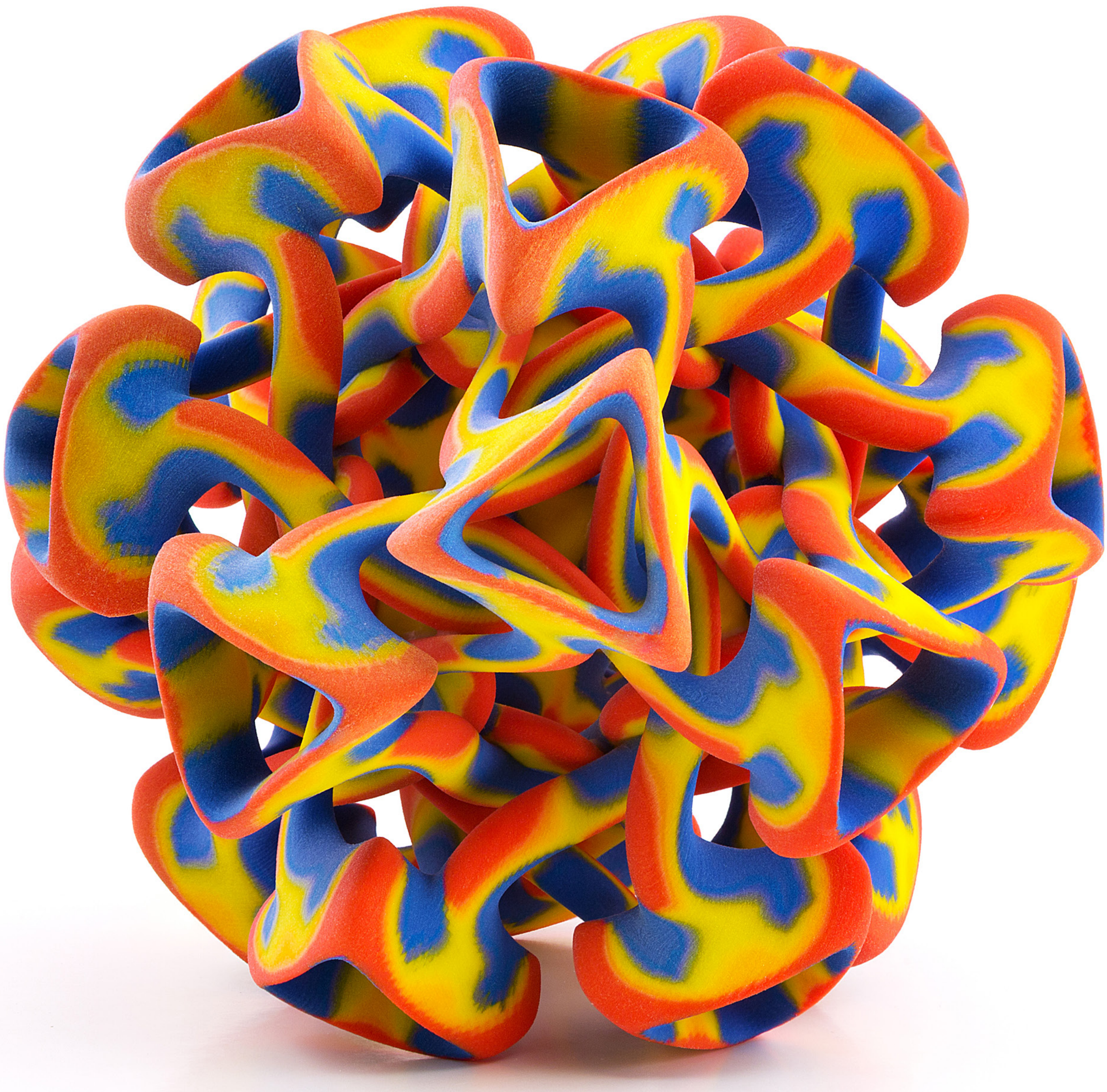
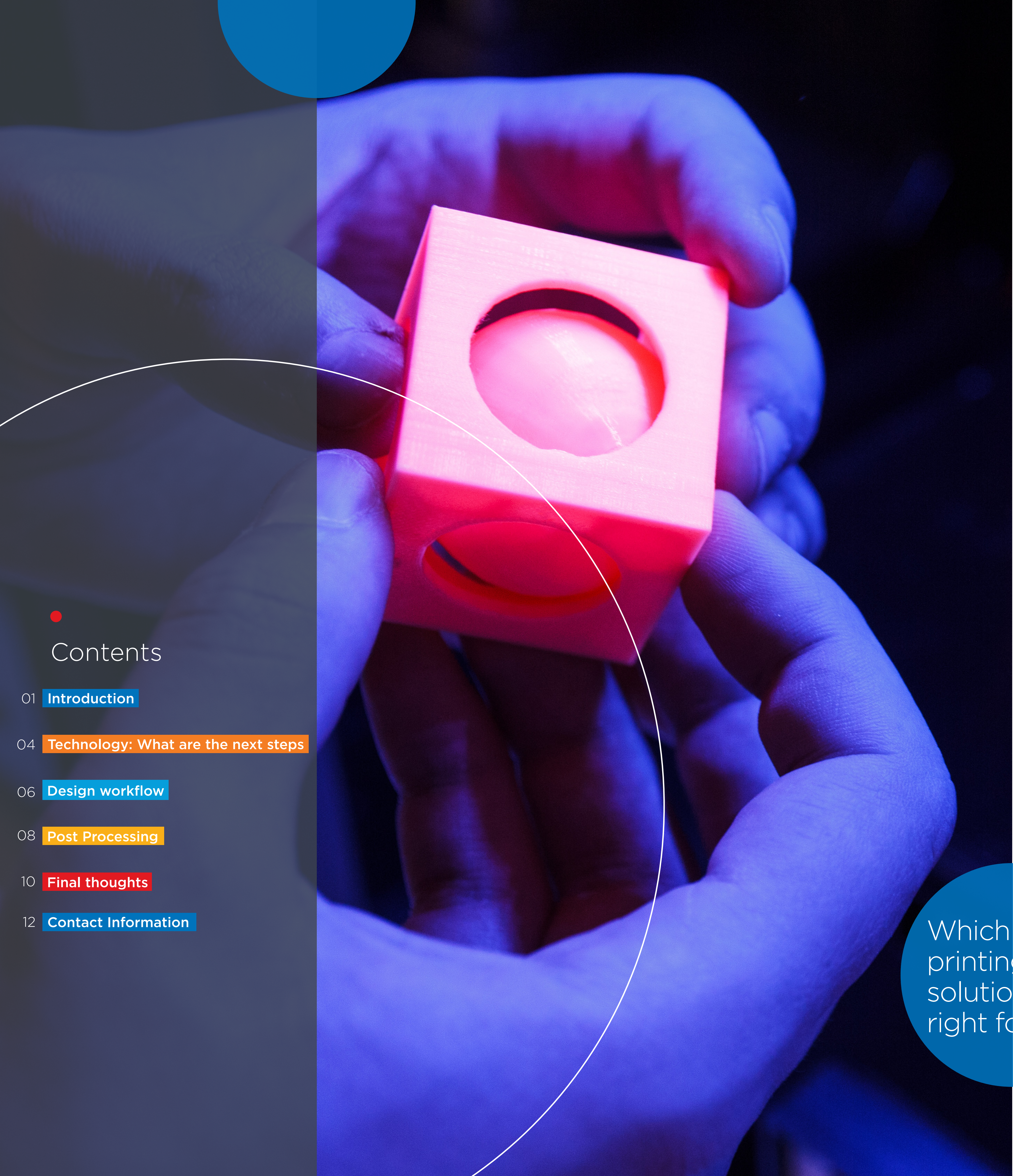
Implementing 3D Printing





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3D Printing

3D PRINTING is coming of age, with global end-user spending on 3D printers set to increase from $1.6bn in 2015 to around $13.4bn in 2018. [1]

For many industries, including manufacturing, engineering and architecture, this spells a revolution. 3D printing has the power to accelerate product development and enable faster and more productive design iterations. It can facilitate more flexible production and unleash creativity by encouraging more experimentation. For businesses, 3D printing has the power to transform business models, unlock competitive advantage and generate new revenue streams.

If you are new to 3D, or considering investing in 3D, we hope this guide will deliver some valuable insight as you start your 3D printing journey. The guide will focus on the fundamental elements of 3D printing, describing the strong correlation between application and choice of 3D technology, and exploring the design work-flow and post processing processes, providing you with an insight into how you could best utilise 3D printing technology in your business.

3D Printing Technologies | Design Workflow | Post Processing

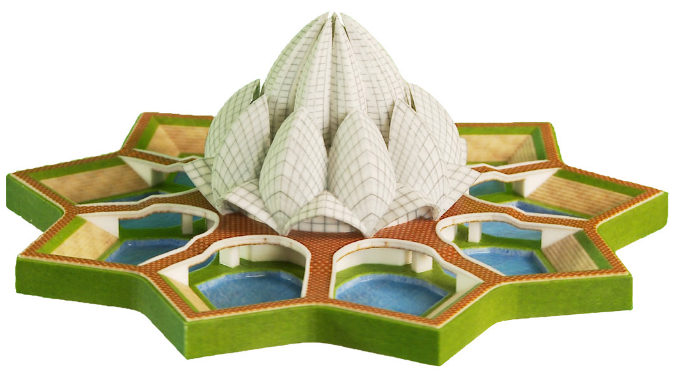
By reading this guide you are taking an important step in your 3D printing journey. By presenting the key considerations for implementation of 3D technology we hope to support you in making an informed investment choice.

Which 3D printing solution is right for me?

The choice of 3D technology will be driven by the desired application. The next section will briefly examine some of the most popular industrial applications which utilise 3D printing. By understanding your application you can determine which 3D printing process will work for you

1 | Gartner: Forecast, 3D printers worldwide 2014-2018

3D applications



Concept modelling

Concept modelling is the creation of a physical representation of a design which enables tactile evaluation and communication.

The time saving achieved through 3D concept modelling allows testing of various design ideas during the product development process at relatively low cost. As a result, concept models can drive significant cost savings, and significantly improve communication in the development process, resulting in better products. 3D models will enable the demonstration of ideas and concepts to clients more clearly, unlocking more value in the creative process. Examples of 3D concept modelling are already prevalent in AEC, Education and Manufacturing industries

Functional prototyping

Functional prototyping with 3D printing provides the ability to prove and perfect designs with agile but precise testing.

3D printed functional prototypes make it far easier and less expensive to test ideas before committing to expensive tooling. As product designs begin to take shape, designers need to verify and test design elements to ensure the new product will function as intended. 3D printing allows design verification to be an iterative process where designers identify and address design challenges to spur new inventions or quickly identify the need for design revisions. It is already used extensively in manufacturing and engineering.

Rapid tooling

Within the manufacturing process, 3D printing enables the rapid development and deployment of customised tooling to improve efficiency and speed.

3D printing is helping revolutionise tool making. Enabling manufacturing and engineering companies to produce short run jigs and fixtures as well as create pre–production tools which can be used for final product sign off. Rapid tooling enables companies to deliver a more efficient and cost effective production process in comparison with traditional production methods. Supporting the delivery of an improved time to market for all tooling.

End-use parts

3D printing can be used to produce end-use parts with enhanced flexibility and speed.

Producing parts with traditional production technologies such as injection moulding means design processes have to stop before the mould is produced, which means that further design improvements can no longer be made due to the high cost of changing the mould.

The direct manufacturing of end-use parts and assemblies in plastic and metal materials using a 3D printer enables the implementation of design changes, even during the production phase. This allows businesses to stay flexible, creating additional design iterations even after initial production, and to respond quickly to changing market requirements.

Materials

Linked to the technologies available are the range of materials that you have the choice to print in. Often the decision to choose a desired technology stems from your application and the associated material requirements. Your 3D printed part may need specific behavioural properties such as rigidity, flexibility or heat toloreances. Selecting, the right material for your need is a simple but important choice.

Technology: What are the next steps?

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Once you've decided on your application, the next step is to make a decision about the right kind of technology. There are a number of 3D printing processes available today. Here we will focus on 3 key methods of 3D printing, MultiJet printing, ColourJet printing and Stereolithography.

MultiJet Printing

MultiJet Printing (MJP) is used to build parts, patterns and moulds in high quality durable plastics, with fine feature detail to address a wide range of applications. These high-resolution printers are economical to own and simple and clean to operate. A big benefit of MJP is that post processing is virtually hands-free , saving operator time and enabling delicate features and complex internal cavities to be thoroughly cleaned without damage. Parts have a smooth finish and offer high levels of durability.

Ideal for: Custom tooling, testing mechanical interfaces (form and fit) pre-production tools (creating the parts that allow you to mass manufacture)

ColorJet printing

ColorJet Printing (CJP) enables the printing of highly detailed, full colour models.

A loose powder is spread in thin layers. After each layer is spread, colour binder containing ink (cyan, magenta, yellow & black) is selectively jetted from inkjet print heads over the layer, causing the powder to solidify. The build platform lowers with every subsequent layer which is spread and printed, resulting in a full-colour three-dimensional model. Whether printed with colour or in standard white, parts can be additionally clear coated to add a hard, smooth coating or wax coated to create a smooth surface finish. Parts are highly detailed but less durable than those produced with MJP or SLA.

Ideal for: Full colour concept models, architectural models and demonstration models

Stereolithography

Stereolithography (SLA) is a printing process by which liquid plastics are cured with laser light to form solid objects. Due to the range of materials, build-speed and surface finish, SLA is an extremely adaptable process for producing highly detailed functional prototypes and end-use parts. Whilst the initial investment in SLA is typically higher than MJP, the unit cost of production is low making it an ideal technology for high volume production.

Ideal for: Functional prototyping, end-use parts and high volume applications.

Software Considerations

File and build preparation are critical processes in the 3D printing workflow. Whilst some of these functions can be performed in CAD packages, it usually makes much more sense to utilise dedicated 3D file preparation software to perform this step. There are a range of software packages which can be used to improve these processes. Choosing the correct software for your application is a critical step in maximising the productivity of your 3D proccesses.

Design workflow

When looking to implement and maximise the benefit of 3D printing it is important to consider your design workflow. The basic design workflow is described here:

Native CAD File
▼
File Preparation
▼
Build Preparation
▼
3D Printing

Design workflow

Sizing and Splitting

Whichever type of technology you are using, the physical size of your printed object needs to be factored into any 3D build. 3D printing job time is always dictated by part height due to the number of layers required. For example, a print job the size of a football will always take longer than 12 golf balls even though the material required is the same. On top of this, it is important to consider the maximum build area of the printer. It may be necessary to resize or to split the model so that it can be printed in parts and assembled in post processing. As well as enabling the printing of objects which exceed the build volume of the printer, when used creatively, this type of operation can enable you to improve print speeds. Specialist file preparation software makes this type of operation easy.

The process starts with the 3D CAD file which needs to be reproduced. This can come from a variety of sources including 3D scan data and new 3D CAD designs. Most modern 3D modelling packages provide interfaces and output formats which are compatible with 3D print software.

File preparation is the next important step. Is any scalling required to print the model? An architectural model for example will require significant scaling that may impact the reproduction of detailed features. Is the model solid and could it be hollowed? Often, a hollowed version of the model will be fit for purpose and will save time and material when printing. Whilst this could be done in a CAD package, it usually makes much more sense to utilise dedicated 3D file preparation software to perform this step (see software considerations)

The final step is to prepare the 3D build. Here decisions will be made about orientation, number of parts and postioning within the build.

Questions to ask could include:

- **Can the parts be orientated to make the build faster?**
- **Can parts be stacked to create a more efficient build?**
- **Can parts be arranged to simplify post-processing?**

Within any application, by implementing an effective deign workflow it is possible to radically improve the productivity of 3D printing processes and to maximise the quality of the 3D printed output.

Post Processing

Following the printing of a 3D part, various operations are required to make the item ready for use. This post-processing stage consists of two main steps, support removal and finishing which will determine the look-and-feel and mechanical performance of your printed object.

Support removal and cleaning	▸	Finishing

Support removal and cleaning. All 3D printing processes utilise support material. This has many advantages including the ability to print connected, moving parts in a single build and the option to stack and orientate objects in a flexible way. The support removal and cleaning process varies by technology. MJP utilises wax material and requires a melting process to remove supports. CJP requires a more traditional cleaning process to remove loose powder. Following this some additional cleaning may be required depending on the required finishing process.

Finishing Depending on the technology used, there are a variety of finishing options available. CJP models can be dipped in sealing materials to enhance strength and colour definition. MJP and SLA models can be finished in a myriad of ways including painting, lacquering, polishing to create clear parts and metal plating. In many prototyping applications, no finishing will be required since the printed model, cleansed of support material will be suitable for the intended use.

As with any production process it is important to start with the end-result in mind. Therefore the type of finishing you want to apply to a printed object can have a significant impact on the technology which you choose to adopt.

Post Processing

Final thoughts

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In this document we have outlined some of the key considerations for those looking to begin their journey with 3D printing. Understanding your application is a vital starting point, enabling you to identify the best 3D printing process to fit your requirement. Additional considerations such as design workflow and post-processing should also be considered as the pre and post printing processes are often as important as the print itself.

3D printing is delivering innovation to businesses across the globe enabling faster and more effective product development and production. By understanding and effectively designing your end-to-end workflow you can fully unlock the potential of 3D printing technology. For more information or advice then please contact your local Canon 3D representative who will be more than happy to discuss how Canon can support as you embark on your journey into 3D printing.

Contact Information

For more information please visit,
www.canon-europe.com/for_work/business-products/3d-printers