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Mechanical Analysis and Design
ME 2104


Lecture 3

Project management

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Plan for this lecture

- Project management overview
- Project management tools
 - » Work breakdown structures
 - » Team calendars
 - » Gantt charts
 - » Budgets

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Managing Design
(Academic Project Management)

- Design is an activity that can consume significant time and resources
- This lecture outlines various techniques that allow a team to manage and control a design project
- The 3Ss of project management:
 - » **Scope**
 - To know the goals and to accomplish them
 - » **Spending**
 - To complete the project within the specified budget
 - » **Scheduling**
 - To finish the project “on time”


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Project Management Approach


- Managing the design process consists of four functions:
 - » Planning
 - Define scope, schedule and spending (the 3Ss)
 - » Organizing
 - Determine who is responsible for each project task
 - » Leading - Motivate team by showing that
 - 1) tasks are fair
 - 2) division of work is fair and
 - 3) level of work produces satisfactory progress toward goals
 - » Controlling
 - Relies on a sound plan to measure progress and take corrective actions

Tools that can be applied in these phases are explained



Project Management Tools

- Work breakdown structures (planning, organizing)
 - » Determines scope of activities
 - » Hierarchical representation (like a family tree) of all tasks
 - » Work is “broken down” into pieces small enough to estimate resources (£, number of persons) and time required
- Team calendar (planning)
 - » Shows time available to the team
 - » Highlights deadlines
- Gantt chart (planning, organizing)
 - » Horizontal bar graph mapping design activities (and their duration) against a timeline
 - » Shows parties responsible for activities




Work Breakdown Structures (WBS)

PM Tools: What must be done to FINISH the job

- WBS is considered the most important management tool for design projects.
- It decomposes overall task into smaller, more manageable subtasks.

As a simple example, consider a spacecraft design:



```

graph TD
    A[Extraterrestrial Rover] --> B[Propulsion]
    A --> C[Guidance]
    A --> D[Power generation]
    A --> E[Science tools]
    A --> F[Communications]
    A --> G[Control]
    E --> H[Robotic arm]
    E --> I[Abrasion tool]
    H --> J[Spectrometer]
    I --> K[Microscopic imager]
          
```

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PM Tools: What must be done to FINISH the job

Work Breakdown Structures (1)

- Observation 1: Each item that you take to a lower level should be *always* broken into *two or more subtasks*

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PM Tools: What must be done to FINISH the job

Work Breakdown Structures (2)

- Observation 2: Break down an activity until you can determine > *how long it will take* and > *who will do it*

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PM Tools: What must be done to FINISH the job

Work Breakdown Structures (3)

- Observation 3: WBS should be *complete* in the sense that any activity that consumes *resources or time* is included
- Observation 4: Any part of the hierarchy of tasks should *add up*

Team Calendars

- A mapping of deadlines (given to you) onto a traditional calendar
- Also include team - generated deadlines for tasks in the WBS
 - » Becomes an extension of the team working agreement
 - » Include recurring or routine activities such as team meetings

March							Design Team							May						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
7	8	9	10	11	12	13								2	3	4	5	6	7	8
14	15	16	17	18	19	20								9	10	11	12	13	14	15
21	22	23	24	25	26	27								16	17	18	19	20	21	22
28	29	30	31											23	24	25	26	27	28	29
														30	31					

Sun	Mon	Tue	Wed	Thu	Fri	Sat	Sun
					SCOPM Propose Bids		
4	5	6	7	8	9	10	
		7:00-8:15PM Team Meeting			11:00AM Proof of Concept Due		
11	12	13	14	15	16	17	
	11:00AM Hunch Office Due				SCOPM Team Docs Review Due		
18	19	20	21	22	23	24	
	11:00AM Proposition Office Due	7:00-8:15PM Team Meeting	11:00AM Bidding Due		SCOPM Draft Final Request Due		
25	26	27	28	29	30	31	
	10:00-11:00AM/7:00-8:15PM Present Results				SCOPM Final Report Due		

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Team Calendars

- Points to keep in mind:
 - » Team calendar should be reviewed at each meeting
 - » Times on calendar should be consistent with WBS

March							Design Team							May								
S	M	T	W	T	F	S							S	M	T	W	T	F	S			
1	2	3	4	5	6														1			
7	8	9	10	11	12	13										2	3	4	5	6	7	8
14	15	16	17	18	19	20										9	10	11	12	13	14	15
21	22	23	24	25	26	27										16	17	18	19	20	21	22
28	29	30	31													23	24	25	26	27	28	29
																30	31					

Sat	Sun	Tue	Wed	Thurs	Fri	Sat
					5:00PM Perkins Ball	
		7:00-8:15PM Team Meeting			11:00AM Proof of Concept Due	
	11:00AM Breakfast Due	7:00-8:15PM Team Meeting			5:00PM Topic Tests Outline Due	
	11:00AM Project Outline Due	7:00-8:15PM Team Meeting	11:00AM Slides Due		5:00PM Draft Final Report Due	
	12:00-11:00AM Present Results Team Meeting				5:00PM Final Report Due	

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Gantt Charts

- The Gantt chart is named after a well known industrial engineer, Henry Laurence Gantt
- During World War I (1910s), he studied manufacturing processes and labor utilization to improve the productivity of munitions factories
- A Gantt chart is an easy-to-use, valuable Project Management tool
- It shows, in one table:
 - » Tasks to be completed
 - » Persons responsible
 - » Start, duration, and end times/dates
 - » Activity precedence (what has to be done first, in what order)

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PM Tools: Keeping track of TIME

Gantt Chart Example

Activities	Responsible party	2003	2004	2005
Project start day	Team	[Bar from Jan 2003 to Jan 2004]		
1.1. Review Product platform & info. modeling	Mary, John	[Bar from Jan 2003 to Jan 2004]		
2.1. Characterize information types	Jane	[Bar from Feb 2003 to Apr 2003]		
2.2. Identify product commercialities	Bill	[Bar from Feb 2003 to Apr 2003]		
2.3. Establish platform categories	Mary	[Bar from Feb 2003 to Apr 2003]		
3. Develop generalized flow model	Team	[Bar from May 2003 to Jul 2003]		
4. Apply flow model to case studies	Bill, John	[Bar from Aug 2003 to Oct 2003]		
5. Develop capture/storage/retrieval agents	Mary, Jane	[Bar from Nov 2003 to Jan 2004]		
6. Develop product family/platform agents	John, Mary	[Bar from Feb 2004 to Apr 2004]		
7. Implement prototypical system	Bill	[Bar from May 2004 to Jul 2004]		
Face-to-face meetings	Team	[Bar from Aug 2004 to Oct 2004]		
Research transfer	Team	[Bar from Nov 2004 to Jan 2005]		

- For scheduling, it is critical to understand the *precedence relationships* between tasks
 - Sequential tasks - Task 1 must be finished before Task 3 can begin
 - Parallel tasks - Tasks 3 and 4 can be undertaken simultaneously (or in parallel)

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Budget: Show Me the Money

- Design project budgets consist of:
 - Research expenses
 - Materials for prototypes
 - Materials for your "final" product (really, it is still a prototype)
 - Value of design team time
- For the upcoming project, you will be allowed only £30
 - This £30 covers the first three categories of the budget
 - For this project, you will be judged (to a certain degree) on the cost of your "final" product - not to exceed £30
 - The total cost of the project will exceed that amount if you include the value of your time

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PM Tools: Show me the MONEY

Value of Design Team Time

- A simple algorithm to estimate value of design team time
 - $Cost_{team} = M_{overhead} * Cost_{direct}$
 - $M_{overhead}$ is a multiplier that covers fringe benefits, supervision, profit and facilities costs to the organization
 - $Cost_{direct}$ is the money/pay that you, the designer, would see in a paycheck
 - Typical values:

$M_{overhead} = 2 - 4$
 $Cost_{direct} = £15 - 50 /hr$
- Even at a minimal wage (£5/hr) for a design team of five for ten hours a week for ten weeks, the cost is £5000-10,000

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Conclusion on Budgets

- Make initial estimates of your budget for
 - » Research expenses
 - » Materials for prototypes
 - » Materials for your "final" product
- For value of team time, keep records of hours spent on the project throughout the semester
 - » The bottom line on the value of design team time:



Einstein discovers that time is actually money.

Time is Money!
