ESD.36 System Project Management **Fall 2003**
System Design and Management Program (SDM)
Prof. Olivier de Weck and Dr. James Lyneis

Homework 1
Network Planning Techniques

Out: September 9, 2003
Due: September 18, 2003, 3pm

Learning objectives
In this homework you will create a project plan using the Critical Path Method (CPM), you will draw a project graph, estimate the early finish time (EF) of the project and identify the critical path and slack times. You will think about the impact of changes in individual task times on the critical path and consider probability distributions of task times and their effect on the project schedule (PERT).

Resources
[1] K.F. Levy, G. L Thompson and J.D. Wiest, "The ABCs of the Critical Path Method", Harvard Business Review, #63508, Harvard Business School Publishing, 1963 – Reading #1

[2] Optional: H. Kerzner, "Project Management: A Systems Approach to Planning, Scheduling and Controlling", John Wiley & Sons, 1998 – Chapter on PERT/CPM

[3] Calendar year 2008 – attached.

[4] Online Normal Distribution Table: http://www.math2.org/math/stat/distributions/z-dist.htm

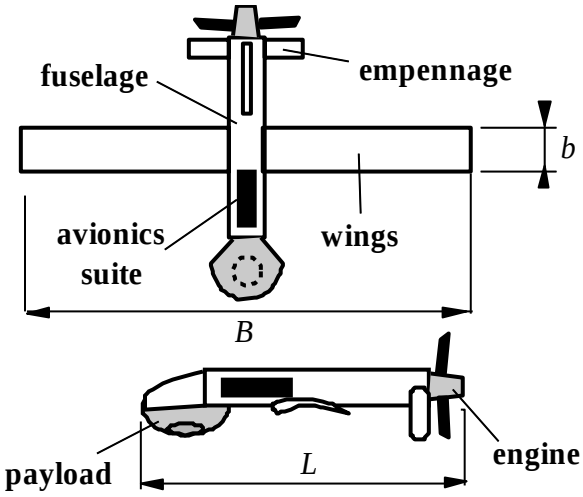

Fig 1. UAV concept, Specifications: L=2000 mm, B=3500 mm, b=500 mm

This homework can be solved without the assistance of software.

Situation
You have recently been promoted to Project Manager at *New Millennium Aerospace (NMA) Inc.*, a leading manufacturer of unmanned aerial vehicles (UAVs) for the government. Your new job is to plan and execute the development project for a UAV, to be used for surveillance purposes. A rough specification and sketch of the new vehicle is shown in Figure 1. The payload is provided by the government as GFE (government furnished equipment), while the engine will be supplied by a well-established commercial company under a subcontract. The remainder of the vehicle, including integration and testing is NMA's - and therefore your - responsibility. Your task today is to create a project schedule, find the critical path and to estimate the finish time of the project. The subsequent project description is hypothetical, but will help you establish the plan.

UAV Project Description

The UAV "pusher" vehicle concept is shown in Figure 1. In a pusher aircraft, the engine is rear-mounted which can lead to higher propulsive efficiency. The vehicle can be decomposed into the following assemblies: fuselage (houses the avionics suite), wings, empennage, payload (a visual and an IR camera, incl. transmitter) and the engine (incl. propeller).

After the *project start* (a,0) you first have to complete the *requirements definition* (b,10) step. Next you will negotiate the *engine specification* (c,3) with the supplier. The engine supplier informs you that *engine delivery* (j,30) can take place 30 days after you release the *engine specification*. In parallel (after *requirements definition*) you can begin the *vehicle layout* (d,5) internally in the company and in parallel negotiate the *GFE interface* (e,8) with the government. Typical times for *GFE delivery* (l,10) after *GFE interface* release are 10 days. Once you have completed the *vehicle layout* you can start the *fuselage design* (f,12). However, in order to start *fuselage design* you need to also have the *engine specification* and the *GFE interface* done, since the engine hooks to the back of the fuselage and the GFE payload attaches to the nose of the UAV.
Once the *fuselage design* is completed you can do the *wing design* (g,10), since you can now estimate the required lift for the vehicle based on the combined weight of the engine, GFE payload and fuselage. Finally, the *empennage design* (i,8) sizes the tail of the UAV to balance the pitching moment produced by the *wing design*. *Avionics design* (h,25) can be done after *GFE interface* definition. V*ehicle integration* (k,15) can take place after *empennage design* and *avionics design* have been completed and the *engine* and *GFE payload* have been *delivered*. Prototype *ground testing* (m,20) follows completion of *vehicle integration*. *Flight testing* (n, 25) follows *ground testing* and leads to the *end* (o,0) of the UAV development project.

Note:

- task descriptions are in italics
- (n,25) means that the task is tagged as "n" and is expected to take 25 work days

Assignment

1. Construct a task table from the UAV project description. Clearly designate each task with its tag, description and identify immediate predecessors and expected task completion times. See [1, Exhibit I] for an example. Try to arrange the task table in "technological order".

2. Create a project graph [similar to 1, Exhibit II] by hand or using a computer program.

3. What is the earliest finish (EF) for the project as a whole (in units of work days)? Show how you arrived at this result.

4. What is the critical path? (e.g. a-b-k-x-z). Highlight the critical path in the project graph from 2.). Explain in a few sentences what this means for you as the project manager. Where will you focus your attention?

5. The *start* date of the project (a,0) has been fixed as January 7, 2008. What is the earliest calendar finish date of the project, assuming that you work only Monday through Friday and that there are no holidays?

6. After some negotiation, the CEO has set a target date (T) of June 30, 2008 for completion of the project. Figure out, for each task, what the total slack (TS) and what the free slack (FS) is. Which task in your project has the largest free slack? How do you suggest to best use this free slack as a manager?

7. Set specific target dates for delivery of the engine (for the supplier) and for the GFE payload (for the government agency). Why did you choose those dates?

8. You just finished the *requirements definition* (b,10) step on time, i.e. it is now January 18, 2008 at 5:00p.m. and you get a phone call from the engine supplier. They inform you that the engine specification (task c) will take 10 working days instead of 3 working days to work out due to a misunderstanding in one of the engine requirements. How does this impact the critical path of the project? Revise the project plan with the changed date. What is the impact on the earliest finish (EF) date? How does this change your focus as a project manager? Explain.

Challenge Question

9. You have just completed all tasks up to (and including) *vehicle integration* (*k*) according to your revised schedule, i.e. all tasks were completed at their earliest finish time (EF). You are now starting *ground testing* and *flight testing*. Based on previous experience, the completion times for these tasks *m* and *n* are somewhat uncertain. The task duration histograms from previous projects are shown in Figure 2.

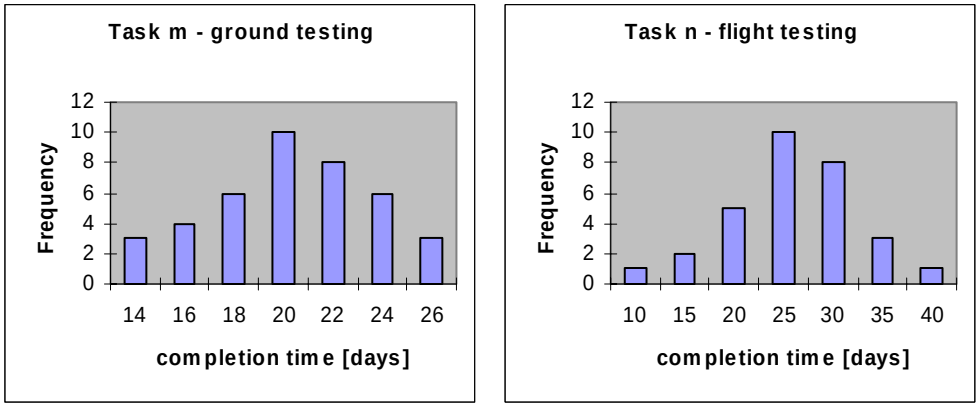

Fig. 2: Task completion time histogram for UAV testing.

The CEO wants to move up the UAV project completion date to **May 23, 2008**. What is the probability (in percent %) that you can make that date?

- **Turn in your answers with the rubric attached as the cover sheet.**

JANUARY 2008

MO	TU	WE	TH	FR	SA	SU
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

FEBRUARY 2008

MO	TU	WE	TH	FR	SA	SU
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29		

MARCH 2008

MO	TU	WE	TH	FR	SA	SU
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
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24	25	26	27	28	29	30
31						

APRIL 2008

MO	TU	WE	TH	FR	SA	SU
	1	2	3	4	5	6
7	8	9	10	11	12	13
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28	29	30				

MAY 2008

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			1	2	3	4
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19	20	21	22	23	24	25
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JUNE 2008

MO	TU	WE	TH	FR	SA	SU
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23	24	25	26	27	28	29
30						

JULY 2008

MO	TU	WE	TH	FR	SA	SU
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

AUGUST 2008

MO	TU	WE	TH	FR	SA	SU
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

SEPTEMBER 2008

MO	TU	WE	TH	FR	SA	SU
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

OCTOBER 2008

MO	TU	WE	TH	FR	SA	SU
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

NOVEMBER 2008

MO	TU	WE	TH	FR	SA	SU
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

DECEMBER 2008

MO	TU	WE	TH	FR	SA	SU
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8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

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