# UESTC3031 - Engineering Project Management & Finance

# (2018 – 2019 Semester 2)

## Break-Even Analysis and Project Plan

## (Assessment [25%] (Report [15%] + Essay Assignment [10%]))

The numbers in square brackets in the right-hand margin indicate the marks allotted to the part of the question against which the mark is shown. These marks are for guidance only.

*Purpose of the Assignment*

- *To demonstrate the development of a project plan and schedule (WBS and Gantt Chart / Network Diagram) via showing interactions and dependencies, discussing the benefits/drawbacks of different types of plan, and identifying critical paths*
- *To demonstrate basics of engineering economics and break-even analysis / make-or-buy analysis*

*Date Issued to Students: 20th March 2019 / Wednesday*
**Deadline / Submission Date: 24th April 2019 / Wednesday**
Submission: via Moodle

**Submission Instructions:**

- You must submit in **ONE pdf document** (not a zipped file, not two times, not in a word document) both the **break-even analysis report and the essay assignment** that accompanies it. Please make sure you start each of the above two on a new page to avoid confusion. You already have the instructions in the lecture notes and have been provided the **assignment answering file** that must be used.
- You must prepare this assessment in **pairs/groups of 2**. You must clearly indicate in the file name and in the document the student name's and IDs in the form **Student1_GUID_UESTCID_Student2_GUID_UESTCID.pdf** and inside the documents you will list a **table with the student's names, GUIDs, and UESTCIDs of your group members** so that we know who submitted with whom.
- The marking criteria is provided.
- You must submit a **plagiarism declaration** and your submission will go through **plagiarism check**.
- **No late submissions will be allowed in the Moodle** so if you don't submit you will get a zero for this complete assessment.
- This is a **SUMMATIVE assessment** (i.e. marked assessment).
- Each of you must submit individually the assessment prepared in groups so we must receive (via Moodle) 2 identical submissions in the system i.e. one for each student member of the group.
- While using references, you must use **IEEE style/format**.

Drs. Duncan Bremner & Imran Shafique Ansari

# Break-Even Analysis (Report [15%])

You are a production engineer in an electronics company responsible for making electronic circuit boards. A customer has come to you with a design for a microcontroller and has requested you a quote for their business. Your manager has provided you with the documentation from the customer that includes a Bill of Materials (BOM) (as given in the Appendix). He has provided you with a list of components (see Table I) required for producing the product and their costs from your approved suppliers (as given in the Appendix).

Your manager has requested that you provide a detailed cost analysis for a few different production volumes. *Examine your analysis based on the following:*

**[Hint: We suggest you set up a spreadsheet to calculate the total costs for each production volume]**

1. Convert all component prices into UK pounds (£) using an exchange rate of £1 (UK Pound) = $1.30 (US Dollar).                                                          **[5]**

2. Calculate the **variable costs** to manufacture a quantity of 8 sample boards (so the customer can check your quality).                                              **[20]**

3. Using the component cost figures provided, calculate the cost to manufacture the following quantities: 100, 1000, 5000 boards.                                       **[20]**

4. You have agreed a deal with your component suppliers, PCB manufacturers, and assembly operation that the total variable cost per board is £7.75 for all volumes between 0 and 5,000 boards. If your company has Fixed Costs of £17,500 and a selling price of £13.50, what is the Margin of Safety if you produce 4,000 boards? Draw a graph to illustrate this point.                                                      **[30]**

5. What does the company profit in the above example when you produce 4000 boards?
                                                                                   **[5]**

6. Your sales manager advises you that a new customer is willing to pay £20.00 per board but only for a maximum order of 2000 boards. How much profit or loss could you make on this order? Will there be a Margin of Safety in this case? If yes, calculate it.
                                                                                   **[20]**

# APPENDIX

# Arduino UNO R3 BOM Costs

*LM1117 (5.0V or 3.3V)* (Price of Each) (Time to deliver: 2 Days)

| Quantity | Price |
| --- | --- |
| 1+ | £0.618 |
| 50+ | £0.516 |
| 100+ | £0.45 |
| 250+ | £0.418 |
| 500+ | £0.386 |
| 1000+ | £0.24 |
| 2500+ | £0.236 |
| 5000+ | £0.232 |

*Crystal (16MHz or 12MHz)* (Price of Each) (Time to deliver: 3 Days)

| Quantity | Price |
| --- | --- |
| 1 + | £0.35 |
| 50 + | £0.197 |
| 100 + | £0.147 |
| 250 + | £0.141 |
| 500 + | £0.135 |
| 1000 + | £0.086 |
| 5000 + | £0.083 |

*ATMega 328 Microcontroller* (Price of Each) (Time to deliver: 2 Days)

| Quantity | Price |
| --- | --- |
| 1 + | £2.00 |
| 10 + | £1.36 |
| 25 + | £1.18 |
| 50 + | £1.08 |
| 100 + | £1.03 |
| 250 + | £0.89 |
| 500 + | £0.83 |
| 1000 + | £0.54 |

## CH340G USB – Serial Interface (Price of Each) (Time to deliver: 3 Days)

| | |
|---|---|
| 1: | $0.3609 |
| 10: | $0.2585 |
| 30: | $0.2402 |
| 100: | $0.2201 |
| 500: | $0.2128 |

## USB Socket (Price of Each) (Time to deliver: 3 Days)

| Quantity | Price |
|---|---|
| 5 + | £0.314 |
| 75 + | £0.252 |
| 150 + | £0.228 |
| 250 + | £0.168 |
| 500 + | £0.158 |
| 1500 + | £0.128 |
| 2500 + | £0.098 |
| 5000 + | £0.056 |

## DC Power Socket (Price of Each) (Time to deliver: 3 Days)

| Quantity | Price |
|---|---|
| 1 + | £1.51 |
| 10 + | £1.381 |
| 25 + | £1.11 |
| 100 + | £0.921 |
| 250 + | £0.908 |
| 500 + | £0.895 |

## 47uF / 25V Electrolytic SMD (Price of Each) (Time to deliver: 1 Day)

| Quantity | Price |
|---|---|
| 5 + | £0.297 |
| 100 + | £0.235 |
| 500 + | £0.196 |
| 2500 + | £0.189 |
| 5000 + | £0.0985 |
| 10000 + | £0.095 |
| 50000 + | £0.0814 |

## 100nF / 10V ceramic 0603 SMD (Price of Each) (Time to deliver: 1 Day)

| Quantity | Price |
|----------|-------|
| 5 + | £0.0214 |
| 100 + | £0.0134 |
| 500 + | £0.0104 |
| 1000 + | £0.0087 |
| 2000 + | £0.0075 |
| 4000 + | £0.0062 |
| 20000 + | £0.0055 |

## 10K Resistor / 0603 SMD (Price of Each) (Time to deliver: 1 Day)

| Quantity | Price |
|----------|-------|
| 5 + | £0.0095 |
| 100 + | £0.0057 |
| 500 + | £0.0041 |
| 1000 + | £0.0032 |
| 2500 + | £0.0026 |

## LED SMD RED (Price of Each) (Time to deliver: 3 Days)

| Quantity | Price |
|----------|-------|
| 5 + | £0.0926 |
| 25 + | £0.0499 |
| 100 + | £0.0478 |
| 250 + | £0.0424 |
| 500 + | £0.0376 |
| 1000 + | £0.0368 |

## Single In Line connector (8 way) [Assume same cost for 6 way and 10way] (Price of Each) (Time to deliver: 3 Days)

| Quantity | Price(£) |
|----------|----------|
| 1 | 0.75000 |
| 10 | 0.70800 |
| 100 | 0.56580 |
| 500 | 0.50500 |
| 1,000 | 0.43413 |
| 5,000 | 0.39363 |
| 10,000 | 0.39250 |

_SMD Switch (Reset)_ (Price of Each) (Time to deliver: 3 Days)

| Quantity | Price |
|----------|-------|
| 5 + | **£0.127** |
| 500 + | **£0.104** |
| 1000 + | **£0.073** |
| 5000 + | **£0.067** |
| 10000 + | **£0.015** |

_PCB Cost: 2 layer, 53 x 68mm. (SEEED)_ (Price of given Total Quantity)

| Quantity | Price |
|----------|-------|
| 5 | $4.95 |
| 10 | $5.55 |
| 50 | $30.68 |
| 100 | $58.11 |
| 500 | $212.56 |
| 1000 | $409.78 |
| 2500 | $881.14 |
| 5000 | $1537.62 |

_Assembly costs: 28 components; 7 thru' hole, 18 SMT (PCBWAY)_ (Price of given Total Quantity)

| Quantity | Price (USD) |
|----------|-------------|
| **5** | **220** |
| **50** | **554** |
| **100** | **727** |
| **500** | **1079** |
| **1000** | **1734** |
| **2500** | **2217** |
| **5000** | **3261** |

**Table I:** *List of Components, and their Quantities*

| Component | Description | Quantity |
|---|---|---|
| ATMega328 | Microcontroller IC | 1 |
| CH340G | USB to Serial IC | 1 |
| LM1117-3.3 | Linear Regulator IC (3.3V) | 1 |
| LM1117-5.0 | Linear Regulator IC (5.0V) | 1 |
| Crystal, 12MHz- HC49 Package | USB Crystal | 1 |
| Crystal, 16MHz-HC49 Package | CPU Crystal | 1 |
| LED1 Red, SMT | LED, Power indication | 1 |
| LED2, Red, SMT | LED Indicator, Pin 13 | 1 |
| C1, C2 | Capacitor, electrolytic, 47uF, 25V | 2 |
| C3, C4, C5, C6 | Capacitor, decoupling, 100nV, 10V, 0603 | 4 |
| R1, R2, R3, R4, R7, R8 | Resistor, 10K, 0603 | 6 |
| SWT_1 | Switch, NO, reset, SMT | 1 |
| CONN_1 | DC Power Connector, Through hole | 1 |
| CONN_2 | USB Connector, Through hole | 1 |
| SIP_1 | 8-Way Single In-Line Connector, Through Hole | 2 |
| SIP_2 | 6-Way, Single In-Line Connector, Through Hole | 1 |
| SIP_3 | 10-Way, Single In-Line Connector, Through Hole | 1 |
| SIP_4 | 6-Way, Dual In-Line header, Through Hole | 1 |
| PCB_1 | Printed Circuit Board, FR-4, Double sided, 1.6mm (53mm x 68mm) | 1 |
| ASSY_1 | Board Assembly costs; 28 Component, 7 Through Hole | 1 |

# Project Plan (Essay Assignment [10%])

You are a manager in an electronics company responsible for making electronics circuit boards. You have recently concluded a very successful project (based on the first part of this assessment) that dealt with break-even analysis of a design for a microcontroller. You had multiple factors to deal with including Bill of Materials (BOM), list of components required for producing the product and their respective costs from your approved suppliers, and project breakdown into a step-by-step process thereby leading to multiple efficient solutions (with a relative analysis) in a faster and reliable manner.

Given your project made to the headlines of a daily, a local magazine editor has approached you as they would like to showcase your efficient project planning within **750 words limit** in their upcoming issue that is themed under 'Projects - Behind the Scenes'.

You are permitted to use all the information from the first part of this assessment. *Prepare your essay based on the following pointers:*

1.  Project team members and their respective responsibilities.          **[5]**

2.  Clear purpose of your project in terms of the Statement of Work.     **[10]**

3.  Work Breakdown Structure with clear emphasis on the work packages.   **[10]**

4.  Let's assume you received an order of 500 boards / units. Now, to start building this microcontroller, the very first component needed is the printed circuit board (PCB) that renders all the other components dependent on it. There might have been other such similar constraints and interdependencies during your project as listed below in Table II.

**Table II:** *Task Details*

| Task Number | Task Description | Duration (days) | Predecessors |
|---|---|---|---|
| 1 | Project Start (Milestone) | 0 | - |
| 2 | Agree Specifications | 1 | 1 |
| 3 | Project Objectives | 1 | 1 |
| 4 | Statement of Work (SOW) | 1 | 2, 3 |
| 5 | Work Breakdown Structure (WBS) | 1 | 4 |
| 6 | Project Network Diagram | 1 | 5 |
| 7 | Project Gantt Chart | 1 | 5 |
| 8 | PCB Design | 2 | 6, 7 |
| 9 | Procurement | 4 | 7 |
| 10 | PCB Board Making | 4 | 8, 9 |
| 11 | Components Delivery | 3 | 9 |

| 12 | Assembly | 7 | 10, 11 |
|----|----------|---|--------|
| 13 | Testing | 2 | 12 |
| 14 | Prepare Manual | 3 | 13 |
| 15 | Order Packaging | 3 | 12 |
| 16 | Packaging and Delivery/Shipment | 3 | 14, 15 |
| 17 | Project Report | 2 | 16 |
| 18 | Project End | 0 | 17 |

*Consider:*

- there was a *national holiday* declared on the day after task 12 completion.
- the *weekends as a normal work day* like any other day of the week.
- the *diagrams / figures to be hand-drawn* with a ruler.

Demonstrate these interdependencies and interlink between various tasks with the help of a Project Network Diagram. **[Hint: The delivery time of each component in given in the Appendix of the first part of this assessment.]**

**[15]**

5. Based on your Project Network Diagram above, how many days did it take to complete this project? Demonstrate with the help of the critical path. **[5]**

6. Timeline of your project with the help of Gantt Chart clearly listing all the tasks. The chart must be **hand-drawn** with a ruler. **[5]**

Please note the editor insists that the word count MUST be between 745~755 words; words over or under this limit will incur a 5% penalty PER WORD outside this limit. The final word count must be included thus ["7xx words"] at the end of your article. This final statement will not be included in the word count.

-------------------------------------- **END OF ASSESSMENT** --------------------------------------