Software Project Management
(A.Y. 2018/2019) – Exam Solution

February 6^{th}, 2019

Preamble

The ACME Software has been asked to develop a complex software system. You, as an employee of the company, have been appointed as Project Manager. The management is now asking you to provide some forecasting in order to decide on how to proceed with the project.

In deriving your prediction you should consider that the **week** gross salary of the emplyees is as following specified:

- *Senior developer:/Analysts* 2000€
- *Junior developer:* 1200€

Moreover historical data show that the company generally experiments a 65% overhead

Exercise 1.

At first in order to derive a more reliable estimation you sketch a set of workpackages (WPs) and tasks that you consider necessary in order to complete the project. Tasks expected durations and their mutual dependencies are detailed in Table 1.

Activity	**Activity Duration (weeks)**				
(Precedents)	**Optimistic (a)**	**Most likely (m)**	**Pessimistic (b)**	**Expected te**	**Standard deviation (s)**
T1.1	4	6	8	6	0,66
T1.2 (T1.1,T2.1)	1,5	5,5	6,5	5	0,83
T1.3 (T1.1)	9	12	15	12	1
T2.1	8	12	16	12	1,33
T2.2 (T2.1)	3	5	7	5	0,66
T2.3 (T1.3,T2.2)	6	12	18	12	2
T3.1 (T2.2)	4	6	14	7	1,66
T3.2 (T1.2,T3.1)	3	4	11	5	1,33
T3.3 (T2.3,T3.2)	9	12	15	12	1
T3.4 (T3.1)	4	4,5	8	5	0,66
T4.1 (T3.1,T3.2)	5	9	13	9	1,33
T4.2 (T4.1)	2	3	10	4	1,33

Table 1: Activities time estimates (in weeks)

To derive a first estimation for the project you apply the PERT approach. Therefore you compute:

- The duration of the project
- The probability of successfully terminating task T4.2 by week 45, task T3.3 by week 44 and task T3.4 by week 42.
- Compute the deadline by which the probability of having finished the project is 95%
- Immagine of being at week 30 into the project, and that tasks 2.3, 3.2 and 3.4 just ended. Having observed a week of delay for activities 3.2 and 3.4, being, according to the plan, expected to end at week 29, which is now the probability of successfully terminating the project by week 43 (considering that no change occurred in relation to the duration and related probabilities of the still missing tasks).

Note: In deriving the PERT network you should try to reduce the number of nodes **12 points**

Solution:

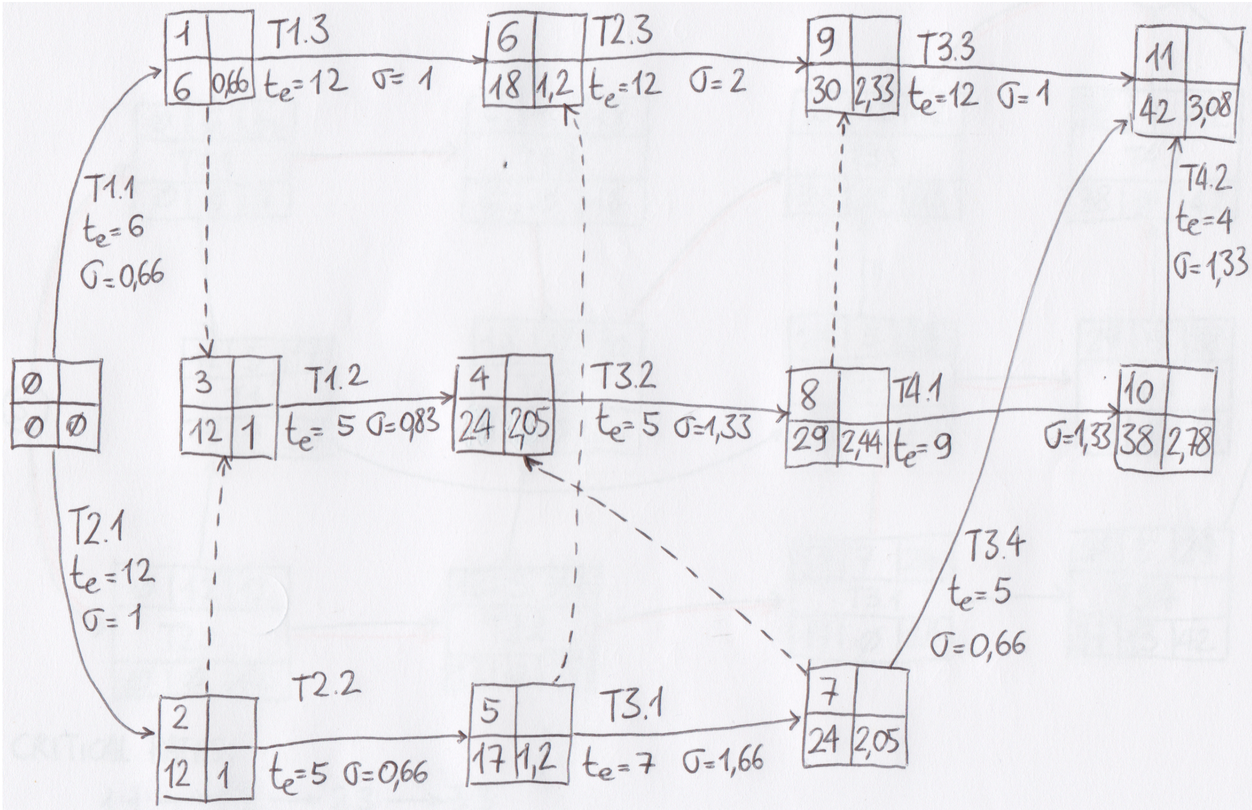

Figure 1: PERT Network

Accoding to the PERT network reported in Figure 1 we can conclude that:

- The expected duration of the project is 42 weeks
- The probability of terminating the various tasks by the given weeks is computed using the formula $Z = (T - t_e)/\sigma$ and then using the graph for Z to get the probability. As a result we get:
  - T4.2 by week 45: 0.974=45-42/3.08 corresponding to a probability of ≈0.83
  - T3.3 by week 44: 0.79=44-42/2.54 corresponding to a probability of ≈0.79
  - T3.4 by week 42: 6.05=42-29/2.15 corresponding to a probability of ≈0.999
- To compute the week by which the probability of having finished the project is 0.95 we can use the formula $T = Z * \sigma + t_e$ where for the value of Z we use the value 1.75. As a result we get 47.39 that is around 47 weeks plus 2 days.
- To answer the question we could consider the need of running a new project in which the only tasks to perform are the ones still not started at week 30 (i.e. T3.4, T4.1, T4.2) with the given durations and dependencies. Then considering that the total time to perform T4.1 and T4.2 is 13 (corresponding to the weeks remaining to reach week 43) we can immediately conclude that the probability of having the project finished by week 43 is 0.5

Exercise 2.

Consider that now you want to derive a plan applying the critical chain method. For each activity the duration you consider is the one reported in Table 1, and indicated as t_e, while as comfort zones you consider the ones corresponding to a duration leading to 95% of probability of terminating the activity itself. In addition yoo judge that 50% is the percentage to use to compute both the project buffer and the feeding buffers (use ceiling to the whole week in order to approximate the numbers you get).

After having derived the sheduling for the project, according to the critical chain method, you want to derive a cost estimation allocating the resources indicated in Table 2 applying a uniform distribution over the duration of the activity. In deriving the plan you consider the following constraints that could affect the total cost of the project:

- the company does not have more than 5 Senior Developers and 5 Junior Developers. The cost for recruitment activities accounts to 15000€ for each resource to be recruited.
- in order to simplify management activities, resources are charged to the project budget for a minimum of 2 weeks (i.e. in case a resource is assigned to a project and then released for less then 2 weeks in any case the budget to be considered is the one corresponding to two weeks)
- in order to simplify management activities, resources should not be released for less than two weeks, otherwise the costs that will be charged on the project will be in any case two weeks (i.e. in case a resource is assigned to the project then released and then again reallocated to the project with a resulting gap smaller than twoo weeks the cost to consider is in any case two weeks).

Task	**Effort**
T1.1	12 SD/6 JD
T1.2	15 SD/5 JD
T1.3	24 SD/12 JD
T2.1	24 SD/24 JD
T2.2	15 SD/10 JD
T2.3	0 SD/24 JD
T3.1	0 SD/14 JD
T3.2	15 SD/10 JD
T3.3	24 SD/36 JD
T3.4	10 SD/5 JD
T4.1	18 SD/18 JD
T4.2	8 SD/8 JD

Table 2: Foreseen effort for each project task in terms of Senior Developers (SD) and Junior Developers (JD)

1. Provide the resource allocation and compute the total cost, when no optimization is introduced to reduce the possible additional costs listed above.
2. Optimize as much as you can the plan, so to reduce the total project cost (consider that it is not possible to split the foreseen tasks in subtasks).

12 points

Solution:

To compute the cost of the project we have to consider the allocation of resources as reported in Figure 3.

1. In case no optimization is performed the total cost has to include the following factors:

   (a) At week 17 a SD is released and reaquired at week 18. According to the second constraint the PM will have to consider an additional week in relation to the total effort of senior developers

   (b) Similarly to the previous case but now the additional weeks to add are three

   (c) Also in this case an additional week for SD has to be considered

   (d) At week 36 the project needs to employ 6 SD and 6 JD. It is then necessary to activate recruitment activities resulting in an additional cost of 30.000€

   In summary it is necessary to consider 5 additional weeks for SD and 30.000€for recruitment activities. We can derive the total cost of the project considering an effort of 170 weeks for SD (total+5) and 172 for JD:

   $$(\textit{Total SD effort} \times 2000 + \textit{Total JD effort} \times 1200) \times 1.65 + 30.000 = (340.000 + 206.400) \times 1.65 + 30.000 = 931.560€$$

2. In order to optimize the total cost it is possible to revise the plan anticipating of a single week task T1.2 (1), and anticipating task T3.4 to week 25 (2). The revised scheduling seems to respect all the constraints leading to additional costs. As a result the tocal cost of the project is in this case 885.060€.

Activity (Precedents)	Activity Duration (weeks)						
	Optimistic (a)	Most likely (m)	Pessimistic (b)	Expected te	Standard deviation (s)	End 95%	Comfort zones
T1.1	4	6	8	6	0,66	8	2
T1.2 (T1.1,T2.1)	1,5	5,5	6,5	5	0,83	7	2
T1.3 (T1.1)	9	12	15	12	1	14	2
T2.1	8	12	16	12	1,33	15	3
T2.2 (T2.1)	3	5	7	5	0,66	7	2
T2.3 (T1.3,T2.2)	6	12	18	12	2	16	4
T3.1 (T2.2)	4	6	14	7	1,66	10	3
T3.2 (T1.2,T3.1)	3	4	11	5	1,33	8	3
T3.3 (T2.3,T3.2)	9	12	15	12	1	14	2
T3.4 (T3.1)	4	4,5	8	5	0,66	7	2
T4.1 (T3.1,T3.2)	5	9	13	9	1,33	12	3
T4.2 (T4.1)	2	3	10	4	1,33	7	3

Table 3: Activities time estimates and corresponding comfort zones (considering 95% probability)

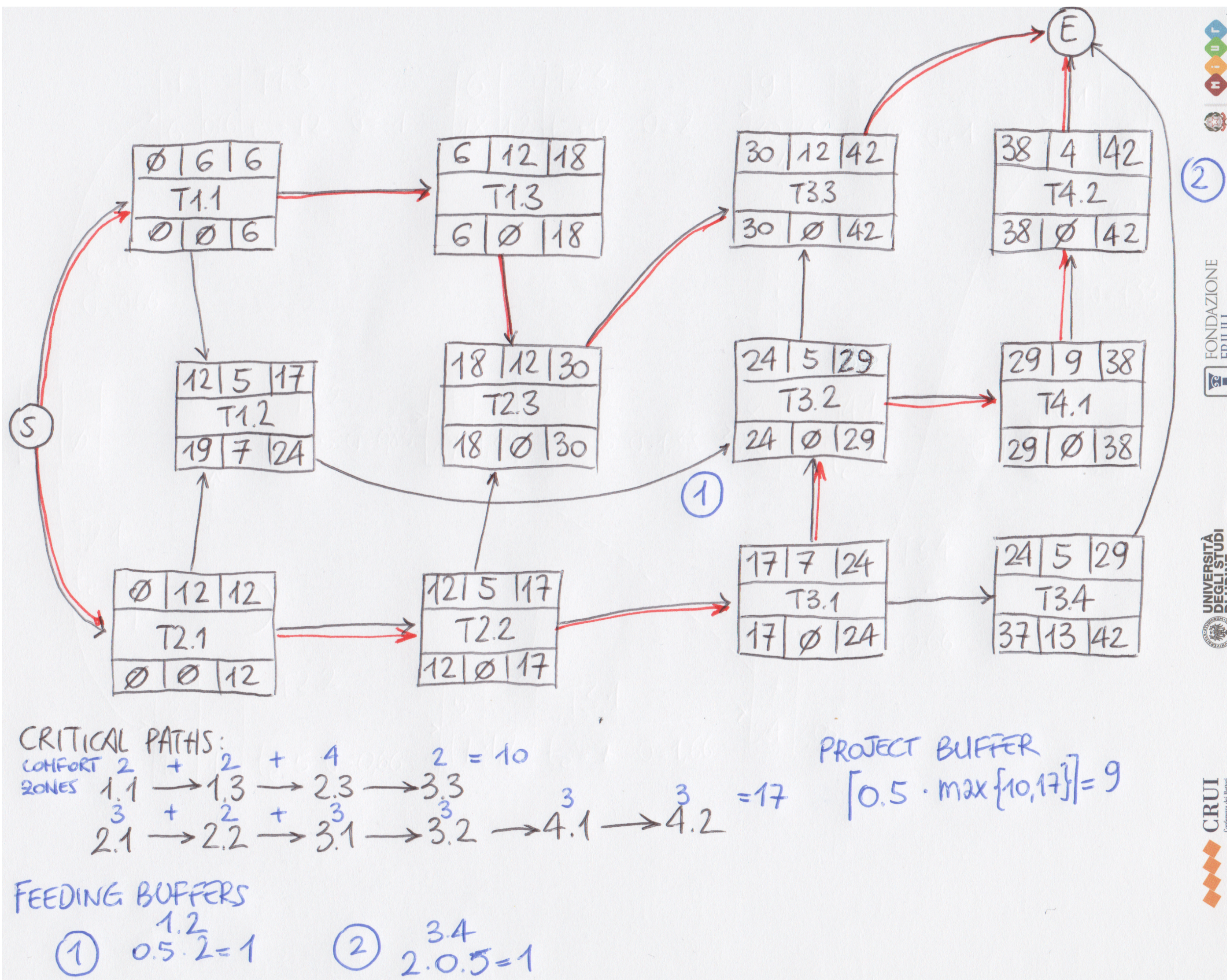

Figure 2: CPM network and buffers

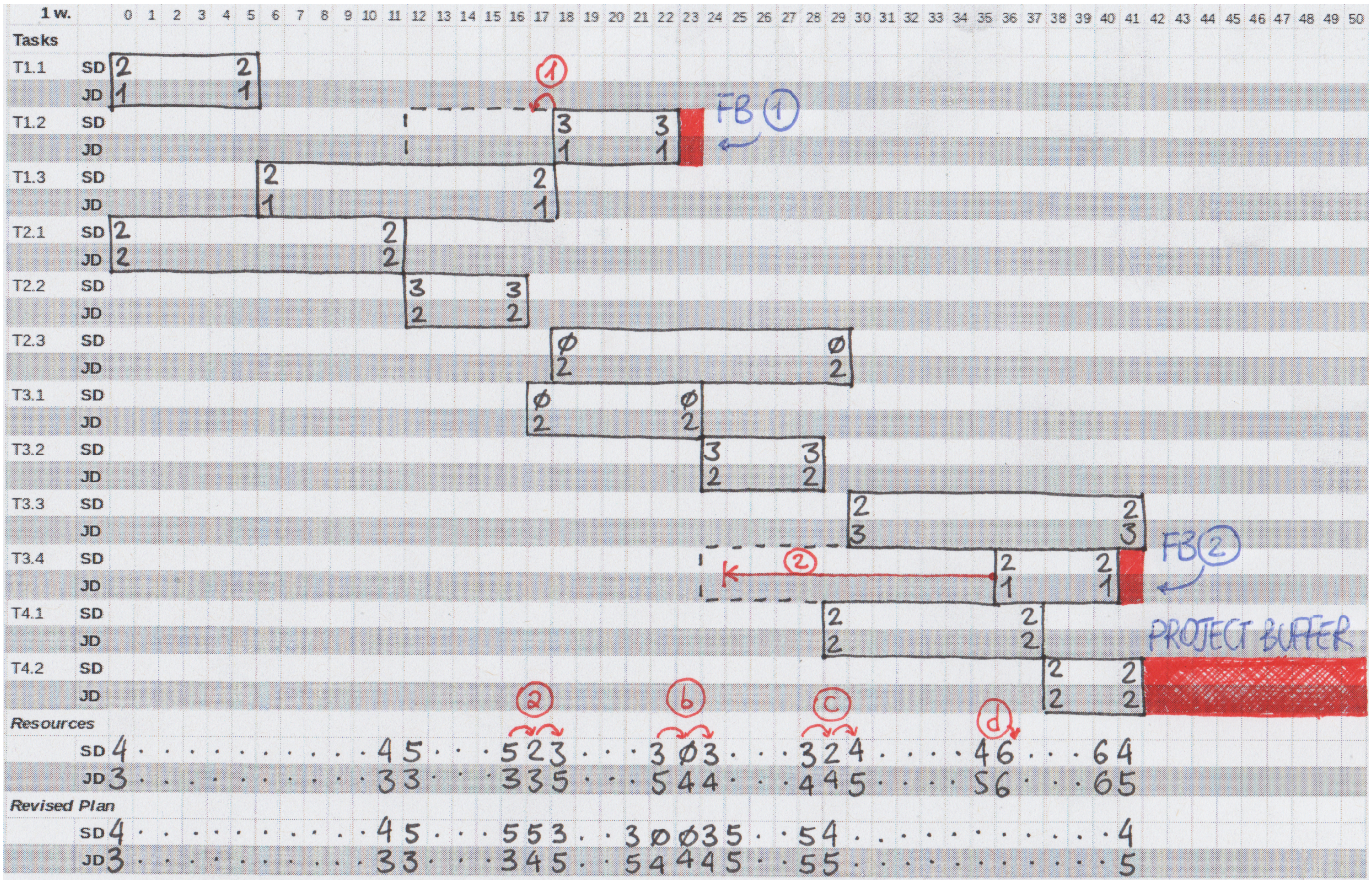

Figure 3: Project resources allocation

Question 1.

Describe how and who manages the sprint backlog, when SCRUM is adopted **3 points**

Answer:

The answer should provide details on who, when, what and how the backlog is used to organize and drive development activities. Related contents are spread over the Agile book.

Question 2.

Shortly describe the different strategies of risk planning, and which are the general principles that should guide a PM in selecting an approch to adopt in relation to a specific risk. **3 points**

Answer:

See PM textbook, Section 7.7 page 172

Question 3.

Describe the characteristics of COCOMOII and its underlying hypothesis **3 points**

Answer:

See PM textbook pages 120 and following.