CASE STUDY - 3D PRINTING

Sorting Wheel

CNC Machining vs. 3D Printing (FFF)

Version 01

Growth Garage

MITSUBISHI CHEMICAL ADVANCED MATERIALS

Sorting Wheel

CNC Machining vs 3D Printing (FFF)

Objective

Relative production cost comparison between **CNC Machining** and **3D Printing** (FFF, Fused Filament Fabrication) of a **sorting wheel**.

Both CNC Machining as well as 3D Printing can be used for **functional prototyping** and **small series production**. In this case study, the production of 1 and 5 pieces are taken into account.

Source: Sorting wheel example produced at MCAM

Application Description

This part is used in an automated sorting operation. It is a non-standard part that only requires 1-5 pieces to be replaced every year. Due to the low volume, injection molding is not practical nor cost efficient and so it is traditionally machined out of a large rod of nylon. Due to the thin fins of the design, machining is a tedious and time intensive process that results in a large amount of waste material.

Sorting Wheel – Input Parameters

CNC Machining vs 3D Printing (FFF)

CNC Machining

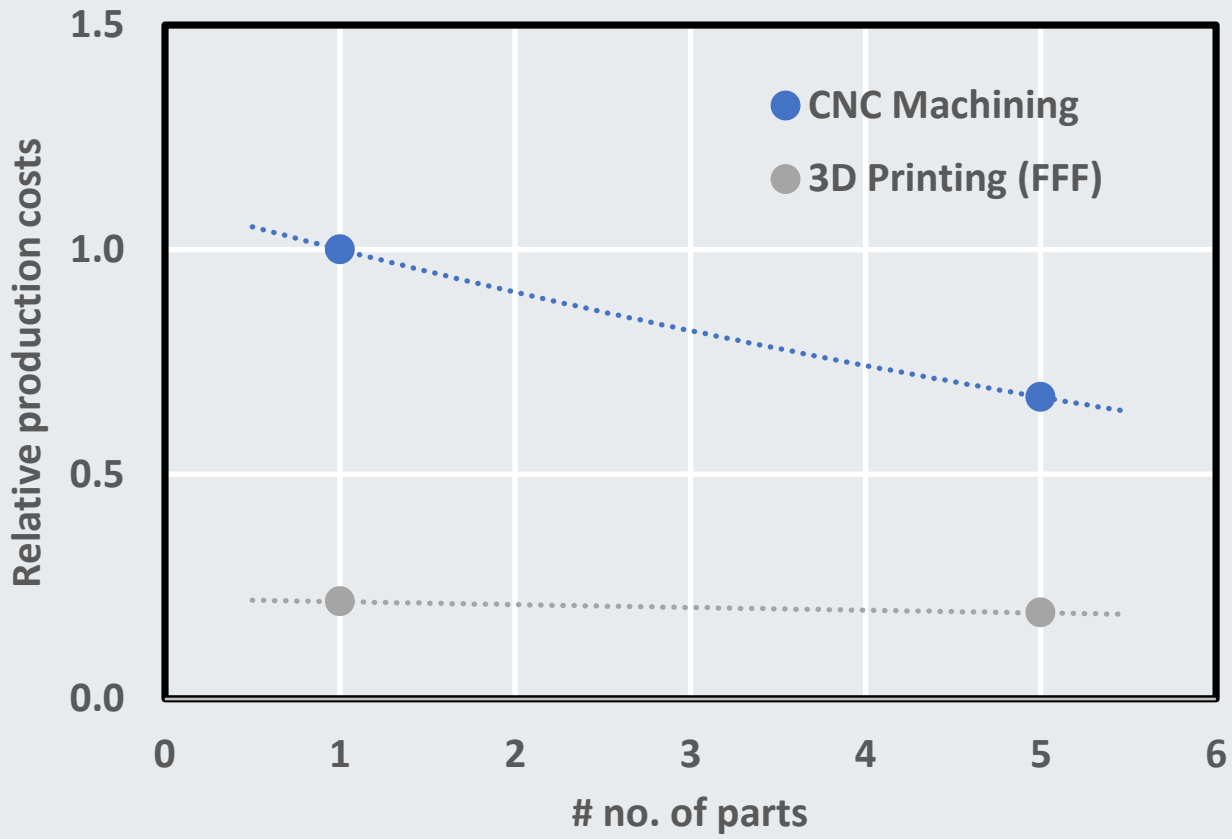
- **Material**
  - Nylon (polyamide)
- **Approx. part dimensions**
  - 6.75”x 6.75”x 3” (172 mm x 172 mm x 76 mm)
- **Required material for part**
  - 4.8 lbs (2,175g)
- **Tolerance**
  - ±0.005” (±0.127 mm)
- **Surface finish**
  - √125 RMS
- **Approx. fabrication time**
  - 20 hours with fixture build (12 hours CNC time)

3D Printing (FFF)

- **Material**
  - Nylon (polyamide)
- **Approx. part dimensions**
  - 6.75”x 6.75”x 3” (172 mm x 172 mm x 76 mm)
- **Required material for part**
  - 0.85 lbs (388g)
- **Tolerance**
  - ±0.010” Z-Direction (±0.25 mm) / ±0.040” XY-Direction (±1 mm)
- **Surface finish**
  - Varies depending on location, fairly rough in Z-direction
- **Approx. print time**
  - 7.25 hours

Sorting Wheel – cost comparison

CNC Machining vs 3D Printing (FFF)



In this example, 3D printing of prototypes or small series production is **significantly lower in costs**.

To chose the right production technology, other requirements such as **surface finish**, **dimensional accuracy**, **part size**, **production time** and **production waste** need to be taken into account. Some of these requirements can be overcome utilizing post processing techniques.

To facilitate smooth scaling of your product, you could consider hybrid production technologies, such as 3D printing of the tool for injection molding: **SPRINT** (Soluble Printed Injection Tooling). This technology requires relative low investment upfront and will result in very reproducible scaling when shifting to hardened steel tooling (high upfront investment) when volumes are increasing.

Scaling matrix

# of parts	Manufacturing technology	Design freedom	Volume (# parts)	Upfront investment (tool)	Speed	Size part	Engineering plastic materials	
1 – 10	Functional prototyping and small series	Very High	Low	Very low	< 1wk	Small – Medium	All, KyronMAX®	3D printing (FDM or FFF) of a visual/functional part
1 – 10	Functional prototyping and small series	Very High	Low	Very low	< 2wks	Small – Medium	All, KyronMAX®	SPRINT (Soluble Printed Injection Tooling) is based on AddiFab's Freeform Injection Molding technology. It provides the flexibility of 3D printing (of the mold) with injection molding quality. It enables the production of small series parts that are 100% functional and can be scaled at low risk to high volume injection molding. Max size of the printed mold 96x54x150mm. Up to 4 molds can be combined to expand the build envelope.
1 – 100	Machining (CNC)	Moderate	Low	Low	2wks	Small – Very large	Limited by degree of fillers or very soft materials	Customization of plates, rods or neat net shapes.
10 – 1000	Near net injection molding + Machining (CNC)	Moderate	Low – Medium	Medium	2wks	Small – Very large	Limited by degree of fillers or very soft materials	Cost effective way of production by combining injection molding of near net shapes (NNS) in combination with machining for adding features and creating very tight tolerances
100 – 10,000	Injection molding – Machined aluminum tool	Low – Moderate	Low – Medium	Medium	4-6 weeks	Medium	All, KyronMAX®	Conventional injection molding.
100 – 250,000	Injection molding – 3D printed metal insert in mother tool	Moderate	Medium – High	Medium	<6wks	Low Medium	All, KyronMAX®	Injection molding with a 3D printed metal insert. Max size is approx. 250*250*250 mm.
>10,000– 1 Million	Injection molding - Hardened Steel tool	High	High	High	10 – 24wks	Very large	All, KyronMAX®	Complete hardened tool with moving parts.

THANK YOU

Get in touch:

brian.yarcich@mcam.com

Visit:

Growth Garage

Visit:

MCAM

Visit:

KyronMAX®

North America

Mitsubishi Chemical Advanced Materials Inc.

2120 Fairmont Avenue,
PO Box 14235 - Reading, PA
19612-4235, USA

Tel 1: 800 366 0300
Tel 2: +1 610 320 6600

Europe

Mitsubishi Chemical Advanced Materials Europe NV

Galgenveldstraat 12,
8700 Tielt, Belgium

Tel: +32 051 42 35 11

Asia Pacific

Mitsubishi Chemical Advanced Materials Asia Pacific Ltd.

Unit 7B, 35/F, Cable TV Tower,
9 Hoi Shing Road, Tsuen Wan,
Hong Kong, China

Tel: +852 2470 26 83