

Chapter 12

ECONOMIC ANALYSIS OF RAPID PROTOTYPING SYSTEMS

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Abstract

Considering the large sums of money required to implement advanced manufacturing technologies (AMT), management must carry out appropriate evaluations and then make critical decisions. Traditional justification methods are insufficient by themselves because they cannot cope with benefits, such as flexibility and enhanced quality, offered by AMT. Selection and justification processes for AMT involve complex problems and require extensive analysis of a large number of criteria. An appropriate decision-making procedure for justification of AMT requires consideration of both economic and non-economic investments. An analytical model is presented for the selection of a rapid prototyping (RP) system from a set of mutually exclusive decision alternatives. The proposed model is based on the analytic hierarchy process (AHP) along with the Expert Choice software and it provides the means for integrating economic with non-economic benefits. A numerical example illustrates an application of the proposed model.

Keywords:

Advanced manufacturing technologies (AMT), rapid prototyping systems, economic analysis, analytic hierarchy process (AHP), Expert Choice.

12.1. Introduction

In order to survive in today's global competitive environment, manufacturing companies must be capable of manufacturing high-quality products at low cost with increasing variety over short lead times and then be able to deliver them to customers at the right time. In order to achieve these objectives and to respond to these challenges, many companies have adopted advanced manufacturing technologies (AMT) such as computer-aided design (CAD), manufacturing resource planning (MRP II), flexible manufacturing systems (FMS), computer-integrated manufacturing (CIM), rapid prototyping technology, and so forth. These technologies have been used extensively in industry. AMT can be considered as a means for increasing productivity, quality, flexibility, and profitability in order to cope with the pressure of international competition. Although AMT can improve overall manufacturing performance, companies maintain some ambivalence toward deciding whether to invest in such technologies. Also, the subject of the economics of AMT recently has become of significant interest to the management science community⁴².

Selection and justification of AMT involve decisions that are critical to the profitability and survival of a manufacturing company in an increasingly competitive environment. AMT requires a high capital outlay yet offers a large number of non-economic benefits such as flexibility, competitiveness, customer satisfaction, and so on which are generally difficult to quantify. Traditional justification approaches are insufficient to justify AMT. Researchers have adopted numerous approaches to justify AMT, but these approaches often provide limited information. For example, economic justification approaches are incapable of analyzing intangible attributes. Justification of AMT is an unstructured problem, and thus it requires extensive analysis of a large number of variables.

The major hurdles in implementing AMT are not engineering shortcomings in the equipment or manufacturing processes, but rather, managerial attitudes and policies are examples in the justification problem²⁵.

Today, most major corporations are struggling with their traditional justification methods because these methods are either misapplied, or the information included in the calculations is inadequate for the multifaceted problem being tackled⁶. Manufacturing technologies reshape the basic ways in which a firm perceives the problems, and hence, they often alter the firm's objectives. Decision-making in such situations becomes quite complex because manufacturing excellence encompasses quality, flexibility, throughput times, customer satisfaction, and many other such problems. Basically, the justification problem for manufacturing systems is a very difficult one to solve because of the following⁶: