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E344 Assignment 3

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21595240

Report submitted in partial fulfilment of the requirements of the module Design (E) 344 for the degree Baccalaureus in Engineering in the Department of Electrical and Electronic Engineering at Stellenbosch University.

April 15, 2021

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   I declare that the work contained in this assignment, except where otherwise stated, is my original work and that I have not previously (in its entirety or in part) submitted it for grading in this module/assignment or another module/assignment.

21595240 Studentenommer / *Student number*	 Handtekening / *Signature*
E. Visser Voorletters en van / *Initials and surname*	April 15, 2021 Datum / *Date*

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Nomenclature

Acronyms and abbreviations

MCU	Microcontroller Unit
AC	Alternating Current
DC	Direct Current
HPF	High-Pass Filter
LPF	Low-Pass Filter
BPF	Band-Pass Filter
BPM	Beats Per Minute
FFT	Fast Fourier Transform
ADC	Analogue to Digital Converter
DAC	Digital to Analogue Converter

Chapter 1

Executive Summary

We will design a high pressure vessel for industrial purposes

Chapter 2

Project Scope

2.1. Introduction

2.2. Objectives

2.3. Deliverables

2.4. Milestones

2.5. Work Breakdown Structure

2.6. Technical Requirements

2.7. Customer Review and Approval Procedures

Chapter 3

Temperature Sensor

Chapter 4

Heart Rate Sensor

Bibliography

Appendix A

Detailed Budget

The detailed budget can be found on the following page. 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.

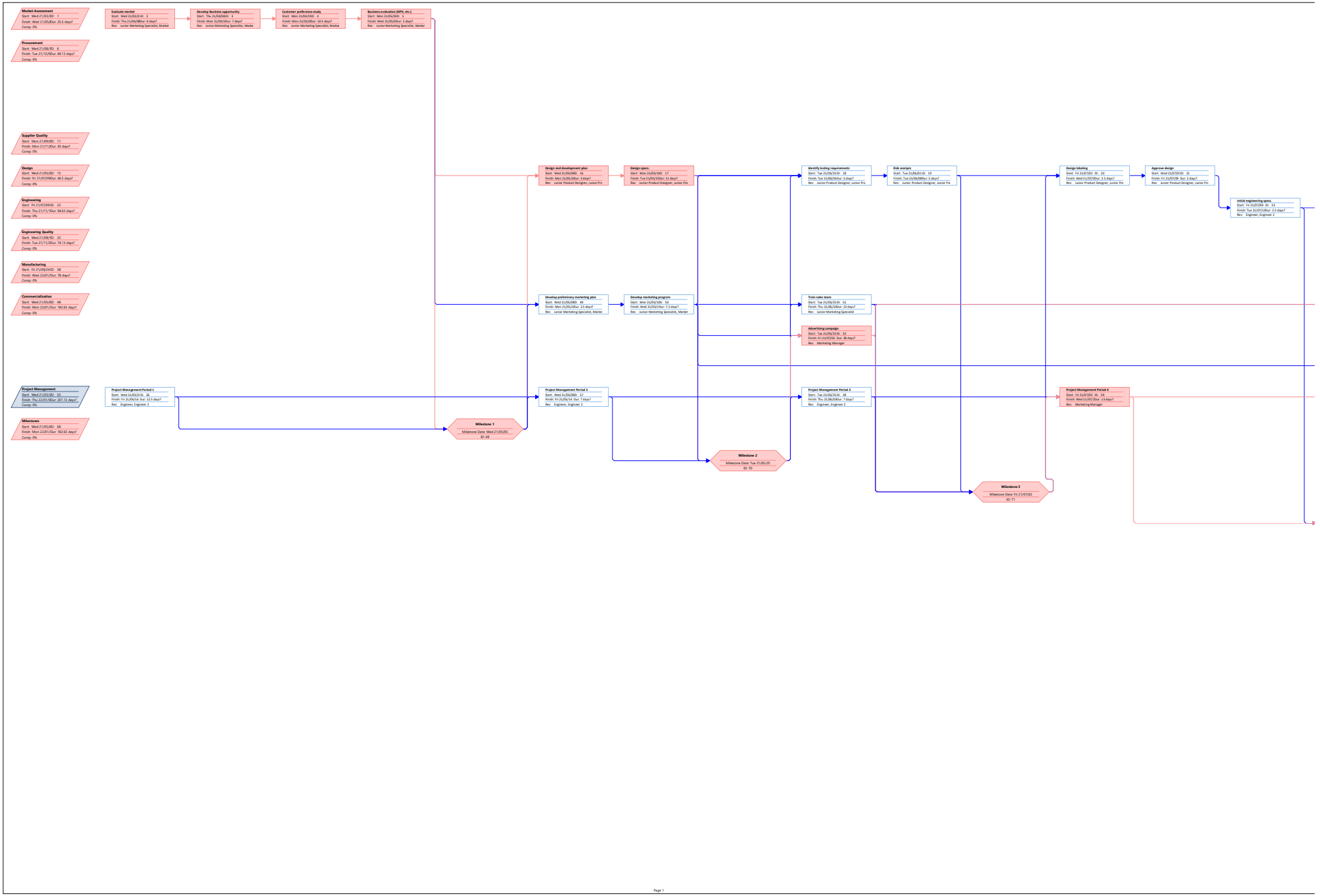
ID	Task Name	Resource Names	Baseline Cost	Baseline Estimated Duration
1	**Market Assessment**		**$32 844.00**	**25.5 days**
2	Evaluate market	Kurt Zollinger,Yukio Ashida	$7 728.00	6 days
3	Develop Business opportunity	Kurt Zollinger,Yukio Ashida	$9 016.00	7 days
4	Customer preference study	Kurt Zollinger,Yukio 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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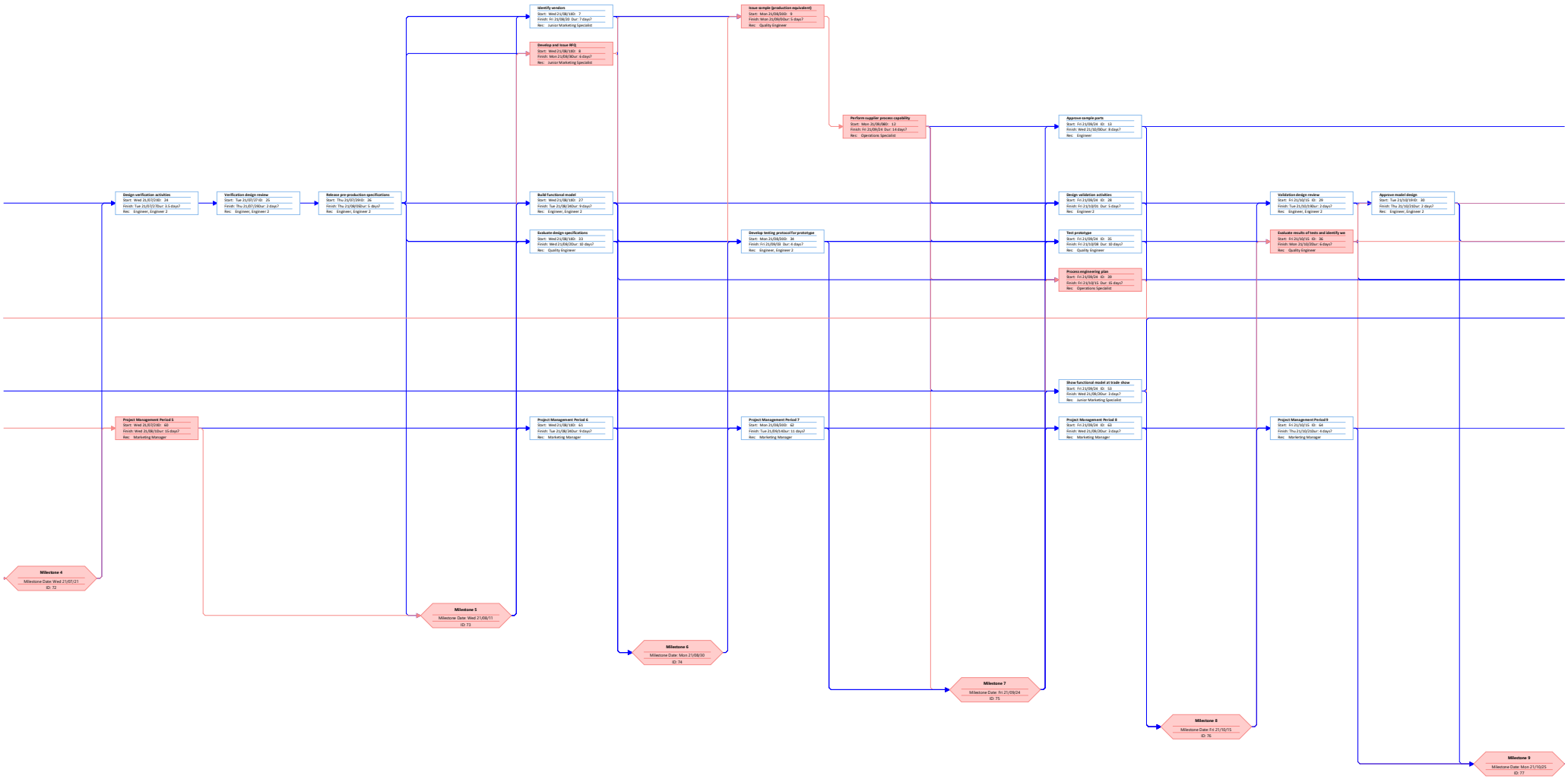
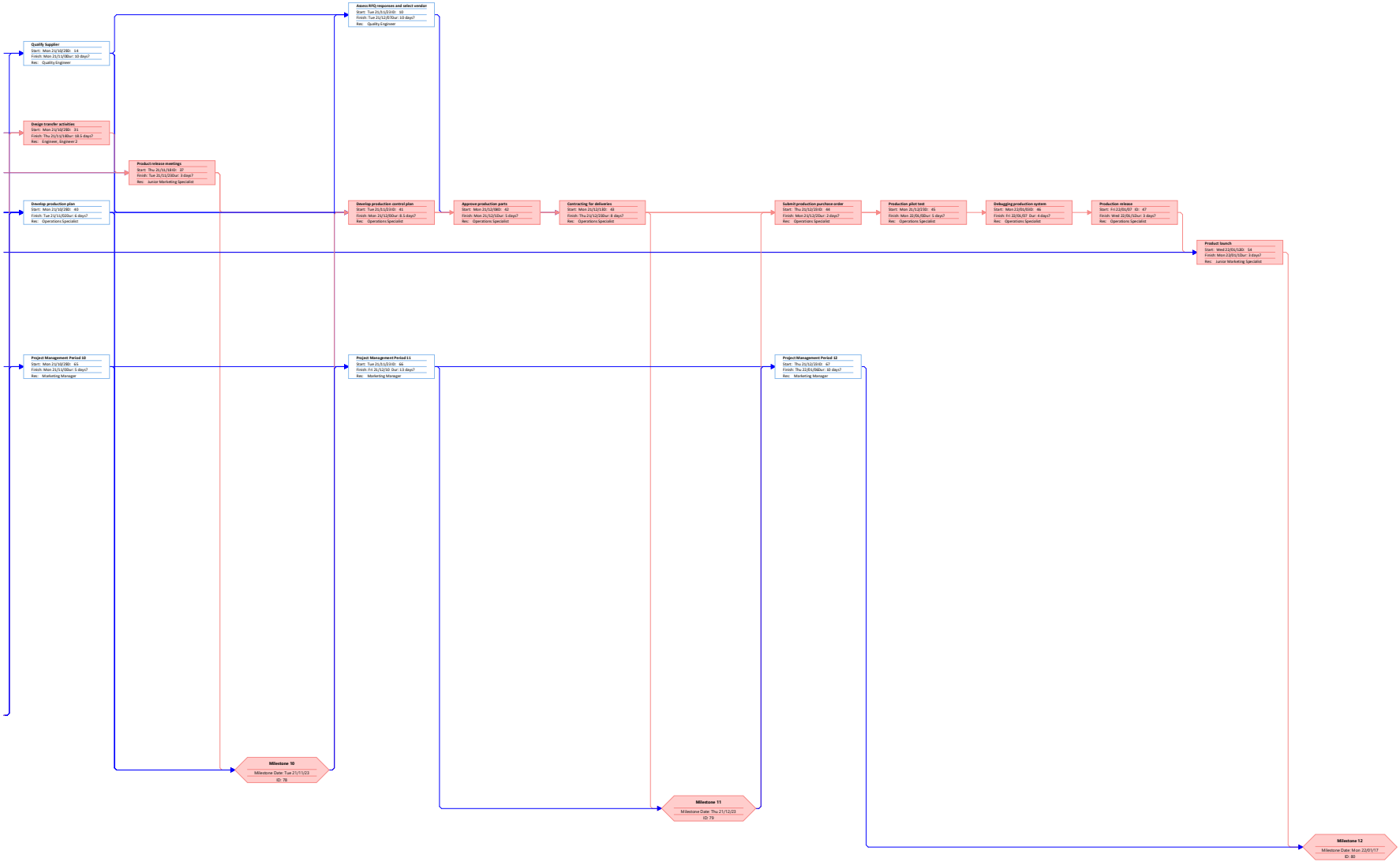
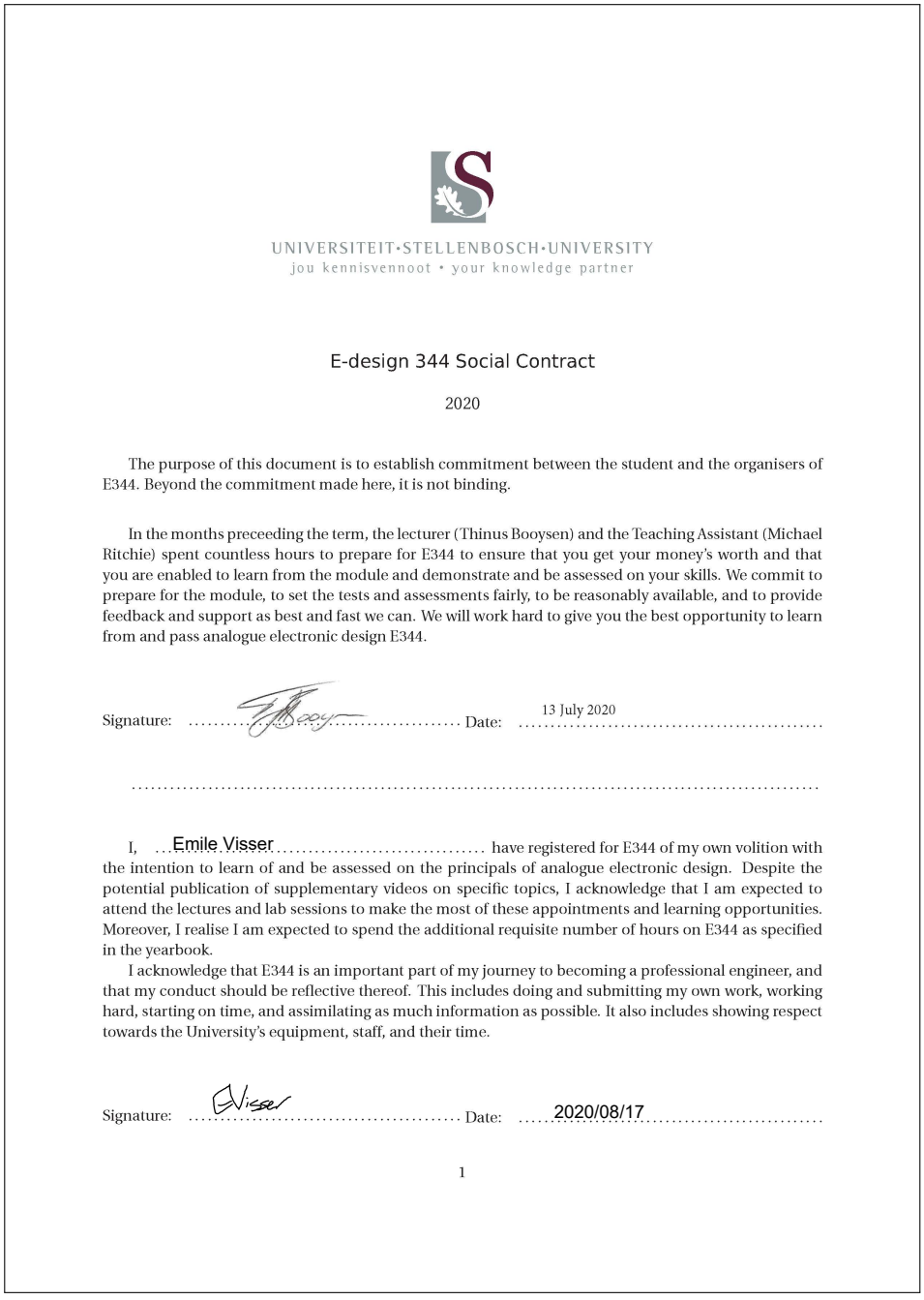
Finish: Wed 21/05/Dur: 25.5 days?
Comp: 0%
Procurement
Start: Wed 21/08/BD: 6
Finish: Tue 21/12/Dur: 84.13 days?
Comp: 0%
Supplier Quality
Start: Mon 21/09/BD: 11
Finish: Mon 21/11/Dur: 45 days?
Comp: 0%
Design
Start: Wed 21/05/BD: 15
Finish: Fri 21/07/09Dur: 46.5 days?
Comp: 0%
Engineering
Start: Fri 21/07/09 ID: 22
Finish: Thu 21/11/1Dur: 94.63 days?
Comp: 0%
Engineering Quality
Start: Wed 21/08/BD: 32
Finish: Tue 21/11/Dur: 74.13 days?
Comp: 0%
Manufacturing
Start: Fri 21/09/24 ID: 38
Finish: Wed 22/01/Dur: 78 days?
Comp: 0%
Commercialization
Start: Wed 21/05/BD: 48
Finish: Mon 22/01/Dur: 182.63 days?
Comp: 0%
Project Management
Start: Wed 21/03/BD: 55
Finish: Thu 22/01/0Dur: 201.13 days?
Comp: 0%
Milestones
Start: Wed 21/05/BD: 68
Finish: Mon 22/01/Dur: 182.63 days?
Comp: 0%
Evaluate market
Start: Wed 21/03/3 ID: 2
Finish: Thu 21/04/3Dur: 4 days?
Res: Junior Marketing Specialist, Market
Develop Business opportunity
Start: Thu 21/04/6 ID: 3
Finish: Mon 21/04/1Dur: 7 days?
Res: Junior Marketing Specialist, Marke
Customer preference study
Start: Mon 21/04/14 ID: 4
Finish: Mon 21/05/2Dur: 10.5 days?
Res: Junior Marketing Specialist, Market
Business evaluation [NPV, etc.]
Start: Mon 21/05/3 ID: 5
Finish: Wed 21/05/3Dur: 2 days?
Res: Junior Marketing Specialist, Market
Design and development plan
Start: Wed 21/05/BD: 16
Finish: Mon 21/05/1Dur: 3 days?
Res: Junior Product Designer, Junior Pro
Design specs
Start: Mon 21/05/1 ID: 17
Finish: Tue 21/05/2Dur: 11 days?
Res: Junior Product Designer, Junior Pro
Identify testing requirements
Start: Tue 21/05/2 ID: 18
Finish: Tue 21/06/0Dur: 5 days?
Res: Junior Product Designer, Junior Pro
Risk analysis
Start: Tue 21/06/0 ID: 19
Finish: Tue 21/06/08Dur: 5 days?
Res: Junior Product Designer, Junior Pro
Design labeling
Start: Fri 21/07/02 ID: 20
Finish: Wed 21/07/0Dur: 2.5 days?
Res: Junior Product Designer, Junior Pro
Approve design
Start: Wed 21/07/10 ID: 21
Finish: Fri 21/07/09 Dur: 2 days?
Res: Junior Product Designer, Junior Pro
Initial engineering specs.
Start: Fri 21/07/09 ID: 23
Finish: Tue 21/07/1Dur: 2.5 days?
Res: Engineer, Engineer 2
Develop preliminary marketing plan
Start: Wed 21/05/BD: 49
Finish: Mon 21/05/14Dur: 2.5 days?
Res: Junior Marketing Specialist, Market
Develop marketing program
Start: Mon 21/05/1BD: 50
Finish: Wed 21/05/1Dur: 7.5 days?
Res: Junior Marketing Specialist, Market
Train sales team
Start: Tue 21/05/2 ID: 51
Finish: Thu 21/06/2Dur: 22 days?
Res: Junior Marketing Specialist
Advertising campaign
Start: Tue 21/05/2 ID: 52
Finish: Fri 21/07/02 Dur: 28 days?
Res: Marketing Manager
Project Management Period 1
Start: Wed 21/03/3 ID: 56
Finish: Fri 21/04/16 Dur: 12.5 days?
Res: Engineer, Engineer 2
Project Management Period 2
Start: Wed 21/05/BD: 57
Finish: Fri 21/05/14 Dur: 7 days?
Res: Engineer, Engineer 2
Project Management Period 3
Start: Tue 21/05/2 ID: 58
Finish: Thu 21/06/0Dur: 7 days?
Res: Engineer, Engineer 2
Project Management Period 4
Start: Fri 21/07/02 ID: 59
Finish: Wed 21/07/0Dur: 13 days?
Res: Marketing Manager
Milestone 1
Milestone Date: Wed 21/05/05
ID: 69
Milestone 2
Milestone Date: Tue 21/05/25
ID: 70
Milestone 3
Milestone Date: Fri 21/07/02
ID: 71


Milestone 4
Milestone Date: Wed 21/07/21
ID: 72
Design verification activities
Start: Wed 21/07/21 ID: 24
Finish: Tue 21/07/27 Dur: 3.5 days?
Res: Engineer, Engineer 2
Project Management Period 5
Start: Wed 21/07/21 ID: 60
Finish: Wed 21/08/11 Dur: 15 days?
Res: Marketing Manager
Verification design review
Start: Tue 21/07/27 ID: 25
Finish: Thu 21/07/29 Dur: 2 days?
Res: Engineer, Engineer 2
Release pre-production specifications
Start: Thu 21/07/29 ID: 26
Finish: Thu 21/08/05 Dur: 5 days?
Res: Engineer, Engineer 2
Milestone 5
Milestone Date: Wed 21/08/11
ID: 73
Identify vendors
Start: Wed 21/08/11 ID: 7
Finish: Fri 21/08/20 Dur: 7 days?
Res: Junior Marketing Specialist
Develop and issue RFQ
Start: Wed 21/08/11 ID: 8
Finish: Mon 21/08/30 Dur: 9 days?
Res: Junior Marketing Specialist
Build functional model
Start: Wed 21/08/11 ID: 27
Finish: Tue 21/08/24 Dur: 9 days?
Res: Engineer, Engineer 2
Evaluate design specifications
Start: Wed 21/08/11 ID: 33
Finish: Wed 21/08/25 Dur: 10 days?
Res: Quality Engineer
Project Management Period 6
Start: Wed 21/08/11 ID: 61
Finish: Tue 21/08/24 Dur: 9 days?
Res: Marketing Manager
Milestone 6
Milestone Date: Mon 21/08/30
ID: 74
Issue sample (production equivalent)
Start: Mon 21/08/30 ID: 9
Finish: Mon 21/09/06 Dur: 5 days?
Res: Quality Engineer
Develop testing protocol for prototype
Start: Mon 21/08/30 ID: 34
Finish: Fri 21/09/10 Dur: 6 days?
Res: Engineer, Engineer 2
Project Management Period 7
Start: Mon 21/08/30 ID: 62
Finish: Tue 21/09/14 Dur: 11 days?
Res: Marketing Manager
Milestone 7
Milestone Date: Fri 21/09/24
ID: 75
Perform supplier process capability
Start: Mon 21/09/06 ID: 12
Finish: Fri 21/09/24 Dur: 14 days?
Res: Operations Specialist
Approve sample parts
Start: Fri 21/09/24 ID: 13
Finish: Wed 21/10/06 Dur: 8 days?
Res: Engineer
Design validation activities
Start: Fri 21/09/24 ID: 28
Finish: Fri 21/10/01 Dur: 5 days?
Res: Engineer 2
Test prototype
Start: Fri 21/09/24 ID: 35
Finish: Fri 21/10/08 Dur: 10 days?
Res: Quality Engineer
Process engineering plan
Start: Fri 21/09/24 ID: 36
Finish: Fri 21/10/15 Dur: 15 days?
Res: Operations Specialist
Show functional model at trade show
Start: Fri 21/09/24 ID: 53
Finish: Wed 21/10/06 Dur: 8 days?
Res: Junior Marketing Specialist
Project Management Period 8
Start: Fri 21/09/24 ID: 63
Finish: Wed 21/08/20 Dur: 3 days?
Res: Marketing Manager
Milestone 8
Milestone Date: Fri 21/10/15
ID: 76
Validation design review
Start: Fri 21/10/15 ID: 29
Finish: Tue 21/10/19 Dur: 2 days?
Res: Engineer, Engineer 2
Evaluate results of tests and identify we
Start: Fri 21/10/15 ID: 36
Finish: Mon 21/10/25 Dur: 6 days?
Res: Quality Engineer
Project Management Period 9
Start: Fri 21/10/15 ID: 64
Finish: Thu 21/10/20 Dur: 4 days?
Res: Marketing Manager
Approve model design
Start: Tue 21/10/19 ID: 30
Finish: Thu 21/10/21 Dur: 2 days?
Res: Engineer, Engineer 2
Milestone 9
Milestone Date: Mon 21/10/25
ID: 77


Qualify Supplier
Start: Mon 21/10/28D 14
Finish: Mon 21/11/08Dur: 10 days?
Res: Quality Engineer
Design transfer activities
Start: Mon 21/10/28D 31
Finish: Thu 21/11/18Dur: 18.5 days?
Res: Engineer, Engineer 2
Develop production plan
Start: Mon 21/10/28D 45
Finish: Tue 21/11/02Dur: 4 days?
Res: Operations Specialist
Project Management Period 10
Start: Mon 21/10/28D 65
Finish: Mon 21/11/08Dur: 5 days?
Res: Marketing Manager
Assess RFQ responses and select vendor
Start: Tue 21/11/23D 10
Finish: Tue 21/12/07Dur: 10 days?
Res: Quality Engineer
Product release meetings
Start: Thu 21/11/18D 37
Finish: Tue 21/11/23Dur: 3 days?
Res: Junior Marketing Specialist
Develop production control plan
Start: Tue 21/11/23D 41
Finish: Mon 21/12/05Dur: 8.5 days?
Res: Operations Specialist
Project Management Period 11
Start: Tue 21/11/23D 66
Finish: Fri 21/12/10 Dur: 13 days?
Res: Marketing Manager
Milestone 10
Milestone Date: Tue 21/11/23
ID: 78
Approve production parts
Start: Mon 21/12/19D 42
Finish: Mon 21/12/19Dur: 5 days?
Res: Operations Specialist
Contracting for deliveries
Start: Mon 21/12/12D 43
Finish: Thu 21/12/22Dur: 8 days?
Res: Operations Specialist
Milestone 11
Milestone Date: Thu 21/12/23
ID: 79
Submit production purchase order
Start: Thu 21/12/29 05 44
Finish: Mon 21/12/30Dur: 2 days?
Res: Operations Specialist
Production pilot test
Start: Mon 22/1/23D 45
Finish: Mon 22/05/09Dur: 5 days?
Res: Operations Specialist
Debugging production system
Start: Mon 22/05/09D 46
Finish: Fri 22/05/27 Dur: 4 days?
Res: Operations Specialist
Production release
Start: Fri 22/05/27 ID: 47
Finish: Wed 22/05/31Dur: 3 days?
Res: Operations Specialist
Product launch
Start: Wed 22/05/13D 14
Finish: Mon 22/05/23Dur: 8 days?
Res: Junior Marketing Specialist
Project Management Period 12
Start: Thu 21/12/29 05 67
Finish: Thu 22/01/06Dur: 10 days?
Res: Marketing Manager
Milestone 12
Milestone Date: Mon 22/01/17
ID: 80

Appendix C

Social contract



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E-design 344 Social Contract

2020

The purpose of this document is to establish commitment between the student and the organisers of E344. Beyond the commitment made here, it is not binding.

In the months preceeding the term, the lecturer (Thinus Booysen) and the Teaching Assistant (Michael Ritchie) spent countless hours to prepare for E344 to ensure that you get your money's worth and that you are enabled to learn from the module and demonstrate and be assessed on your skills. We commit to prepare for the module, to set the tests and assessments fairly, to be reasonably available, and to provide feedback and support as best and fast we can. We will work hard to give you the best opportunity to learn from and pass analogue electronic design E344.

Signature: ..... Date: 13 July 2020

I, Emile Visser have registered for E344 of my own volition with the intention to learn of and be assessed on the principals of analogue electronic design. Despite the potential publication of supplementary videos on specific topics, I acknowledge that I am expected to attend the lectures and lab sessions to make the most of these appointments and learning opportunities. Moreover, I realise I am expected to spend the additional requisite number of hours on E344 as specified in the yearbook.

I acknowledge that E344 is an important part of my journey to becoming a professional engineer, and that my conduct should be reflective thereof. This includes doing and submitting my own work, working hard, starting on time, and assimilating as much information as possible. It also includes showing respect towards the University's equipment, staff, and their time.

Signature: ..... Date: 2020/08/17

1

Appendix D

GitHub Activity Heatmap