# Homework #2 Manufacturing Economics

#### How Part Quantity Affects Cost and Thus Process Selection

Assignment Analyze the costs, particularly capital costs, to manufacture a copying machine hub by two processes: machining and injection molding. Since answers to Questions 2-8 can depend on the adequacy of the calculations in Question 1, submit the homework in two stages. First, Mfg. Econ. 1 (Question #1) and after that is graded and returned then Mfg. Econ. 2 (Questions 2-8).

Major Purpose of Assignment - learn the Manufacturing Economics concepts given in Chapter 2, specifically:

1. The economic balance between labor and capital costs (equipment, tooling) so the best process can be selected.
2. The quantity of parts needed is a major factor in process selection. Low quantity favors more manual processes and high quantity favors processes with more automated processes (i.e., more equipment and tooling)
3. The cost of process equipment which can be used to make different parts cost is depreciated (distributed, prorated) over many years and so is assigned to a part as though it is rented to produce that part.
4. Tooling, and some equipment, is part specific and their installed purchase cost is depreciated over the number of parts produced. Tooling cost is often large and can be the determining factor between a manual or an automated process.

Minor Purpose-get some experience making reasonable assumptions and working with approximate values, rather than 3 decimal place values (helpful skills to have in your toolkit).

40 pts. 1. Estimate the manufacturing units costs (cost per part) for both processes using:

1. a part (a hub in a printer or copy machine) weighs 1/2 oz.
2. machining wastes 80% of raw stock, molding wastes 5 %
3. bar stock costs $2 per lb. and molding pellets cost $1 per lb. (optional-may assume lower at high quantities; however, the cost decrease has a secondary or tertiary effect. This homework is concerned about the primary effect on per part cost, the depreciation of capital expenses [machine tools and toolings])
4. labor costs: assume 1 person for the machining process and less for injection molding (that is, they spend a fraction of their time on this part and they have other machines/parts to attend to)
5. the machine capital costs are spread over 15 years and prorated to this part on a time used basis (assume a 2 shift, 50 week/year operation)
6. overhead operating costs of $5 per hour for machining and $8 per hour for molding (higher energy costs to heat polymer)
7. the tooling cost has to be recovered on this order
8. the order is for 10 parts, for 1,000, 100,000 10,000,000 & 1 109 parts (order may extend over several years)

10 pts. 2. Plot or sketch total unit cost vs. part quantity. How does total unit cost vary with quantity?

5 pts. 3. Place the two processes on a Quantity-Variety plot (Fig. 2-3 in Course Notes).

10 pts. 4. Discuss the merits of (near) net shape (Concept on p. 2-1 of Course Notes). Which process in HW2 is more net shape?

5 pts. 5. Which is the cheapest process for making hubs?

15 pts. 6. Discuss how this homework illustrates “how part quantity affects part cost and thus process selection” (the mainpurpose of the homework). Have at least one paragraph and be as specific/clear as possible. Be sure to mention the role of each of the elements of part cost as well as the total.

10 pts. 7. Briefly discuss the merit in “making reasonable assumptions and working with approximate values” (minor purpose of homework).

5 pts. 8. Briefly discuss the challenges you had in “making reasonable assumptions and working with approximate values”

20 pts. 9. (MEEG653 only) Modify the machining case with automation to gain labor efficiencies. Add some fixtures (tooling) that speed up the loading and unloading of the part in the CNC machine. Assume the fixtures cost $10,000 and they increase the production rate by 20%. Discuss the economic advantages and disadvantages of adding the fixture. Just compare with the basic machining case. The calculation portion and the discussion portion are worth 10 points each. As the total possible points are 120, the score will be divided by 1.2 to normalize the homework points to a 100 basis.

Advice

1. Please use the summary worksheet on page B-3 (this homework and all homework available as a Word doc on Canvas)
2. This homework will require you to make more assumptions than you may be use to making. Try to make reasonable assumptions. Be sure to state them and the basis for making them.
3. Keep it simple ignoring practical considerations such as raw material cost will drop with quantity and the mold could wear out and need to be replaced as these factors are minor compared with the message of the homework.

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1. Make sure one can follow your calculations.
2. Approximate costs for injection molding machines and molds are given on pages 507-508 of the textbook. I’m not sure why the textbook mentions both dies and molds. Assume a tooling cost of $1000 for machining (optional-may increase tooling costs at higher quantities to gain labor efficiencies). The approximate machining capital equipment cost can be estimated using Table 18.2 (from the Textbook’s 4th edition and is on page B-4 of this assignment) relative to the cost of the injection molding machine. Values for injection molding cycle time are given on page 506 which can be converted to a production rate for molding. A production rate for machining can be estimated using the molding rate and relative ratio given in Table 18.2 but use a “low” for a machining production rate.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Machining | |  | |  | Unit Cost, $/unit ($/hub) | | | | |
|  | Raw Data | | Cost-Time Basis, $/hr | | 10 hubs | 1,000 hubs | 10^5 hubs | 10^7 hubs | 10^9 hubs |
| Labor |  | |  | |  |  |  |  |  |
| Material |  | | xxxxxxxxxxxxxxxxxxxxx | |  |  |  |  |  |
| Overhead-Op. |  | |  | |  |  |  |  |  |
| Overhead-Cap. | xxxxxxxxxxxxxxxxxxxxx | | xxxxxxxxxxxxxxxxxxxxx | | xxxxxx | xxxxxx | xxxxxx | xxxxxx | xxxxxx |
| machine |  | |  | |  |  |  |  |  |
| tooling |  | | xxxxxxxxxxxxxxxxxxxxx | |  |  |  |  |  |
| Total |  | |  | |  |  |  |  |  |

Show calculations not in above “boxes” and note assumptions & their basis.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Molding |  |  | Unit Cost, $/unit ($/hub) | | | | |
|  | Input Data | Cost-Time Basis, $/hr | 10 hubs | 1,000 hubs | 10^5 hubs | 10^7 hubs | 10^9 hubs |
| Labor |  |  |  |  |  |  |  |
| Material |  | xxxxxxxxxxxxxxxxxxxxx |  |  |  |  |  |
| Overhead-Op. |  |  |  |  |  |  |  |
| Overhead-Cap. | xxxxxxxxxxxxxxxxxxxxx | xxxxxxxxxxxxxxxxxxxxx | xxxxxx | xxxxxx | xxxxxx | xxxxxx | xxxxxx |
| machine |  |  |  |  |  |  |  |
| tooling |  | xxxxxxxxxxxxxxxxxxxxx |  |  |  |  |  |
| Total |  |  |  |  |  |  |  |

Show calculations not in above “boxes” and note assumptions & their basis.

## Comparative Costs and Production Volumes for Processing of Plastics

***In this Homework use a “low” for a machining production rate***

