Expert Judgement for Budget Approach

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WBS 8.7

Sustainable Home Construction Project: Week 8 Final Deliverables

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Budget Approach

The Sustainable Home construction project is based on a budget not to exceed $1,000,000. This budget was derived from an initial top-down estimate by the corporate managers. While this top-down method was the main input in developing the budget other key elements were utilized creating the budget for this construction project. Since the design was not yet finalized it was logical to utilize a top-down approach to determine the estimated project cost. (Larson & Gray, 2014, p. 135) Table 3 below is an example of the top-down estimate for the Sustainable Home Construction project.

Determining an Accurate Budget

Once the initial project plan was developed and key requirements determined then research from the National Association of Home Builders (NAHB) provided accurate cost estimates as the project developed. The cost estimate for a single family home in 2013 was just under $250,000; while others averaged construction prices for a new home at approximately $400,000 (Taylor, 2014, p. 1). We were also able to obtain detailed pricing of a high-end 3500 square foot home with geothermal heat pump unit, built by Prindle and Prindle Inc. of Boise Idaho. (personal communication, November 2, 2014)

The U.S. Green Building Council defined a LEED house, “Leadership in Energy & Environmental Design” (USGBC, n.d.). LEED provides specific building criteria that allows for the estimate to be modified in order to meet the project objectives. The budget would become more accurate as the project progressed. (Larson & Gray, 2014, p. 274)

The time-phased work report in Table 4 is a break down by primary tasks from the project plan and shows Name of key task, remaining cost, actual cost, cost or (estimated cost) with Actual Cost of Work Performed (ACWP), Budgeted Cost of Work Performed (BCWP), and Budgeted Cost of Work Scheduled (BCWS) to provide for accurate tracking of each deliverable and if it is under cost or over cost as compared to the project estimate. This tracking takes into account cost of resources paid. The information in Table 4 would provide accurate budget tracking as the project progressed allowing for adjustments and changes when each high level task was reported.

When utilizing Microsoft Project 2013 the team can also track the variance over time utilizing the report option. The variance over time in Microsoft Project 2013 allows for viewing “Cost and schedule variances for the project based on status date. If CV is negative, then the project is over budget. If SV is positive value then the project is behind schedule.”

Table 3 Sustainable Home Construction Project Cost Estimate

WBS	Task Name	Duration	Resource Names	Cost
1	Sustainable Home Construction Project	180 days		$681,157.52
1.1	Project Initiation	2 days		$78,040.00
1.2	Project planning	47 days		$72,680.00
1.2.1	Design	47 days		$67,680.00
1.2.2	Permitting	30 days	County Government, Permit Fees[1]	$5,000.00
1.2.3	Design complete	0 days		$0.00
1.3	Executing	127 days		$524,037.52
1.3.1	Foundation	22 days	Foundation Materials[1]	$17,120.00
1.3.2	Geothermal Heat pump ground unit	11 days	Geothermal Materials[1]	$53,900.00

1.3.3	Framing	17 days	Framing Materials[1],Roofing Materials[1],Trusses[1]	$139,476.40
1.3.4	HVAC system	13 days	HVAC Materials[1]	$14,160.00
1.3.5	Electrical	9 days	Electrical Materials[1]	$21,455.20
1.3.6	Plumbing	11 days	Plumbing Materials[1]	$22,191.20
1.3.7	Communication systems wiring	10 days	Communication System Materials[1]	$23,000.00
1.3.8	Interior structure ready for drywall	0 days		$0.00
1.3.9	Solar system	4 days	Solar Panel Materials[1]	$25,600.00
1.3.10	Exterior finish	30 days		$57,800.56
1.3.11	Interior	69 days		$119,454.16
1.3.11.1	Drywall	18 days	Drywall Materials[1]	$19,040.00
1.3.11.2	Interior finish carpentry	18 days	Interior Finish Materials[1]	$16,400.00
1.3.11.3	Interior painting	11 days	Paint (Int)[1]	$12,200.00
1.3.11.4	Kitchen and bathroom cabinetry	14 days	Cabinets[1]	$20,380.00
1.3.11.5	Appliances and fixtures	22 days		$23,574.16
1.3.11.6	Finish flooring	7 days		$27,860.00
1.3.11.7	Interior complete	0 days		$0.00
1.3.12	Structure complete (Interior and Exterior)	0 days		$0.00
1.3.13	Landscaping	26 days	Landscaping Materials[1]	$29,880.00
1.4	Monitoring and control	129 days		$4,480.00
1.5	Closing	3 days		$1,920.00
1.5.1	Final inspection and acceptance by owners	3 days	Customer, PM	$1,920.00

Table 4: Cost of Top Level Tasks

Name	Remaining Cost	Actual Cost	Cost	ACWP	BCWP	BCWS
Lot purchased	$75,000.00	$0.00	$75,000.00	$0.00	$0.00	$0.00
Contract signed, Project started	$3,040.00	$0.00	$3,040.00	$0.00	$0.00	$0.00
Design	$67,680.00	$0.00	$67,680.00	$0.00	$0.00	$0.00
Permitting	$5,000.00	$0.00	$5,000.00	$0.00	$0.00	$0.00
Design complete	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Foundation	$17,120.00	$0.00	$17,120.00	$0.00	$0.00	$0.00
Geothermal Heat pump ground unit	$53,900.00	$0.00	$53,900.00	$0.00	$0.00	$0.00
Framing	$139,476.40	$0.00	$139,476.40	$0.00	$0.00	$0.00
HVAC system	$14,160.00	$0.00	$14,160.00	$0.00	$0.00	$0.00
Electrical	$21,455.20	$0.00	$21,455.20	$0.00	$0.00	$0.00
Plumbing	$22,191.20	$0.00	$22,191.20	$0.00	$0.00	$0.00
Communication systems wiring	$23,000.00	$0.00	$23,000.00	$0.00	$0.00	$0.00
Interior structure ready for drywall	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Solar system	$25,600.00	$0.00	$25,600.00	$0.00	$0.00	$0.00
Exterior finish	$57,800.56	$0.00	$57,800.56	$0.00	$0.00	$0.00
Interior	$119,454.16	$0.00	$119,454.16	$0.00	$0.00	$0.00
Structure complete (Interior and Exterior)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Landscaping	$29,880.00	$0.00	$29,880.00	$0.00	$0.00	$0.00
Final inspection and acceptance by owners	$1,920.00	$0.00	$1,920.00	$0.00	$0.00	$0.00

Time-Phased Budget

A time-phased budget for this project was established to assist in determining progress payments to the service providers and to help in conducting schedule compression analysis. In addition, project performance measures such as Earned Value, Cost Performance Index (CPI), and Schedule Performance Index (SPI). CPI measures the "cost efficiency of the work accomplished to date" (Larson and Gray, 2014, p. 473). When the value of CPI is greater than 1.0, the project or task is better than planned through that period. When looking at the Schedule Performance Index (SPI), like CPI, when it is less than 1.0 can be considered 'worse than planned.' The time-phased budget can be found in Appendix 2.

Reducing the Schedule Length and Impact on Budget

The current project plan has a duration of 201 days, with project completion on 16 October 2015. There is a possibility that the homeowners will need to move in earlier than they are currently planning, because they will be selling their existing home. As a result, the project team assessed an alternate course of action to determine the feasibility of an earlier move-in date. By crashing some of the critical tasks, the team could bring the project time from 201 days down to 188.25 days for a 30 September completion. Further crashing could be done to determine additional time savings, although that would come with a price. This approach assumed that material costs would not change and so the crash could be achieved through paying overtime at a rate of 1.5 times the normal rate.

To figure out which task should be crashed, and knowing we were attempting to meet the schedule by adding overtime work for select workers, we looked at the lowest pay-rate employees first. Since that was the excavators, the first task to be crashed was WBS 1.3.1 – Excavation. By adding 2 hours of overtime per day to each of their schedules, one can see in the Table 5 that the resulting completion time was reduced from 5 to 3.75 days, at a cost of $200.

Table 5 – Example of Crashed Task

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	WBS	Task Mode	Task Name	Duration	Start	Finish	Predecessor	Resource Names	Cost
4	1.1.2		Contract signed, Project started	1 day	Tue 1/6/15	Tue 1/6/15	3	Lawyer, Customer,PM	$3,040.0
5	**1.2**		**Project planning**	**47 days**	**Thu 1/8/15**	**Mon 3/16/15**	**4**		**$72,680.0**
6	**1.2.1**		**Design and Permitting**	**47 days**	**Thu 1/8/15**	**Mon 3/16/15**	**4**		**$72,680.0**
13	**1.3**		**Executing**	**147 days**	**Tue 3/17/15**	**Mon 10/12/15**	**12**		**$527,117.5**
14	1.3.1		Excavation	3.75 days	Tue 3/17/15	Fri 3/20/15	12	Excavator1, Excavator2	$1,800.0
15	**1.3.2**		**Foundation**	**15 days**	**Thu 3/26/15**	**Wed 4/15/15**	**12**	**Foundation**	**$15,520.0**

Name: Excavation Duration: 3.75 days Effort driven Manually Scheduled Previous Next

Start: Tue 3/17/15 Finish: Fri 3/20/15 Task type: Fixed Units % Complete: 0%

ID	Resource Name	Units	Work	Ovt. Work	Baseline Work	Act. Work	Rem. Work
13	Excavator1	100%	40h	10h	0h	0h	40h
14	Excavator2	100%	40h	10h	0h	0h	40h

Continuing to follow that methodology, we then crashed the following activities:

1.3.2 – Foundation (Concrete workers)

1.3.4.14 – Pour sidewalks and driveways (Concrete workers)

Bumping the concrete workers up to 2 hours per day of overtime resulted in a net time savings for the overall project of 5 1/2 days, at a cost increase of only approximately $1200. With just these few inexpensive crashes, the project saved almost 7 days in the overall schedule.

Further crashing, looking now at the roofing task saved another 3.5 days following the same methodology. Then by adding overtime to the siding installers and also the drywall team, we were able to reduce the project completion date to 30 September. With this addition, as can be seen in table 6 below from the project plan that reflects these crashed activities, we now could meet a 1 October move-in date for the customers at an additional cost of only $2700.

Table 6 – Final Cost and Time for Crashed Project Plan

	WBS	Task Mode	Task Name	Duration	Start	Finish	Cost	P
1	**1**		**Sustainable Home Construction Project**	**188.25 days**	**Mon 1/5/15**	**Wed 9/30/15**	**$687,737.52**	
2	**1.1**		**Project Initiation**	**2 days**	**Mon 1/5/15**	**Tue 1/6/15**	**$78,040.00**	
5	**1.2**		**Project planning**	**47 days**	**Thu 1/8/15**	**Mon 3/16/15**	**$72,680.00**	**4**
13	**1.3**		**Executing**	**135.25 days**	**Tue 3/17/15**	**Fri 9/25/15**	**$530,617.52**	**1**
121	**1.4**		**Monitoring and control**	**129 days**	**Mon 2/2/15**	**Mon 8/3/15**	**$4,480.00**	
129	**1.5**		**Closing**	**3 days**	**Fri 9/25/15**	**Wed 9/30/15**	**$1,920.00**	**1**

Outsourcing Strategy

The Sustainable Home Project is an entirely outsourced project, making it difficult to demonstrate an advantage for additional outsourcing. However, the framing contractor, Hammer and Nail Construction Inc. has been offered another job which will start near the half-way point of their contracted work on our project. Both have the potential for being very lucrative prospects and they don't wish to lose out on either opportunity.

Hammer and Nail is a high-end rough framing company with an excellent reputation of in for quality and timeliness of work. They usually contract out at a higher price per job than most other companies, but are in demand with high quality home builders because of the quality of work they are known for. They typically complete all the framing and roofing work on the job site to ensure that the building is straight, level, and built to their high professional standards.

The Challenge

The Sustainable Home Construction job needs to start framing on the April 16, 2015, and is scheduled for completion and inspection on the June 9, 2015. The other job site is scheduled to begin construction on the May 5th and is also a quality home build with potential for follow-on contracts. Hammer and Nail has a large enough of a construction crew to handle only one job site at a time with three part-time workers who can handle minor jobs under supervision. In order to meet the requirements of both job sites Hammer and Nail will have to outsource a portion of the work. They will need someone who is reliable enough to maintain their high construction standards and timeliness of work. Spiffy Topper Roofing Company is based in the area and is known for quality services. The owner is a former employee of Hammer and Nail

Construction. Both respect each other's workmanship and have referred customers to each other for the last several years.

Jim Purvis, the owner of Hammer and Nail, approached Johnny Rickenbacker of Spiffy Topper at the town Christmas parade with a plan to join forces. Johnny's construction crews had a busy year, the year before but, due to the economy, most people were holding off on major home repair. For the most part Spiffy Topper was doing patch and fix work instead of roof replacements, which pays the bills but doesn't sit well with Johnny. "It's hard to guarantee a patch in an old roof, the rest of the roof may fail then I look bad for fixing it even though my part is quality." Johnny was eager to start putting his guys to work on complete jobs again.

The Solution

Spiffy Toppers crews were made up of experienced construction people with the same attitude towards "doing a job right" as Johnny and they, too, earned a premium wage. During their conversation Johnny told Jim that his crews could get the roofing work done in two thirds of the time Jim had planned for his crew. This meant shortening the scheduled roofing time from three weeks to two; and Hammer and Nail would be able to use the people they would have had roofing to complete the framing work even earlier. All in all they would be able to cut the entire job requirement time by 20 days, allowing Hammer and Nail to send two thirds of their workers and a foreman to start on the next project on time.

Since the original job bid for the Sustainable Home project was already accepted, reducing the schedule would not affect Hammer and Nail's net profit, as long as the outsourcing costs didn't exceed their expected organic cost. Knowing this, Johnny agreed to accept the rate Hammer and Nail had bid on the roofing job even though it was slightly lower than what he would have bid; but only, if he were given an opportunity to bid on future Sustainable Home project roofing jobs whenever Jim became aware them.

The two companies agreed and began to draw up the contract. One minor contention was who would bear overall responsibility on the job site for the work being done. Jim demanded that his foreman, a tough, no-nonsense sort who he has trusted for years, take the lead. But Johnny having worked for the man was unwilling to put his employees under his supervision. Johnny normally acted as a foreman on his roofing crews; he liked to work with the guys but decided working alongside a prior supervisor would put him at a disadvantage. The two agreed that Jim's foreman would have decision making power at the site but had to work through Johnny's assistant on roofing issues and if an unresolvable disagreement were to arise, both Johnny and Jim would be available to work it out. With the line of communication, the compensation, and time frames agreed upon. It seemed that all they need to do is get their respective legal counsel to draft the papers.

Conclusion

By outsourcing the roofing portion of the Sustainable Home Construction Project to Spiffy Topper Roofing, Jim was able to complete the contracted task in less time enabling him to start the new project on its proposed start date. Although Spiffy Topper would receive the profits for the roofing portion of the Sustainable Home job, having Johnny's company finish the roofing allowed Jim to move his foreman and most of his crew to the next job without delay. This enabled Johnny to accept concurrent projects and created greater profit in the long run.

Reference

Larson, E. W., & Gray, C. F. (2014). *Project management: The managerial process.* (6th ed.). New York, NY: McGraw-Hill Education.

Taylor, H. (2014). *Cost of constructing a home.* National Association of Home Builders. Retrieved from http://www.nahb.org/generic.aspx

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