

Economic Consideration in Material Selection



Section 1. Introduction

In engineering practice there are other important criteria that must be considered in the development of a marketable product. Some of these are economic in nature, which, to some degree, are unrelated to scientific principles and engineering practice, and yet are significant if a product is to be competitive in the commercial marketplace.

It is essential for the engineer to know about and understand economic issues simply because the company/ institution for which he or she works must realize a profit from the products it manufactures. Materials engineering decisions have economic consequences with regard to both material and production costs.

There are three factors over which the materials engineer has **control** and that **affect the cost of a product**; they are (1) component design, (2) the material(s) used, and (3) the manufacturing technique(s) that are employed. *These factors are interrelated in that component design may affect which material is used, and both component design and the material used will influence the choice of manufacturing technique(s).* Economic considerations for each of these factors is now briefly discussed.

1- Component Design:

Some fraction of the cost of a component is associated with its design. In this context, **component design** is the specification of **size, shape, and configuration**, which will affect in-service component **performance**. For example, if **mechanical forces** are present, then **stress analyses** may be required. Detailed drawings of the component must be prepared; computers are normally employed, using software that has been generated for this specific function.

It is often the case that a single component is part of a complex device or system consisting of a large number of components (i.e., the television, automobile, DVD player/recorder, etc.). Thus, design must take into consideration each component's contribution to the efficient operation of the complete system.

2- Materials:

In terms of economics, we want to select the material or materials with the appropriate combination(s) of properties that are the least expensive. Once a family of materials has been selected that satisfy the design constraints, cost comparisons of the various candidate materials may be made on the basis of cost per part. Material price is usually quoted per unit mass. In addition, during manufacturing there ordinarily is some unavoidable material waste, which should also be taken into account in these computations.

3- Manufacturing Techniques:

As already stated, the choice of manufacturing process will be **influenced** by both the **material selected and part design**. The entire manufacturing process will normally consist of **primary and secondary operations**. **Primary** operations are those that **convert the raw material into a recognizable part** (i.e., casting, plastic forming, powder compaction, molding, etc.), whereas **secondary** ones are those subsequently **employed to produce the finished part** (i.e., heat treatments, welding, grinding, drilling, painting, decorating).

The major cost considerations for these processes include capital equipment, tooling, labor, repairs, machine downtime, and waste. Of course, within this cost analysis, rate of production is an important consideration. If this particular part is one component of a system, then assembly costs must also be addressed. Finally, there will undoubtedly be costs associated with inspection and packaging of the final product.

As a sidelight, there are also other factors not directly related to design, material, or manufacturing that figure into the product selling price. These factors include labor fringe benefits, supervisory and management labor, research and development, property and rent, insurance, profit, taxes, and so on.

In Summary

Economic Considerations

The economics of engineering is very important in product design and manufacturing. To minimize product cost, materials engineers must take into account component design, what materials are used, and manufacturing processes. Other significant economic factors include fringe benefits, labor, insurance, profit, etc.

References

- (1) *Materials Science and Engineering, an Introduction; seventh edition; William D. Callister, Jr.*

Questions

- (1) *State the factors may affect the cost of a product?*
- (2) *In simple words, summarize the economic considerations in material selection.*