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| Activity 20-1 | Apply Design for Manufacturing (DFM) Methods |
| Textbook Reference: | Ulrich & Eppinger – chapter 11 |
| Purpose / Goal: | To learn how to apply Design for Manufacturing analysis to a project. To understand and apply costing structures to the team project and produce an estimated project cost. |
| Materials / Resources Required: | Laptop, paper, pen/pencil, textbook, “Example – Manufacturing Costs.xlsx” and “Shop Resources” – both available from LMS |
| Time Allocated: | 1 hour 50 minutes |

# Description

The Design for Manufacturing approach creates helps keep designers aware of the costs and cost trade-offs of their designs. Using the appropriate tools as outlined in the textbook, students will perform the first step of DFM to develop a detailed manufacturing cost estimate for their team project. As the team project is a one of a kind prototype, the remaining steps will not be performed.

The manufacturing cost estimate developed during this activity is to be completed independently by the team and included in their Milestone 3 deliverable, the final report.

# Estimating Manufacturing Costs

## Background Information

Manufacturing costs can be broken into:

* Component costs
* Assembly / fabrication / manufacturing costs
* Overhead

Costs can also be identified as fixed versus variable. Fixed costs are the onetime costs associated with the project. Variable costs are those that depend on the number of units being made. For example, although it may cost $1000 to make the first unit it might only cost an additional $400 each time you make another copy of the product.

As you identify the costs for your project, classify them as either fixed or variable.

## Resources

### The Spreadsheet Tool

To assist the teams in compiling their cost estimates, an Excel spreadsheet “Example – Manufacturing Costs.xlsx” has been provided. Note that the spreadsheet takes advantage of “grouping” to help divide the costs into categories while providing subtotals for each of those categories. Experiment with the grouping and ungrouping feature. Note that when the group is collapsed, you can still see its subtotal.

### Cost Approximations

The textbook has appendices to chapter 11 that provide a range of typical costs.

Students have access to the various shops and facilities here at Rensselaer for fabrication / assembly. A resource document explaining their various costs is provided in LMS.

Labor is an area frequently misunderstood by student engineers. Materials that have to be purchased have a clearly identifiable cost – it’s on the receipt! Student labor is humorously referred to as “free” in the context of academic classes since, of course, no paychecks are issued. But to develop an understanding of costs, the team should identify a theoretical cost structure for labor items.

## The Process

1. Appoint one team member to open the example spreadsheet and record data.
2. Use any of your design creativity tools to identify as many of the various cost items as possible.
3. Start with the material costs. These are usually easier to identify.
4. Be as specific as possible without attempting to list “every nut & bolt, every wire, every gear” in the project.
5. If you are not able to identify individual items then identify the assembly / sub-assembly.
6. Do not worry about listing the multiple components if you are purchasing an assembly. For example, if you plan to include a microcontroller and the chip is part of a development kit, simply list the development kit. If you will use a gear motor, you do not need to separately list the motor and the gearbox.
7. Enter all the gathered information into the spreadsheet.
8. Review each line item and identify the quantity required and the cost per item.
9. Leverage the textbook’s list of estimated costs.
10. Leverage the costing information associated with the Rensselaer shops.
11. Utilize the textbook for additional guidance and suggestions on breaking the items down.
12. Expand the spreadsheet as required.

Although the team project is not one that is expected to be mass produced, you should include explanations of potential cost savings in your write-up for Milestone 3. This should include cost savings due to quantity discounts, potential re-design opportunities, alternate design approaches, etc.

It is important to recognize that cost estimates are a dynamic document. As the design process continues, additional information and insight gathered will suggest changes to the cost estimate. Be sure that your team captures this original cost estimate and saves it as your “baseline”. Make a working copy of it and update the working copy as your information grows. Include both your original baseline cost estimate and your final cost estimate in your Milestone 3 report.