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Technology Education Concepts

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## Rapid Prototyping: Hype vs. Reality

Many product designers and engineers who are researching additive RP systems as a way to test form, fit and function of their prototypes may be unaware that there is a better, cheaper, faster solution. Roland subtractive RP systems (SRP™) produce form models faster than any 3D printer on the market and easier than any other CNC mill on the market. That's because Roland offers a complete software/hardware solution that combines the ease of use of 3D printers with the benefits of CNC-machined parts.

On the following pages, you'll find a comparison of actual parts milled with a Roland milling machine and a 3D printer. You'll also find a Cost of Ownership comparison. Finally, we've included a testimonial by inventor and entrepreneur Joe Matteo.

### Table of Contents

p.1	Subtractive Rapid Prototyping
p.1	Key Advantages of SRP Over 3D Printers
p.2	Roland MDX Product Comparison
p.3	Fit, Finish and Functionality
p.4	Material Selection
p.5	Making Parts In-house vs. Using an Outside Machine Shop
p.6	Cost of Ownership
p.7	SRP Player Software Workflow
p.8	Customer Testimonial

### Key Advantages of SRP Over 3D Printers:

- SRP (Subtractive Rapid Prototyping) provides a wide choice of materials, smooth surface finish, tight tolerances (MDX-40 +/- .002", MDX-540 +/- .001) and a low cost of ownership.
- All Roland products come complete with bundled CAM software. No G-Code programming required.
- Products include a 1yr parts/labor warranty and one way shipping.
- Mills use industry standard tooling.

# Roland MDX Product Comparison

Model	Price	Build size	Materials	Options	Notes
MDX-15	\$3,145	6" x 4" x 2.4"	Foams, plastics, wood		Includes probe scanner for 3D scanning
MDX-20	\$4,696	8" x 6" x 2.4"	Foams, plastics, wood		Includes probe scanner for 3D scanning
MDX-40A	\$7,995	12" x 12" x 4.1 with 4th axis: 4.7" dia. x 10.6"	Foams, plastics, wood	4th axis, dust bin, probe scanner	G-Code supported, but not required
MDX-540	\$20,995	19.6" x 15.7" x 6.1"  With 4th axis: 7" dia. x 14"	Foams, plastics, wood, light metals (brass, aluminum, copper)	4th axis, t-slot table, cover	G-Code supported, but not required
MDX-540S	\$26,295				"S" = high precision ball screws provide ultra high surface smoothness and repeat accuracy
MDX-540A	\$31,495				"A" = Automatic tool changer included (4 tools)
MDX-540SA	\$36,795				



MDX-40A Series



MDX-540 Series



MDX-15/20 Series

# Fit, Finish and Functionality

## Tighter Tolerances

Roland MDX SRP Mills deliver the exact precision required. By contrast, additive systems lay down material in layers, and the tolerances are limited by the thickness of these layers.

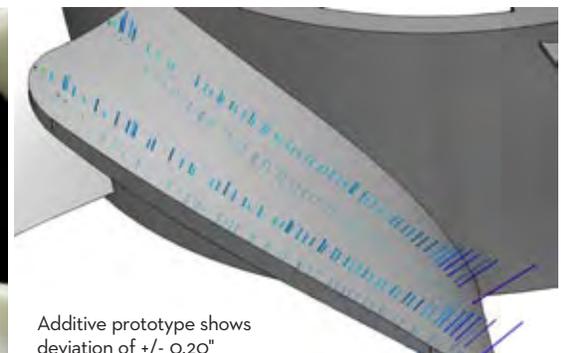
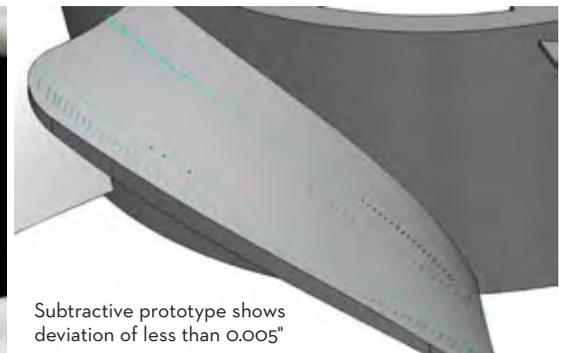
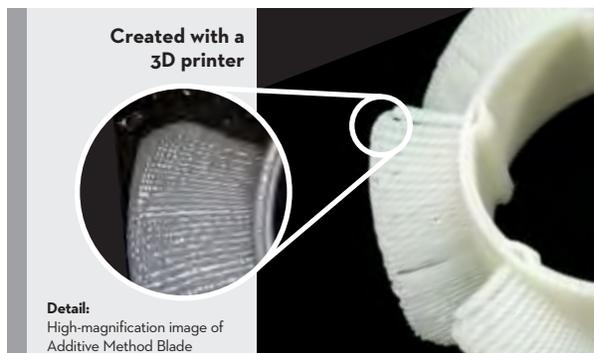
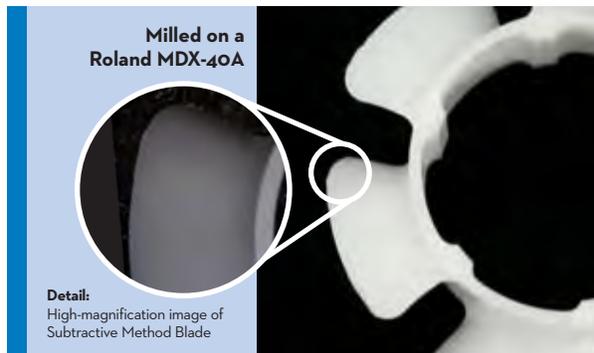
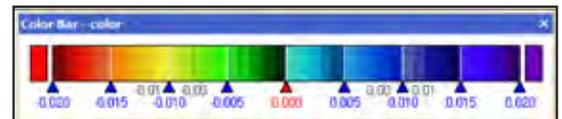
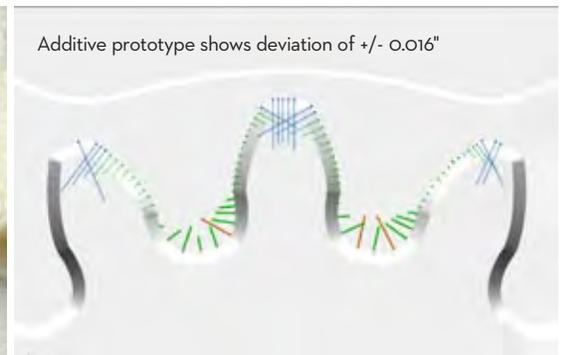
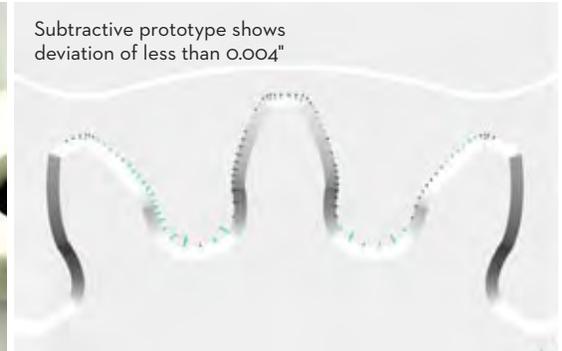
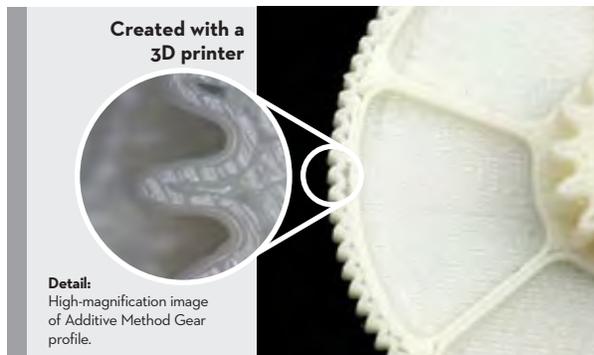
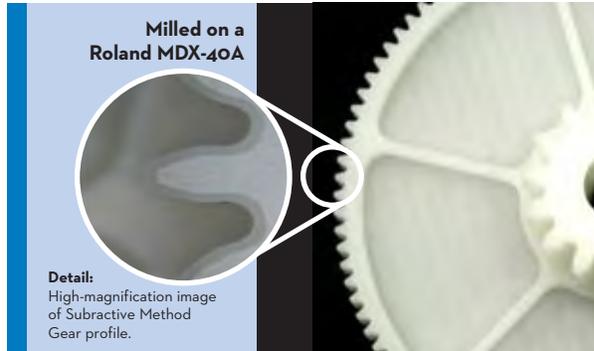
## Smoother Surface Finish

When viewed side by side, the difference is clear.

## Details

Subtractive parts were milled with Acetal Copolymer on the MDX-40A.

Additive parts used ABS-based material.

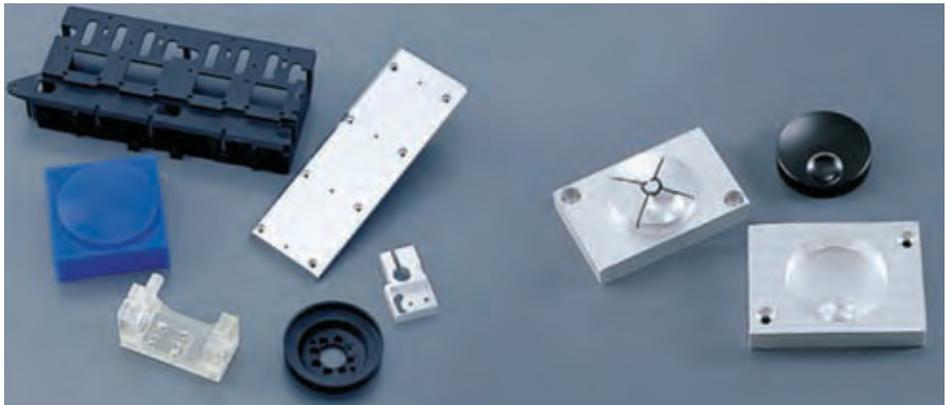


# Material Selection

**Support for a wider range of materials** - Choose from ABS, acrylic, aluminum, chemical woods, plaster, styrene, Acetal, Nylon and FDA approved plastics.



Acrylic, Acetal and other plastic materials are perfect for SRP.



Short-run industrial parts, prototypes and molds milled with SRP on wax, aluminum, ABS, Acetal and acrylic.



Acrylic wheel milled using Subtractive Rapid Prototyping (SRP).



Tooling board gear shift knob prototype created with the MDX-40A, shown with finished parts.



Finished phone prototype with wood, ABS and aluminum parts milled by the MDX-540.



ABS iPod prototype case milled with SRP.

# How much will SRP save you?

## Making parts in-house vs. using an outside machine shop.

The following examples are real world parts that were used for a variety of applications from visual concept models to prototypes and functional production parts, all created using Roland SRP technology. SRP gives you a greater choice of materials so you can select the optimum material for your design instead of being limited to proprietary materials from 3D print vendors. The tight tolerances and smooth surface finish of SRP ensure you won't compromise a thing.



### Fan Part

This functional model is used on our machines to blow chips out of the cutting area when milling acrylic, wood or aluminum. Once the model was created it was put to work immediately after being removed from the machine. Visit our website to see a video of this part being created and used.

Approximate part dimensions: 40mm x 40mm x 10mm | Part build time: 1.1 hour

R.O.I.	
Acetal Material	\$9.50
Labor (1/2 hr)	\$17.32
<b>Total Cost</b>	<b>\$26.82</b>
Value	\$199.00
<b>Savings</b>	<b>\$172.18</b>



### Hair Dryer Prototype

When the designers wanted to test the fit and finish of a new travel sized hair dryer, they used Roland SRP technology to produce a prototype that would go beyond concept. Accurate materials, smooth surface finish and tight tolerances gave them an assembly that could stand up to thermal and impact testing.

Approximate part dimensions: 135mm x 175mm x 60mm | Part build time: 12 hours

R.O.I.	
Acetal Material	\$65.00
Labor (2 hrs)	\$69.30
<b>Total Cost</b>	<b>\$134.30</b>
Value	\$1,768.00
<b>Savings</b>	<b>\$1,633.70</b>



### Gear Prototype

This gear was used as a prototype to test real world functionality. This is a fully operational gear, cut in the exact material that the final product would be produced in. It's fit, finish, and structural integrity mimic the final product allowing for accurate component testing.

Approximate part dimensions: 51mm x 51mm x 15mm | Part build time: 3.7 hours

R.O.I.	
Nylon Material	\$5.00
Labor(1/2 hr)	\$17.32
<b>Total Cost</b>	<b>\$22.32</b>
Value	\$199.00
<b>Savings</b>	<b>\$176.68</b>



### Bearing Block Prototype

Medium density tooling board provides extremely fast concept models that are dimensionally accurate. This material allows users to create concept models at a fraction of the time of plastics or non-ferrous metals giving you a dimensionally accurate, smooth surfaced model that will hold up to design reviews.

Approximate part dimensions: 165mm x 67mm x 40mm | Part build time: 3.2 hours

R.O.I.	
Tooling Board Material	\$25.00
Labor (1 hr)	\$34.00
<b>Total Cost</b>	<b>\$59.00</b>
Value	\$950.00
<b>Savings</b>	<b>\$891.00</b>



### Rocker Arm Prototype

This aluminum rocker arm prototype was an early design model used to test the overall shape and function of a mountain bike part. This prototype was created in production grade material to match the production part and confirm fit, finish and functionality.

Approximate part dimensions: 140mm x 45mm x 7.5mm | Part build time: 2.1 hours

R.O.I.	
Tooling Board Material	\$25.00
Labor (1 hr)	\$34.00
<b>Total Cost</b>	<b>\$59.00</b>
Value	\$950.00
<b>Savings</b>	<b>\$891.00</b>



### Fixturing Prototype

This assembly is composed of several close tolerance parts. The jig required a special fixture clamp that was not commercially available and was quickly created on a Roland SRP milling machine. The acetyl copolymer material will maintain tolerances over the entire production run.

Approximate part dimensions: 28mm x 98mm x 48mm | Part build time: 4.2 hours

R.O.I.	
Acetal Material	\$20.00
Labor (1 hr)	\$34.00
<b>Total Cost</b>	<b>\$54.00</b>
Value	\$375.00
<b>Savings</b>	<b>\$321.00</b>

*Note: Parts featured here were sent to an outside service bureau whose price was average for machine shops.*

# Cost of Ownership

Affordable pricing, no annual maintenance fees and low material costs will save you thousands over alternative RP systems.

6

Comparable 3D Printer vs. Roland MDX-540A	Comparable 3D Printer <sup>2</sup>	Roland MDX-540A
Build Area	10x10x12	15x15x6
Warranty	90 days	1 year
Machine Purchase Price	\$29,900.00	\$31,495.00
Accessories/options/support removal bath <sup>3</sup>	\$3,000.00	\$6,970.00
<b>Purchase Price Subtotal</b>	<b>\$32,900.00</b>	<b>\$38,465.00</b>
Annual Maintenance	\$3,000.00	\$0.00
Annual Material Cost <sup>1</sup> – Finishing costs (binders, fillers, support removal solution, support removal tools, etc)	\$2,592.00	\$432.00
Annual Cost Subtotal	\$5,592.00	\$432.00
<b>5 year maintenance &amp; material cost</b>	<b>\$27,960.00</b>	<b>\$2,160.00</b>
Total 5 year cost of ownership	\$60,860.00	\$40,625.00
<b>5 year savings over comparable 3D printer</b>	<b>\$20,235.00</b>	

Comparable 3D Printer vs. Roland MDX-40A	Comparable 3D Printer <sup>2</sup>	Roland MDX-40A
Build Area	8x6x6	12x12x4
Warranty	1 year	1 year
Machine Purchase Price	\$14,900.00	\$11,590.00
Accessories/options/support removal bath <sup>4</sup>	\$3,000.00	\$1,160.00
<b>Purchase Price Subtotal</b>	<b>\$17,900.00</b>	<b>\$12,750.00</b>
Annual Maintenance	\$1,500.00	\$0.00
Annual Material Cost <sup>1</sup> – Finishing costs (binders, fillers, support removal solution, support removal tools, etc)	\$2,592.00	\$432.00
Annual Cost Subtotal	\$4,092.00	\$432.00
<b>5 year maintenance &amp; material cost</b>	<b>\$20,460.00</b>	<b>\$2,160.00</b>
Total 5 year cost of ownership	\$38,360.00	\$14,910.00
<b>5 year savings over comparable 3D printer</b>	<b>\$23,450.00</b>	

<sup>1</sup> Material Cost Calculator		
Estimated cost/cubic inch	\$6.00	\$1.00
Average cu/in per part	12	12
Average cost per part	\$72.00	\$12.00
Parts per year	36	36
<b>Total annual material cost</b>	<b>\$2,592.00</b>	<b>\$432.00</b>

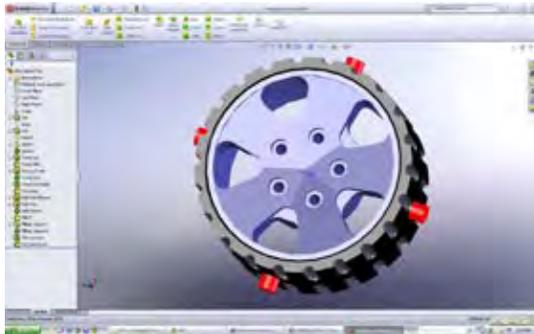
<sup>2</sup>Information correct at time of printing

<sup>3</sup>MDX-540A accessories include: safety cover, rotary 4th axis, 4 standard tools, 4 collets

<sup>4</sup>MDX-40A options include: dust tray and 3D probe scanner, and 4 standard tool

# SRP Player Workflow

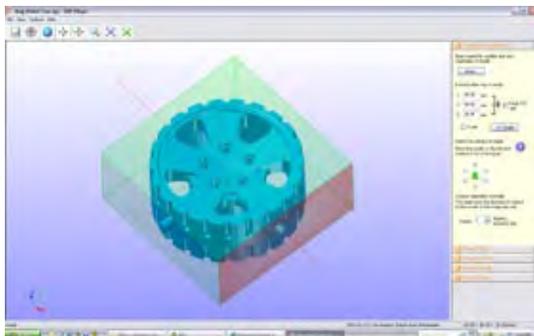
Roland MDX SRP Mills come complete with SRP Player Software to prepare your CAD model for SRP prototyping with no programming skills required.



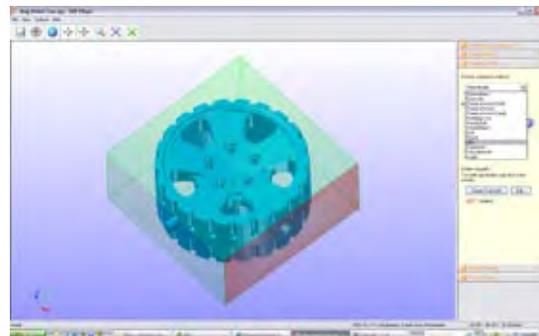
**1.** Create your design in your favorite 3D Software



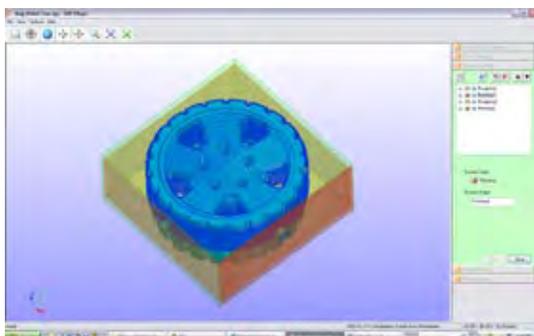
**2.** Export from your CAD as an .STL file or .DXF, .3DM, or .IGS/.IGES



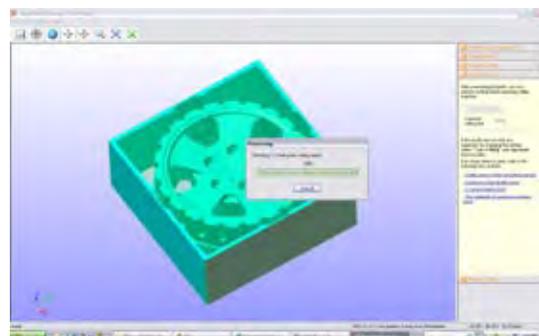
**3.** Open the .STL File in Roland SRP Player Software (included with machine)



**4.** Follow the Wizards to orient model, select material and tool size



**5.** SRP Player automatically generates machine instructions (Tool Paths)



**6.** Preview results, then click "Send to Machine" to make your model!

# Customer Testimonial

## Subtractive Rapid Prototyping for Microscale Medical Applications

*“The process of product development is really accelerated by having this machine. It has allowed me to cost effectively make parts I wouldn’t previously consider attainable.”*

Joe Matteo, founder MicroTypes, LLC

Ask MicroTypes, LLC founder Joe Matteo why he chose Roland’s MDX-540 Subtractive Rapid Prototyping milling machine and he’ll start by naming the many substances the MDX-540 can process. “The driver for me was the broad choice of materials. I wanted to use the parts produced as actual prototypes, so I was looking beyond fit and finish,” said Matteo. “With the MDX, I can machine our devices in, for example, aluminum, Delrin, Teflon and PEEK to test the best material for our applications.”

Matteo relies on the Roland MDX-540 to produce precision components for high-tech instruments used in medicine and science. The instruments contain micro-scale parts with features as small as 75 microns, approximately the thickness of a human hair. Maintaining pressures as high as 1000 psi (pounds per square inch) requires that the prototype parts have extremely accurate fit and finish to create tight seals. “The machine’s precision is incredible,” said Matteo. “I can create a slip fit or a press fit without hesitation.”

“Reducing costs and increasing the number of iteration cycles in the development process is critical for high technology products to be successful. The process of product development is really accelerated by having this machine. It has allowed me to cost effectively make parts I wouldn’t previously consider attainable,” said Matteo. “I rely on the MDX-540 to get our products to market quickly.”

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