Mosaic

3D Printing Custom Foot Orthotics:

Throughput and cost-per-part analysis using Element/Array

Executive Summary - Element and Array in Orthotics

Although advancements in 3D Printing technology have made printers more accessible, reliable, easy of use, a lack of scalability, and high labor component remain a pain point for businesses looking to incorporate additive manufacturing into their workflow. As over 65% of businesses are seeking to adopt additive manufacturing processes and technologies, it is imperative we work to address these issues head-on.

Array and Element offer core technologies that dramatically improve your production throughput, providing your business with a scalable solution for the utilization of 3D printing in the workplace. As it pertains to orthotics, Element and Array – in conjunction with our software solution, Canvas – provide an entirely new workflow that drastically improves the efficiency of existing orthopedic production methods, helping patients to more quickly access the care they need. These improvements are achieved through automating many of your current production methods, enabling you to significantly reduce the cost per pair.

With Array and Element, you are able to digitize the entirety of your production process from creating the original patient foot scan, to modifying your file and sending it to print. In addition to the obvious benefit of making your production processes more efficient and accessible for staff, this can incur incredible cost savings, allowing you to optimize margins by serving a larger pool of patients.

Adopting a digital process with can save up to **93% of labor time per pair,** and **decrease** cost per pair **by up to 71%**, increasing your profit on a per pair basis. These workflows and comparisons are examined below, to help you understand how adopting digital manufacturing can greatly impact the future of your clinic or lab.

Traditional Orthotics Approach

35-60mins

Time needed to make a pair of Orthotics

250%-428% slower

Array/Element Approach

13mins

Time needed to make a pair of Orthotics

2.5x more parts per hour of Labor

21-46mins

Time saved using Array/Element

Produces 2.5x as many orthothics

Breakdown of each method

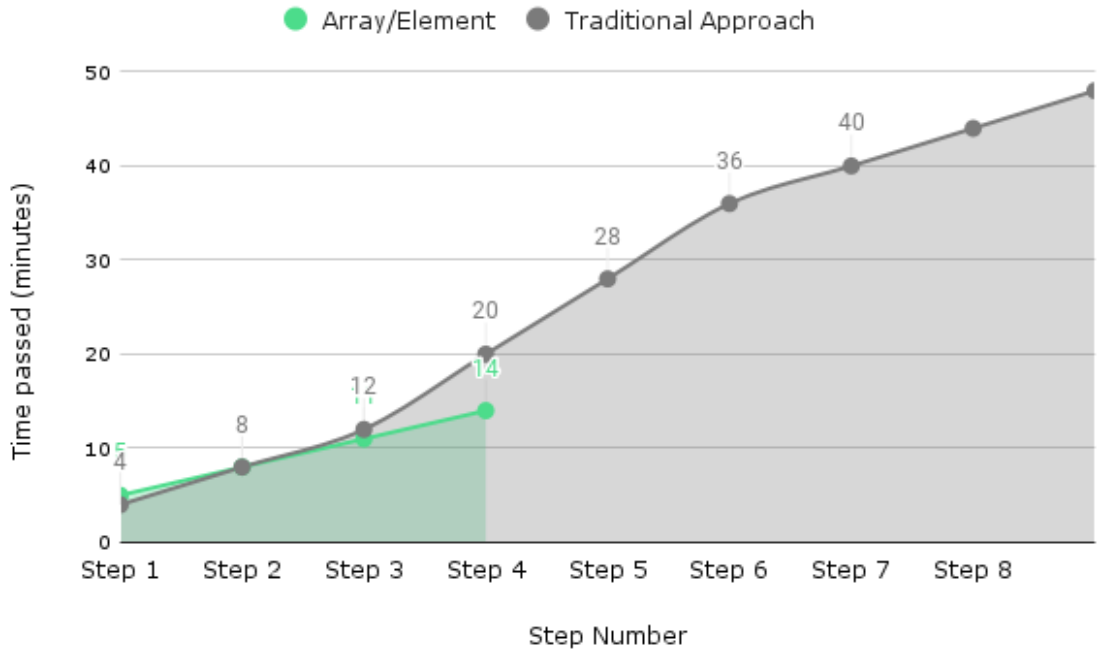
Traditional Orthotics Approach

1	Cast of Patient's Foot	3-5 Minutes	**35-60mins of Labor**
2	Scan Cast of Foot	3-5 Minutes	
3	Program CAM for CNC	3-5 Minutes	
4	Mill and process part for forming	5-10 Minutes	
5	Thermoform plastic sheet	5-10 Minutes	
6	Cut out shell and sand	5-10 Minutes	
7	Apply corrections and met pads	3-5 Minutes	
8	Apply glue and top+bottom covers	3-5 Minutes	
9	Trace, trim and buff top cover	3-5 Minutes	

Array/Element Approach

1	Scan patient's foot	5 Minutes	**13mins of Labor**
2	Process with the Printed Foot Software	3 Minutes	
3	Import into Canvas and send to Element/Array	3 Minutes	
4	Remove orthotic pair from Printer for patient	3 Minutes	

Labor Cost (as Time) Spent Producing Orthotics



An Introduction to Element and Array

Element is an industrial 3D printer, at an accessible price. It has been designed with reliability and user experience in mind. Array is an automated 3D printing system, consisting of four Element 3D printers. Array helps companies scale their output, while decreasing their total cost per part. Array and Element offer a number of benefits over existing approaches to help incorporate 3D printing into your organization

Plug and Play

We have curated an end to end workflow (scan to orthotic) that is easy to use. We provide training and support to help you get up and running quickly and to ensure long term success.

Reliability and Repeatability

Element and Array were designed to produce parts at scale. This means Element and Array have the highest quality components to ensure repeatability across parts, and reliability to print for years to come.

Autonomous Printing

Array's automation systems and part storage cart allow it to run for a min of 72 hours with no operator intervention. 24/7 operation increases printer uptime by over 50%, leading to significant cost and throughput benefits.

Scalability

With Array, one operator can run the equivalent of 250 3D printers. Multiple Arrays can work in parallel with each other, giving you a scalable approach to streamline your process at any required throughput level. This means one operator can manage the systems to print over 10,000 custom orthotics / month.

Modular Design

Element and Array were designed with serviceability in mind. This means Element and Array can be operated by non-technical users. With an easily swappable extruder, and the ability to remove and replace an Element print core you can be sure your Array spends its hours printing productively.

Accessible, High Quality Materials

Mosaic Materials were designed to be a long term solution, with a focus on automation, accessibility and quality. You can learn more about these materials via the material data sheets attached to the end of this report.

Simple, Straightforward Software

Array's automation systems and part storage cart allow it to run for a min of 72 hours with no operator intervention. 24/7 operation increases printer uptime by over 50%, leading to significant cost and throughput benefits.

Same Orthotic, made with a Modern Process

Array and Element are able to produce a broad range of orthotic styles, including many of the most popular styles and a few exciting new variations as well. These new variations include orthotics that require no post processing, making the entire production process digital.

¾ length with added foam top cover

Similar to current ¾ length orthotics, these require the addition of a foam top cover after the printing process is complete. Typically, these orthotics take around 1-1.5 hours / pair to complete. They are printed fully custom, and other than the foam top cover do not require any post processing. Available in two materials, our durable Polypropylene or our Ortho Composite Polypropylene for a stiffer and thinner orthotic.

Full Length with added foam top cover

Similar to the ¾ length orthotics, if you prefer to add the foam top cover, you can decrease print time and associated machine cost by removing the printed top cover, and installing a foam top cover manually. Typically, these orthotics take around 45 minutes to 1.5 hours per pair to complete. Printed in our Mosaic Aero this is light weight, smooth, and has a digitally customizable stiffness ranging from soft to rigid.

Full Length - Printed top cover

This is a new variation, only possible with 3D printing. This orthotic requires no post-processing and is ready to be used by the patient immediately after printing. This means lower lead times for patients, and lower cost per part for labs and practitioners. Typically, these orthotics take around 3-5 hours / pair to complete.

ROI and Buyback Period

When thinking about your return on investment and equipment payback period, it's important to note a few different aspects:

1. **Equipment cost and amortization time**
2. **Running / variable costs**
3. **Overhead and setup cost**

In order to run this calculation, one must look at the average sale price per pair of orthotics, and remove the total cost of the produced part. Below, we look at the profitability of the current, non-3D printed method of producing a specific orthotic:

Calculating Profitability

When comparing this to existing production methods, you will see a significant change in profitability per part. This profitability is key, as it leads to the quick payback period above, as well as a high ROI over time. It also gives you flexibility to make your orthotics more accessible, allowing you to serve a broader range of patients.

For this model, we'll use the below inputs for the cost of a traditionally manufactured ¾ length orthotic with a foam top cover.

Cost, Traditional / Non-3D Printed method

Materials and Equipment	$47.26
Labor	$57.88
Total (per part)	**$105.13**

The average custom orthotic will sell to customers for $400, leaving a profit per pair of $294.86. If you are producing 50 / month, the monthly profit comes to **$13,743** and yearly that climbs to $176,916.

The Buyback Period

On the next page, we outline a couple of scenarios to help outline what the buyback period would look like with the new 3D Printing method, as well as calculating projected return on investment in each scenario.

Scenario 1: Element 3D Printer, 50 pairs/month, full foot, printed top layer

Equipment Amortization	$3.48
Material Cost	$4.04
Labor + Overhead	$39.94
Total Cost (per part)	**$47.46**

At 50 pairs per month at a low price of $250 a pair, this would be a profit / pair of $202.54. At 50 pairs per month, and a sales price of $400 per pair, this would lead to a profit / pair of $352.54. Over 1 month, this leads to a **profit of $17,627** - *enough to cover the initial equipment expense of $8,000 - $12,000 in less than 30 days.*

Scenario 2: Array, 400 pairs/month, full foot, printed top layer

Equipment Amortization	$3.27
Material Cost	$4.04
Labor + Overhead	$13.36
Total Cost (per part)	**$21.67**

At 400 pairs / month and a sales price of $250, profit/pair is $228.33. At 400 pairs / month and a sales price of $400 per pair, this would lead to a profit / pair of $378.33. Over 1 month, this leads to a **profit of $151,332** - *enough to cover the initial equipment expense of $80,000 - $100,000 in less than 30 days.*

Scenario 3: 2x Arrays, 1000 pairs / month, ¾ length, foam top layer

Equipment Amortization	$1.83
Material Cost	$5.04
Labor + Overhead	$18.12
Total Cost (per part)	**$25.01**

At 1000 pairs / month and a low-end sales price of $250, profit/pair would be $199.99. At 1000 pairs / month and a sales price of $400 per pair, this would lead to a profit / pair of $374.99. Over 1 month, this leads to a **profit of $374,990** - *enough to cover the initial equipment expense of $160,000 - $200,000 in less than 30 days.*

Profitability Comparison Table for Each Workflow

Array	Element	Traditional
Throughput	**Throughput**	**Throughput**
250 pairs/week	25 pairs/week	12.5 pairs/week
1000 pairs/month	100 pairs/month	50 pairs/month
12000 pairs/year	1200 pairs/year	600 pairs/year
Total Cost Per Part	**Total Cost Per Part**	**Total Cost Per Part**
$25.01 USD	*$36.95 USD*	*$105.13 USD*
Profit / Pair	**Profit / Pair**	**Profit / Pair**
$374.99 USD	*$363.05 USD*	*$294.86 USD*
Difference compared to Traditional	**Difference compared to Traditional**	
$80.13 USD	*$68.19 USD*	
Yearly Margin Difference	**Yearly Margin Difference**	
$961,560 USD	**$81,828 USD**	
+76.21 %	*+64.86 %*	

With Element, your cost would be cut down by 65%. If you needed to increase throughput and adopted the Array solution, you could cut your cost per part down by 76%.

With Element you would have a profit per pair of $363. With 50 pairs per month, your profit monthly would increase from $13,700 to $18,150, and your yearly profit would increase from $177,000 to $217,800. This represents a 23% increase in profit over the course of the year.

If you're an Orthotics Lab operating at Array level throughput (1000 / month) your impact is even more evident, as evidenced in the following table:

	Traditional	Array
Orthotics / Month	1000	1000
Cost / Pair	$105.14	$25.01
Profit / Pair	$294.86	$374.99
Monthly Profit	$294,860	$374,990
Yearly Profit	**$3,538,320**	**$4,499,880**

Over the course of your first year, a single Array could drive an additional 27% profit, leading to over $950,000 in additional margin for your lab over a 12 month period. This is over 5x what two Arrays cost to purchase, in additional margin in 1 year. The monetary benefits are in addition to Element and Array helping bring a fully digital workflow into your business, helping your team manage production in a more efficient manner.

The Printed Foot + Canvas Software Platforms

Mosaic's printers work with a wide variety of O&P software packages giving you the ultimate flexibility.

If you don't already have a workflow to go from scanning to printing, we have partnered with The Printed Foot to offer an end to end solution for orthotics production. The Printed Foot allows you to go from scan data, to 3D printable file in less than 5 minutes. Once you have the printable file, Mosaic's Canvas software allows you to easily manage your printing workflows, estimate lead times for customers, and track material usage.

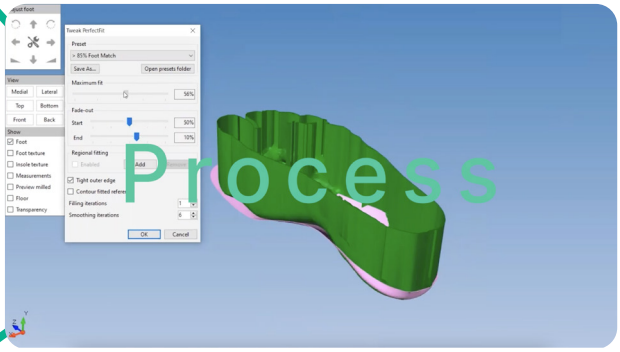
The Printed Foot starts at under $1 per orthotic pair at high volumes and the pricing is already factored into the total costing shared above.

The combination of The Printed Foot and Canvas ensures you can manage the full workflow in a digital environment, creating an efficient way to produce custom orthotics.

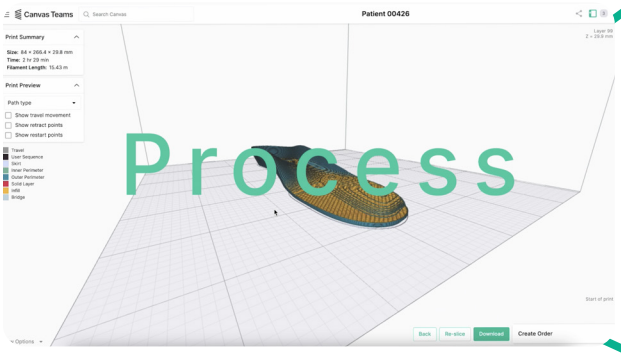
The 3D Printer Software Workflow

1. Photo software scans a patient's foot

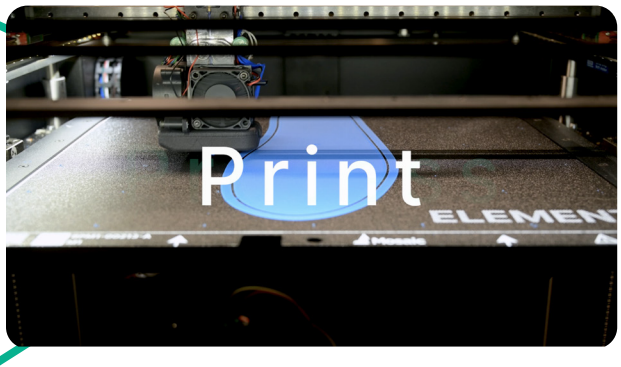
2a. Process scan in The Printed Foot software



2b. Bring file from The Printed Foot, into Mosaic's Canvas



3. Process file and send to Array / Element (Digital) for printing



4. Final orthothic removed from printer and insterted into patient shoe

Materials

While Element and Array are able to create parts in a wide variety of materials (including CF Nylon, PEEK, ABS, and TPU), for the production of orthotics and orthopedics, most practitioners and labs gravitate towards Mosaic Polypropylene, Mosaic Composite Polypropylene and Mosaic Aero. These materials can easily and consistently be used to produce high performance and high quality custom foot orthotics.

Typically, accommodative full foot orthotics (either with or without a printed top cover) are printed in Mosaic Aero material, while ¾ length rigid orthotics are printed in Mosaic Polypropylene or Mosaic Composite Polypropylene.

You can learn more about these materials by contacting our Materials Team at orthotics@mosaicmfg.com.

Looking Towards The Future

Mosaic's end-to-end custom foot orthotics production solution is revolutionizing how orthotics are made, bringing benefits to customers, labs and clinics. By digitizing the production process, you can better control costs and implement a smoother manufacturing process to increase efficiency of your team.

Mosaic's Array Platform is here to not only make it easier for you to make the leap into 3D printing but also to provide an end-to-end solution that fits your needs.

3D printing's ability to produce individual components quickly, without very little user input and is one of the strongest selling points for conventional 3D printing machines and applications. Array turns all of those dials up, by innovating on these already powerful selling points and providing solutions that can and will grow with your individualized 3D printing needs.

If you're interested in learning more about how you can adopt Mosaic's end-to-end production system for your clinic or lab, contact us at: orthotics@mosaicmfg.com.

Mosaic Manufacturing Ltd. is a digital manufacturing company creating the next generation of product delivery systems. Founded in 2013, Mosaic began by enabling 3D printers to create substantially more useful and valuable products. Now, we're working to scale this technology to help millions of people get value from the upcoming waves of customization and personalization.

111 Peter St, Unit 403
Toronto, ON
Canada
M5V 2H1