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Cost Slope Analysis Technique Summary

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Abstract:

Cost Slope Analysis considers the following: direct, indirect cost, under normal and crashing (shortened) duration. Specifically, it provides a logical way to determine which activities are the most cost and time efficient to be shortened. While shortening any task would mostly increase its direct cost, through the decreasing of the overall project duration, the proper decision could save on indirect cost which in turn increases the project's overall profit. Moreover, through the Optimum Cost-Time Point plotted on the Project Cost-Duration Graph, Project Manager can logically determine a crashing decision's best point of maximum profit in time, plan for the least cost required, and stop crashing the project duration at the point of a marked diminishing return. Cost Slope Analysis thus can help discovering which critical path activities would be the most cost and time efficient to be shortened and how much overall project duration could be crashed, in order to produce the maximum overall project profit. (Larson & Gray, 2011)

Cost Slope Analysis

Technique Introduction

Cost Slope Analysis is a cost management technique useful in finding a) the most cost efficient Critical Path Activities to be shortened, b) the Optimum Cost-Time Point, indicating the ideal point for a Cost to Time tradeoff , marking a crashing schedule's point of maximum profit or its point of diminishing return. (Larson & Gray, 2011) The technique requires:

a) Identifying the Critical Path Activities and their dependencies, and

b) The following 4 Cost Slope Analysis Index:

1) Indirect Cost and Duration (Normal and Crash Mode)
2) Direct Cost and Duration (Normal and Crash Mode)
3) Maximum crash time allowed per Critical Path Activity due to technical or resources constraints
4) Financial risks, including but not limited to: late delivery penalties fees, early delivery incentives (faster time-to-market benefit) etc.

Cost Slope Formula

Cost Slope's Formula can be expressed as:

Cost Slope = (Crash Cost – Normal Cost)/ (Normal Time – Crash Time)

Technique Summary and Workflow

Cost Slope Analysis's goal is to find the "Optimum Cost-Time Point" (OCTP) on the Project Cost-Duration Graph (Larson & Gray, 2011). Assuming a) there is a linear relationship showing the shortening of the critical path activities would result in a higher direct cost and total cost, and b) the longer total project duration would result in a higher indirect cost and total cost. The workflow for the Cost Slope Analysis to find the OCTP can be described as:

1) Gather the Critical Path Activities and their dependencies. This is important because Critical Path Activities naturally have "zero free float", making them the most cost efficient to crash (shorten).
2) Gather all the required "4 Cost Slope Analysis Index", listed above.
3) Calculate each Critical Path Activity's Cost Slope using the "Cost Slope Formula"

4) Select the Critical Path Activities with the “minimum” total cost slope; create a list with the cheapest cost slope Critical Path Activities on the top.

5) Begin “crashing” the schedule (shortening the total project duration), starting with the minimum cost slope Critical Path Activities considering a) focus on decreasing the overall project duration b) respecting the maximum crash time given by the SMEs and considering other project factors.

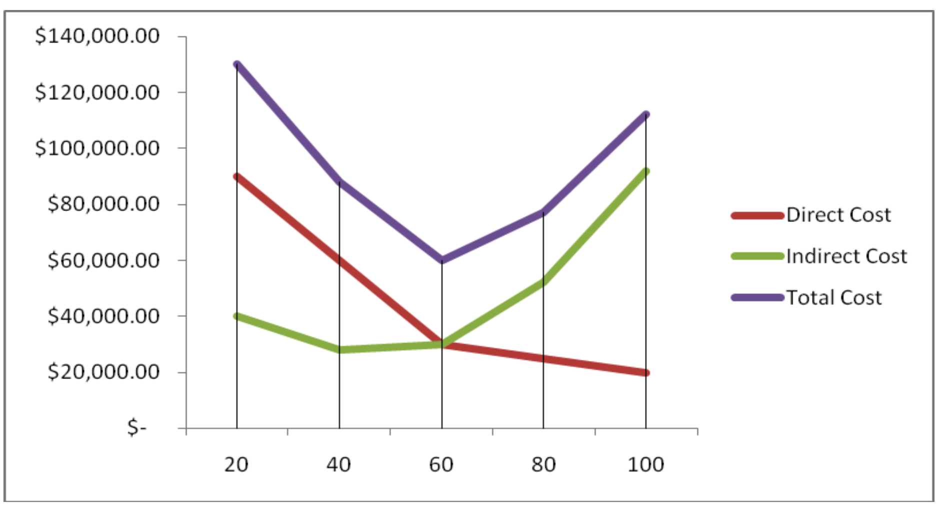
6) Build a table with the following dimensions: Project Duration, Direct Cost, Indirect Cost, Financial Risk and Total Cost. (See Example Table 1)

Example Table 1:

Project Duration	Direct Cost	Indirect Cost	Total Cost	Financial Risk
20	$ 90,000.00	$ 40,000.00	$ 130,000.00	
40	$ 60,000.00	$ 28,000.00	$ 88,000.00	
60	**$ 30,000.00**	**$ 30,000.00**	**$ 60,000.00**	
80	$ 25,000.00	$ 52,000.00	$ 77,000.00	$ 20,000.00
100	$ 20,000.00	$ 92,000.00	$ 112,000.00	$ 40,000.00

7) Complete the Cost Slope Analysis and deriving the “Optimum Cost-Time Point” from a Project Cost-Duration Graph (See Example Graph 1). In our example, the OCTP point is at the 60th day.

Example Graph 1:



Cost Slope Analysis with an Example Localization Project's Simulation Data

Assumptions

For the sake of demonstrating Cost Slope Analysis, a simulated "LullSim Localization Project" will be used. A few assumptions will be established using a mixture of a) a simulated Baselined Schedule's Critical Path Activities (calculated using MS Project) and b) a simulated Cost Slope calculations of some of these Critical Path Activities. The analysis will also provide a set of "Normal Total Project Cost and Duration" as the starting point, normally these would match a project's baseline schedule.

The analysis presented here would demonstrate how it is done following the workflow outlined in the earlier section of this paper; nevertheless, it serves mostly as a theoretical demonstration since most of the "4 Cost Slope Analysis Index" are unknown and they will be supplied based on various and mixed project assumptions due to the limits of the simulation data.

Critical Path Activities:

Example Table 2:

Task ID	Critical	Task Name
	Yes	**LullSim Loc.Proj**
	No	**Glossary**
4	No	Localize French Glossary
5	No	Localize German Glossary
6	No	Localize Japanese Glossary
8	No	Review French Glossary
9	No	Review German Glossary
10	No	Review Japanese Glossary
12	No	Correct French Glossary
13	No	Correct German Glossary
14	No	Correct Japanese Glossary
16	**Yes**	**Software**
20	No	Localize French Code Freeze Software Files
21	No	Localize German Code Freeze Software Files
22	No	Localize Japanese Code Freeze Software Files
24	Yes	Localize French Final Software Files
25	Yes	Localize German Final Software Files
26	No	Localize Japanese Final Software Files
32	Yes	Review French Localized Software

33	Yes	Review German Localized Software
34	No	Review Japanese Localized Software
40	Yes	Implement French Software Corrections
41	Yes	Implement German Software Corrections
42	Yes	Implement Japanese Software Corrections
48	Yes	Conduct Functional QA of French Beta
49	Yes	Conduct Functional QA of German Beta
50	Yes	Conduct Functional QA of Japanese Beta
52	Yes	Implement French Beta Corrections
53	Yes	Implement German Beta Corrections
54	Yes	Implement Japanese Beta Corrections
60	Yes	Review French Release Candidate
61	Yes	Review German Release Candidate
62	Yes	Review Japanese Release Candidate
72	**Yes**	**Documentation**
73	**Yes**	**Localize Code Freeze Documentation**
74	Yes	Localize French Code Freeze Documentation
75	Yes	Localize German Code Freeze Documentation
76	No	Localize Japanese Code Freeze Documentation
78	**Yes**	**Localize Final Documentation**
79	**Yes**	**Localize French Final Documentation**
80	Yes	Localize French Final Getting Started Guide
81	No	Localize French Final Quick Reference Guide
82	Yes	Localize French Final Using LullSIM
83	Yes	Localize French Final Administering LullSIM
85	**Yes**	**Localize German Final Documentation**
86	Yes	Localize German Final Getting Start Guide
87	No	Localize German Final Quick Reference Guide
88	Yes	Localize German Final Using LullSIM
89	Yes	Localize German Final Administering LullSIM
91	**Yes**	**Localize Japanese Final Documentation**
92	No	Localize Japanese Final Getting Started Guide
93	No	Localize Japanese Final Quick Reference Guide
94	No	Localize Japanese Final Using LullSIM
95	Yes	Localize Japanese Final Administering LullSIM
97	**Yes**	**QA Localized Documentation**
98	**Yes**	**Review French Documentation**
99	No	Review French Getting Started Guide
100	No	Review French Quick Reference Guide
101	Yes	Review French Using LullSIM
102	Yes	Review French Administering LullSIM

104	**Yes**	**Review German Documentation**
105	No	Review German Getting Started Guide
106	No	Review German Quick Reference Guide
107	Yes	Review German Using LullSIM
108	Yes	Review German Administering LullSIM
110	**Yes**	**Review Japanese Documentation**
111	No	Review Japanese Getting Started Guide
112	No	Review Japanese Quick Reference Guide
113	No	Review Japanese Using LullSIM
114	Yes	Review Japanese Administering LullSIM
116	No	Correct French Documentation
117	No	Correct German Documentation
118	Yes	Correct Japanese Documentation
120	**Yes**	**Online Help**
121	No	Convert French Online Help
122	No	Convert German Online Help
123	Yes	Convert Japanese Online Help
129	No	Correct French Online Help
130	No	Correct German Online Help
131	Yes	Correct Japanese Online Help
133	**Yes**	**Marketing Communications (MarCOM)**
134	No	Localize French MarCOM Materials
135	No	Localize German MarCOM Materials
136	Yes	Localize Japanese MarCOM Materials
138	No	Review French MarCOM Materials
139	No	Review German MarCOM Materials
140	Yes	Review Japanese MarCOM Materials
142	No	Correct French MarCOM Materials
143	No	Correct German MarCOM Materials
144	Yes	Correct Japanese MarCOM Materials
146	**Yes**	**Manufacturing**
159	**Yes**	**Translation Memory**
160	No	Compile French Translation Memory
161	No	Compile German Translation Memory
162	Yes	Compile Japanese Translation Memory

The 4 Cost Slope Analysis Index:

1) Indirect Cost and Duration (Normal and Crash Mode)

   a. Assuming: Fixed overhead cost = $10,000 indirect cost per day, see Example Table 4 below

2) Direct Cost and Duration (Normal and Crash Mode)

a. For individual Work Package, see Example Table 3 below

b. Project Total's Direct Cost and Duration (Normal Mode)

Task Name	Start	Finish	Normal Duration	Normal Direct Cost
LullSim Loc.Proj	Mon 1/28/08	Mon 8/05/08	134 days	$373,502

3) Maximum crash time allowed per Critical Path Activity due to technical or resources constraints

a. N/A, Unknown

4) Financial risks

a. N/A, Unknown

Controllable Critical Path Activities' Cost Slope Calculation:

The following Example Table 3 shows a list of controllable critical path activities in an ascending order, sorted by the smallest to the largest given Cost Slope (data table was provided via a non-verified simulation as a demonstration only). The main index added here is the "Actual Crash Cost per Day", which is calculated as:

Actual Crash Cost Per Day = Normal Cost + Cost Slope (One Crash Cost per Day)

Example Table 3:

Pred	ID	Line Name	Normal Time	Normal Cost	Crash Time	Crash Cost	Cost Slope	Actual Crash Cost Per Day
42	136	Localize Japanese MarCOM Materials	8	4608	3	5917	261.80	4869.80
118	123	Convert Japanese Online Help	5	3200	4	3840	640.00	3840.00
74	82	Localize French Final Using LullSIM	12	10755	6	15131	729.33	11484.33
83	102	Review French Administering LullSIM	15	0	10	4000	800.00	800.00
20	24	Localize French Final Software Files	20	7088	10	15188	810.00	7898.00
21	25	Localize German Final Software Files	20	7088	10	15188	810.00	7898.00
82	101	Review French Using LullSIM	20	0	14	5000	833.33	833.33
74	83	Localize French Final Administering LullSIM	10	8955	4	14876	986.83	9941.83
74	80	Localize French Final Getting Started Guide	8	7230	3	12211	996.20	8226.20
17	74	Localize French Code Freeze Documentation	45	48263	20	74250	1039.48	49302.48
17	75	Localize German Code Freeze Documentation	45	48263	20	74250	1039.48	49302.48
76	95	Localize Japanese Final Administering LullSIM	10	11540	4	18347	1134.50	12674.50
136	140	Review Japanese MarCOM Materials	2	0	1	2000	2000.00	2000.00

Cost Slope Analysis Table:

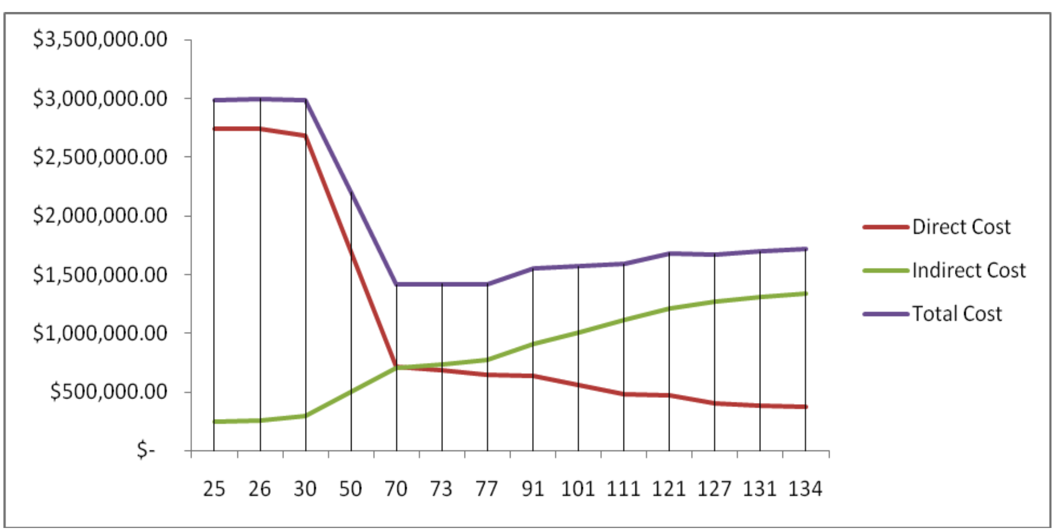
Example Table 4:

Project Duration	Direct Cost	Indirect Cost	Total Cost	Financial Risk	Indirect Cost per day
25	$ 2,739,247.20	$ 250,000.00	$ 2,989,247.20	$ -	$ 10,000.00
26	$ 2,737,247.20	$ 260,000.00	$ 2,997,247.20	$ -	$ 10,000.00
30	$ 2,686,549.20	$ 300,000.00	$ 2,986,549.20	$ -	$ 10,000.00
50	$ 1,700,499.60	$ 500,000.00	$ 2,200,499.60	$ -	$ 10,000.00
70	$ 714,450.00	$ 700,000.00	$ 1,414,450.00	$ -	$ 10,000.00
73	$ 689,771.40	$ 730,000.00	$ 1,419,771.40	$ -	$ 10,000.00
77	$ 650,004.07	$ 770,000.00	$ 1,420,004.07	$ -	$ 10,000.00
91	$ 638,337.40	$ 910,000.00	$ 1,548,337.40	$ -	$ 10,000.00
101	$ 559,357.40	$ 1,010,000.00	$ 1,569,357.40	$ -	$ 10,000.00
111	$ 480,377.40	$ 1,110,000.00	$ 1,590,377.40	$ -	$ 10,000.00
121	$ 472,377.40	$ 1,210,000.00	$ 1,682,377.40	$ -	$ 10,000.00
127	$ 403,471.40	$ 1,270,000.00	$ 1,673,471.40	$ -	$ 10,000.00
131	$ 388,111.40	$ 1,310,000.00	$ 1,698,111.40	$ -	$ 10,000.00
134	$ 373,502.00	$ 1,340,000.00	$ 1,713,502.00	$ -	$ 10,000.00

Optimum Cost-Time Point:

Based on the above assumptions, the "Optimum Cost-Time Point" for the "LullSim Localization Project" is between the 70th~ the 73th day. (Appendix A)

Example Graph 2:



References

Larson, E. W., & Gray, C. F. (2011). Project Management: The Managerial Process. New York: McGraw-Hill Companies, Inc.