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Project Man. 412 Assignment 2

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Report submitted in partial fulfilment of the requirements of the module
Project Management 412 for the degree Baccalaureus in Engineering at Stellenbosch University.

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Contents

List of Figures

List of Tables

Chapter 1

Executive Summary

We will design a high pressure vessel for industrial purposes

Chapter 2

Project Scope Statement

2.1. Introduction

2.2. Objectives

The objective of this project is to develop an industrial scale vessel for storing gaseous byproducts of petroleum refining under high pressures. subject to time and monetary constraints (specifically, 200 work days starting from 31/03/21 and $380 000,00) specified by the customer while minimizing risk and maximizing stakeholder value. The product must be designed according to the the technical requirements specified by the multi-disciplinary team of engineers assigned to this project (Sec. 2.6), the limits/exclusions detailed in Sec. 2.7, and approved by the customer per the procedures outlined in Sec. 2.8.

The process for developing this product consists of evaluating the market to develop and execute a marketing plan based on these results. Using these results with the product specifications, the high-pressure vessel is designed, testing methods are derived and a risk analysis is conducted. The design's functionality is then tested by building a prototype that is subjected to the testing methods of the previous phase. These results are also used to determine if the prototype satisfies the design requirements.

If the prototype does not yield satisfactory results, the process is repeated until the requirements are met (given that the project's cost does not overrun). Once this step is reached, the manufacturing plan is developed and the product is advertised according to the marketing plan. Once sufficient materials are sourced, the manufacturing plan and the product is launched. This is also the point at which the project concludes.

2.3. Deliverables

The project consists of various deliverables that must be completed for the project to progress. The due dates of these deliverables and the resources responsible for them are listed in Tab. 2.1 below:

Deliverable Date	Deliverable	Resources Responsible
08/04/21	Market Assessment Report	Yukio Ashida, Kurt Zollinger
03/05/21	Customer Preference Report	Yukio Ashida, Kurt Zollinger
19/05/21	Marketing Program	Yukio Ashida, Kurt Zollinger
06/01/22	Product Launch Presentation	Kurt Zollinger
10/05/21	Design and Development Plan	Junior Product Designer 1,2
25/05/21	Detailed Technical Design Schematics	Junior Product Designer 1,2
01/06/21	Product Tolerance and Liability Limits Report	Junior Product Designer 1,2
08/06/21	Risk Analysis Report	Junior Product Designer 1,2
09/07/21	Final Preliminary Design Plans	Junior Product Designer 1,2
13/07/21	Initial Engineering Templates	Tom Bechur, Darryl Sandefur
29/07/21	Final Product Design	Tom Bechur, Darryl Sandefur
05/08/21	Pre-Production Specifications	Tom Bechur, Darryl Sandefur

Deliverable Date	Deliverable	Resources Responsible
24/08/21	Product Prototype	Tom Bechur, Darryl Sandefur
12/10/21	Prototype Approval	Tom Bechur, Darryl Sandefur
25/08/21	Quality Assessment Report	Quality Engineer
09/09/21	Prototype Testing Protocols	Darryl Sandefur
29/09/21	Prototype Test Results	Quality Engineer
14/10/21	Prototype Test Result Evaluation	Quality Engineer
30/08/21	RFQ	Operations Specialist
06/09/21	Production Sample	Quality Engineer
15/09/21	Supplier Capability Report	Operations Specialist, Tom Bechur
27/09/21	Sample Approval	Tom Bechur
28/10/21	Supplier Notification	Quality Engineer
22/10/21	Production Plan	Operations Specialist
25/11/21	Production Control Plan	Operations Specialist
02/12/21	First-Run Product Assessment	Operations Specialist
14/12/21	Deliveries Contracts	Operations Specialist
03/01/21	Production Contract	Operations Specialist
16/04/21	Project Status Update	Tom Bechur, Darryl Sandefur
14/05/21	Project Status Update	Tom Bechur, Darryl Sandefur
03/06/21	Project Status Update	Tom Bechur, Darryl Sandefur
21/07/21	Project Status Update	Yukio Ashida
11/08/21	Project Status Update	Yukio Ashida
24/08/21	Project Status Update	Yukio Ashida
14/09/21	Project Status Update	Yukio Ashida
20/09/21	Project Status Update	Yukio Ashida
12/10/21	Project Status Update	Yukio Ashida
21/10/21	Project Status Update	Yukio Ashida
01/12/21	Project Status Update	Darryl Sandefur
21/12/21	Project Status Update	Darryl Sandefur

Table 2.1: Deliverables with Delivery Date and Responsible Resources

2.4. Milestones

The project has been divided into twelve milestones, each with associated deliverables. This division can be seen in Tab. 2.2 below:

Milestone	Deliverables	Date
1	Market Assessment Report Customer Preference Report Project Status Update	05/05/21
2	Design and Development Plan Detailed Technical Design Schematics Marketing Program Project Status Update	25/05/21
3	Product Tolerance and Liability Limits Report Risk Analysis Report Project Status Update	02/07/21

Milestone	Deliverables	Date
4	Final Preliminary Design Plans Initial Engineering Templates Project Status Update	21/07/21
5	Final Product Design Pre-Production Specifications Project Status Update	11/08/21
6	RFQ Product Prototype Quality Assessment Report Project Status Update	30/08/21
7	Production Sample Supplier Capability Report Prototype Testing Protocols	15/09/21
8	Sample Approval Prototype Test Results Trade Show Presentation Project Status Update	06/10/21
9	Prototype Approval Prototype Test Result Evaluation Project Status Update	14/10/21
10	Supplier Notification Production Plan Project Status Update	12/11/21
11	Production Control Plan First-Run Product Assessment Deliveries Contracts Project Status Update	14/12/21
12	Production Contract Product Launch Presentation Project Status Update	06/01/22

Table 2.2: Milestones with Associated Deliverables and Dates

2.5. Work Breakdown Structure

2.6. Technical Requirements

This section describes the technical requirements determined by the multi-disciplinary team of engineers assigned to this project, subject to approval by the customer

2.6.1. Chemical Requirements

2.6.2. Civil Requirements

2.6.3. Electrical and Electronic Requirements

The high-pressure vessel must be monitored using a suite of analogue and digital sensors. This will be the purview of the electrical and electronic engineer.

This sensor suite must be designed and built using cost-effective and accurate components that can withstand the pressure inside the pressure vessel to be developed. Redundant sensors must also be included to provide reasonably accurate measurements in the event of a component failure or if the pressure vessel moves outside of its normal operating parameters.
All designs must follow industry best practice and safety standards.

2.6.4. Mechanical Requirements

The pressure vessel must be designed to have sufficient strength to resist failure under normal operating conditions. Theoretical stress and strain calculations must be performed to select the initial vessel material, dimensions and boundary conditions for the design. A finite element analysis can then be performed to refine these selections. The mechanical engineer will be charged with performing these calculations and analyses.

2.6.5. Mechatronic Requirements

2.7. Limits and Exclusions

2.8. Customer Review and Approval Procedures

Chapter 3

Project Baseline

The baseline for this project has been calculated using Microsoft Project and can be seen in A.1 and B.1.

end date, before deadline

Analysing this network leads to several potential problem areas.

The first is that this project is sensitive to the hiring time of new resources. For example, if junior product designers are not hired by the time Phase 2 starts, the entire project will be delayed. To mitigate this potential problem, two engineers are hired that can cover a variety of specialities in the event that required resources are not obtained. The hiring strategy must also take this possibility into account, such as possibly hiring resources a period earlier than they are required.

There are also several places where tasks from the same department must be done in parallel (e.g. commercialization in Phase 3), this means that there must be at least two members of this department to finish the tasks in time, especially if one of the tasks is on the critical path.

The hiring strategy takes these concerns into account by hiring redundant resources for tasks that are on the critical path (e.g. hiring two junior designers for the design tasks on the critical path). Redundant bids are also placed on several resources in the event that a singular bid is not accepted. The loss in team longevity/cohesion is considered an acceptable sacrifice to mitigate the risk of not acquiring critical resources.

The managerial action strategy consists of regular pizza parties for all employees at the end of each phase. This is for improving team morale at a negligible cost. Furthermore, four management recognition awards are to be given at evenly spaced phase intervals to all employees to boost morale and team cohesion further. These awards are spaced evenly to ensure that once the effect of one award fades, the effect of the next award is activated.

It was decided that the benefit of training resources is not worth the associated costs (direct course costs and lost labour). Therefore, the training strategy consists of not sending any resources to training.

Chapter 4

Budget

This chapter documents the budget that has been planned for this project. Resources that have not been hired as of Phase 1 have been assigned using generic resources and their cost has been calculated using average rates for their respective specialisation.

The cost breakdown of the project can be found in the Tab. 4.1 below:

Cost Type	Cost ($)
Direct Resource Costs	309 428,00
Training Costs	0
Managerial Action Costs	1 600,00
Contingency	6 220,56
Overhead (20%)	61 885,60
Total:	379 134,16

Table 4.1: Project Cost Breakdown

An overhead cost of 20% is added to account for unforeseen events and worker inefficiencies. A contingency fund of 2% of the direct costs is added. The use of this contingency fund is specified in the chapter regarding Resource Analysis (Ch.5).

The cost breakdown of the managerial actions planned for the project is found in Tab. 4.2 below:

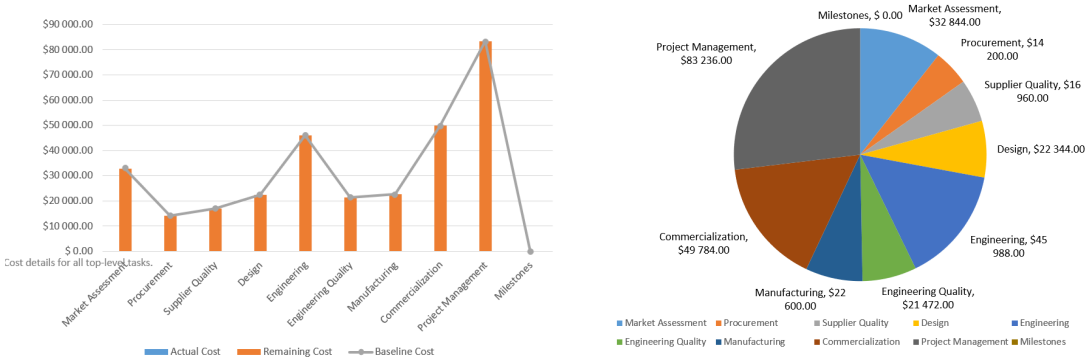
Managerial Action	Action Amount	Action Unit Cost ($)	Cost ($)
Pizza Party	12	50,00	600
Management Recognition Award	4	250,00	1000
		Total:	1 600,00

Table 4.2: Managerial Actions Cost Breakdown

The managerial actions planned to be taken consist of a pizza party for all employees at every period as well as management recognition awards at regular intervals throughout the project. Further details regarding managerial action strategy can be found in Ch. 3.

It was decided that training resources was not worth the cost and lost hours for the relatively small gains in efficiency.

An overview of the cost status and distribution of the costs associated with the various tasks over the full project duration can be found in Fig. 4.1 below:



(a) Status of Task Costs

(b) Distribution of Task Costs

Figure 4.1: Status and Distribution of Task Costs

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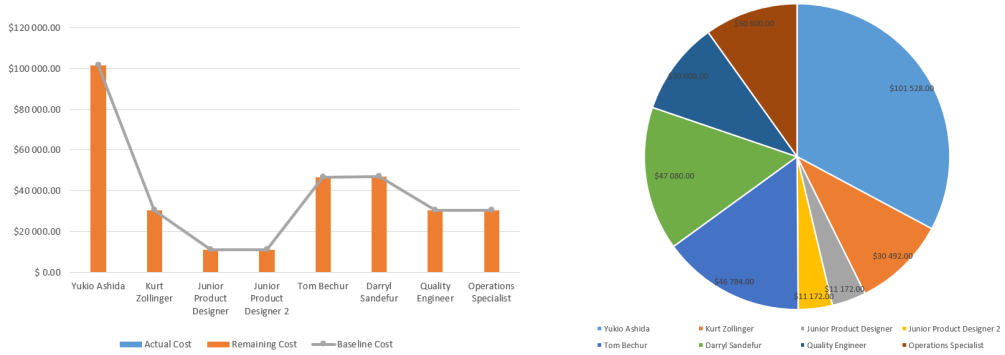
An overview of the cost status and distribution of the costs associated with the various resources over the full project duration can be found in Fig. 4.2 below:



(a) Status of Resource Costs

(b) Distribution of Resource Costs

Figure 4.2: Status and Distribution of Resource Costs

.

The cumulative direct costs and direct cost per month is given in Fig. 4.3 below:

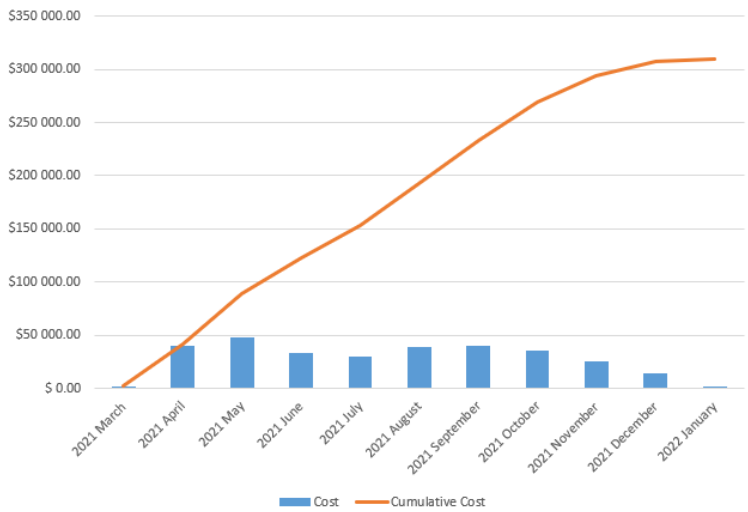


Figure 4.3: Direct Cumulative Cost and Direct Cost per Month

A detailed budget with task assignments, baseline budget and baseline duration can be found in A.1.

Chapter 5

Risk Analysis

Probability	Probability Percentage	Probability Score
Very High	80-100%	5
High	60-80%	4
Medium	40-60%	3
Low	20-40%	2
Very Low	0-20%	1

Table 5.1: Probability Scores Used for Risk Matrix

Impact	Impact score
Very High	5
High	4
Medium	3
Low	2
Very Low	1

Table 5.2: Impact Scores Used for Risk Matrix

Prob.						
	Very High	5	10	15	20	25
	High	4	8	12	16	20
	Medium	3	6	9	12	15
	Low	2	4	6	8	10
	Very Low	1	2	3	4	5
		Very Low	Low	Medium	High	Very High
				Impact		

Table 5.3: Risk Matrix Used for Risk Analysis

Bibliography

Appendix A

Detailed Budget

The detailed budget can be found on the following pages. Note that the image can be zoomed in to read details of the various tasks.

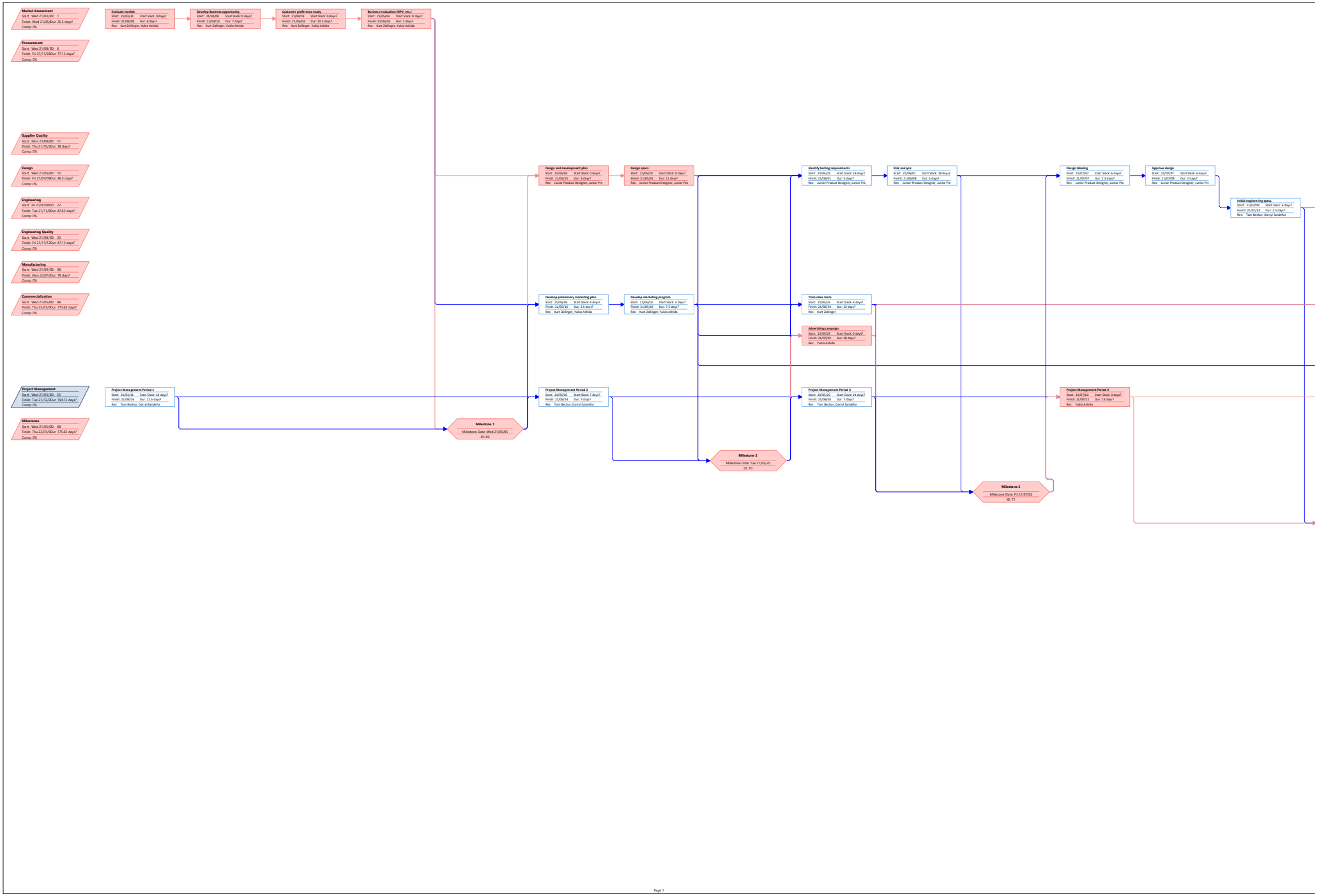
ID	Task Name	Resource Names	Baseline Cost	Baseline Estimated Duration
1	**Market Assessment**		**$32 844.00**	**25.5 days**
2	Evaluate market	Kurt Zollinger,Yukio Ashida	$7 728.00	6 days
3	Develop Business opportunity	Kurt Zollinger,Yukio Ashida	$9 016.00	7 days
4	Customer preference study	Kurt Zollinger,Yukio Ashida	$13 524.00	10.5 days
5	Business evaluation (NPV, etc.)	Kurt Zollinger,Yukio Ashida	$2 576.00	2 days
6	**Procurement**		**$15 552.00**	**84.13 days**
7	Identify vendors	Kurt Zollinger	$3 528.00	7 days
8	Develop and Issue RFQ	Kurt Zollinger	$3 024.00	6 days
9	Issue sample (production equivalent)	Quality Engineer	$3 000.00	5 days
10	Assess RFQ responses and select vendors	Quality Engineer	$6 000.00	10 days
11	**Supplier Quality**		**$15 952.00**	**45 days**
12	Perform supplier process capability	Operations Specialist	$5 600.00	14 days
13	Approve sample parts	Tom Becher	$4 352.00	8 days
14	Qualify Supplier	Quality Engineer	$6 000.00	10 days
15	**Design**		**$22 344.00**	**46.5 days**
16	Design and development plan	Junior Product Designer,Junior Product Designer 2	$2 352.00	3 days
17	Design specs.	Junior Product Designer,Junior Product Designer 2	$8 624.00	11 days
18	Identify testing requirements	Junior Product Designer,Junior Product Designer 2	$3 920.00	5 days
19	Risk analysis	Junior Product Designer,Junior Product Designer 2	$3 920.00	5 days
20	Design labeling	Junior Product Designer,Junior Product Designer 2	$1 960.00	2.5 days
21	Approve design	Junior Product Designer,Junior Product Designer 2	$1 568.00	2 days
22	**Engineering**		**$45 988.00**	**94.63 days**
23	Initial engineering specs.	Tom Becher,Darryl Sandefur	$2 460.00	2.5 days
24	Design verification activities	Tom Becher,Darryl Sandefur	$3 444.00	3.5 days
25	Verification design review	Tom Becher,Darryl Sandefur	$1 968.00	2 days
26	Release pre-production specifications	Tom Becher,Darryl Sandefur	$4 920.00	5 days
27	Build functional model	Tom Becher,Darryl Sandefur	$8 856.00	9 days
28	Design validation activities	Darryl Sandefur	$2 200.00	5 days
29	Validation design review	Tom Becher,Darryl Sandefur	$1 968.00	2 days
30	Approve model design	Tom Becher,Darryl Sandefur	$1 968.00	2 days
31	Design transfer activities	Tom Becher,Darryl Sandefur	$18 204.00	18.5 days
32	**Engineering Quality**		**$21 464.00**	**74.13 days**
33	Evaluate design specifications	Quality Engineer	$6 000.00	10 days
34	Develop testing protocol for prototype	Tom Becher,Darryl Sandefur	$4 352.00	8 days
35	Test prototype	Quality Engineer	$6 000.00	10 days

ID	Task Name	Resource Names	Baseline Cost	Baseline Estimated Duration
36	Evaluate results of tests and identify weaknesses	Quality Engineer	$3 600.00	6 days
37	Product release meetings	Kurt Zollinger	$1 512.00	3 days
38	**Manufacturing**		**$22 600.00**	**78 days**
39	Process engineering plan	Operations Specialist	$6 000.00	15 days
40	Develop production plan	Operations Specialist	$2 400.00	6 days
41	Develop production control plan	Operations Specialist	$3 400.00	8.5 days
42	Approve production parts	Operations Specialist	$2 000.00	5 days
43	Contracting for deliveries	Operations Specialist	$3 200.00	8 days
44	Submit production purchase order	Operations Specialist	$800.00	2 days
45	Production pilot test	Operations Specialist	$2 000.00	5 days
46	Debugging production system	Operations Specialist	$1 600.00	4 days
47	Production release	Operations Specialist	$1 200.00	3 days
48	**Commercialization**		**$48 944.00**	**182.63 days**
49	Develop preliminary marketing plan	Kurt Zollinger,Yukio Ashida	$3 220.00	2.5 days
50	Develop marketing program	Kurt Zollinger,Yukio Ashida	$9 660.00	7.5 days
51	Train sales team	Kurt Zollinger	$11 088.00	22 days
52	Advertising campaign	Yukio Ashida	$21 952.00	28 days
53	Show functional model at trade show	Kurt Zollinger	$1 512.00	3 days
54	Product launch	Kurt Zollinger	$1 512.00	3 days
55	**Project Management**		**$91 148.00**	**201.13 days**
56	Project Management Period 1	Tom Becher,Darryl Sandefur	$12 300.00	12.5 days
57	Project Management Period 2	Tom Becher,Darryl Sandefur	$6 888.00	7 days
58	Project Management Period 3	Tom Becher,Darryl Sandefur	$6 888.00	7 days
59	Project Management Period 4	Yukio Ashida	$10 192.00	13 days
60	Project Management Period 5	Yukio Ashida	$11 760.00	15 days
61	Project Management Period 6	Yukio Ashida	$7 056.00	9 days
62	Project Management Period 7	Yukio Ashida	$8 624.00	11 days
63	Project Management Period 8	Yukio Ashida	$2 352.00	3 days
64	Project Management Period 9	Yukio Ashida	$3 136.00	4 days
65	Project Management Period 10	Yukio Ashida	$3 920.00	5 days
66	Project Management Period 11	Yukio Ashida	$10 192.00	13 days
67	Project Management Period 12	Yukio Ashida	$7 840.00	10 days
68	**Milestones**		**$0.00**	**182.63 days**

Appendix B

Network Diagram

The network diagram can be found on the following three pages. Note that the diagram is read left to right, the pages are contiguous and the images can be zoomed in to read details of the various tasks.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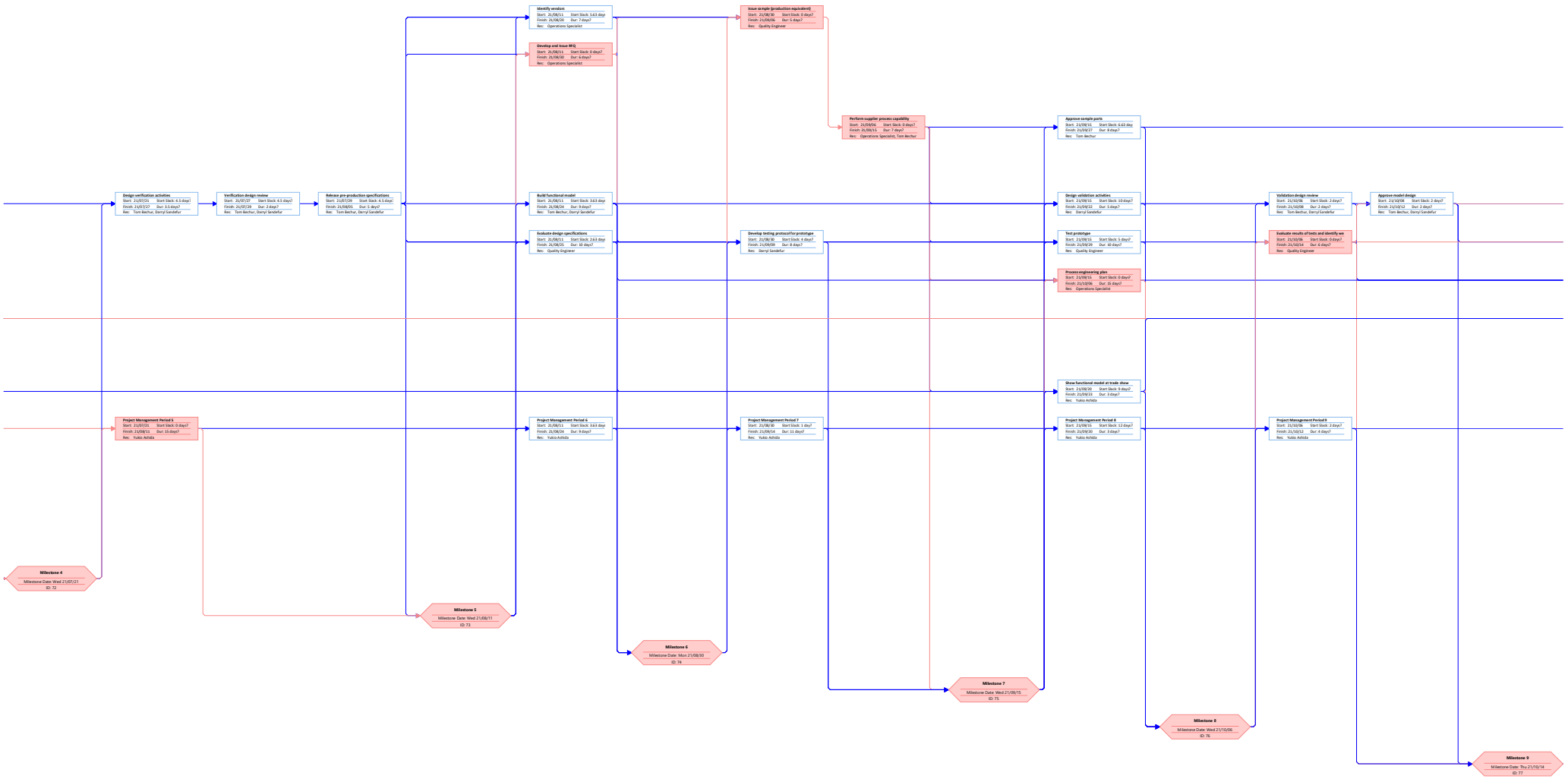
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Milestone 6
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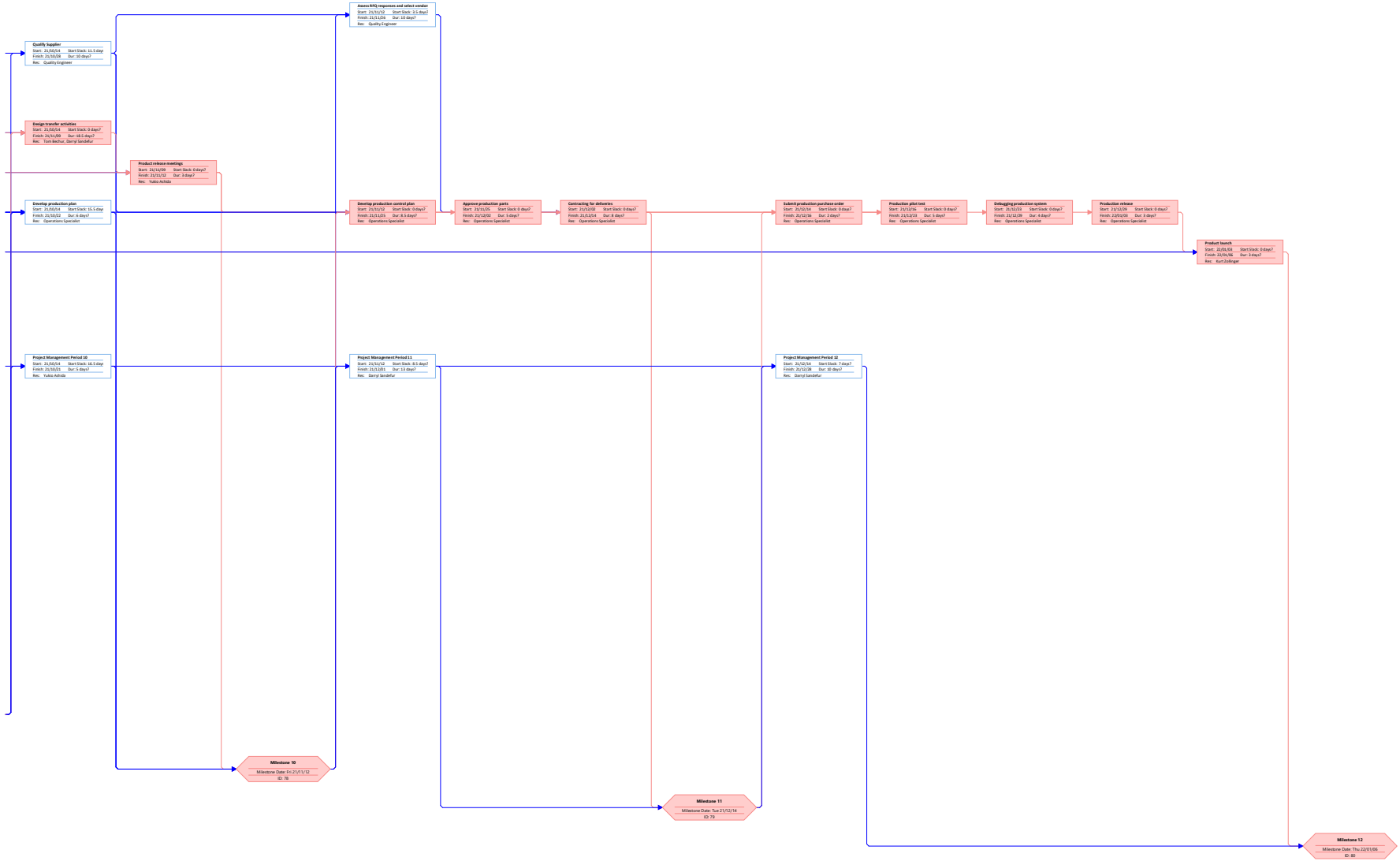
ID: 74
Milestone 7
Milestone Date: Wed 21/09/15
ID: 75
Milestone 8
Milestone Date: Wed 21/10/06
ID: 76
Milestone 9
Milestone Date: Thu 21/10/14
ID: 77


Qualify Supplier
Start: 21/10/14 Start Slack: 11.5 day
Finish: 21/10/28 Dur: 10 days?
Res: Quality Engineer
Design transfer activities
Start: 21/10/14 Start Slack: 0 days?
Finish: 21/11/09 Dur: 18.5 days?
Res: Tom Bechar, Darryl Sandefur
Develop production plan
Start: 21/10/14 Start Slack: 15.5 day
Finish: 21/10/22 Dur: 6 days?
Res: Operations Specialist
Project Management Period 10
Start: 21/10/14 Start Slack: 16.5 day
Finish: 21/10/21 Dur: 5 days?
Res: Yukio Ashida
Assess RFQ responses and select vendor
Start: 21/11/12 Start Slack: 3.5 days?
Finish: 21/11/26 Dur: 10 days?
Res: Quality Engineer
Product release meetings
Start: 21/11/09 Start Slack: 0 days?
Finish: 21/11/12 Dur: 3 days?
Res: Yukio Ashida
Milestone 10
Milestone Date: Fri 21/11/12
ID: 78
Develop production control plan
Start: 21/11/12 Start Slack: 0 days?
Finish: 21/11/25 Dur: 8.5 days?
Res: Operations Specialist
Approve production parts
Start: 21/11/26 Start Slack: 0 days?
Finish: 21/12/10 Dur: 5 days?
Res: Operations Specialist
Contracting for deliveries
Start: 21/12/02 Start Slack: 0 days?
Finish: 21/12/14 Dur: 8 days?
Res: Operations Specialist
Project Management Period 11
Start: 21/11/12 Start Slack: 8.5 days?
Finish: 21/12/01 Dur: 13 days?
Res: Darryl Sandefur
Milestone 11
Milestone Date: Tue 21/12/14
ID: 79
Submit production purchase order
Start: 21/12/14 Start Slack: 0 days?
Finish: 21/12/16 Dur: 2 days?
Res: Operations Specialist
Production pilot test
Start: 21/12/16 Start Slack: 0 days?
Finish: 21/12/23 Dur: 5 days?
Res: Operations Specialist
Debugging production system
Start: 21/12/23 Start Slack: 0 days?
Finish: 21/12/29 Dur: 4 days?
Res: Operations Specialist
Production release
Start: 21/12/29 Start Slack: 0 days?
Finish: 22/01/03 Dur: 3 days?
Res: Operations Specialist
Project Management Period 12
Start: 21/12/14 Start Slack: 7 days?
Finish: 21/12/28 Dur: 10 days?
Res: Darryl Sandefur
Product launch
Start: 22/01/03 Start Slack: 0 days?
Finish: 22/01/06 Dur: 3 days?
Res: Kurt Zollinger
Milestone 12
Milestone Date: Thu 22/01/06
ID: 80