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An Analytical Paper on Rapid Prototyping

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Abstract: Rapid Prototyping Technology (RPT) has been applied in many industries in recent years, especially in the area of product development.Existing processes provide the ability to quickly produce a tangible solid part from a range of materials, such as photo curable resin, powders, paper, and photo curable resin directly from three-dimensional CAD data.The paper provides an overview of the pattern, application areas, major advantages for manufacturing industries and technology's development.Rapid Prototyping is a collection of techniques that produce a scale model of a physical part or assembly using three-dimensional computer-aided data.Construction of assembly parts is achieved by using an additive layer manufacturing technology or 3D printing to make it appear as attractive as possible.The first prototyping methods have been used to produce prototype parts as well as model parts which have proven to be very useful in the manufacturing industry.These prototypes are currently used to produce different quality products without evidence of adverse short-run economies.

Keywords: Component, Manufacturing, Product Development, Rapid Prototyping,Simulation.

INTRODUCTION

Many new and less industrialized countries are aggressively looking for better tools,technologies, and processes to compete more effectively for agility in the international marketplace.For low-wage and low-cost products these countries no longer want but they work hard and fast to move into new, more competitive high-tech industries, moving forward at a stunning pace to upgrade engineering and production capabilities[1].In the last 5 years, very few technologies have offered as much as rapid prototyping technology.Prototyping is a technology that allows us to turn digital designs into 3-dimensional solid objects for moulds manufacturing, machine parts, models, and prototypes.This produces solid objects one layer at a time, producing models of high quality as soon as possible rather than weeks or months.They consist of various processes, some of which are laminated object manufacturing (LOM), fused deposition model (FDM), direct shell manufacturing (DSP), stereo lithography (SL), selective laser sintering (SLS),3D printing,a host of others already marketed or in the developmental stage.

Prototyping is used as a method of validating designs for a long time before they are committed to production. The time to build and debug the prototype increased to impractical levels as designs grew larger and more complex.As a result, the focus shifted to simulation validation of the design and availability of software models.A verification strategy is combined with ease of use of simulation in realism of a prototype[2].

TECHNOLOGY OVERVIEW

Fabrication technique can be classified as additive,subtractive, and formative.Every current fabrication technique either falls into one of these categories or is a hybrid method that falls into more than one category.Rapid prototyping techniques are a collection of technologies capable of performing such processes under computer control with little or no human intervention is required once the process has started[3]. Figure 1 shows rapid prototyping techniques.

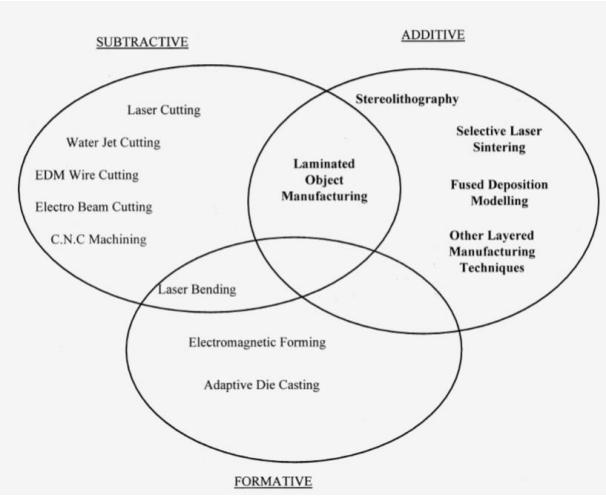

Fig.1: Rapid Prototyping Techniques

Computer numerical control techniques such as drilling, friction, and grinding do not adhere strictly to the five criteria due to the human interaction that may be required to remove the work piece in order to produce complex

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geometries.However, they are included if the capabilities are combined into versatileCNC machining centre then an automatic manufacturing facility could be provided by such a device[4].

BENEFITS OF RAPID PROTOTYPING

Rapid prototyping allows full functional verification at operating frequencies of 22 MHz in the system.It is ability to run at speeds in real time that gives its major advantage over simulation and emulation to rapid prototyping.The main advantage of this methodology is that designs can be proven under live testing.Therefore, vectors do not need to be exhaustive and tests can be carried out in real time.A system that operates at frequencies of 22 MHz clock processes data ten times faster than simulation based on the workstation.The final output like audio or video must be measured at real-time speeds for certain algorithms such as filtering, clipping, compression and decompression due to the subjective nature of the receiver.If the system is running in real time, the algorithm's quality can be assessed on the fly. Otherwise it is important to catch large vector sets and create a replay mechanism[5].

Due to the real-time test capability, rapid prototyping can greatly reduce the design time for communications applications.In fact, by assessing the subjective nature of the product under live tests, the consistency of the final product can be improved, thereby covering a much larger set of test conditions[5].

TERMINOLOGY

The fact that rapid prototyping is still a relatively infant technology means that a standard set of nomenclature has yet to be adopted that describes it.The first rapid prototyping device is established in 1980. It generated considerable concern with many organizations launching research programs, designing systems and many articles published on the potential applications of this new technology.In this time, several concepts have been introduced to define the new processes, based on the techniques used to produce parts and the potential applications of the systems.Some terms accurately reflected the technology's nature and remained in use, while others have lack of understanding since it has been dropped[6].A wide terminology range is shown in Figure 2.

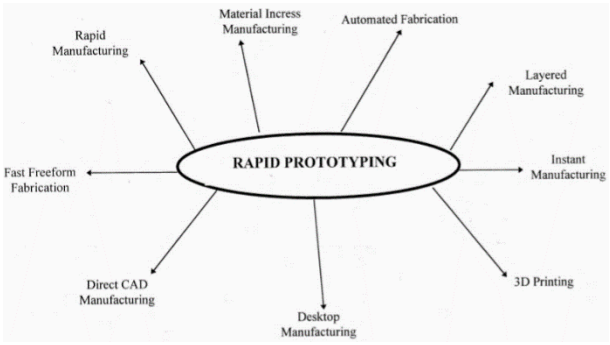

Figure 2: Terminology Associated with Rapid Prototyping

1. *Layered Manufacturing Process:*

All rapid prototyping methods, whether commercially available or under development, are based on a layered manufacturing approach in which objects are made as a series of horizontal cross-sections, each shaped independently from the related raw materials and bonding to preceding layers.Most systems are common to the main process stages involved in manufacturing parts, but the mechanisms by which the individual layers are created obviously depend on the particular system. Stages of the common process are shown in Figure 3. The starting point for any process is the source of the abstract geometry of the object to be constructed from which it necessary to compile a data set is describing that geometry.These data need to be manipulated to generate the instructions needed to control the process in the final stage of the component being actually manufactured[7].

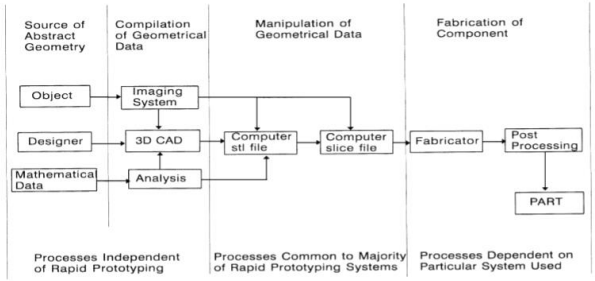

Figure 3: Main Process in Rapid Prototyping System

2. *Issues in Layered Manufacturing:*

The method of manufacturing objects as a series of horizontal layers presents a unique set of problems, regardless of the techniques involved in each layer's manufacturing.Some of these issues are technical and may be due to hardware constraints while others may be

due to finishing operations. These are boiling issues and have impacted applications downstream.This section is intended to provide some insight into the considerations that made by layered manufacturing techniques[8].

3. Communication and Availability Enhancement:

Rapid prototyping has made prototypes, parts easy to access, and this enhances the assembly process required to support the production process.Most people are feeling comfortable with the easily assembled prototype parts using the rapid prototyping technique under enhanced communication.Communication has improved because compared to the two dimensional drawings, people find it comfortable to understand the object of three dimensions much better[9].These dimensions are replaced by the changing techniques of rapid prototyping in assembling the prototype parts of the manufacturing process under the traditional assembly line with time.Prototype parts are easily assembled using the rapid prototyping technique; thus, many people in the manufacturing industry are made easier to work. The prototype parts using the rapid prototyping has also resulted in considerable cost and time savings.The use of rapid prototyping has led to improved assembly of the prototype parts by improving effective communication to promote assembly.Effective communication brought about by rapid prototyping technique has contributed to the exchange of prototypes during the design stage, thus contributing to the ease of assembly of the prototype components.The prototype parts are tested at the time of manufacture using a design to see if the desired work is being performed.Rapid manufacturing refers to the use of parts produced by fast prototyping systems as models in further processes of manufacture.Rapid manufacturing techniques can be used to produce metallic components, to manufacture polymeric parts in a variety of different engineering plastics, or to create multiple copies of a part from one master[10].

CONCLUSION

Sweeping changes in manufacturing practices began in the 1980, and intensified in the 1990 with additional impetus.Greater product life cycle, reliability, better quality and elimination of wastes have become industry standards.Most specifically, greater emphasis is now being placed on the development of new products and time to market.Products of excellent quality, satisfying a market niche, are without doubt prerequisites for a successful business and with the added benefits of reduced costs and more design iterations, components can now be produced in a fraction of the time.Designers have been issued with new tools from the RPT collection out of old constraints.Managers need to take on new business practices, designers need to understand the power at their disposal, process engineers need to know about new process routes and marketing staff need to be aware of their new found ability to react rapidly to changes in the market.The global marketplace is carelessness impatient, price-sensitive and intolerant.We need to move quickly, eliminate non-value adding costs and deliver unprecedented quality. These are the new survival rules.The quick prototype can achieve operating frequencies that allow the complete design to be tested in real time.Projects with tight time-to-market schedules and projects requiring subjective quality verification greatly benefit from the rapid design prototyping.This ultimately leads to better quality products which will be placed on the market in less time.

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