

3D PRINTING

In light of the growing market for 3D printing, the Ministry of Electronics and Information Technology (MeitY) will shortly release a strategy targeted at promoting it on a large scale.

The USA remains the global leader in 3D printing, with more than 35% market share.

In Asia, about 50% of its market is cornered by China, followed by Japan at 30%, and South Korea at 10%.

Features of the Policy:

Encourage market leaders to set up worldwide 3D manufacturing facilities in India, while restricting the import of printed materials for domestic use.

Objective:

- Assist in the creation of a favourable environment for the design, development, and deployment of 3D printing and additive manufacturing.
- Assist domestic enterprises in overcoming technical and economic constraints so that they might create complementary and ancillary facilities for global technology giants like the United States and China.

Focus areas

- Engines, interior and exterior elements of luxury vehicles, landing gear, sophisticated brackets, and turbine blades are some of the key areas of focus and application in the auto and ancillary auto and motor spare part business.
- It could be used in consumer electronics, printed circuit boards, apparel, toys, and jewellery, among other things.

Potential Market:

- According to MeitY's predictions, the global market for additive manufacturing would increase at a compound annual growth rate of 23.2 percent to USD 34.8 billion by 2024.
- 3D printing may not result in an increase in net employment, but it is a technology that can be advanced.

About 3D printing:

- Through a layering approach, 3D printing uses computer-aided design (CAD) to build three-dimensional things.
- A 3D printer creates a three-dimensional object from a CAD (computer-aided design) file in 3D printing.
- Additive manufacturing technologies are used to create 3D printed objects.
- An object is built in an additive technique by laying down successive layers of material until the object is complete.
- Each of these layers can be viewed as a cross-section of the item that has been lightly cut.
- We can make complex shapes with less material using 3D printing than we can with standard manufacturing processes.

Working

- A common 3D printer functions similarly to an inkjet printer controlled by a computer.
- In a method known as fused depositional modelling, it builds up a 3D model one layer at a time, from the bottom up, by repeatedly printing over the same area (FDM).
- The printer builds a model over the course of several hours by converting a 3D CAD drawing into a series of two-dimensional, cross-sectional layers—effectively independent 2D prints that are stacked one on top of the other.

Ink of 3D printer

- A 3D printer does not utilise liquid ink like an inkjet printer does, nor does it use solid powder like a laser printer does.
- The 3-D printer deposits layers of molten plastic or powder and utilises adhesive or ultraviolet radiation to fuse them together (and to the existing structure).
- The commodity thermoplastic polymers Acrylonitrile butadiene styrene (ABS) Polylactic acid (PLA) Polyethylene terephthalate glycol-modified polyethylene terephthalate glycol-modified polyethylene terephthalate glycol-modified polyethylene terephthalate glycol-modified polyethylene terephthalate glycol (PETG).
- These materials are readily available and very inexpensive, as they are produced in large numbers by the global chemicals and plastics industries.
- Aluminium and bronze powders, certain grades of stainless steels, a few aluminium alloys, cobalt-chromium combinations, and a small number of titanium alloys are the most readily available metallic raw materials.
- To increase the envelope of metals for 3D printing, private industry and independent research institutions are investing significant R&D resources.

Benefits of 3 D printing:

- It has the potential to dramatically lower overall construction costs.
- The whole building time differs by an order of magnitude.
- Reduces the associated carbon footprint
- Increases the productivity of the labour force.
- Allows for raw material flexibility and the use of environmentally friendly resources.

Applications of 3 D Printing

- Some interesting examples of 3D-printed objects include, but are not limited to: -
- Prosthetic limbs and other body parts
- Homes and other buildings
- Food
- Medicine
- Firearms

- Liquid structures
- Glass products
- Acrylic objects
- Movie props
- Musical instruments
- Clothing
- Medical models and devices
- 3D printing clearly has applications in many industries.

3D printing software

- CAD software uses a variety of file formats, but the following are the most common:
- STL - Standard tessellation language, or STL, is a three-dimensional rendering format that can usually only handle one colour. This is the most common file format for desktop 3D printers.
- VRML (Virtual Reality Modeling Language) is a multi-color model development language that is commonly used for printers with more than one extruder.
- AMF (Additive Manufacturing File Format) is an open standard for 3D printing that is based on.xml. It also has the ability to accommodate numerous colours.
- GCode - Another file type that can provide comprehensive instructions for the 3D printer to follow when laying down each slice is GCode.

Advantages of 3 D Production Process

- Faster prototyping - Because 3D printing can produce parts in hours, the prototyping process is sped up. This allows each stage to be completed more quickly.
- 3D printing has been known for a few decades and has risen in popularity since roughly 2010. With such a large range of printers and software packages now available, practically anyone can learn how to do it.
- Better product quality – 3D printing produces consistent product quality. The end product will usually be of the same quality as long as the model is accurate and fit for purpose, and the same sort of printer is employed.
- Excellent for product design and testing - 3D printing is one of the most useful tools for product development and testing. It allows users to easily design and test models, allowing for easy refinement.

- Cost-effective - 3D printing has the potential to be a low-cost method of production. The procedure is usually mechanised when the model is built, and raw material waste is usually minimal.
- The possibilities of 3D printing are nearly boundless when it comes to product creation. The sky is the limit as long as it can be designed in CAD and printed on a large enough printer.
- Flexible Design- Unlike traditional manufacturing techniques, 3D printing allows for the design and printing of more complicated designs. Traditional technologies impose design constraints that are no longer applicable when 3D printing is used.
- 3D printers can print with a variety of materials, and some can even blend or switch between them. This can be difficult and costly in traditional printing.
- Print on Demand—unlike traditional manufacturing processes—print on demand does not necessitate a large amount of storage space for inventory. This saves both space and money because there is no need to print in volume until it is absolutely necessary. A virtual library holds all of the 3D design files. This means they can be found and printed whenever they are required. Editing individual files instead of wasting out-of-date inventory and investing in tools allows for very low-cost design changes.
- Minimizing Waste- When opposed to alternative technologies that cut big chunks of non-recyclable materials, part manufacture just requires the materials needed for the part itself, resulting in little or no waste. The procedure not only saves resources, but it also lowers the cost of the materials used.
- Environmentally Friendly - Because this technique decreases the amount of waste generated, the process is essentially green.
- Advanced Healthcare: Organs for the human body, such as livers, kidneys, and hearts, are being printed using 3D printing in the medical field to help save lives. Further advancements and applications are being created in the healthcare sector, which will provide some of the most significant benefits from the usage of technology.

Disadvantages:

- Reduction in Manufacturing Jobs: Because much manufacturing is automated and done by printers, there may be a reduction in human labour. Many third-world countries, on the other hand, rely on low-wage labour to keep their economies

afloat, and this technology could jeopardise these manufacturing jobs by eliminating the need for production abroad.

- Materials are limited. Items can be printed in a variety of polymers and metals using 3D printing. However, the raw material variety available is not exhaustive. This is because not all metals or polymers can be thermally regulated to enable for 3D printing. Furthermore, many of these printing materials are not recyclable, and just a handful are food-safe.
- Build Size Restrictions: 3D printers currently have limited print chambers, limiting the size of parts that can be created. Anything larger will have to be printed in multiple parts and then put together afterward. Because the printer must produce more components before manual labour is employed to connect the parts together, this can raise costs and time for larger parts.
- Inaccuracies in the design: Because some printers have tighter tolerances, the final product may differ from the original design. This can be corrected in post-production, but keep in mind that this will add to the overall production time and expense.
- Part Structure: Parts are created layer by layer with 3D printing (also known as Additive Manufacturing). Although these layers attach to one another, they can delaminate when subjected to specific forces or orientations. This issue is magnified when utilising Fused Deposition Modeling to create objects (FDM),. Polyjet and multijet items are also prone to brittleness.
- Issues with Copyright: People will be able to produce phoney and counterfeit things more easily as 3D printing becomes more widespread and accessible, and it will be nearly difficult to tell the difference. This has obvious implications for copyright as well as quality control.

Way forward:

- Additional challenges preventing widespread adoption include a lack of investment and a lack of 3D printing research and development centres. A better awareness of 3D printing technology and its uses among users, on the other hand, will undoubtedly aid in its acceptance in India.
- The Indian market has a lot of promise because the use of 3D printing solutions has been steadily increasing in recent years due to improved general market awareness, and there is still a lot of room for growth here compared to more established markets like Japan, Germany, or the United States.

- Today, 3D printing technology is advancing at the same rate as its applications.
- 3D printing is becoming more mainstream as a result of cutting-edge technological advancements, expanding value chains, and market innovations.
- According to Smithers' latest analysis, "The Future of Global 3D Printing through 2027," this market is expected to grow at a breakneck pace over the next ten years.
- It will rise from \$5.8 billion in 2016 to \$55.8 billion in 2027, representing a 23.0% annual growth rate.
- In the coming years, the development of raw materials for 3D printing will likewise speed substantially.
- Material compositions and processing procedures will be improved, making them more user-friendly.
- From food to medical supplies to massive coral reefs, 3D printing has the ability to democratise the manufacturing of commodities.
- 3D printing equipment may one day be seen in homes, businesses, disaster zones, and perhaps outer space.
- As this technology spreads, it may be able to provide crucial supplies to disadvantaged and hard-to-reach people.
- Overall, this cutting-edge technology has the potential to reshape our communities and the development sector.

MCQs for practice:

Q. Consider the following statements regarding 3D printing policy:

1. It helps in encouraging market leaders to set up worldwide 3D manufacturing facilities in India, while restricting the import of printed materials for domestic use.
2. It could be used in consumer electronics, printed circuit boards, apparel, toys, and jewellery, among other things.

Select the correct option:

- a. 1 only
- b. 2 only
- c. Both 1&2
- d. None of the above

Correct answer: C

Encourage market leaders to set up worldwide 3D manufacturing facilities in India, while restricting the import of printed materials for domestic use.

It could be used in consumer electronics, printed circuit boards, apparel, toys, and jewellery, among other things.

Q. in which of the following fields 3D printing can be used:

1. Prosthetic limbs and other body parts
2. Homes and other buildings
3. Food
4. Medicine
5. Firearms
6. Liquid structures
7. Glass products

Select the correct option:

- a. 1,2,3 only
- b. 2,4,7 only
- c. 1,3,4 7 only
- d. All of the above

Correct answer: D

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Mains question for practice:

Q. What is 3D printing? How it can help in sustainable development? Why should India adopt it?