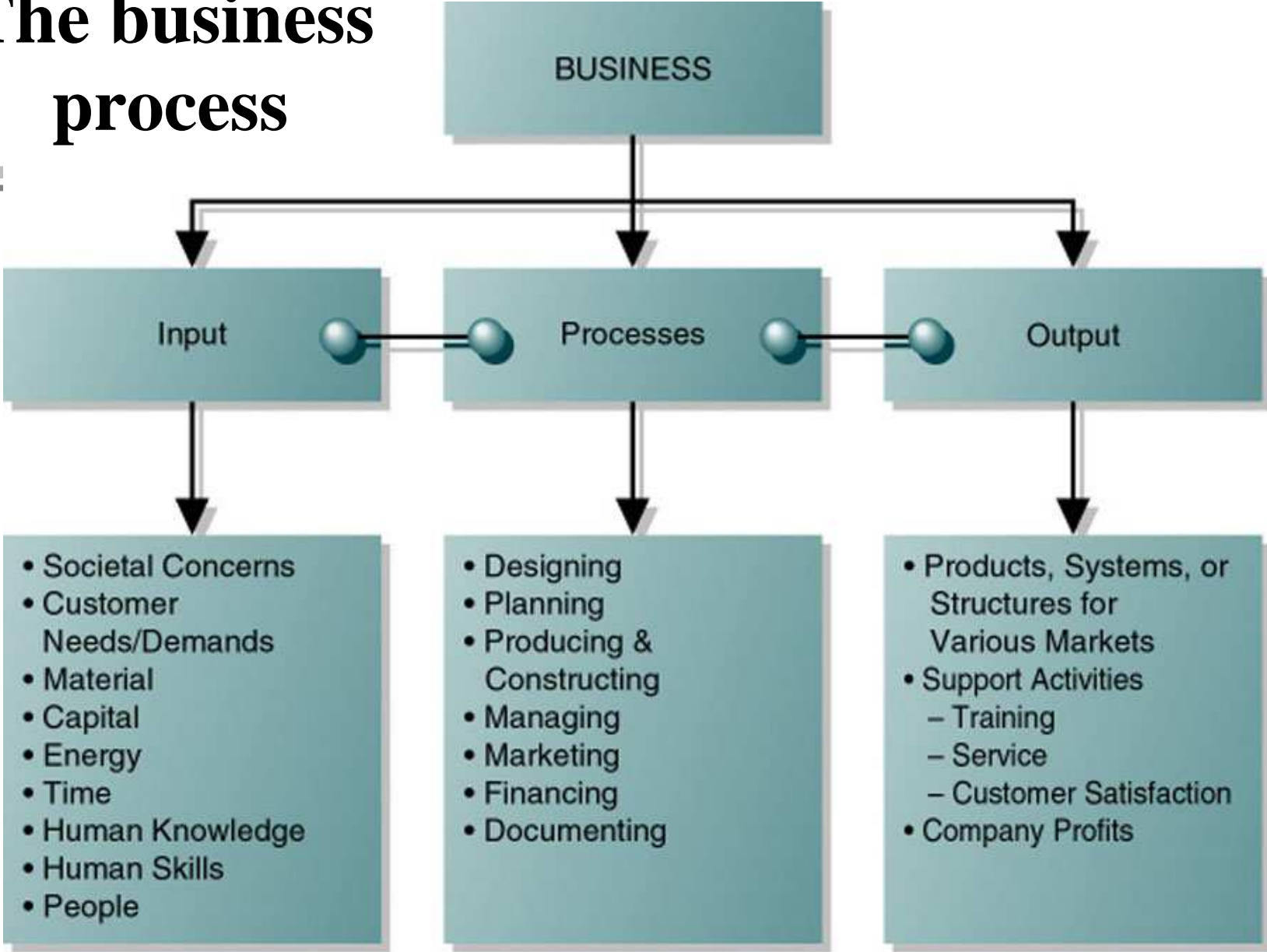
**MEA: 102 students**

- Coursework T1 74 - 72 %
- Tests (90) 73 - 71 %
- Coursework 57 - 55 %
- Tests 1 - 1 %

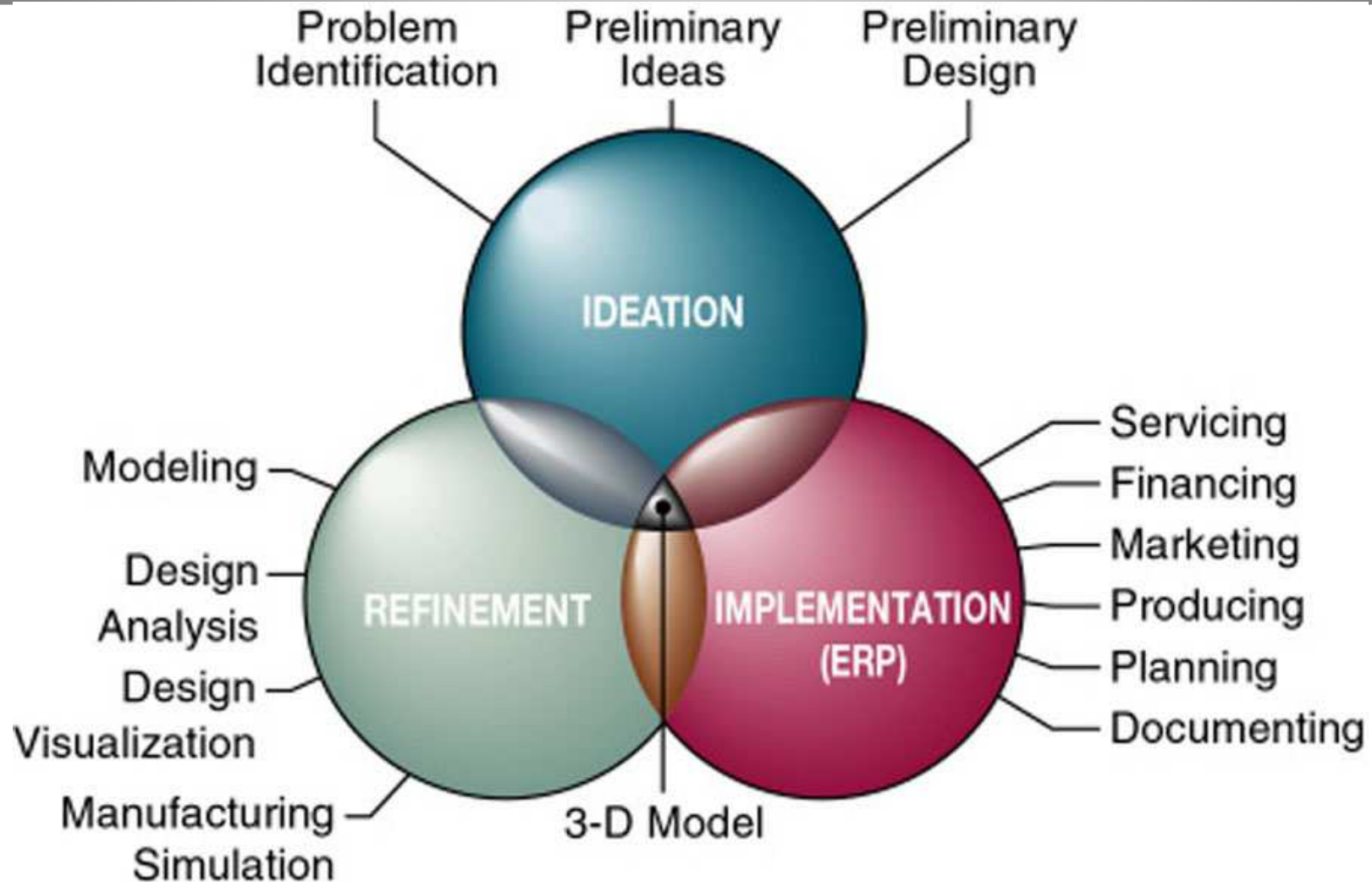
**ATS: 20 students**

- Coursework 10 - 50 %
  - Tests (17) 15 - 75 %
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- Pass all 10 - 50%

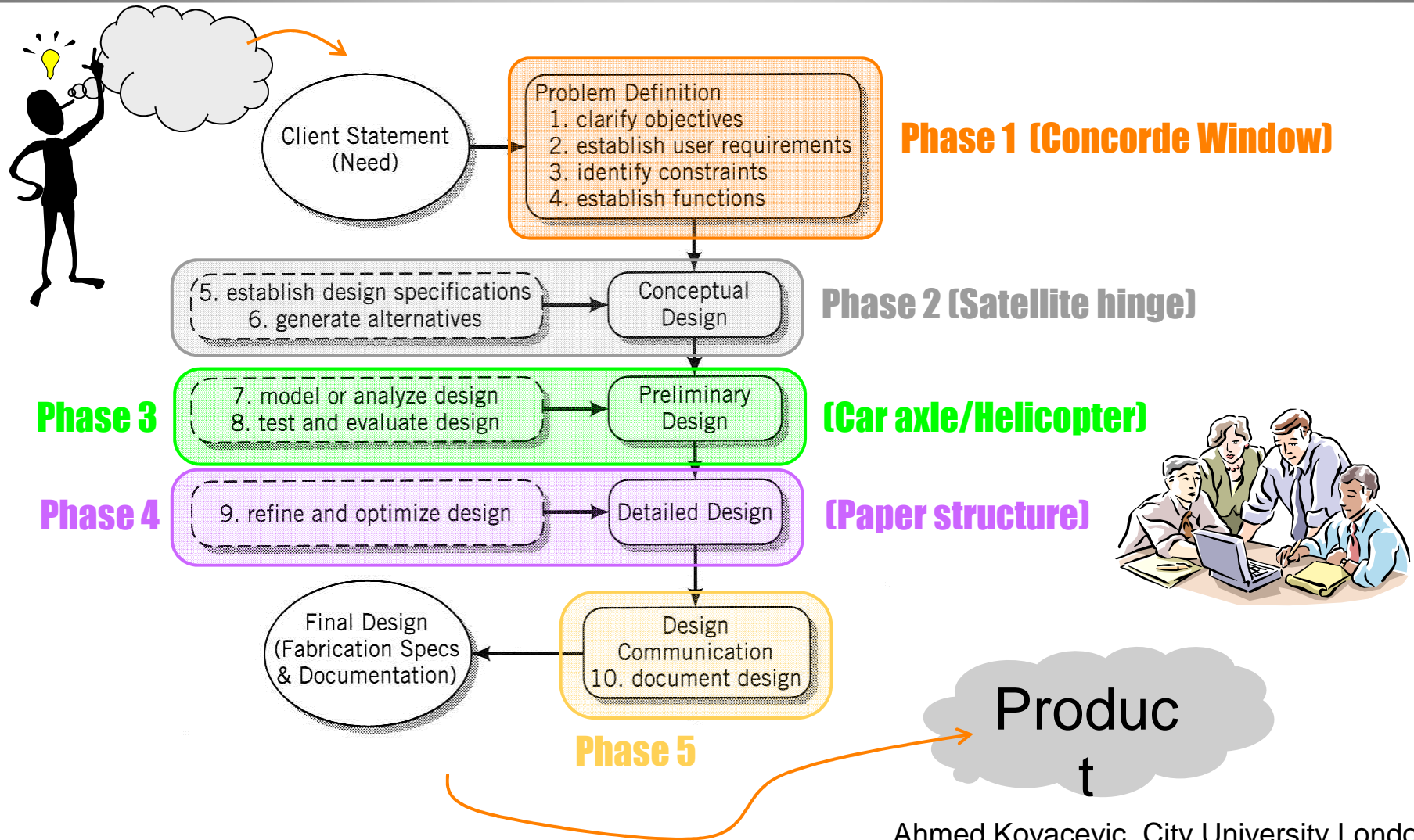
# The business process



# Phases of Engineering Design



# Engineering Design Process



# Failure Mode and Effects Analysis

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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***

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# *MOVIES*

# FMEA in Design and Maintenance

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*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

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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?

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***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

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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





# 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 - Satellite 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

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## Engineering Drawing and Design

### 2<sup>nd</sup> TEST

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