



GE Additive

# Ready? Go.

Help improve orthopedic applications and drive cost savings with proven metal additive solutions.



Orthopedic Solutions

# From prototype to improved orthopedic outcomes, **find your metal additive advantage with GE Additive.**

Leaders in orthopedics are going to market using metal additive manufacturing and shaping the future of patient care.

**When you're ready to realize your metal additive advantage, GE Additive has the products to help you:**



**Achieve higher throughput with reduced post-processing steps for standard, off-the-shelf implants.**

OR



**Enable cost-efficient and flexible production of patient-specific implants and customized instruments.**

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## **You can realize the benefits for additive in orthopedics.**

### **Design freedom**

Customize the design for patient needs and desired mechanical properties.

### **Complexity is not an obstacle**

Add features that increase functionality and effectiveness of the implant without increasing production steps or cost.

### **Mechanics of the body**

Design porosity, pore size and interconnectivity of trabecular structures to allow for enhanced initial fixation and bone ingrowth.

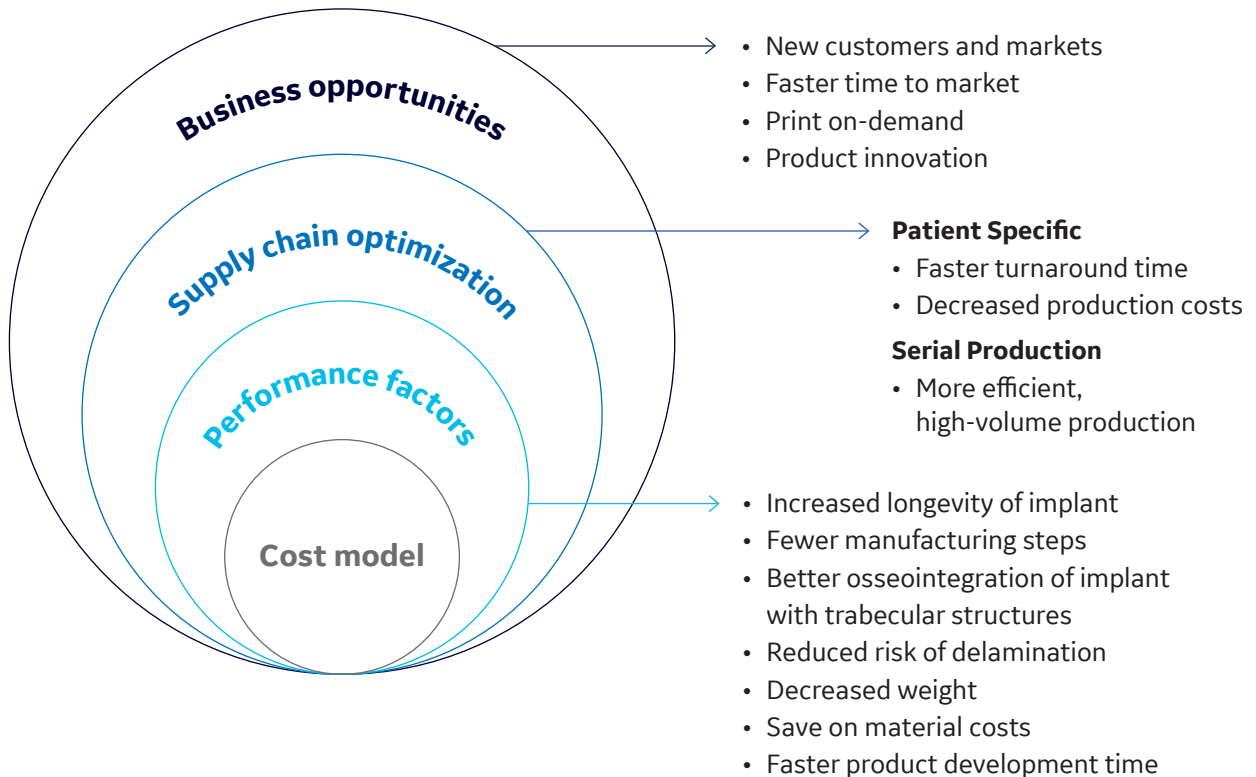
### **One implant**

Reduce the risk of delamination with integrated trabecular structures and simplify the supply chain with implants made in one step and one part.

### **Flexible and efficient production**

Achieve minimal waste and high productivity with off-the-shelf, serial production and low-volume, patient-specific implants.

# Thinking through the bigger business case



“The business case isn’t in a part-to-part comparison; it needs to be justified through system-wide impact. **If a patient-specific implant can accelerate patient recovery, reduce risk and lower overall healthcare costs** for the Quebec government, then we have a business case.”<sup>5</sup>

– François Gingras  
Director of Industrial Equipment at CRIQ



# How much further can metal additive take you?

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## Improve safety and patient outcomes

Endocon's acetabular cup cutter, endoCupcut, features additively manufactured blades for safer, more efficient implant removals

Concept Laser M2 and Mlab machines

**From: 30%** rejection rate of casted blades

**To: 3%** rejection rate of additive blades<sup>6</sup>

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## Enable flexible and efficient production

Endocon's endoCupcut offers variability in one instrument and can be combined with up to 15 additively manufactured stainless steel blades, in various shapes and sizes

Concept Laser M2 and Mlab machines

**From: 3.5 months** for a traditionally manufactured device

**To: 3 weeks** with additive manufacturing

**45% costs saved** compared to traditional methods<sup>7</sup>

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## Customize implants with design freedom

4WEB Medical's spine implant's unique design was made possible with additive

Arcam EBM Q10plus

**360° hierarchical surface roughness** to stimulate bone ingrowth

**75% of implant** filled with graft material for maximal bone incorporation

**40,000+ implants** made in 5 years<sup>8</sup>

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## Increase functionality without added complexity

Sutru Ltd.'s automated suturing device for safer surgeries

Concept Laser Mlab

**From: 1 stitch per 25 seconds by hand**

**To: 3 needle rotations per second<sup>9</sup>**

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## Grow business with serial additive production

Lima Corporation's acetabular hip cup, in full production since 2007

Arcam EBM Q10plus

**9 product launches** between 2007–2018

**145,000 units** produced over 10 years<sup>10</sup>

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## Increase production for new revenue growth

AK Medical, the first Chinese orthopedic company to provide CFDA-certified metal implants

Arcam EBM Q10plus

**100% revenue increase** from metal additive implants in the first half of 2018<sup>11</sup>



# You can learn to manufacture additive implants more efficiently and cost-effectively.

## GE AddWorks™\* offerings

Collaborate alongside global leaders in metal additive manufacturing to strengthen your entry into the production of high-precision implants and instruments.

### Discovery Workshop

Explore additive manufacturing and build your business case. Draft your project roadmap with a cost analysis, benefits and implementation strategy.

### Design Workshop\*\*

An advanced training course teaching universal additive design techniques, including topics like support structures and intricate geometries.

### Industrialization Workshop\*\*

Access tools such as machines and facilities to enable full production. Create a step-by-step plan and a time frame to move toward the production of your metal additive part.

### Production Sprint\*\*

Industrialization Workshop + establish process specifications. Identify and document your “critical Xs” and quality control measures to enable the full production of your application.

## What are our Workshops?

Learn foundational knowledge and fundamental additive strategies in a classroom environment. Workshops typically run three to five days.

## What are our Application Sprints?

Get comprehensive support anywhere on your path to production with training, workshops, and consulting with GE’s AddWorks experts.

## Work alongside the experts who’ve done it before.

Our team is ready to help you bring new innovation to market faster.

### With support from GE Additive

- Avoid missteps in identifying a good business case and move more efficiently toward additive manufacturing production.
- Learn how to incorporate proven methodologies, material parameters, and best practices for additive manufacturing.

### Without support

- Undergo a steep, long learning curve for your team.
- Limit your ability to think ahead. Risk unanticipated expenses and obstacles.

# At the cutting edge of joint replacement surgery

**Challenge:** To meet the rising demands of orthopedic products from an aging Chinese population, AK Medical needed to increase productivity of its orthopedic implants. However, large-scale production of conventionally manufactured implants sometimes don't fit patient-specific needs. AK Medical was looking for a solution that would support both customized implants as well as their off-the-shelf products.

**Approach:** Leveraging metal additive electron beam melting (EBM) technology, AK Medical was able to scale production of orthopedic implants while developing innovative, customized solutions. Today, the company has successfully used EBM technology for over a decade to deliver a diverse range of customized, metal additive implants as well as large-scale, off-the-shelf parts.

## EBM advantages:

**38% costs saved with an acetabular cup** with EBM technology, compared to other additive technologies<sup>12</sup>

**Ability to stack parts in the build tank** for increased productivity<sup>13</sup>

**Build integrated mesh structures** to allow bone ingrowth<sup>14</sup>

**Customized metal additive implants** designed case by case to deal with complicated diseases

## Results:<sup>15</sup>

**100% increased revenue** from metal additive implants during the first half of 2018

**8 Arcam EBM Q10plus machines** scaled volume production in-house

**5 metal additive implants** certified by the National Medical Products Administration (NMPA)



“With our advanced products, we strive to make the treatment of orthopedic conditions more efficient and easier, while bringing about better outcomes and quicker recovery time to our patients.”<sup>16</sup>

– Li Zhijiang  
CEO and executive director at AK Medical



# Improve productivity and transform lives. We're ready.

Our customers have produced **more than 1.6 million medical devices** over the past 13 years. We've seen firsthand how powerful metal additive technology can be to an organization's bottom line—and their patients' well-being. Minimize your learning curve with GE Additive's proven solutions to common challenges.





### Challenge 1

## Identifying the Right Application and Production Setup for Additive

A business plan for metal additive can fall apart in the development phase when the team realizes the part they chose won't result in the ROI they envisioned.

**With GE Additive:** The best application for additive isn't always the costliest or most difficult to manufacture. Engineers must adopt an additive mindset to solve for patient and doctors' needs. Our experts can help your team identify the right production step for additive and build a roadmap for development.

### Challenge 2

## Return on Investment

Sometimes manufacturers won't see a positive ROI with additive if they look only at the cost to make a part. A part-centric business case means manufacturers lose out on larger ROI and innovative, patient-focused solutions while industry leaders forge ahead.

**With GE Additive:** Uncover all the opportunities for ROI that go beyond part cost and consolidation. Thinking through the bigger business case means also looking at performance factors, supply chain optimization and new business opportunities. Work with our team to avoid making critical missteps when creating your business case and determining your ROI.

### Challenge 3

## Gap in Resources, Talent or Experience

**"Lack of adequate skill sets is an industry issue,"** according to an estimated three in four business executives.

**With GE Additive:** Leverage GE Additive's technical expertise, based on our own additive challenges and successes. Get training, hands-on support and more when your team partners with our engineers and specialists from GE's AddWorks\*\*.

### Challenge 4

## Design with Precision

Achieving precision with additive can prove challenging, especially when building medical devices for optimal part quality.

**With GE Additive:** Make high-quality parts faster when you work with GE Additive's experts and proven additive technology. We'll help you establish a locked-down process for full scale production.

\*\*Our AddWorks services for applications in the healthcare industry may be limited and will require additional review

# GE Additive's end-to-end solutions, ready when you are.

See where our experts and offerings can support you—wherever you are on the path to full metal additive production.

## Machines

Our specialty machines offer low machine-to-machine variance to meet your industry requirements and scale production.

Machines:

- **Concept Laser M2 Series 5 (DMLM)**, enabling high productivity and greater surface quality and accuracy
- **Arcam EBM Q10plus**, driving cost savings and large volume production in combination with optimal part characteristics
- **Arcam EBM Spectra L**, allows for mass production of parts by offering the unique EBM feature to tightly stack parts without compromising on quality.

## Powders

Our powders from AP&C are ISO 13485 certified, high-performing powders that take into account a variety of mechanical behavior design data and material science.

Powders:

- Titanium alloys
- Cobalt chromium
- Stainless steels

## AddWorks from GE Additive

Our global team of 200-plus engineers and manufacturing specialists can support your team and accelerate additive adoption in learning AM fundamentals.

- Workshops and training\*\*
- Application Sprints\*\*
- Consulting services\*\*









EBM AND LASER:

# Which 3D printing technology is best for you?



# Our experts will help you find the machine type fit for your orthopedic application.

Key advantages

## Electron Beam Melting (EBM) machines

### Design Freedom

- Allow for dense nesting of entire build tank and large, bulky parts without swelling
- Easily remove supports on parts to create thin, free-floating beams at low costs

### High Productivity

- Achieve high productivity for large volumes with stacking capabilities
- High process temperatures produce parts with no residual stress

### Cost-Effectiveness

- Minimum and easy-to-remove support structures enable efficient production and low post-processing costs
- Reuse in-process powder extracted from the fully automated Powder Removal Station (PRS)



Spinal implant courtesy of 4WEB and made with EBM technology

## Direct Metal Laser Melting (DMLM) machines

### Design Freedom

- Allow for complex internal passages, thinner walled structures and undercuts
- Create highly detailed and fine-feature parts directly from a CAD file

### Surface Quality

- Achieve exceptional surface characteristics and minimal porosity
- Deliver best-in-class repeatability, productivity and usability

### Productivity & Safety

- Suited for highly regulated industries by providing superior part yield
- Contactless, closed powder handling for less waste and operator exposure



Spinal implant courtesy of Tsunami Medical Srl and made with DMLM technology

Machines and available materials



Spectra L



Q10plus



M2 Series 5

Ideal for medical implants with porous surface finishes with the capability to stack parts in a single build for high productivity.

#### Build volume:

350 x 430 mm (Ø/H)

#### Spectra L materials

- Arcam EBM Ti6Al4V Grade 5
- Arcam EBM Ti6Al4V Grade 23

#### Build volume:

200 x 200 x 200 mm (W x D x H)

#### Q10plus materials

- Arcam EBM Ti6Al4V Grade 5
- Arcam EBM Ti6Al4V Grade 23
- Arcam EBM CoCr
- Arcam EBM Ti Grade 2

Ideal for high-resolution medical implants and volume production.

#### Build volume:

245 x 245 x 350 mm (x,y,z)

#### M2 Series 5 materials

- Stainless Steel 316L
- Stainless Steel 17-4PH
- Maraging Steel M300
- Tool Steel H13
- Aluminium AlSi10Mg
- Aluminium A205
- Aluminium AlSi7Mg
- Cobalt CoCrW
- Nickel 718
- Nickel 625
- Nickel X
- Titanium Ti6Al4V ELI Grade 23
- Titanium cp-Ti
- Titanium Ti6242
- Cobalt CoCrMo

For the ready.



GE Additive

# Are you ready?

To go from prototype to production, faster.

To drive productivity and customization.

When you're ready to enable cost-efficient, industry leading solutions with additive orthopedic implants, the pioneers in full metal additive production have the products to enable your journey.

**Let's go. Talk to GE today.**

[www.ge.com/additive/orthopedics](http://www.ge.com/additive/orthopedics)

<sup>1</sup>GE Additive, "Orthopedic\_Precision\_Targeting\_GE\_Additive\_External" (accessed July 31, 2020).

<sup>2</sup>GE Additive, "Orthopedic\_Precision\_Targeting\_GE\_Additive\_External" (accessed July 31, 2020).

<sup>3</sup>JBJS Reviews: [https://journals.lww.com/jbjsreviews/Abstract/2020/07000/Patient\\_Satisfaction\\_Functional\\_Outcomes\\_and.7.aspx](https://journals.lww.com/jbjsreviews/Abstract/2020/07000/Patient_Satisfaction_Functional_Outcomes_and.7.aspx)

<sup>4</sup>GE Additive, "Orthopedic\_Precision\_Targeting\_GE\_Additive\_External" (accessed July 31, 2020).

<sup>5</sup>Quebec's CRIQ selects GE Additive Arcam EBM, <https://www.ge.com/additive/stories/quebecs-criq-selects-ge-additive-arcam-ebm> (accessed May 4, 2020).

<sup>6</sup>Additive at the cutting edge of joint replacement surgery, <https://www.ge.com/additive/stories/additive-cutting-edge-joint-replacement-surgery> (accessed May 4, 2020).

<sup>7</sup>Additive at the cutting edge of joint replacement surgery, <https://www.ge.com/additive/stories/additive-cutting-edge-joint-replacement-surgery> (accessed May 4, 2020).

<sup>8</sup>GE Additive, "Orthopedic\_Precision\_Targeting\_GE\_Additive\_External" (accessed May 7, 2020).

<sup>9</sup>GE Additive: <https://www.ge.com/additive/case-studies/redesigning-medical-instruments-using-3d-metal-printing> (May, 2017).

<sup>10</sup>GE Additive, "Orthopedic\_Precision\_Targeting\_GE\_Additive\_External" (accessed May 7, 2020).

<sup>11</sup>GE Additive, "Orthopedic\_Precision\_Targeting\_GE\_Additive\_External" (accessed July 31, 2020).

<sup>12</sup>GE Additive Customer Value white paper – Benefits of EBM (accessed July 31, 2020).

<sup>13</sup>GE Additive, "Orthopedic\_Precision\_Targeting\_GE\_Additive\_External" (accessed July 31, 2020).

<sup>14</sup>GE Additive, "Orthopedic\_Precision\_Targeting\_GE\_Additive\_External" (accessed July 31, 2020).

<sup>15</sup>GE Additive, "Case Study EBM AK Medical" (accessed July 31, 2020).

<sup>16</sup>GE Additive, "Case Study EBM AK Medical" (accessed July 31, 2020).