Rapid prototyping

INTEGRATED PRODUCT DEVELOPMENT AND STRATEGIES ASSIGNMENT – I S. SATISH BABU 11MD34 RAPID PROTOTYPING Rapid prototyping is the automatic construction of physical objects using additive manufacturing technology. The use of additive manufacturing for rapid prototyping takes virtual designs from computer aided design (CAD) or animation modeling software, transforms them into thin, virtual, horizontal cross-sections and then creates successive layers until the model is complete. It is a process where the virtual model and the physical model are almost identical.

With additive manufacturing, the machine reads in data from a CAD drawing and lays down successive layers of liquid, powder, or sheet material, and in this way builds up the model from a series of cross sections. These layers, which correspond to the virtual cross section from the CAD model, are joined together or fused automatically to create the final shape. The primary advantage to additive fabrication is its ability to create almost any shape or geometric feature. The standard data interface between CAD software and the machines is the STL file format.

An STL file approximates the shape of a part or assembly using triangular facets. Smaller facets produce a higher quality surface. VRML (or WRL) files are often used as input for 3D printing technologies that are able to print in full color. Types of Rapid Prototyping: Several rapid prototyping methods have been created to produce objects of complex geometries in a relatively short amount of time. These systems are beneficial to engineers by allowing them to better understand the products that they are designing and by providing them with a way to create a visual aid to communicate with others.

Rapid prototyping allows design challenges to be determined earlier in the design process, saving time and money. The technology of rapid prototyping is easy to access and simple to understand. A large number of competing technologies are available in the marketplace. As all are additive technologies, their main differences are found in the way layers are built to create parts. Some are melting or softening material to produce the layers (SLS, FDM) where others are laying liquid materials thermosets that are cured with different technologies.

In the case of lamination systems, thin layers are cut to shape and joined together. Prototyping technologies| Base materials| Selective laser sintering (SLS)| Thermoplastics, metals powders| Direct metal laser sintering (DMLS)| Almost any alloy metal| Fused deposition modeling (FDM)| Thermoplastics, eutectic metals| Stereolithography (SLA)| photopolymer| Laminated object manufacturing (LOM)| Paper| Electron beam melting (EBM)| Titanium alloys| 3D printing (3DP)| Various materials| SELECTIVE LASER SINTERING

Selective laser sintering (SLS) is an additive manufacturing technique that uses a high power laser (for example, a carbon dioxide laser) to fuse small particles of plastic, metal (direct metal laser sintering), ceramic, or glass powders into a mass that has a desired 3-dimensional shape. The laser selectively fuses powdered material by scanning cross-sections generated from a 3-D digital description of the part (for example from a CAD file or scan data) on the surface of a powder bed.

After each cross-section is scanned, the powder bed is lowered by one layer thickness, a new layer of material is applied on top, and the process is repeated until the part is completed. Compared to other methods of additive manufacturing, SLS can produce parts from a relatively wide range of commercially available powder materials. These include polymers such as nylon, (neat, glass-filled or with other fillers) or polystyrene, metals including steel, titanium, alloy mixtures, and composites and green sand.

The physical process can be full melting, partial melting, or liquid-phase sintering. And, depending on the material, up to 100% density can be achieved with material properties comparable to those from conventional manufacturing methods. In many cases large numbers of parts can be packed within the powder bed, allowing very high productivity. FUSED DEPOSITION MODELLING FDM works on an " additive" principle by laying down material in layers. A plastic filament or metal wire is unwound from a coil and supplies material to an extrusion nozzle which can turn the flow on and off.

The nozzle is heated to melt the material and can be moved in both horizontal and vertical directions by a numerically controlled mechanism, directly controlled by a computer-aided manufacturing (CAM) software package. The model or part is produced by extruding small beads of thermoplastic material to form layers as the material hardens immediately after extrusion from the nozzle. Stepper motors or servo motors are typically employed to move the extrusion head. Several materials are available with different trade-offs between strength and temperature properties.

As well as acrylonitrile butadiene styrene (ABS) polymer, polycarbonates, polycaprolactone, polyphenylsulfones and waxes. A " water-soluble" material can be used for making temporary supports while manufacturing is in progress, this soluble support material is quickly dissolved with specialized mechanical agitation equipment utilizing a precisely heated sodium hydroxide solution. STEREOLITHOGRAPHY APPARATUS Stereolithography is an additive manufacturing process using a vat of liquid UV-curable photopolymer " resin" and a UV laser to build parts a layer at a time.

On each layer, the laser beam traces a part cross-section pattern on the surface of the liquid resin. Exposure to the UV laser light cures, solidifies the pattern traced on the resin and adheres it to the layer below. After a pattern has been traced, the SLA's elevator platform descends by a single layer thickness, typically 0. 05 mm to 0. 15 mm (0. 002" to 0. 006"). Then, a resin-filled blade sweeps across the part cross section, re-coating it with fresh material. On this new liquid surface, the subsequent layer pattern is traced, adhering to the previous layer.

A complete 3-D part is formed by this process. After building, parts are cleaned of excess resin by immersion in a chemical bath and then cured in a UV oven. Advantages of Rapid Prototype System: Some of the advantages of rapid prototyping systems are: 1) Reduction in project cost and risk. 2) Can be used in different industries. 3) Easily the errors in previous design can be detected and errors can be rectified. 4) Only upon the complete satisfaction the complete product is designed.

Factors like manufacturability, robustness and functionality of design are checked before sending it for production. 5) Greater visualization capabilities are improved right from the first stage if designing. This helps the user in knowing how the final product will look like. 6) All the designing flaws can be detected easily before the manufacturing of the product starts. 7) Manufacturer, designer and user can discuss the product and work forward to get the best product. This helps to give the user higher output product.

Disadvantages of prototyping: 1) Producer might produce a system inadequate for overall organization needs. 2) User can get too involved whereas the program cannot be to a high standard. 3) Structure of system can be damaged since many changes could be made. 4) Not suitable for large applications. 5) Over long periods, can cause loss in consumer interest and subsequent cancellation due to a lack of a market (for commercial products). 6) May slow the development process, if there are large number of end users to satisfy.