Title: Margin Expansion Through Cost Reduction Focused Redesign Of A Bicycle

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Note:

Charter/Overview

The aim of this project is to redesign elements of one of our company's legacy products, a standard five speed commuter bicycle, in an effort to cut costs and expand the product's profit margin through cost reduction. Through mechanical engineering, manufacturing engineering, component engineering, marketing, and engineering change researcher efforts, areas for cost improvements will be identified and developed through redesign. The tasks associated with these functional areas are clearly outlined in Appendix A and the resources responsible for these tasks are clearly outlined in Appendix B with resource loading addressed in Appendix J.

Ultimately, mechanical components will be redesigned, manufacturing processes optimized, and labor and overhead will be analyzed in order to address current design and production problems and identify areas of high cost that can be improved. In turn, these improvements will be realized through product implementation.

Project Scope

The three main objectives of this project are as follows:

- Cross-functionally identify areas of high cost
- Collaboratively brainstorm and identify actions to drive cost out of the product in order to expand profit margin with the goal of reducing the overall cost of the product by 10% which equates to an additional 10% increase in margin
- Work cross-functionally as a project team to implement identified cost reduction changes in order to release these changes into production

This project will not address the following and all endeavors related to these items will be considered out of the scope of this project:

- Adding new features or value to the product; this is strictly a cost reduction exercise
- Using the margin expansion realized in this project to reduce the overall average sales price of the product; this is out of the scope of the project and ultimately up to upper management to assess further down the road
- Implementing cost reduction measures across all product lines; the project manager will include recommendations for future projects as part of the termination phase of this project, as described in the termination task list in Appendix O, but the project manager will not guarantee that all cost reduction measures identified and implemented in this project will automatically translate and apply to cost reduction in other product lines

General Approach

This project will be led by a Project Manager who will coordinate the project to completion with contribution from five departments within the organization including; Mechanical Engineering,

Manufacturing Engineering, Component Engineering, Marketing, and Engineering Change Orders as shown in organizational chart in Appendix C . As illustrated in the RACI Matrix in Appendix B, to achieve optimal cost reduction in the process and in the design of the bicycle, each department involved will be accountable for the tasks specifically pertaining to their department with the input of closely affected departments.

To complete this project on schedule, as indicated in baseline schedule in Appendix D, a resource loading table was composed, as shown in Appendix J, which identifies hours to be spent by each resource/department on each task. And if delays or deviations occur to the schedule or resource availability the project manager will easily take notice and act accordingly using the critical rate control limits in Appendix M.

It is our objective to be aligned with our goal as company to be in pursuit of harmonious growth and enhancement of profitability. This proposed project will give us the opportunity to re-evaluate the numerous aspects involved in producing our standard five speed commuter bicycle. As this bicycle is our top seller (our bread and butter), we are intestinally focusing on its re-evaluation since it would be the most financially impactful once the margin is expanded.

It is our aim to cut costs and expand the product's profit margin, not necessarily to reduce the cost of the product, but its upper management's purgative how to best utilize the savings identified.

As our company produces and sells their products in house, there will be no contractual obligation with third parties other than direct part suppliers.

Schedules

The project will begin on January 1st and is scheduled to be completed on May 19th as detailed in the summary/ aggregate baseline schedule in Appendix D. There will be five phase gates, as shown below, to internally track the progress of the project:

- BOM Scrub
- Market Research
- Manufacturing Analysis
- ECO Process
- Mechanical Engineering Redesign

Like most projects, the schedule of this project is bound to change and vary throughout the length of the project. In an effort to mitigate this risk, optimistic, most likely, and pessimistic task duration estimates are outlined and provided in the probability table in Appendix F. A

probability distribution of project completion times in Appendix I visually represents the probability of completing the project between 110 and 148 days. Budget and cost are also bound to change along with the schedule. Through careful analysis a bottom up budget has been outlined in Appendix E in an effort to accurately estimate project costs and a project schedule has been outlined with the critical path clearly identified and outlined in red in Appendix G. Associated task slack times are outlined in the activity on node network and associated table in Appendix H.

Resources/Personnel

The following functional resources, and their associated responsibilities, will be required to successfully complete the project:

- Component Engineer (C.E.): Responsible for the analysis and scrub of the bill of materials (BOM), sourcing all BOM items, identifying areas for margin improvement relative but not limited to component engineering, and engaging in cross-functional communication with members of the project team
- Market Researcher: Responsible for market analysis, identifying the business opportunity for cost reducing the product, seeking the voice of customer (VOC), providing VOC analysis, constructing the quality function deployment (QFD) diagram, and engaging in cross-functional communication with members of the project team
- Manufacturing Engineer (Mfg.E.): Responsible for identifying areas for margin improvement relative but not limited to manufacturing (including but not limited to process, labor, overhead, supplier, waste, and shipping) and engaging in cross-functional communication with members of the project team
- Mechanical Engineer (M.E.): Responsible for identifying areas of margin improvement relative but not limited to the mechanical aspects of the product, mechanical redesign and associated analysis, verification, validation and safety testing as well as engaging in cross-functional communication with members of the project team
- Engineering Change Order Researcher: Responsible for writing the engineering change order (ECO) and request (ECR), implementing changes relative to the engineering change order, and engaging in cross-functional communication with members of the project team
- Project Manager (PM): Responsible for facilitating cross-functional communication within the team and to departments outside of the project, holding team members accountable for their deliverables (either directly or indirectly through the team member's functional manager) and ultimately responsible for all project tasks

Please note that each resource may delegate tasks to other personnel or split tasks between personnel in their functional department which is demonstrated in the responsible, accountable, consult, inform (RACI) matrix of Appendix B.

Risk Management

There are several areas of risk that will need to be controlled and potentially mitigated. Scope, budget/cost, and schedule are the obvious areas of critical importance which will be monitored through the critical ratio equation and associated chart throughout the course of the project, as shown in Appendix N. Additional areas to formally monitor and control are expressed in Appendix M and shown below:

- Estimated Percent of Cost Reduction
- Technical Feasibility
- Return on Investment/Payback Period
- Team Member Morale and Participation

Other factors will be monitored by the project manager on a more informal basis such as market potential and acceptance, competitor movement, and manufacturing hiccups. However, as the project progresses, the project manager will need to be open to monitoring and controlling additional areas of risk as they become known in order to effectively execute the project.

Project Monitoring and Control

The overall performance of the project will be measured on a bi-monthly basis by the Project Manager using an aggregate performance measurement. Using the Planned Value table in Appendix K, assuming the 50-50 rule for all activities and using the simple graph illustrating the earned value as shown in Appendix L, the Project Manager will be able to identify if the total value of the work accomplished is in balance with the planned cost.

The critical ratio will also be utilized by the PM on a bi-weekly basis as illustrated in the critical ratio chart in Appendix N, to determine the status of the actual progress and cost compared to the scheduled progress and cost. Additionally, there are several areas of the project which will be monitored as listed in Appendix M in order to predict the project's outcome and insure the desired progress.

Project Termination and Evaluation

This project will be terminated on 05/19/2016 through termination by integration following the engineering release of the newly cost reduced project. A high level of the termination task list shown in Appendix O is as follows:

Termination by Integration Task List

1. Personnel
    1.1. Component Engineering Responsibilities
        1.1.1. Resume role and normal job functions
        1.1.2. Resume reporting to functional manager
        1.1.3. Determine sustaining support role
    1.2. Marketing Responsibilities
        1.2.1. Resume role and normal job functions
        1.2.2. Resume reporting to functional manager
        1.2.3. Determine sustaining support role
    1.3. Manufacturing Responsibilities
    1.4. ECO Researcher Responsibilities
    1.5. Mechanical Engineering Responsibilities
2. Mechanical Engineering
3. Manufacturing
4. Marketing
5. Equipment, Purchasing, Distribution, etc.
6. Risk Identification and Management
7. Project History and Project Audit Report

Appendices

Appendix A

Action Plan	
Objective: Cost Reduction	
Steps	**Responsibility**
1. Component Engineering BOM Scrub	
1.1 Pull current BOM	Component Engineer
1.2 Source all items and materials	Component Engineer
1.3 ID areas for margin improvement	Component Engineer
1.4 Communicate findings cross-functionally to manufacturing and engineering for evaluation	Component Engineer
1.5 Evaluate manufacturing and engineering feedback/concerns	Component Engineer
2. Marketing Research	
2.1 VOC	
2.1.1 ID Business Opportunity	Market Researcher
2.1.2 ID concerns, complaints, must haves, wouldn't it be cool if's…	Market Researcher
2.2 QFD	
2.2.1 ID Customer Needs	Market Researcher
2.2.2 ID Key Features	Market Researcher
2.2.3 ID high cost materials	Market Researcher
2.2.4 Determine features that can be altered for cost reduction	Market Researcher
3. Manufacturing Concerns	
3.1 Process Improvement (reducing constraints/bottle necking)	Manufacturing Engineer
3.2 Labor Improvement	Manufacturing Engineer
3.3 Overhead Improvement	Manufacturing Engineer
3.4 Re-evaluate Part Suppliers	Manufacturing Engineer
3.5 Waste Reduction (Lean Manufacturing)	Manufacturing Engineer
3.6 Shipping Material Cost Reduction	Manufacturing Engineer
3.7 Join all analysis to identify conflicts and finalize	Manufacturing Engineer
4. ECO Process	
4.1 Write engineering change request	
4.1.1 ID what needs to be changed	ECO Researcher
4.1.2 ID reason for change	ECO Researcher
4.1.3 Write description of change	ECO Researcher
4.1.4 List documents and departments affected by change	ECO Researcher
4.2 Get project into queue	ECO Researcher
4.3 Work cross-functionally with sustaining for approval	ECO Researcher
4.4 Implement changes	ECO Researcher
5. Engineering Redesign Product	

5.1 Mechanical redesign	Mechanical Engineer
5.2 Safety compliance verified	Mechanical Engineer
5.3 FEA analysis	Mechanical Engineer
5.4 Order prototypes and tooling	Mechanical Engineer
5.5 Evaluate prototypes	Mechanical Engineer
5.6 Order production parts	Mechanical Engineer
5.7 Final Field Validation	Mechanical Engineer
5.8 Final Verification	Mechanical Engineer
5.9 Final Safety Testing	Mechanical Engineer
5.10 Release cost reduced product	Mechanical Engineer

Appendix B

RACI Matrix

Responsibility

WBS

Subproject	Task	Component Lead	Component Engineer	ECO Researcher	Mechanical Engineer Lead	Mechanical Engineer	Manufacturing Engineer Lead	Manufacturing Engineer	Marketing Lead	Market Researcher	Project Manager
Component Engineering BOM Scrub	1.1	A	R		C		C				R
	1.2	A	R	C	C		C				R
	1.3	A	R	C	C		C		C		R
	1.4	A	R		C		C				R
	1.5	A	R		C		C				R
Marketing Research	2.1	C		C	C		C		A	R	R
	2.2	C		C	C		C		A	R	R
Manufacturing Concerns	3.1	C			C		A	R			R
	3.2	C			C		A	R			R
	3.3	C			C		A	R			R
	3.4	C		C	C		A	R			R
	3.5	C			C		A	R			R
	3.6	C		C	C		A	R			R
	3.7	C		C	C		A	R	C		R
ECO Process	4.1	C		A	C		C				R
	4.2	C		A	C		C				R
	4.3	C		A	C		C				R
	4.4	C		A	C		C		C		R
Engineering Redesign Product	5.1			C	A	R	C		C		R
	5.2			C	A	R	C				R
	5.3			C	A	R	C				R
	5.4			C	A	R	C				R
	5.5			C	A	R	C				R
	5.6			C	A	R	C				R
	5.7			C	A	R	C				R
	5.8			C	A	R	C				R
	5.9			C	A	R	C				R
	5.10			C	A	R	C		C		R

Legend:

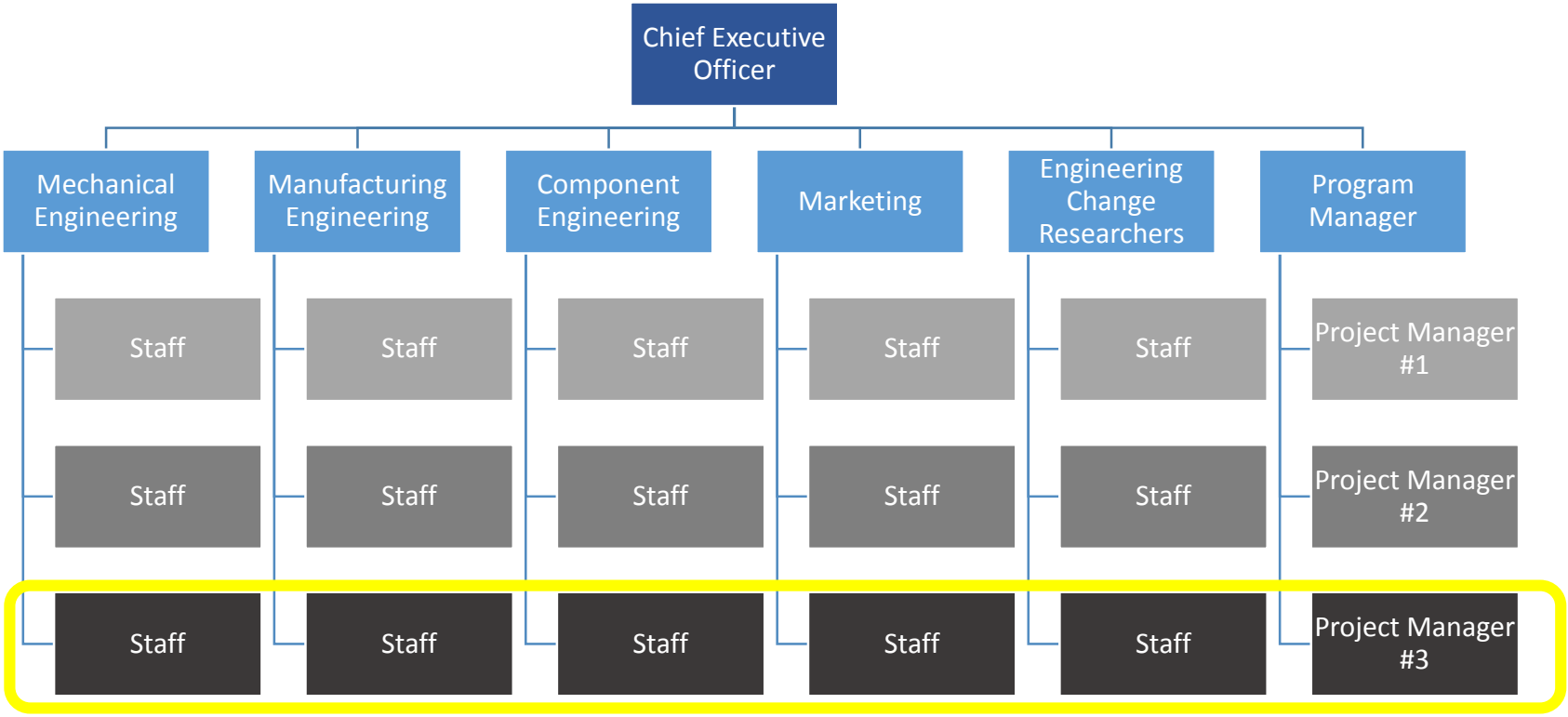
R Responsibility

C Consult

A Accountability

Appendix C

In relation to the rest of the organization this project is a balanced matrix where the project and functional managers have balanced control over the project and resources. Both managers are expected to work together and maintain mutual respect for each other throughout the length of the project. Below is a figure demonstrating this positioning. Our project is highlighted in yellow.



Positioning of Our Project Relative to the Organization

Appendix D

The table below outlines the summary/aggregate baseline schedule of the project. It is important to note that the main schedule driver is the fact that bicycle sales spike during the warmer summer months of June, July and August. So there is definitely a sense of urgency for completing this project on time.

Summary/Aggregate Baseline Schedule								
Milestones/ Phase Gates		**Task**	**Responsible Dpt.**	**2016**				
				Jan	**Feb**	**Mar**	**Apr**	**May**
BOM Scrub	1.1	Pull current BOM	C.E.	---------				
	1.2	Source all items and materials		---------				
	1.3	ID areas for margin improvement		---------				
	1.4	Communicate findings cross-functionally to manufacturing and engineering for evaluation		---------				
	1.5	Evaluate manufacturing and engineering feedback/concerns		**X**				
Market Research	2.1	VOC	Mkt.	---------				
	2.2	QFD		**X**				
Manufacturng Analysis	3.1	Process Improvement (reducing constraints/bottle necking)	Mfg. E.	---------				
	3.2	Labor Improvement		---------				
	3.3	Overhead Improvement		---------				
	3.4	Re-evaluate Part Suppliers		---------				
	3.5	Waste Reduction (Lean Manufacturing)		---------				
	3.6	Shipping Material Cost Reduction		---------				
	3.7	Join all analysis to identify conflicts and finalize		**X**				
ECO Process	4.1	Write engineering change request	ECO	---------				

	4.2	Get project into queue		---------				
	4.3	Work cross-functionally with sustaining for approval		---------				
	4.4	Implement changes					---------	**X**
Mechanical Enginering Redesign	5.1	Mechanical redesign	M.E.	---------	----------			
	5.2	Safety compliance verified			----------			
	5.3	FEA analysis			----------			
	5.4	Order prototypes and tooling			----------	----------		
	5.5	Evaluate prototypes				----------		
	5.6	Order production parts					---------	
	5.7	Final Field Validation					---------	
	5.8	Final Verification					---------	
	5.9	Final Safety Testing					---------	
	5.10	Release cost reduced product						**X**

Legend

X	Milestone Planned
O	Milestone Achieved (TBD)
	Planned Completion
	Actual Completion (TBD)
------	Planned Progress
====	Actual Progress (TBD)
!	Project Completion

Appendix E

The table below illustrates the Bottom-up estimates, where the costs of individual work items are estimated. By adding all items we obtain the project's total cost.

Bottom Up Time-Phased Budget							
Task	**Time (hours)**	**Estimate**	Monthly Budget				
			1	2	3	4	5
1. Component Engineering BOM Scrub	**176**						
1.1 Pull current BOM	8	$800	$800				
1.2 Source all items and materials	32	$3,200	$3,200				
1.3 ID areas for margin improvement	80	$8,000	$8,000				
1.4 Communicate findings cross-functionally to manufacturing and engineering for evaluation	16	$1,600	$1,600				
1.5 Evaluate manufacturing and engineering feedback/concerns	40	$4,000	$3,200	$800			
2. Marketing Research	**128**						
2.1 VOC							
2.1.1 ID Business Opportunity	24	$2,400	$2,400				
2.1.2 ID concerns, complaints, must haves, wouldn't it be cool if's…	24	$2,400	$2,400				
2.2 QFD							
2.2.1 ID Customer Needs	16	$1,600	$1,600				
2.2.2 ID Key Features	16	$1,600	$1,600				
2.2.3 ID high cost materials	16	$1,600	$1,600				
2.2.4 Determine features that can be altered for cost reduction	32	$3,200	$3,200				
3. Manufacturing Concerns	**256**						
3.1 Process Improvement analysis (reducing constraints/bottle necking)	40	$4,000	$4,000				
3.2 Labor Improvement analysis	24	$2,400	$2,400				
3.3 Overhead Improvement analysis	32	$3,200	$3,200				
3.4 Re-evaluate Part Suppliers	64	$6,400	$6,400				
3.5 Waste Reduction analysis	40	$4,000	$4,000				

(Lean Manufacturing)							
3.6 Shipping Material Cost Reduction analysis	24	$2,400	$2,400				
3.7 Join all analysis to identify conflicts and finalize	32	$3,200	$3,200				
4 ECO Process	**116**						
4.1 Write engineering change request							
4.1.1 ID what needs to be changed	8	$800		$800			
4.1.2 ID reason for change	8	$800		$800			
4.1.3 Write description of change	8	$800		$800			
4.1.4 List documents and departments affected by change	8	$800		$800			
4.2 Get project into queue	8	$800		$800			
4.3 Work cross-functionally with sustaining for approval	16	$1,600		$1,600			
4.4 Implement changes	60	$6,000					$6,000
5. Engineering Redesign Product	**552**						
5.1 Mechanical redesign	80	$8,000		$8,000			
5.2 Safety compliance verified	48	$4,800		$4,800			
5.3 FEA analysis	32	$3,200		$2,400	$800		
5.4 Order prototypes and tooling	120	$50,000			$50,000		
5.5 Evaluate prototypes	80	$8,000			$6,400	$1,600	
5.6 Order production parts	120	$20,000				$20,000	
5.7 Final Field Validation	16	$1,600				$1,600	
5.8 Final Verification	16	$1,600				$800	$800
5.9 Final Safety Testing	16	$1,600					$1,600
5.10 Release cost reduced product	24	$2,400					$2,400
	Totals	**$168,800**	**$55,200**	**$21,600**	**$57,200**	**$24,000**	**$10,800**

Appendix F

The table below shows the Expected Activity Time (TE), Variance (σ^2), and Standard Deviation (σ). By considering the optimistic, most likely and pessimistic time it takes to complete a task, we are able to identify the variance in our estimate.

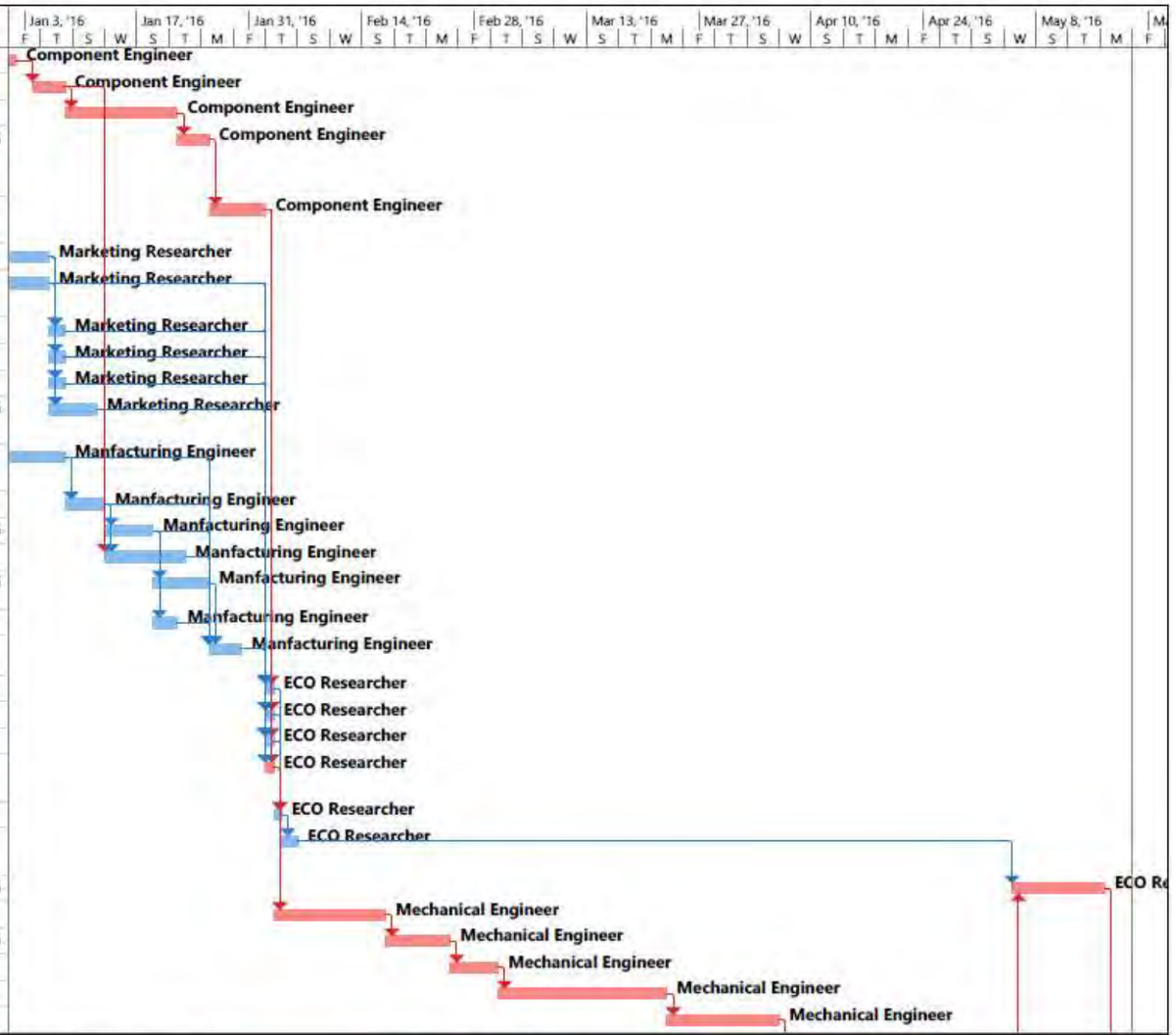
Probability Table								
Task	**Optimistic Time (hrs)**	**Most Likely Time (hrs)**	**Pessimistic Time (hrs)**	**Expected Time, TE (hrs)**	**Variance, σ2**	**Standard Deviation, σ**	**Immediate Precedence**	**Cost**
1. Component Engineering BOM Scrub								
1.1 Pull current BOM	4	8	12	8.0	1.778	1.333	__	$800
1.2 Source all items and materials	28	32	56	35.3	21.778	4.667	1.1	$3,533
1.3 ID areas for margin improvement	72	80	104	82.7	28.444	5.333	1.2	$8,267
1.4 Communicate findings cross-functionally to manufacturing and engineering for evaluation	8	16	20	15.3	4.000	2.000	1.3	$1,533
1.5 Evaluate manufacturing and engineering feedback/concerns	32	40	50	40.3	9.000	3.000	1.4	$4,033
2. Marketing Research								
2.1 VOC							__	
2.1.1 ID Business Opportunity	20	24	30	24.3	2.778	1.667	N/A	$2,433
2.1.2 ID concerns, complaints, must haves, wouldn't it be cool if's…	20	24	30	24.3	2.778	1.667	N/A	$2,433
2.2 QFD							2.1	
2.2.1 ID Customer Needs	14	16	24	17.0	2.778	1.667	N/A	$1,700
2.2.2 ID Key Features	15	16	18	16.2	0.250	0.500	N/A	$1,617
2.2.3 ID high cost materials	14	16	25	17.2	3.361	1.833	N/A	$1,717
2.2.4 Determine features that can be altered for cost reduction	28	32	44	33.3	7.111	2.667	N/A	$3,333
3. Manufacturing Concerns								
3.1 Process Improvement analysis (reducing constraints/bottle necking)	32	40	54	41.0	13.444	3.667	__	$4,100
3.2 Labor Improvement analysis	20	24	32	24.7	4.000	2.000	3.1	$2,467

3.3 Overhead Improvement analysis	28	32	44	33.3	7.111	2.667	3.2	$3,333
3.4 Re-evaluate Part Suppliers	52	64	80	64.7	21.778	4.667	1.2, 3.2	$6,467
3.5 Waste Reduction analysis (Lean Manufacturing)	32	40	54	41.0	13.444	3.667	3.3	$4,100
3.6 Shipping Material Cost Reduction analysis	20	24	32	24.7	4.000	2.000	3.3	$2,467
3.7 Join all analysis to identify conflicts and finalize	18	32	50	32.7	28.444	5.333	3.1-3.6	$3,267
4 ECO Process								
4.1 Write engineering change request							1.5,2.2,3.7	
4.1.1 ID what needs to be changed	3	8	14	8.2	3.361	1.833	N/A	$817
4.1.2 ID reason for change	4	8	14	8.3	2.778	1.667	N/A	$833
4.1.3 Write description of change	6	8	15	8.8	2.250	1.500	N/A	$883
4.1.4 List documents and departments affected by change	3	8	12	7.8	2.250	1.500	N/A	$783
4.2 Get project into queue	4	8	12	8.0	1.778	1.333	4.1	$800
4.3 Work cross-functionally with sustaining for approval	14	16	20	16.3	1.000	1.000	4.2	$1,633
4.4 Implement changes	48	60	84	62.0	36.000	6.000	4.3, 5.9	$6,200
5. Engineering Redesign Product								
5.1 Mechanical redesign	66	80	98	80.7	28.444	5.333	4.1	$8,067
5.2 Safety compliance verified	20	48	68	46.7	64.000	8.000	5.1	$4,667
5.3 FEA analysis	24	32	44	32.7	11.111	3.333	5.2	$3,267
5.4 Order prototypes and tooling	95	120	150	120.8	84.028	9.167	5.3	$12,083
5.5 Evaluate prototypes	58	80	100	79.7	49.000	7.000	5.4	$7,967
5.6 Order production parts	100	120	140	120.0	44.444	6.667	5.5	$12,000
5.7 Final Field Validation	14	16	20	16.3	1.000	1.000	5.6	$1,633
5.8 Final Verification	12	16	22	16.3	2.778	1.667	5.7	$1,633
5.9 Final Safety Testing	14	16	22	16.7	1.778	1.333	5.8	$1,667
5.10 Release cost reduced product	18	24	40	25.7	13.444	3.667	5.10	$2,567

Appendix G Gantt Chart

The Gantt chart below as populated in Microsoft Project utilizing the data and analysis gathered and performed in Appendices B and F. Slack times are outlined in Appendix H. Please note the critical path is highlighted in red. Also, note that the majority of the critical path tasks are associated with the mechanical engineering related tasks which indicates the importance of these tasks.

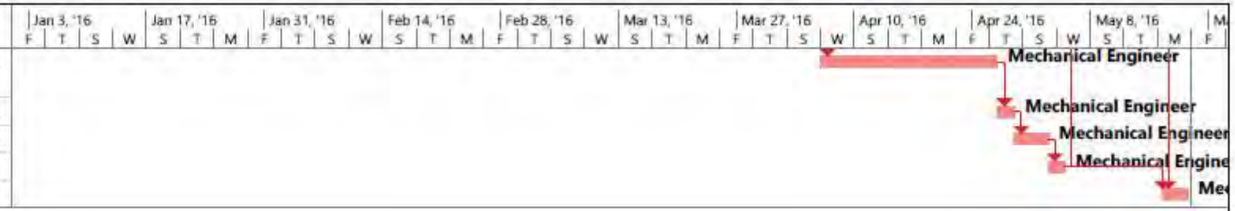
ID	Task Name	Duration	Predecessors	Start	Finish
1	1.1 Pull current BOM	8 hrs		Fri 1/1/16	Fri 1/1/16
2	1.2 Source all items and materials	32 hrs	1	Mon 1/4/16	Thu 1/7/16
3	1.3 ID areas for margin improveme	80 hrs	2	Fri 1/8/16	Thu 1/21/16
4	1.4 Communicate findings cross-functionally to manufacturing and engineering for	16 hrs	3	Fri 1/22/16	Mon 1/25/16
5	1.5 Evaluate manufacturing and engineering feedback/concerns	40 hrs	4	Tue 1/26/16	Mon 2/1/16
6	2.1.1 ID Business Opportunity	24 hrs		Fri 1/1/16	Tue 1/5/16
7	2.1.2 ID concerns, complaints, must haves, wouldn't it be cool	24 hrs		Fri 1/1/16	Tue 1/5/16
8	2.2.1 ID Customer Needs	16 hrs	6,7	Wed 1/6/16	Thu 1/7/16
9	2.2.2 ID Key Features	16 hrs	6,7	Wed 1/6/16	Thu 1/7/16
10	2.2.3 ID high cost materials	16 hrs	6,7	Wed 1/6/16	Thu 1/7/16
11	2.2.4 Determine features that can be altered for cost reduction	32 hrs	6,7	Wed 1/6/16	Mon 1/11/16
12	3.1 Process Improvement (reducing constraints/bottle	40 hrs		Fri 1/1/16	Thu 1/7/16
13	3.2 Labor Improvement	24 hrs	12	Fri 1/8/16	Tue 1/12/16
14	3.3 Overhead Improvement	32 hrs	13	Wed 1/13/16	Mon 1/18/16
15	3.4 Re-evaluate Part Suppliers	64 hrs	13,2	Wed 1/13/16	Fri 1/22/16
16	3.5 Waste Reduction (Lean Manufacturing)	40 hrs	14	Tue 1/19/16	Mon 1/25/16
17	3.6 Shipping Material Cost Reductio	24 hrs	14	Tue 1/19/16	Thu 1/21/16
18	3.7 Join all analysis to identify conflicts and finalize	32 hrs	12,13,14,15,16,17	Tue 1/26/16	Fri 1/29/16
19	4.1.1 ID what needs to be changed	8 hrs	18,5,7,8,9,10,11	Tue 2/2/16	Tue 2/2/16
20	4.1.2 ID reason for change	8 hrs	18,5,7,8,9,10,11	Tue 2/2/16	Tue 2/2/16
21	4.1.3 Write description of change	8 hrs	18,5,7,8,9,10,11	Tue 2/2/16	Tue 2/2/16
22	4.1.4 List documents and departments affected by change	8 hrs	18,5,7,8,9,10,11	Tue 2/2/16	Tue 2/2/16
23	4.2 Get project into queue	8 hrs	19,20,21,22	Wed 2/3/16	Wed 2/3/16
24	4.3 Work cross-functionally with sustaining for approval	16 hrs	23	Thu 2/4/16	Fri 2/5/16
25	4.4 Implement changes	60 hrs	34,24	Thu 5/5/16	Mon 5/16/16
26	5.1 Mechanical redesign	80 hrs	22	Wed 2/3/16	Tue 2/16/16
27	5.2 Safety compliance verified	48 hrs	26	Wed 2/17/16	Wed 2/24/16
28	5.3 FEA analysis	32 hrs	27	Thu 2/25/16	Tue 3/1/16
29	5.4 Order and receive prototypes	120 hrs	28	Wed 3/2/16	Tue 3/22/16
30	5.5 Evaluate prototypes	80 hrs	29	Wed 3/23/16	Tue 4/5/16



Project: ETM 545
Date: Thu 5/28/15

Task
Split
Milestone
Summary
Project Summary
Inactive Task
Inactive Milestone
Inactive Summary
Manual Task
Duration-only
Manual Summary Rollup
Manual Summary
Start-only
Finish-only
External Tasks
External Milestone
Deadline
Critical
Critical Split
Progress
Manual Progress

ID	Task Name	Duration	Predecessors	Start	Finish
31	5.6 Order and receive production parts	120 hrs	30	Wed 4/6/16	Tue 4/26/16
32	5.7 Final Field Validation	16 hrs	31	Wed 4/27/16	Thu 4/28/16
33	5.8 Final Verification	16 hrs	32	Fri 4/29/16	Mon 5/2/16
34	5.9 Final Safety Testing	16 hrs	33	Tue 5/3/16	Wed 5/4/16
35	5.10 Release cost reduced product	24 hrs	25,34	Mon 5/16/16	Thu 5/19/16

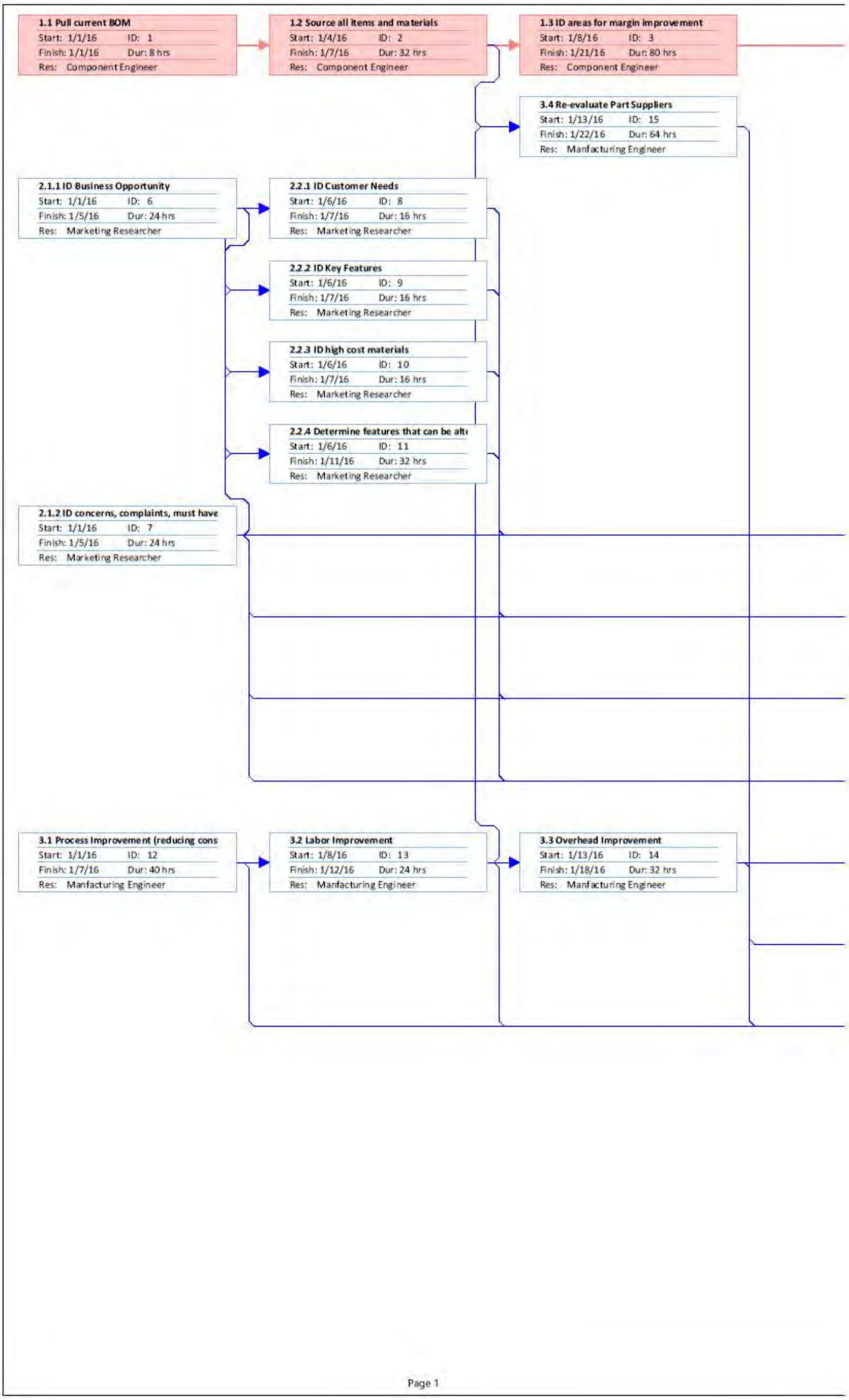


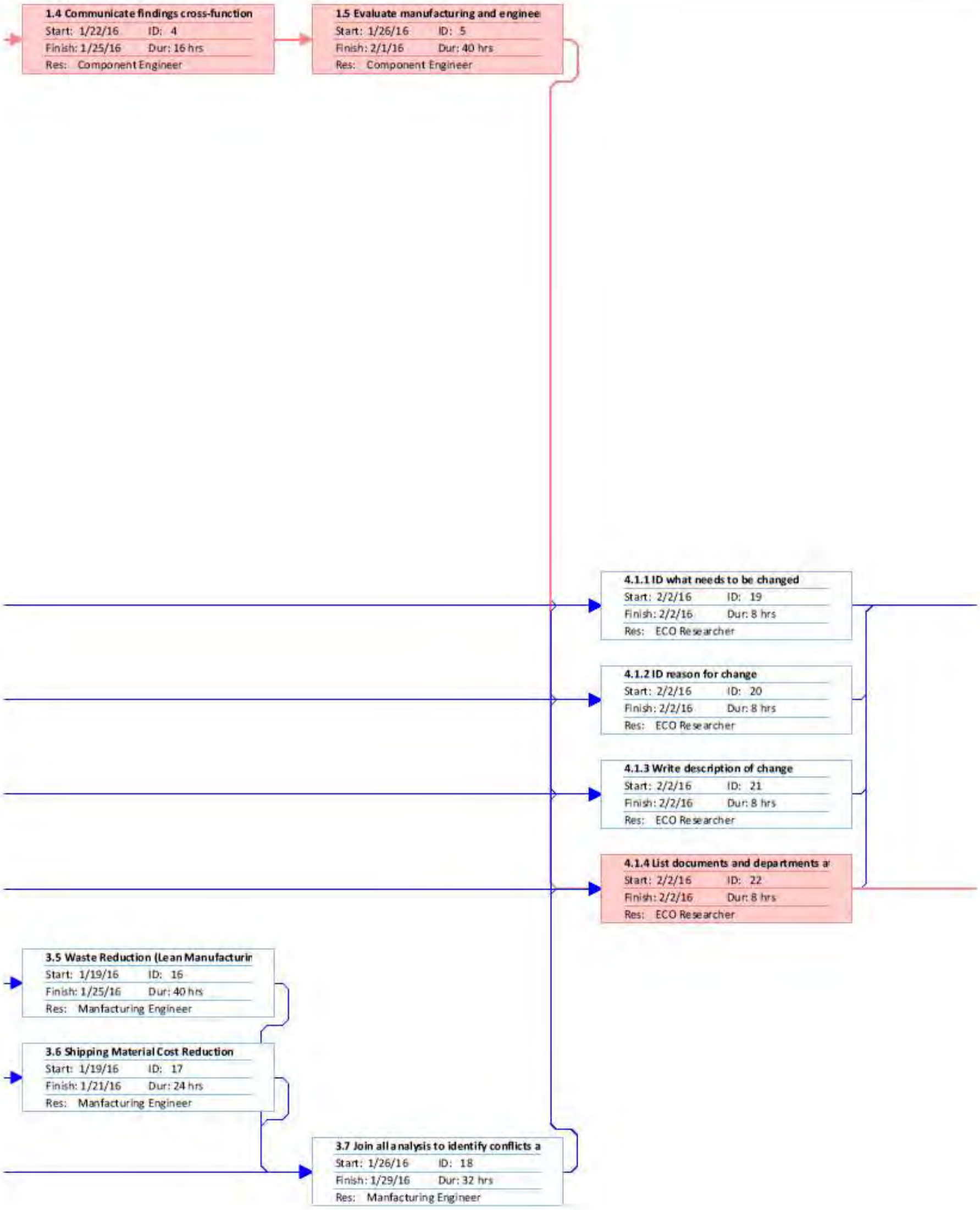
Project: ETM 545
Date: Thu 5/28/15

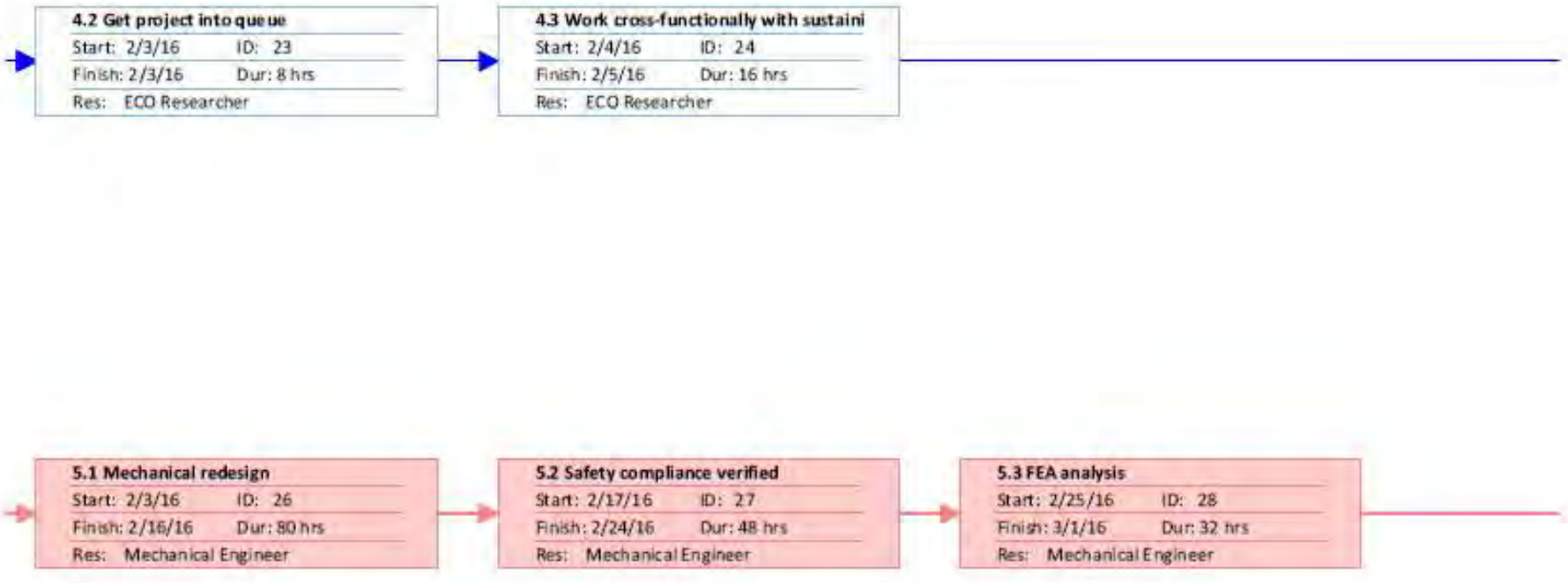
Task	Inactive Task	Manual Summary Rollup	External Milestone	Manual Progress
Split	Inactive Milestone	Manual Summary	Deadline	
Milestone	Inactive Summary	Start-only	Critical	
Summary	Manual Task	Finish-only	Critical Split	
Project Summary	Duration-only	External Tasks	Progress	

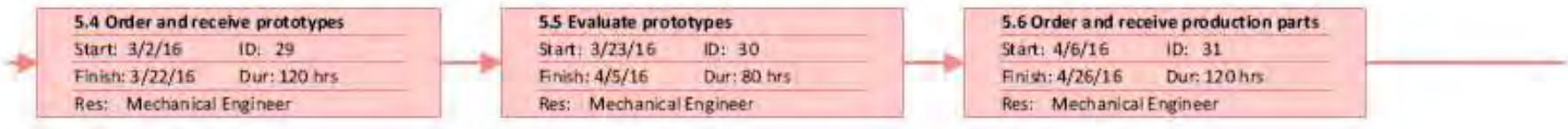
Appendix H AON Network Diagram

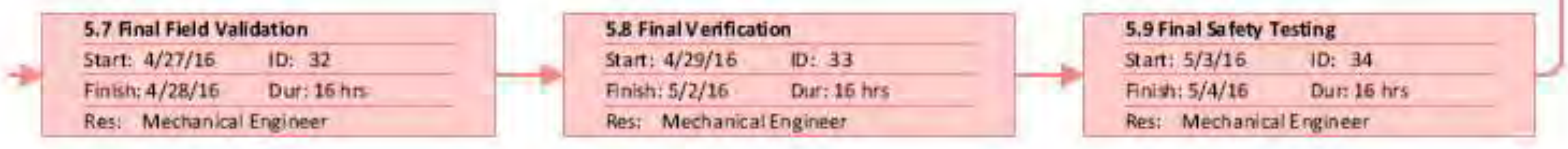
The Activity on Network Diagram below is a Microsoft Project populated visual representation of the schedule's critical path and associated resources as shown in the Gantt chart of Appendix G. Please note that the critical path is again highlighted in red. Also, the associated table that follows demonstrates the slack times associated with each task.




1.4 Communicate findings cross-function
Start: 1/22/16 ID: 4
Finish: 1/25/16 Dur: 16 hrs
Res: Component Engineer
1.5 Evaluate manufacturing and enginee
Start: 1/26/16 ID: 5
Finish: 2/1/16 Dur: 40 hrs
Res: Component Engineer
4.1.1 ID what needs to be changed
Start: 2/2/16 ID: 19
Finish: 2/2/16 Dur: 8 hrs
Res: ECO Researcher
4.1.2 ID reason for change
Start: 2/2/16 ID: 20
Finish: 2/2/16 Dur: 8 hrs
Res: ECO Researcher
4.1.3 Write description of change
Start: 2/2/16 ID: 21
Finish: 2/2/16 Dur: 8 hrs
Res: ECO Researcher
4.1.4 List documents and departments ar
Start: 2/2/16 ID: 22
Finish: 2/2/16 Dur: 8 hrs
Res: ECO Researcher
3.5 Waste Reduction (Lean Manufacturir
Start: 1/19/16 ID: 16
Finish: 1/25/16 Dur: 40 hrs
Res: Manfacturing Engineer
3.6 Shipping Material Cost Reduction
Start: 1/19/16 ID: 17
Finish: 1/21/16 Dur: 24 hrs
Res: Manfacturing Engineer
3.7 Join all analysis to identify conflicts a
Start: 1/26/16 ID: 18
Finish: 1/29/16 Dur: 32 hrs
Res: Manfacturing Engineer


4.2 Get project into queue
Start: 2/3/16 ID: 23
Finish: 2/3/16 Dur: 8 hrs
Res: ECO Researcher
4.3 Work cross-functionally with sustaini
Start: 2/4/16 ID: 24
Finish: 2/5/16 Dur: 16 hrs
Res: ECO Researcher
5.1 Mechanical redesign
Start: 2/3/16 ID: 26
Finish: 2/16/16 Dur: 80 hrs
Res: Mechanical Engineer
5.2 Safety compliance verified
Start: 2/17/16 ID: 27
Finish: 2/24/16 Dur: 48 hrs
Res: Mechanical Engineer
5.3 FEA analysis
Start: 2/25/16 ID: 28
Finish: 3/1/16 Dur: 32 hrs
Res: Mechanical Engineer


5.4 Order and receive prototypes
Start: 3/2/16 ID: 29
Finish: 3/22/16 Dur: 120 hrs
Res: Mechanical Engineer
5.5 Evaluate prototypes
Start: 3/23/16 ID: 30
Finish: 4/5/16 Dur: 80 hrs
Res: Mechanical Engineer
5.6 Order and receive production parts
Start: 4/6/16 ID: 31
Finish: 4/26/16 Dur: 120 hrs
Res: Mechanical Engineer


5.7 Final Field Validation
Start: 4/27/16 ID: 32
Finish: 4/28/16 Dur: 16 hrs
Res: Mechanical Engineer
5.8 Final Verification
Start: 4/29/16 ID: 33
Finish: 5/2/16 Dur: 16 hrs
Res: Mechanical Engineer
5.9 Final Safety Testing
Start: 5/3/16 ID: 34
Finish: 5/4/16 Dur: 16 hrs
Res: Mechanical Engineer


4.4 Implement changes
Start: 5/5/16 ID: 25
Finish: 5/16/16 Dur: 60 hrs
Res: ECO Researcher
5.10 Release cost reduced product
Start: 5/16/16 ID: 35
Finish: 5/19/16 Dur: 24 hrs
Res: Mechanical Engineer

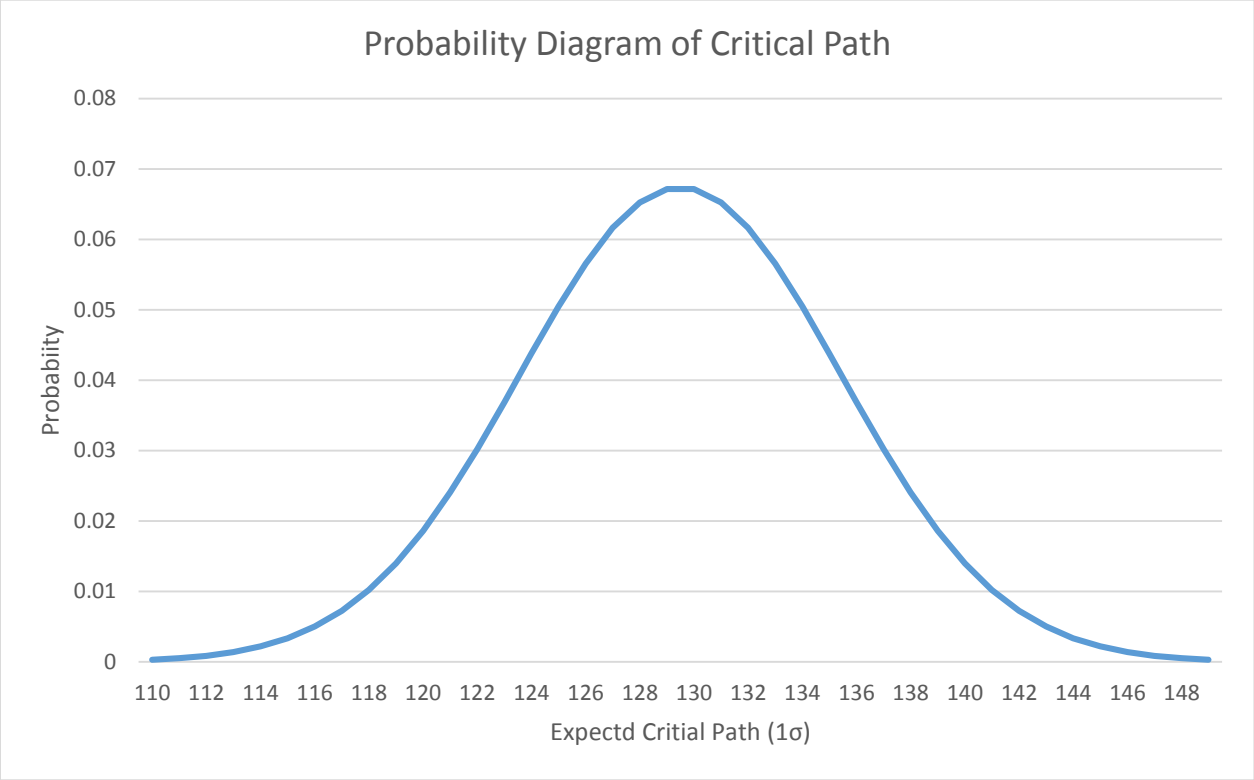
Project: ETM 545
Date: Thu 5/28/15

Critical		Critical Summary		Critical Marked		Project Summary	
Noncritical		Summary		Marked		Highlighted Critical	
Critical Milestone		Critical Inserted		Critical External		Highlighted Noncritical	
Milestone		Inserted		External			

Task Name	Duration	Predecessors	Start	Finish	Total Slack	Resource Names
1.1 Pull current BOM	8 hrs		Fri 1/1/16	Fri 1/1/16	0 hrs	Component Engineer
1.2 Source all items and materials	32 hrs	1	Mon 1/4/16	Thu 1/7/16	0 hrs	Component Engineer
1.3 ID areas for margin improvement	80 hrs	2	Fri 1/8/16	Thu 1/21/16	0 hrs	Component Engineer
1.4 Communicate findings cross-functionally to manufacturing and engineering for evaluation	16 hrs	3	Fri 1/22/16	Mon 1/25/16	0 hrs	Component Engineer
1.5 Evaluate manufacturing and engineering feedback/concerns	40 hrs	4	Tue 1/26/16	Mon 2/1/16	0 hrs	Component Engineer
2.1.1 ID Business Opportunity	24 hrs		Fri 1/1/16	Tue 1/5/16	120 hrs	Marketing Researcher
2.1.2 ID concerns, complaints, must haves, wouldn't it be cool if's…	24 hrs		Fri 1/1/16	Tue 1/5/16	120 hrs	Marketing Researcher
2.2.1 ID Customer Needs	16 hrs	6,7	Wed 1/6/16	Thu 1/7/16	136 hrs	Marketing Researcher
2.2.2 ID Key Features	16 hrs	6,7	Wed 1/6/16	Thu 1/7/16	136 hrs	Marketing Researcher
2.2.3 ID high cost materials	16 hrs	6,7	Wed 1/6/16	Thu 1/7/16	136 hrs	Marketing Researcher
2.2.4 Determine features that can be altered for cost reduction	32 hrs	6,7	Wed 1/6/16	Mon 1/11/16	120 hrs	Marketing Researcher
3.1 Process Improvement (reducing constraints/bottle necking)	40 hrs		Fri 1/1/16	Thu 1/7/16	8 hrs	Manfacturing Engineer
3.2 Labor Improvement	24 hrs	12	Fri 1/8/16	Tue 1/12/16	8 hrs	Manfacturing Engineer
3.3 Overhead Improvement	32 hrs	13	Wed 1/13/16	Mon 1/18/16	8 hrs	Manfacturing Engineer
3.4 Re-evaluate Part Suppliers	64 hrs	13,2	Wed 1/13/16	Fri 1/22/16	16 hrs	Manfacturing Engineer
3.5 Waste Reduction (Lean Manufacturing)	40 hrs	14	Tue 1/19/16	Mon 1/25/16	8 hrs	Manfacturing Engineer
3.6 Shipping Material Cost Reduction	24 hrs	14	Tue 1/19/16	Thu 1/21/16	24 hrs	Manfacturing Engineer
3.7 Join all analysis to identify conflicts and finalize	32 hrs	12,13,14,15,16,17	Tue 1/26/16	Fri 1/29/16	8 hrs	Manfacturing Engineer
4.1.1 ID what needs to be changed	8 hrs	18,5,7,8,9,10,11	Tue 2/2/16	Tue 2/2/16	588 hrs	ECO Researcher
4.1.2 ID reason for change	8 hrs	18,5,7,8,9,10,11	Tue 2/2/16	Tue 2/2/16	588 hrs	ECO Researcher
4.1.3 Write description of change	8 hrs	18,5,7,8,9,10,11	Tue 2/2/16	Tue 2/2/16	588 hrs	ECO Researcher
4.1.4 List documents and departments affected by change	8 hrs	18,5,7,8,9,10,11	Tue 2/2/16	Tue 2/2/16	0 hrs	ECO Researcher
4.2 Get project into queue	8 hrs	19,20,21,22	Wed 2/3/16	Wed 2/3/16	588 hrs	ECO Researcher
4.3 Work cross-functionally with sustaining for approval	16 hrs	23	Thu 2/4/16	Fri 2/5/16	504 hrs	ECO Researcher
4.4 Implement changes	60 hrs	34,24	Thu 5/5/16	Mon 5/16/16	0 hrs	ECO Researcher
5.1 Mechanical redesign	80 hrs	22	Wed 2/3/16	Tue 2/16/16	0 hrs	Mechanical Engineer
5.2 Safety compliance verified	48 hrs	26	Wed 2/17/16	Wed 2/24/16	0 hrs	Mechanical Engineer
5.3 FEA analysis	32 hrs	27	Thu 2/25/16	Tue 3/1/16	0 hrs	Mechanical Engineer
5.4 Order and receive prototypes	120 hrs	28	Wed 3/2/16	Tue 3/22/16	0 hrs	Mechanical Engineer
5.5 Evaluate prototypes	80 hrs	29	Wed 3/23/16	Tue 4/5/16	0 hrs	Mechanical Engineer
5.6 Order and receive production parts	120 hrs	30	Wed 4/6/16	Tue 4/26/16	0 hrs	Mechanical Engineer
5.7 Final Field Validation	16 hrs	31	Wed 4/27/16	Thu 4/28/16	0 hrs	Mechanical Engineer
5.8 Final Verification	16 hrs	32	Fri 4/29/16	Mon 5/2/16	0 hrs	Mechanical Engineer
5.9 Final Safety Testing	16 hrs	33	Tue 5/3/16	Wed 5/4/16	0 hrs	Mechanical Engineer
5.10 Release cost reduced product	24 hrs	25,34	Mon 5/16/16	Thu 5/19/16	0 hrs	Mechanical Engineer

Appendix I

The following chart is a probability distribution of project completion times between 110 and 148 days. Through analysis and estimation the project is expected to be completed in 139 days with a 95% confidence index.



Appendix J

The table below describes the amount of individual resources an existing schedule requires during specific time periods.

Resource Loading																		
			Jan			**Feb**			**Mar**			**Apr**			**May**		
ID	**Resource Name**	**Work(hrs)**	10	20	30	10	20	30	10	20	30	10	20	30	10	20	30
1	**Component Engineer**	**176**	48h	64h	56h	8h											
	1.1 Pull current BOM	8	8h														
	1.2 Source all items and materials	32	32h														
	1.3 ID areas for margin improvement	80	8h	64h	8h												
	1.4 Communicate findings cross-functionally to manufacturing and engineering for evaluation	16			16h												
	1.5 Evaluate manufacturing and engineering feedback/concerns	40			32h	8h											
2	**Market Researcher**	**128**	120h	8h													
	2.1.1 ID Business Opportunity	24	24h														
	2.1.2 ID concerns, complaints, must haves, wouldn't it be cool if's…	24	24h														
	2.2.1 ID Customer Needs	16	16h														
	2.2.2 ID Key Features	16	16h														
	2.2.3 ID high cost materials	16	16h														
	2.2.4 Determine features that can be altered for cost reduction	32	24h	8h													
3	**Manufacturing Engineer**	**256**	48h	128h	80h												
	3.1 Process Improvement analysis (reducing constraints/bottle necking)	40	40h														
	3.2 Labor Improvement	24	8h	16h													

	analysis																
	3.3 Overhead Improvement analysis	32		32h													
	3.4 Re-evaluate Part Suppliers	64		48h	16h												
	3.5 Waste Reduction analysis (Lean Manufacturing)	40		16h	24h												
	3.6 Shipping Material Cost Reduction analysis	24		16h	8h												
	3.7 Join all analysis to identify conflicts and finalize	32			32h												
4	**ECO Researcher**	**116**				56h									32h	28h	
	4.1.1 ID what needs to be changed	8				8h											
	4.1.2 ID reason for change	8				8h											
	4.1.3 Write description of change	8				8h											
	4.1.4 List documents and departments affected by change	8				8h											
	4.2 Get project into queue	8				8h											
	4.3 Work cross-functionally with sustaining for approval	16				16h											
	4.4 Implement changes	60													32h	28h	
5	**Mechanical Engineer**	**552**				56h	48h	48h	64h	48h	72h	48h	56h	64h	24h	24h	
	5.1 Mechanical redesign	80				56h	24h										
	5.2 Safety compliance verified	48					24h	24h									
	5.3 FEA analysis	32						24h	8h								
	5.4 Order prototypes and tooling	120							56h	48h	16h						
	5.5 Evaluate prototypes	80									56h	24h					
	5.6 Order production parts	120										24h	56h	40h			
	5.7 Final Field Validation	16												16h			
	5.8 Final Verification	16												8h	8h		
	5.9 Final Safety Testing	16													16h		
	5.10 Release cost reduced product	24														24h	

Appendix K

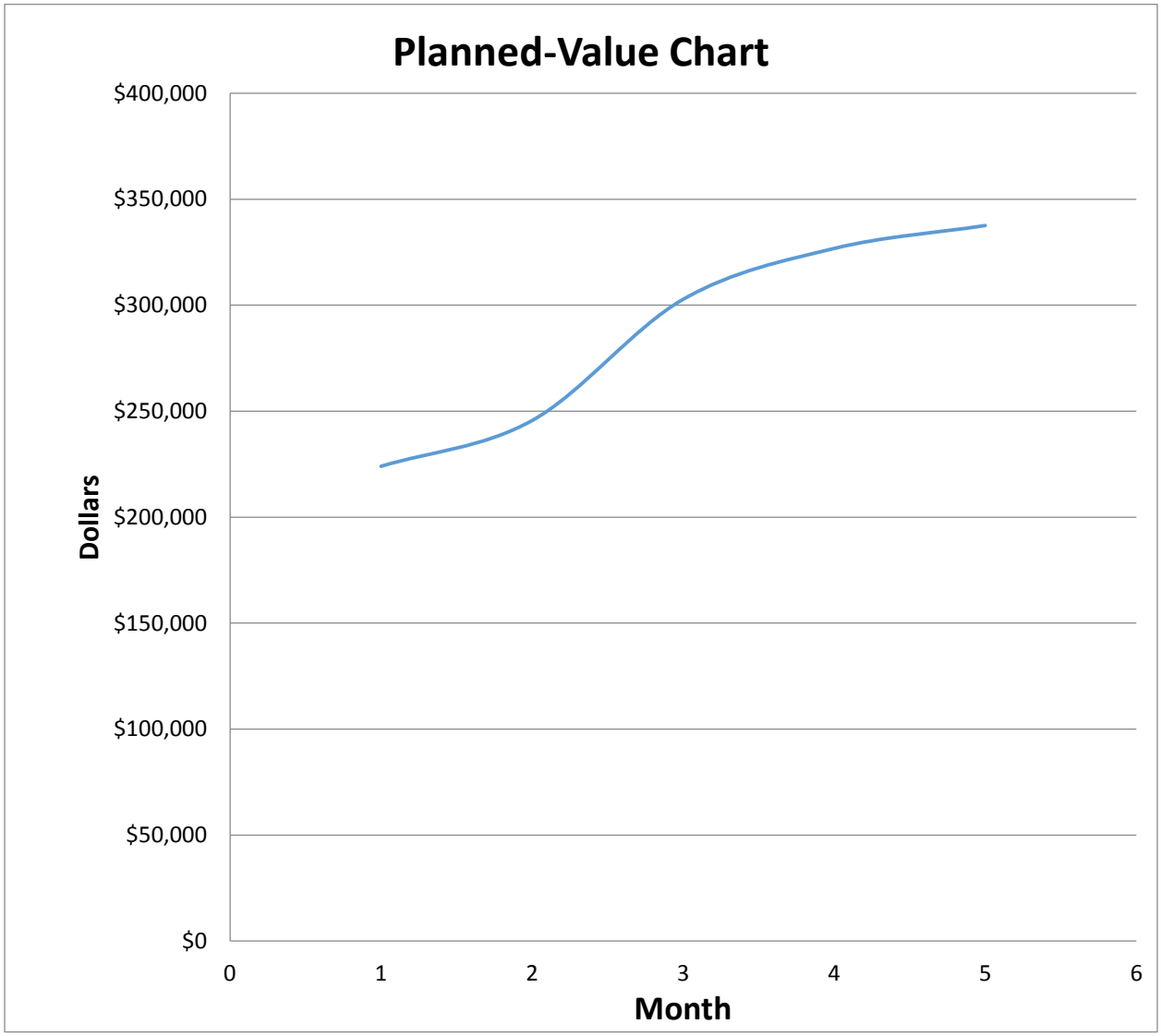
The baseline budget (PV) using the 50–50 rule is calculated in the table below. Fifty percent completion is assumed when the task is begun, and the remaining 50 percent when the work is complete.

Planned-Value with 50-50 assumption for all tasks						
Task	**Estimate**	**Jan**	**Feb**	**Mar**	**Apr**	**May**
1. Component Engineering BOM Scrub						
1.1 Pull current BOM	$800	$800				
1.2 Source all items and materials	$3,200	$3,200				
1.3 ID areas for margin improvement	$8,000	$8,000				
1.4 Communicate findings cross-functionally to manufacturing and engineering for evaluation	$1,600	$1,600				
1.5 Evaluate manufacturing and engineering feedback/concerns	$4,000	$3,200	$800			
2. Marketing Research						
2.1 VOC						
2.1.1 ID Business Opportunity	$2,400	$2,400				
2.1.2 ID concerns, complaints, must haves, wouldn't it be cool if's…	$2,400	$2,400				
2.2 QFD						
2.2.1 ID Customer Needs	$1,600	$1,600				
2.2.2 ID Key Features	$1,600	$1,600				
2.2.3 ID high cost materials	$1,600	$1,600				
2.2.4 Determine features that can be altered for cost reduction	$3,200	$3,200				
3. Manufacturing Concerns						
3.1 Process Improvement analysis (reducing constraints/bottle necking)	$4,000	$4,000				
3.2 Labor Improvement analysis	$2,400	$2,400				
3.3 Overhead Improvement analysis	$3,200	$3,200				
3.4 Re-evaluate Part Suppliers	$6,400	$6,400				
3.5 Waste Reduction analysis (Lean Manufacturing)	$4,000	$4,000				
3.6 Shipping Material Cost Reduction analysis	$2,400	$2,400				
3.7 Join all analysis to identify conflicts and finalize	$3,200	$3,200				
4 ECO Process						
4.1 Write engineering change request						

4.1.1 ID what needs to be changed	$800		$800			
4.1.2 ID reason for change	$800		$800			
4.1.3 Write description of change	$800		$800			
4.1.4 List documents and departments affected by change	$800		$800			
4.2 Get project into queue	$800		$800			
4.3 Work cross-functionally with sustaining for approval	$1,600		$1,600			
4.4 Implement changes	$6,000					$6,000
5. Engineering Redesign Product						
5.1 Mechanical redesign	$8,000		$8,000			
5.2 Safety compliance verified	$4,800		$4,800			
5.3 FEA analysis	$3,200		$2,400	$800		
5.4 Order prototypes and tooling	$50,000			$50,000		
5.5 Evaluate prototypes	$8,000			$6,400	$1,600	
5.6 Order production parts	$20,000				$20,000	
5.7 Final Field Validation	$1,600				$1,600	
5.8 Final Verification	$1,600				$800	$800
5.9 Final Safety Testing	$1,600					$1,600
5.10 Release cost reduced product	$2,400					$2,400
Total	**$168,800**	**$55,200**	**$21,600**	**$57,200**	**$24,000**	**$10,800**
Cumulative Total	**$168,800**	**$224,000**	**$245,600**	**$302,800**	**$326,800**	**$337,600**

Appendix L

A baseline planned-value chart based on the planned-value table assuming the 50-50 rule for all activities as outlined in Appendix K.



Appendix M

Monitor and Control

There are several areas of the project that will need to be monitored in order to predict the project's outcome. Once the schedule, budget, and scope are agreed upon by all parties involved those will be the three main areas that must be monitored and controlled in order for the project to be successful. Critical ratio, which is discussed in Appendix N, is a big indicator of how the triple constraint of the project is progressing. Due to the nature of this project the following key factors must also be monitored and controlled:

- Estimated Percent of Cost Reduction/Margin Expansion:

  This critical value will fluctuate throughout the project based on tooling costs, supplier negotiations, and the quantity and quality of cost reduction ideas that are identified. However, if at any point during the project the estimated percent of cost reduction of the bicycle becomes negative, meaning cost is being added to the product, the project will need to be reassessed immediately with the possibility of terminating the project early.

- Technical Feasibility:

  Generating new ideas, identifying new ways to drive cost out of the product, and implementing associated changes is the ultimate goal of this project. But, these ideas and changes to the product must be technically feasible in order to generate cost savings.

- Return on Investment/Payback Period:

  This value is a critical indicator of the project's level of success because ultimately this project will be evaluated based on the percent cost reduction/margin expansion as well as how quickly these savings can be realized. The project will be deemed successful and worth the initial investment if the payback period can be held to one fiscal year.

- Team Member Morale and Participation:

  This factor is also critical to gauge, monitor, and influence but, can also be more difficult to decipher. The project manager for this project will need to carefully observe as well as gently influence the team in a positive way that encourages creative thinking which is critical to identifying areas of the product that can be cost reduced, cross-functional collaboration and communication, and on time deliverables.

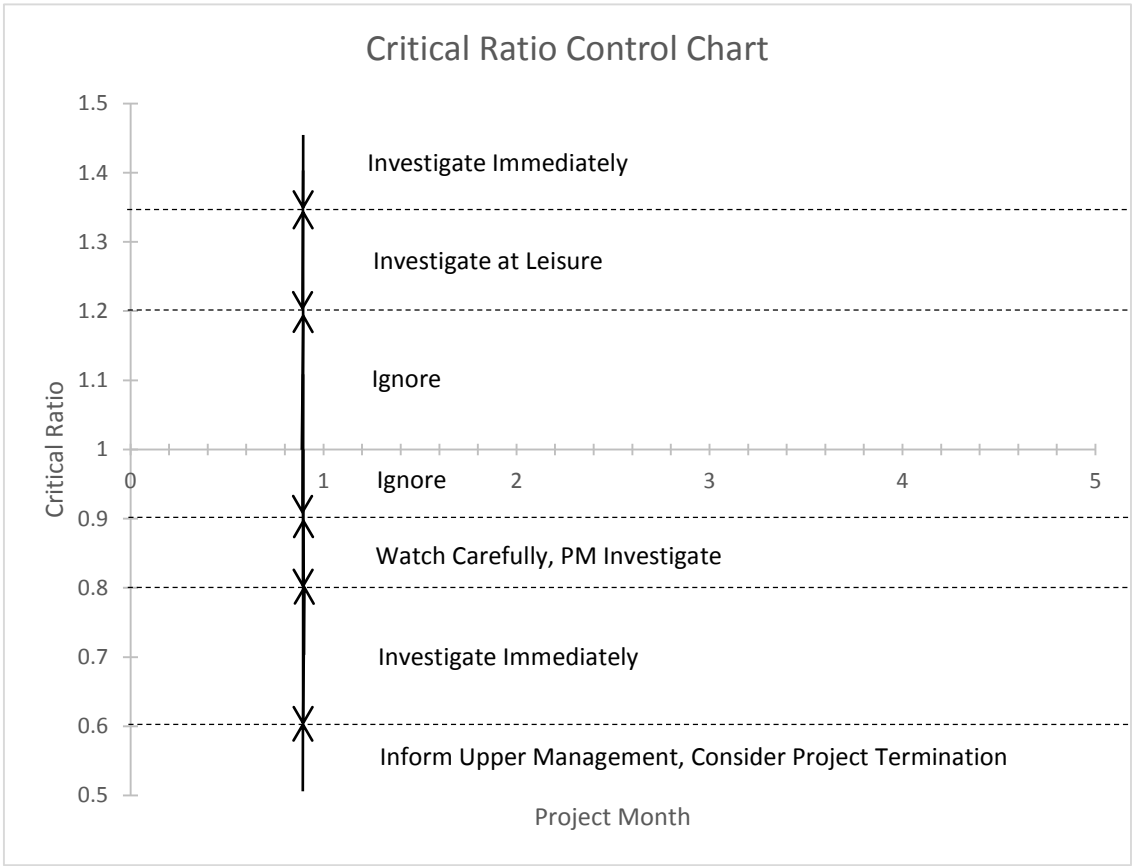
Other factors will be monitored by the project manager on a more informal basis including but not limited to market potential and acceptance, competitor movement, and manufacturing hiccups. Also, as the project progresses additional factors may be added to this list to monitor and control in order to effectively execute the project.

Appendix N

Monitor and Control (continued)

Critical ratio will be calculated and plotted on the chart below at each milestone/phase gate throughout the duration of the project in an effort to monitor progress. Critical ratio is equal to actual over scheduled progress multiplied by budgeted over actual cost. In general, a ratio of greater than 1 signifies favorable progress and cost (i.e. meeting or exceeding schedule expectations, meeting or exceeding scope expectations, coming in under budget, or some combination of all three) whereas a ratio of less than 1 signifies unfavorable progress and cost (i.e. not meeting schedule, scope, budget, or some combination of all three).

For the purpose of this project (reduce cost, expand margin, all in a timely fashion so cost savings can be realized as soon as possible), critical ratio is the most complete monitoring tool and project indicator. As opposed to cost variance, cost performance index, schedule variance, and schedule performance index which only indicate either cost or schedule development, critical ratio indicates both.



Appendix O

The following task list will need to be completed in order for the project to be successfully terminated upon completion of the project tasks. The project will be terminated by integration.

Termination by Integration Task List

1. Personnel
    1.1. Component Engineering Responsibilities
        1.1.1. Resume role and normal job functions
        1.1.2. Resume reporting to functional manager
        1.1.3. Determine sustaining support role
    1.2. Marketing Responsibilities
        1.2.1. Resume role and normal job functions
        1.2.2. Resume reporting to functional manager
        1.2.3. Determine sustaining support role
    1.3. Manufacturing Responsibilities
        1.3.1. Resume role and normal job functions
        1.3.2. Resume reporting to functional manager
        1.3.3. Determine sustaining support role
    1.4. ECO Researcher Responsibilities
        1.4.1. Resume role and normal job functions
        1.4.2. Resume reporting to functional manager
        1.4.3. Determine sustaining support role
    1.5. Mechanical Engineering Responsibilities
        1.5.1. Resume role and normal job functions
        1.5.2. Resume reporting to functional manager
        1.5.3. Determine sustaining support role
2. Mechanical Engineering
    2.1. Ensure that all engineering change orders have been completed and closed
    2.2. Communicate confirmed lead times to all other functional departments
    2.3. Monitor final assembly
3. Manufacturing
    3.1. Ensure technicians and floor staff are aware and trained on all changes (process, assembly order, material, etc.)
    3.2. Optimize current production system layout
4. Marketing
    4.1. Ensure sales department is aware of the changes
    4.2. Ensure that the marketing strategy is ready for implementation and optimization
5. Equipment, Purchasing, Distribution, etc.
    5.1. Ensure all equipment is being fully optimized for maximum production
    5.2. Ensure orders have been placed for all materials needed for manufacturing

5.3. Communicate distribution plan with each functional department

6. Risk Identification and Management
   6.1. Identify risks that may prevent successful termination of the project
   6.2. Plan for remedial actions should the identified risks occur
7. Project History and Project Audit Report
   7.1. Compile all phase gate/milestone reviews, implemented changes and their associated documentation and overall benefits, and ultimate cost reduction and margin expansion outcome in one centralized report to effectively communicate the process used throughout the project along with the results of the project
   7.2. Include recommendations for future projects of a similar nature; recommendations may include suggesting the cost reduction efforts identified and implemented in this project may be relevant to other product lines and should be referred to for cost reduction focused projects in the future