Software Project Management
A.Y. 2019/2020 – Duration: 2h30m

March 18^{th}, 2020

When you will have finished please **scan or take a picture of the sheets you would like to deliver**. You can either **upload the file on drive** and send the link to andrea.polini@unicam.it, or you can **just send it in attachment**.

Preamble

UNICAM appointed you as a project manager, and is asking you to develop a complex software system. You have to provide soon some forecasting in order to decide on how to proceed with the project.

In deriving your prediction you should consider that the **daily** gross salary of the UNICAM employees is as following specified:

- *Senior developer/Analysts:* **400€**
- *Junior developer:* **250€**

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 (**add the missing values** for the standard deviation).

Activity	Activity Duration (days)				
(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)	3	3,5	7	4	0,66
T1.3 (T1.2,T2.1)	10	12	20	13	1,66
T1.4 (T1.3,T2.3)	6	8	16	9	1,66
T2.1	4	6	14	7	
T2.2 (T1.1,T2.1)	2	6	10	6	
T2.3 (T2.2,T3.2)	8	9	16	10	1,33
T3.1	3,5	4,5	8,5	5	0,83
T3.2 (T1.1,T2.1,T3.1)	8	9,5	14	10	1
T3.3 (T3.2)	7	8	15	9	1,33
T4.1 (T1.3,T2.3)	12,5	13,5	17,5	14	0,83
T4.2 (T1.3,T2.3,T3.3)	12	13	20	14	1,33
T4.3 (T4.1,T4.2)	5	6,5	11	7	1
T4.4 (T4.2)	4	5,5	10	6	1

Table 1: Activities time estimations (in days)

To derive a first estimation you apply the PERT approach to compute:

- the duration of the project
- the probability to successfully terminate task T1.3 by day 27, task T4.1 by day 41 and task T3.3 by day 27.
- Compute the deadline by which the probability of having finished the project is 95%
- while you are running the project you recognize that the dependencies for task T4.2 can be revised, and according to the new understanding it could start as soon as T3.3 ends (so no need to wait for tasks T1.3 and T2.3. Which would be the duration of the project if you put in place the modification? Which is the probability to end the project by day 50?

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

Exercise 2.

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 90% (use a value for $z = 1,28$) of probability of terminating the activity itself. In addition you judge that 33% is the percentage to use to compute the project buffer and 25% the percentage for the feeding buffers (use ceiling to the whole day in order to approximate the numbers you get). In the plan consider that the activities for which the foreseen end coincides with the end of the project **do not need** a corresponding feeding buffer.

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 each activity. In deriving the plan you should consider that the following constraints could affect the total cost of the project:

- the company does not have more than 8 Senior Developers and 8 Junior Developers. The cost for recruitment activities accounts to 10000€ for each resource to be recruited at junior level and 15000€at senior level
- in order to simplify management activities:
  - resources are charged to the project budget for a minimum of 2 days (i.e. in case a resource is assigned to a project and then released for less then 2 days in any case the budget to be considered is the one corresponding to two days) still trying to postpone the start of activities as much as possible.
  - resources should not be released for less than two days, otherwise the costs that will be charged on the project will be in any case two days (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 or equal to two days the cost to consider is in any case two days).

Task	**Effort**	**Task**	**Effort**	**Task**	**Effort**	**Task**	**Effort**
T1.1	6 SD/6 JD	T2.1	28 SD/28 JD	T3.1	15 SD/10 JD	T4.1	14 SD/14 JD
T1.2	8 SD/4 JD	T2.2	30 SD/24 JD	T3.2	20 SD/10 JD	T4.2	28 SD/28 JD
T1.3	65 SD/52 JD	T2.3	30 SD/30 JD	T3.3	9 SD/18 JD	T4.3	42 SD/21 JD
T1.4	27 SD/18 JD					T4.4	12 SD/18 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 applied to reduce the possible additional costs listed above.
2. Optimize as much as you can the plan, so to reduce the project total cost (consider that here it is not possible to split the foreseen tasks in subtasks).

– Tables 3 and 4 at the end of the exam text are provided for your convenience –

12 points

Question 1.

Imagine of being at day 30 in a project and you observe that complexively hwat you earned so far ca be accounted for 50k€ while you face costs for 60k€ which corresponds also to the value you should had earned at that day, according to the plan. Provides values for:

- Schedule variance, Cost performance index, Schedule performance index

Assuming that the cost at completion of the project were 100k€ which would be the revised estimation now? **3 points**

Question 2.

Describe what a burn down chart is and how it can be used in a SCRUM team (who is responsible for managing it? What kind of information it conveys? What happens if stories are added to the sprint while it is running? . . .) **3 points**

Question 3.

Explain what information radiators are, and why are they used? **3 points**

1 d.		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	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Tasks																																																			
T1.1	**SD**																																																		
	JD																																																		
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T4.4	**SD**																																																		
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Resources																																																			
	SD																																																		
	JD																																																		
Revised Plan																																																			
	SD																																																		
	JD																																																		

Table 3: Exercise 2 - Resource Allocation

1 d.		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	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
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Table 4: Exercise 2 - Resource Allocation

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998
3.5	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998	0.9998
3.6	0.9998	0.9998	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.7	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.8	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999
3.9	0.99995	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 5: Conversion z to probability and viceversa