PROJECT MANAGEMENT ANALYSIS IN THE INTERNET FORECASTING INDUSTRY: A CASE STUDY

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ABSTRACT

B&W Systems design and distribute a variety of management software products through the Internet and retail outlets like Best Buy. The company is currently considering the development of an Internet based forecasting system. This system is designed specifically for the new start-up and small business owner. The project manager has developed the task descriptions, time estimates and immediate predecessor (IP) relations. The project manager plans to use existing software components during the development phase as a means of keeping project costs and the overall timeframe within bounds. The primary objective of this teaching case is to introduce the student to the rationale and mechanics behind project management.

CASE OVERVIEW AND OBJECTIVES

B&W Systems design and distribute a variety of management software products through the Internet and retail outlets like Best Buy. The company is currently considering the development of an Internet based forecasting system, and wishes to effectively manage the project. The primary objective of this teaching case is to introduce the student to the rationale and mechanics behind project management. This case is designed primarily as an out-of-class exercise with a write-up analysis and results being submitted via an email attachment (WORD or PDF). The time to complete the project is estimated at two to four hours.

The case learning objectives are threefold:

1. To understand the basic steps of project management.
2. To use the Program Evaluation and Review Technique (PERT) to compute the estimated completion time for a project, and the probability of completing the project to meet a deadline.
3. To use the concept of project crashing along with linear programming to determine a crashing cost function and do project crash analysis.

CASE INTRODUCTION

Bob Phillips, director of operations at B&W Systems, was in charge of an important project. The firm had been doing a poor job of forecasting recently, as its forecasted sales were either considerably larger or smaller than actual sales. Therefore, it was thinking about a better way to do forecasting. At a recent board meeting, Grace Johnson, the vice president of marketing, reported on a new Internet based forecasting system, Forecasto. She presented her rationale for using this new forecasting system by highlighting its proven track record with other companies. The board meeting concluded with the CEO tasking Phillips to look into the potential implementation of Forecasto, and report back his findings to the board the following week.

CASE BACKGROUND

B&W Systems design and distribute a variety of management software products through the Internet and retail outlets like Best Buy. The company is currently considering the development of an Internet based forecasting system. This system is designed specifically for the new start-up and small business owner. Phillips, after consulting with the technical staff and reviewing historical efforts, has developed the task descriptions, time estimates and immediate predecessor (IP) relations. This information is reported in Appendix 1. Phillips plans to use existing software components during the development phase as a means of keeping project costs and the overall timeframe within bounds. Nevertheless, multiple task time estimates were formulated due, in part, to the inherent uncertainties associated with software development.

B&W's management team has established a 35-week completion time for this effort. A preliminary assessment by the project management indicates that some of the project tasks will need to be shortened to meet the management deadline of 35 weeks. Accordingly, the project manager has prepared a set of task crashing estimates that are highlighted in Appendix 2. Phillips knew that this was an important project to manage, and that he would have to do a thorough analysis for the board. He needed to estimate the completion time and budget for the project. Furthermore, he knew that he would need to determine the probability that the project could be completed within the deadline of 35 weeks.

Phillips knew that the board would also want to know the minimum expected time that the project could be completed, and the probability of completing the project in this time. In addition, Phillips wanted to know the additional cost for reducing the project time to the required 35 weeks, and which specific tasks should be crashed to achieve this milestone. He thought that there could be some potential issues which make cause the market assessment to take longer than accepted. So, Phillips wanted to investigate the impact on the crashing solution if the expected time for task B (market assessment) was increased from 7 to 9 weeks. He had thought of an idea that could decrease development time significantly. Therefore, Phillips also wanted to see the impact on the crashing solution if the expected time for task D (development) was decreased to 7 weeks.

The CEO would certainly want to see the crashing cost function at the next board meeting. So, Phillips needed to produce that also. Phillips was curious to discover whether or the crash cost curve was non-linear.

Phillips had taken a course in project management in business school, and he was eager to use some of the techniques he had learned, such as the Program Evaluation and Review Technique (PERT), project crashing, and linear programming to do the analysis on this project. He only had a week to complete the analysis, and so he was eager to get started.

DISCUSSION QUESTIONS AND ANALYSIS

1. What is the estimated completion time for this project? What is the estimated project budget? What is the probability that the project can be completed in 35 weeks?

The expected time for each task is computed using the formula:

Expected Time = (Most Optimistic Time + 4 * Most Likely Time + Most Pessimistic Time) / 6. (1)

The variance for each task is computed using the formula:

Variance = (Most Pessimistic Time – Most Optimistic Time)^2 / 36. (2)

A forward pass and backward pass through the network must be performed to determine the earliest start, earliest finish, latest start, and latest finish times of each task.

Slack = Latest Start Time – Earliest Start Time or Latest Finish Time – Earliest Finish Time. (3)

Appendix 3 summarizes the results.

From Appendix 3, the last task to finish is task K and it finishes at 40 weeks. So, the expected completion time for the project is 40 weeks.

The estimated project budget is simply the sum of the Normal Costs of all the activities. These costs can be found in Appendix 2. The estimated project budget is $205,000.

To determine the probability that the project can be completed in 35 weeks, we need to know the variance of the project. The variance of the project is the sum of the variances of the activities that are on the critical path, and the critical path includes the activities which have zero slack. From Appendix 3, we can see that the critical path includes activities A, C, D, E, F, J, and K. So, using the variances from Appendix 3, the variance of the critical path is 7.17 weeks^2.

The NORMDIST formula in Excel should be used to compute the probability that the project can be completed in 35 weeks. The NORMDIST formula in the context of project management has four parameters:

Parameter 1 – the deadline, in this case 35 weeks

Parameter 2 – the expected completion time for the project, in this case 40 weeks

Parameter 3 – the standard deviation of the project; this is the square root of the variance of the project and for this project equals 2.68 weeks

Parameter 4 – the value for this is 1, which will give a cumulative probability

So, the formula is =NORMDIST(35, 40, 2.68, 1) = 3.09%.

2. What is the minimum expected time that this project can be completed? What is the probability of completing the project in this time?

Project crashing using the data in Appendix 2 must be used to answer this question. Linear Programming is the best modeling technique to determine the minimum expected project completion time of 33 weeks.

The probability of completing the project in this time is 50% because 33 weeks is the mean of a normal distribution.

3. **What is the additional cost for reducing the project time to the required 35 weeks? Which specific tasks do you recommend to crashed to achieve this milestone?**

Using linear programming, the answer can be found to be $41,214.29.

The specific tasks to crash to achieve this milestone are:

C – 0.67 weeks; D – 2.33 weeks; F – 1 week; H – 0.17 weeks; K – 1 week

4. **What is the impact on the crashing solution if the expected time for task B is increased from 7 to 9 weeks?**

Because task B has so much slack time (see Appendix 3), it turns out that increasing its expected time from 7 to 9 weeks has no impact on the crashing solution.

5. **What is the impact on the crashing solution if the expected time for task D is decreased to 7 weeks?**

Because task D has zero slack and is on the critical path, decreasing its expected time to 7 weeks does significantly improve the crashing solution. Using linear programming, the new crashing solution can be found to be:

Additional cost = $27,047.62

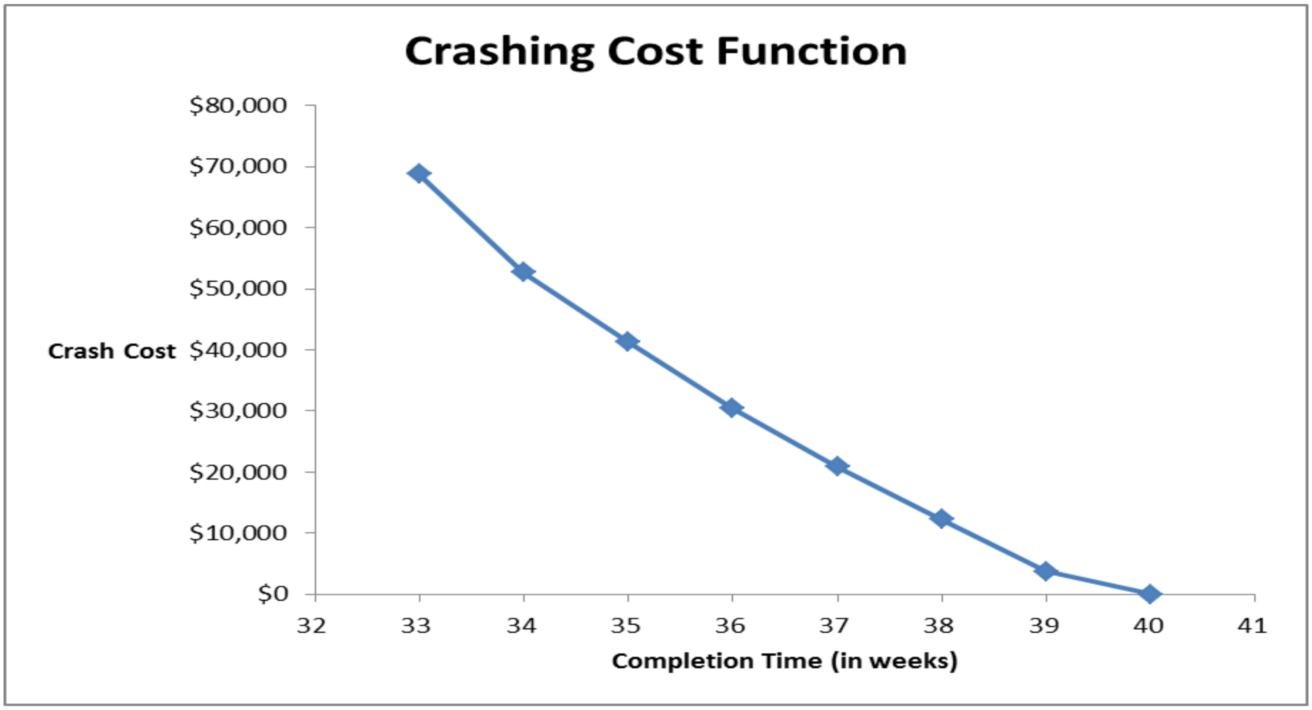
The specific tasks to crash to achieve this are:

D – 2.33 weeks; F – 1 week; H – 0.17 weeks; K – 0.33 weeks

6. **Develop a graphic of the crashing cost function. Why is the crash cost curve non-linear?**

Using linear programming, the crashing cost function is shown in Figure 1.

Figure 1



The crash cost curve is non-linear because the crash costs per week for the different tasks are not equal.

APPENDIX 1

Project Description and Time Estimates (weeks)

Task	Description	Most Optimistic	Most Likely	Most Pessimistic	I.P.
A	Requirements	2	3	4	-
B	Market Assessment	4	7	10	A
C	Design	5	6	9	A
D	Development	6	7	16	C
E	Testing	7	9	10	D
F	Revising	4	5	6	B,E
G	Documentation	3	6	10	D
H	Quality Assurance	2	4	7	C,E
I	Pricing	2	2	2	B
J	Production	3	4	14	F,G,H,I
K	Distribution	2	3	4	J

APPENDIX 2

Project Crash Data

Task	Normal Costs ($)	Crash Time (weeks)	Crash Costs ($)
A	10000	3	10000
B	20000	6	25000
C	15000	5	30000
D	45000	6	65000
E	10000	8	20000
F	15000	4	18000
G	20000	4	30000
H	10000	3	15000
I	5000	2	5000
J	40000	5	50000
K	15000	2	25000

APPENDIX 3

Task	Expected Time	Variance	Earliest Start Time	Earliest Finish Time	Latest Start Time	Latest Finish Time	Slack
A	3.00	0.11	0.00	3.00	0.00	3.00	0.00
B	7.00	1.00	3.00	10.00	19.50	26.50	16.50
C	6.33	0.44	3.00	9.33	3.00	9.33	0.00
D	8.33	2.78	9.33	17.67	9.33	17.67	0.00
E	8.83	0.25	17.67	26.50	17.67	26.50	0.00
F	5.00	0.11	26.50	31.50	26.50	31.50	0.00
G	6.17	1.36	17.67	23.83	25.33	31.50	7.67
H	4.17	0.69	26.50	30.67	27.33	31.50	0.83
I	2.00	0.00	10.00	12.00	29.50	31.50	19.50
J	5.50	3.36	31.50	37.00	31.50	37.00	0.00
K	3.00	0.11	37.00	40.00	37.00	40.00	0.00

REFERENCES

[1] Ragsdale, C.T., Spreadsheet Modeling & Decision Analysis, 6th Edition, South-Western, 2011