Whitebread Sailboat Race Case Study

Group 4

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Executive Summary

Our team has been tasked with advising Bjorn and his sailing team on the scheduling and budgeting of the design and construction of his team's sailboat as well as the crew selection and training. We began by discussing our analysis and process. This included the decisions we made regarding the project network and work breakdown structure, which are shown below in figure 1 and figure 2. We carefully analyzed the wording of the case in order to create the project network with the proper predecessors and slack time. After inputting this information into Microsoft Project, we found that our baseline duration was 50 weeks, which is 5 weeks over the 45-week requirement. Our baseline budget was also calculated to be $3,216,000, which is $16,000 over the tentative budget limit. Microsoft Project also calculated the critical path for us. The critical path for our project is design, build hull, install ballast tanks, build deck, crew maintenance, initial sail training, and sea trials. This critical path will be what we focus on when we look to shorten the project duration, and it can be seen in the Gantt chart provided in figure 5.

In our recommendation, we begin by discussing the priority matrix for this project. Because the project has a strict completion time of 45 weeks, we must constrain time. We also note that we aim to enhance cost as to complete the project with as low of a budget as possible and thus accept performance. Based on our analysis we recommend crashing three tasks in order to complete the project in 45 weeks or less. These crash tasks are design, crew maintenance training, and initial sail training. This solution was agreed upon by our team because it is the crash solution that best minimizes the project cost. After crashing these tasks, our team was able to limit the project schedule to 45 weeks at a cost of $3.85 million. While we were not able to keep the budget below $3.2 million, this was the optimal solution due to the very strict deadlines.

In our recommendation section, we discuss the cost-duration trade off dilemma in more detail. The process for analyzing this trade off goes as follows:

a. Identify the critical path
b. Determine if the network is insensitive
c. Identify the direct and indirect costs
d. Construct a cost-duration table
e. Identify solutions and alternatives
f. Check resource allocation

Finally, we discussed some of the risks and considerations for our recommendation. These risks and considerations include the inherent risks of crashing tasks, which puts further stress on other tasks near the critical path. There are also performance risks that are included in strict deadline projects, yet we believe that we are putting Bjorn and his team in the best position for success. We conclude our report satisfied with the recommendation we made for the Whitebread Sailboat Team and believe that they will be ready for competition in 45 weeks.

Introduction

In this report, our team will assist Bjorn and his team in the scheduling and budgeting of the design, construction, crew selection, and crew training for his team's sailboat which will be competing in the Whitebread World Sailboat Race. Our team approached this project with two goals in mind: completing the project in 45 weeks or fewer and within the $3.2 million budget or as close to it as possible. We will begin by discussing the process and analysis our team went through in order to make a recommendation for Bjorn and his team. Then, we will make our schedule and budget recommendation to fulfill the goals discussed above. Within our recommendation, we will also discuss some of the considerations made during our analysis. We will attach figures such as the project network, work breakdown structure, and Gantt chart as well. Overall, our team will aim to provide a clear and concise analysis and recommendation in order to complete this project in 45 weeks or less and at the least possible cost.

Analysis and Process

Our first goal was to determine from the list of activities and the included description of the sequential order of those activities provided what the project network would look like. We were able to identify two major paths: new vessel construction and crew assembly. These two paths came together during the final testing and maintenance activities to complete the boat in time for racing. We have included the project network below.

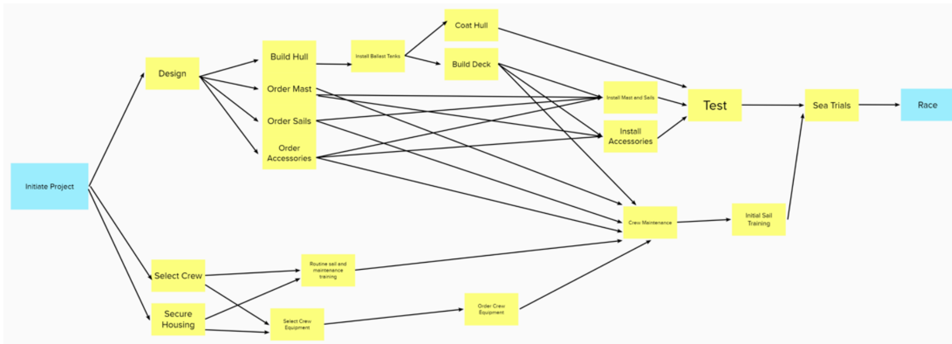

Figure 1: Project Network

The project network identified the many tasks to include in the work breakdown structure. The team decided Design was a major task to identify as 1.1. New vessel construction was broken down into many activities within 1.2. Testing and Trials made up 1.3. The many steps of building and training the crew made up 1.4. Finally, old and new vessel operation were included as 1.5 and 1.6 in order to account for the operation costs per week during the scheduling process.

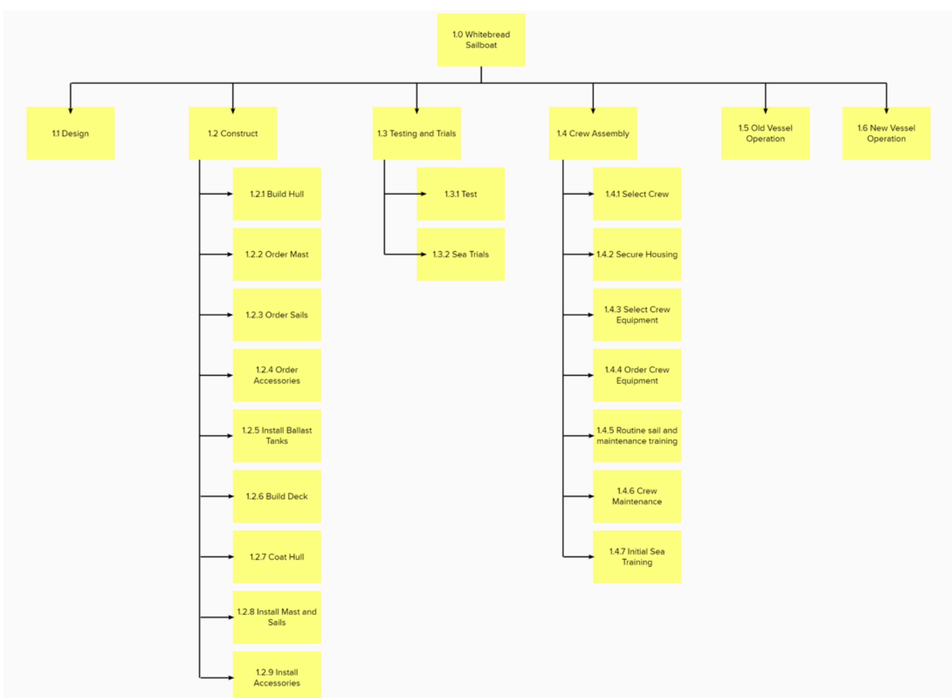

Figure 2: Project Work Breakdown Structure

With a project network diagram and a work breakdown structure complete, the team was ready to convert these findings into a Microsoft Project. The "Normal" times and costs were entered as a baseline so that updated crash times and costs could easily to added in another column after analyzing the current "normal" situation.

Although all provided activities came in under the $3.2 million budget, that did not account for the operating costs per week of the old and new vessel at $4,000 and $6,000 respectively. These additional costs raised the "normal" costs up to $3,216,000. The duration of the project also reached 50 weeks, exceeding the required 45 weeks.

WBS		Task Name	Baseline Duration	Baseline Cost
1		**Whitebread Sailboat**	**250 days**	**$3,216,000.00**
1.1	A	Design	6 wks	$40,000.00
1.2		**Construct**		**$2,420,000.00**
1.2.1	B	Build Hull	12 wks	$1,000,000.00
1.2.2	D	Order Mast	8 wks	$100,000.00
1.2.3	E	Order Sails	6 wks	$40,000.00
1.2.4	F	Order Accessories	15 wks	$600,000.00
1.2.5	C	Install Ballast Tanks	2 wks	$100,000.00
1.2.6	G	Build Deck	5 wks	$200,000.00
1.2.7	H	Coat Hull	3 wks	$40,000.00
1.2.8	J	Install Mast and Sails	2 wks	$40,000.00
1.2.9	I	Install Accessories	6 wks	$300,000.00
1.3		**Testing and trials**		**$260,000.00**
1.3.1	K	Test	5 wks	$60,000.00
1.3.2	L	Sea Trials	8 wks	$200,000.00
1.4		**Cew Assembly**		**$270,000.00**
1.4.1	M	Select Crew	6 wks	$10,000.00
1.4.2	N	Secure Housing	3 wks	$30,000.00
1.4.3	O	Select Crew Equipment	2 wks	$10,000.00
1.4.4	P	Order Crew Equipment	5 wks	$30,000.00
1.4.5	Q	Routine Sail and Maintenance Training	15 wks	$40,000.00
1.4.6	R	Crew Maintenance	10 wks	$100,000.00
1.4.7	S	Initial Sail Training	7 wks	$50,000.00
1.5		Old Vessel Operation	19 wks	$76,000.00
1.6		New Vessel Operation	25 wks	$150,000.00

Figure 3: WBS with Baseline Duration/Cost

MS Project determined the critical path followed A -> B -> C -> G -> R -> S -> L. Any of these tasks could be crashed to shorten the overall duration by 5 weeks, but only A, B, R, S, and L had effective crash reductions. The team determined the cost increase and time decrease provided to find the cost changes per week. It was determined that A, R, and S crashing would properly reduce the overall project duration by 5 weeks, while minimizing the increase in costs. Finally, the changes in per week operational costs for the old and new vessel were calculated to set our new total cost at $3.85 million.

WBS		Task Name	Predecessor	Duration	Baseline Duration	Cost	Baseline Cost	Start	Finish
1		**Whitebread Sailboat**		**225 days**	**250 days**	**$3,850,000.00**	**$3,216,000.00**	**Mon 10/5/20**	**Fri 8/13/21**
1.1	A	Design		4 wks	6 wks	$160,000.00	$40,000.00	Mon 10/5/20	Fri 10/30/20
1.2		**Construct**		**125 days**		**$2,420,000.00**	**$2,420,000.00**	**Mon 11/2/20**	**Fri 4/23/21**
1.2.1	B	Build Hull	2	12 wks	12 wks	$1,000,000.00	$1,000,000.00	Mon 11/2/20	Fri 1/22/21
1.2.2	D	Order Mast	2	8 wks	8 wks	$100,000.00	$100,000.00	Mon 11/2/20	Fri 12/25/20
1.2.3	E	Order Sails	2	6 wks	6 wks	$40,000.00	$40,000.00	Mon 11/2/20	Fri 12/11/20
1.2.4	F	Order Accessories	2	15 wks	15 wks	$600,000.00	$600,000.00	Mon 11/2/20	Fri 2/12/21
1.2.5	C	Install Ballast Tanks	4	2 wks	2 wks	$100,000.00	$100,000.00	Mon 1/25/21	Fri 2/5/21
1.2.6	G	Build Deck	8	5 wks	5 wks	$200,000.00	$200,000.00	Mon 2/8/21	Fri 3/12/21
1.2.7	H	Coat Hull	8	3 wks	3 wks	$40,000.00	$40,000.00	Mon 2/8/21	Fri 2/26/21
1.2.8	J	Install Mast and Sails	9,5,7	2 wks	2 wks	$40,000.00	$40,000.00	Mon 3/15/21	Fri 3/26/21
1.2.9	I	Install Accessories	9,5,7	6 wks	6 wks	$300,000.00	$300,000.00	Mon 3/15/21	Fri 4/23/21
1.3		**Testing and trials**		**80 days**		**$260,000.00**	**$260,000.00**	**Mon 4/26/21**	**Fri 8/13/21**
1.3.1	K	Test	11,12,10	5 wks	5 wks	$60,000.00	$60,000.00	Mon 4/26/21	Fri 5/28/21
1.3.2	L	Sea Trials	14,23	8 wks	8 wks	$200,000.00	$200,000.00	Mon 6/21/21	Fri 8/13/21
1.4		**Cew Assembly**		**185 days**		**$810,000.00**	**$270,000.00**	**Mon 10/5/20**	**Fri 6/18/21**
1.4.1	M	Select Crew		6 wks	6 wks	$10,000.00	$10,000.00	Mon 10/5/20	Fri 11/13/20
1.4.2	N	Secure Housing		3 wks	3 wks	$30,000.00	$30,000.00	Mon 10/5/20	Fri 10/23/20
1.4.3	O	Select Crew Equipment	17,18	2 wks	2 wks	$10,000.00	$10,000.00	Mon 11/16/2(	Fri 11/27/20
1.4.4	P	Order Crew Equipment	19	5 wks	5 wks	$30,000.00	$30,000.00	Mon 11/30/2(	Fri 1/1/21
1.4.5	Q	Routine Sail and Maintenance Training	17,18	15 wks	15 wks	$40,000.00	$40,000.00	Mon 11/16/2(	Fri 2/26/21
1.4.6	R	Crew Maintenance	20,21,7,6,5,9	9 wks	10 wks	$340,000.00	$100,000.00	Mon 3/15/21	Fri 5/14/21
1.4.7	S	Initial Sail Training	22	5 wks	7 wks	$350,000.00	$50,000.00	Mon 5/17/21	Fri 6/18/21
1.5		Old Vessel Operation	17,18	17 wks	19 wks	$68,000.00	$76,000.00	Mon 11/16/2(	Fri 3/12/21
1.6		New Vessel Operation	24	22 wks	25 wks	$132,000.00	$150,000.00	Mon 3/15/21	Fri 8/13/21

Figure 4: WBS with Adjusted Duration/Cost for 45 Week Limit

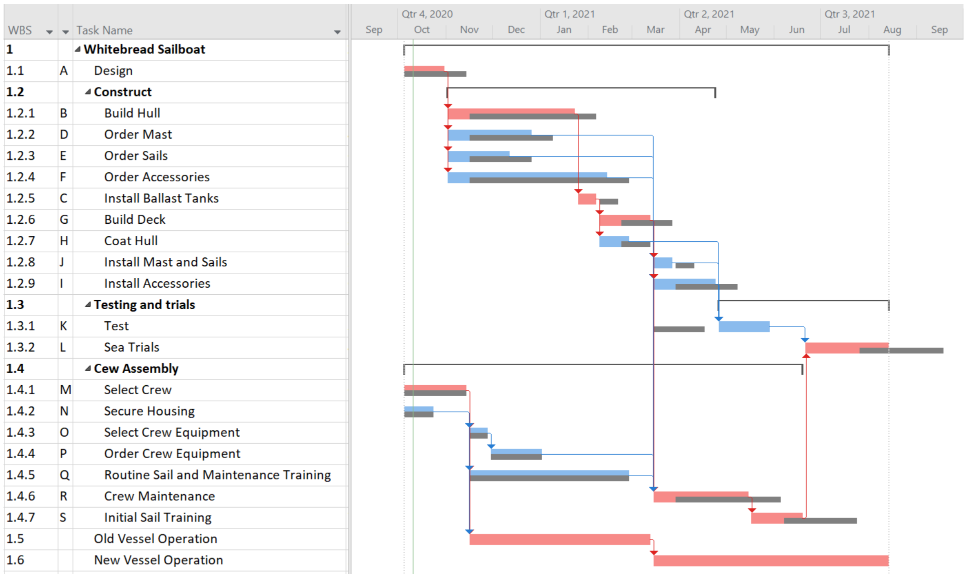

Figure 5: Gantt Chart with Critical Path (red tasks) and Baseline (grey overlay)

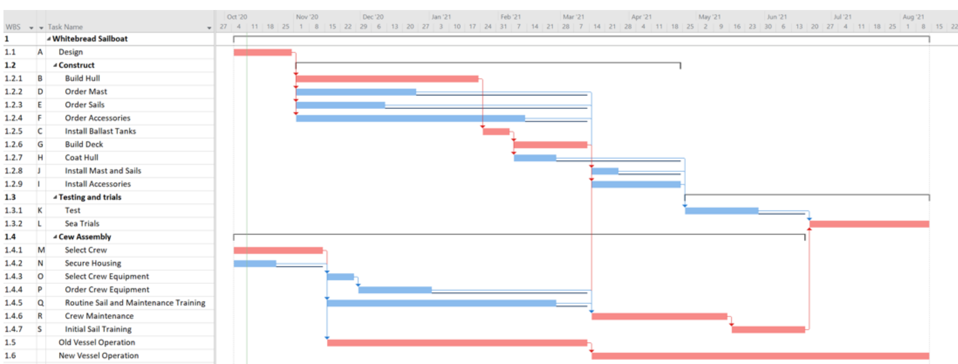

Figure 6: Gantt Chart with Critical Path (red tasks) and Slack (thin black bar)

Recommendation

We will divide our recommendation into internal and external aspects, which means the project duration reducing process itself and the considerations and risks outside the process.

Priority Matrix

When dealing with project duration reduction issues, it is recommended to sort a set of items into an order of importance. By identifying what matters most for project stakeholders, project managers can make determinations systematically and will not get lost. Priority matrix is a commonly used tool to solve this problem. It includes time, performance and cost and set constraint, enhance and accept levels separately. For example, Figure 7 shows a priority matrix for this Whitbread World Sailboat Race project. Their goal is to have a winning boat and crew ready to compete in next year's competition at a cost of $3.2 million, and to leave port for the UK to start the race in 45 weeks. Considering this project is a race preparation, we identify the most important thing is to attend the final race on time. 45 weeks is a maximum and there is no room for negotiation, otherwise all efforts will be in vain. Therefore, time is the aspect to constrain. Besides, a budget estimation is mentioned and that becomes the aspect to enhance. Although all project managers hope to have a better project performance, it is necessary to compromise this aspect here to meet requirements of stakeholders which is more important for an overall high-quality project completion.

	Time	Performance	Cost
Constrain	✓		
Enhance			✓
Accept		✓	

Figure 7: Priority Matrix

Setting the Stage

After project managers reach consensus with stakeholders and completely understand project activities, they are recommended to identify gaps between current baseline and ideal situation. Project network diagram is a useful tool to know duration, slack, and the critical path. Also, the WBS should be clarified and cost should be estimated simultaneously. Microsoft Project could help to set those down and we use it for the whole process.

Cost-duration Trade-off Decision

A cost-duration graph is essential for most projects that have a cost and duration dilemma. Our selection is the most efficient simplified process which works in this situation well. However, when managing larger, more complicated projects, we recommend following a more comprehensive process which is mentioned below.

a) Identify the critical path and critical activities. Critical activities refer to any particular schedule activity that happens to be part of a critical path that takes place within a project schedule. For this project, the critical path and corresponding activities have been mentioned in the early section.
b) Determine if the network is insensitive. A project is insensitive when it has a dominant critical path, which means no near-critical path and with a minimum risk of noncritical activities becoming critical. Always remember the sensitivity of the project and check if a critical path has changed in the network diagram when making further adjustments. This project is insensitive because the critical path is unlikely to change, the critical activities have a very late end date compared to other predecessors. This erases our concerns of moving toward 45 weeks.
c) Identify direct and indirect costs. Direct costs are assigned directly to a work package and activity. Indirect cost cannot be associated with any of them but vary directly with time. For this project, direct costs are the sheet Karin and Trygve submitted for each activity and corresponding crash cost, indirect cost are old/new vessel operating fees. Compared with crash cost, the potential total indirect cost is pretty small and will not influence our decisions on crashing time strategies.
d) Construct a cost-duration table. The most important part of this table is the slope and maximum crash time for each activity. The slope is the increase in cost per unit of time. It's a very intuitive way to measure cost performance. Highlighting the critical activity in this table would benefit later work, such as Table 1.

Activity		maximum crash time	Slope(cost/week)	Crash
A	Design	2	60	✓
B	Build hull	2	200	
C	Install ballest tanks	0	0	

D	Order mast	1	40	
E	Order sails	0	0	
F	Order accessoris	2	100	
G	Build deck	0	0	
H	Coat hull	0	0	
I	Install accessories	1	100	
J	Install mast and sails	1	40	
K	Test	1	40	
L	Sea trials	1	250	
M	Select crew	1	10	
N	Secure housing	0	0	
O	Select crew equipment	0	0	
P	Order crew equipment	0	0	
Q	Routine sail and maintenance	3	30	
R	Crew maintenance training	1	240	✓
S	Initial sail training	2	150	✓

Table 1: Cost-Duration

e) Identify solutions and alternatives. In this stage, the project manager has the option to compare different solutions, such as whether it is possible to reach an even shorter duration and has a smaller cost as well, whether win-win situations could be realized. A cost-duration table would be useful to know the optimum point sometime. For this project, it will complicate the problem if we draw a cost-duration table, because one crash time length could have different costs. And also, we are seeking the best options, no alternatives should be selected here.

f) Check resource allocation. Sometimes, limited resources should be considered to rearrange crash solutions. It may dictate which activities are crashed. Final solution could be made after this step.

Considerations and Risks

It is suggested to create the cost-duration graph in the preproject planning phase without an imposed duration because normal time is more meaningful. Especially for this time constraint project, it is crucial to fully prepare before it starts. This project is a good example to demonstrate its importance. We crash design, one of the earliest steps, from 6 to 4 weeks. If a late decision is made, it could cause a much higher cost or missing the deadline.

Risk is another aspect to consider and evaluate. Originally, Karin noted that design of the hull, deck, mast, and accessories should only take six weeks—given the design prints from past race entries and a few prints from other countries' entries. However, this would potentially harm the design performance. Design is more of a product of intelligence and time than an expensive promotion. Given the situation that the sailboat represents the latest technologies and human skills each country can muster, it is a challenge and risk for Bjorn to develop a satisfactory innovative design and discover enhancement points. Besides, there is a risk for the whole project team if this beginning session is late. For crew maintenance training and initial sail training, they are in the late stage of this project. Crashing time could produce a nervous and stressful environment around the team, worrying about the schedule.

All in all, our final selection is the one that can be done in 45 weeks with the least cost. We should still understand considerations and risks together when making this crash time solution to make it complete.

Conclusion

In our report, we lay out a clear schedule and budget for Bjorn and his sailboat crew. If they follow our recommended schedule, they will be able to complete the sailboat design, construction, crew selection, and crew training in under 45 weeks and in time for the Whitebread World Sailboat Race. Our recommended budget was calculated to minimize the total cost of this project, and our budget came in at $3.85 million. We also analyzed and discussed our priorities, trade-offs, considerations, and risks. We highly suggest Bjorn implement this strategy and budget because we believe our analysis and recommendation puts his team in the best position for success.

Name	Hours Worked
Ryan Finlay	6
Jinghan Luo	6
Tony Teleky	7