Chapter 10

Strategic Justification of Rapid Prototyping Systems

Rakesh Narain[1] and Joseph Sarkis[2]
[1]Department of Mechanical Engineering, Motilal Nehru National Institute of Technology, Allahabad-211004, India, narainr@rediffmail.com. [2] *Clark University, Graduate School of Management, 950 Main Street, Worcester, Massachusetts, 01610, jsarkis@clarku.edu*

Abstract:

The consideration of whether to adopt rapid prototyping (RP) technology in general or a specific system in particular is not a trivial issue for most organizations. This technology has influences and has implications for a variety of intra-organizational functions and inter-organizational boundaries. The decision issues faced by these organizations include the balancing of needs across the organization and its partners, consideration of tangible and intangible factors, and the consideration of strategic and operational dimensions. In this chapter we introduce some of the categories of attributes and factors that organizations need to consider. The various factors are then evaluated using a multiattribute utility model called the analytical network process. An illustrative example provides insights into the execution of the technique. The technique is useful due to its capability to consider the many relationships and influences among the factors. It is also flexible enough to consider perceptual as well as more objective data and information when analyzing the problem situation.

Key words:

Strategic Technology Justification, Multiattribute Utility Theory, Analytical Network Process, Analytical Hierarchy Process, Decision Analysis, Technology Management, Investment Analysis, Multiple Criteria Decision Making.

10.1. Introduction

Time to market is a crucial success factor for most organizations. The winners in today's competitive marketplace are those companies that can bring innovative high value products & services to the customer ahead of their competitors. Rapid Prototyping (RP) technology enables an organization to acquire such a capability[12]

RP is a term which includes a range of new technologies for producing accurate parts directly from 3D-CAD models, without the use of tooling, in a few hours with minimal human intervention. RP uses state-of-the-art laser technology, positioning systems, material and process technologies in various processes.

Ever since the birth of RP technology, around mid 1980's there has been tremendous technical advancement and global proliferation of RP technology. Starting with the single commercially available RP system known as Stereolithography manufactured by 3D Systems, today we have a score of RP systems available. These include such technologies as: Solid Ground Curing (SGC), Solid Object Ultraviolet Laser Plotter (SOUP), Laminated Object Manufacturing (LOM), Fused Deposition Modeling (FDM), Selective Laser Sintering (SLS), 3D Printing etc. A detailed classification of RP has been given by Kruth[11] and Pham and Gault[14].

As per an estimate, by the year 2002, some 10,000 RP systems were to be installed through out the world generating global revenue of RP of over $700 million. According to the Wohlers report[19], the RP industry, which includes product sales and services worldwide, grew 9.2% to $ 528.9 million in 2003, up from $ 484.5 million in 2002. The industry is expected to grow to $ 586 million in 2004 and $ 655 million in 2005. A difficulty and variation in the estimates is due to definitions of RP technology, but clearly industry is spending hundreds of millions of dollars on this technology with a continuous increase as product markets continue to customize.

Initially the technology was used as a product development tool, mainly to evaluate the ease of assembly and manufacture of designed products. But over the years the area of application has widened into other fields including rapid tooling, medical modeling, automotives, aerospace parts, building construction, jewelry, home appliances, to name a few.[8]

RP Technologies are generally known as an additive fabrication process as they build parts through layer-by-layer addition of material, in contrast to