

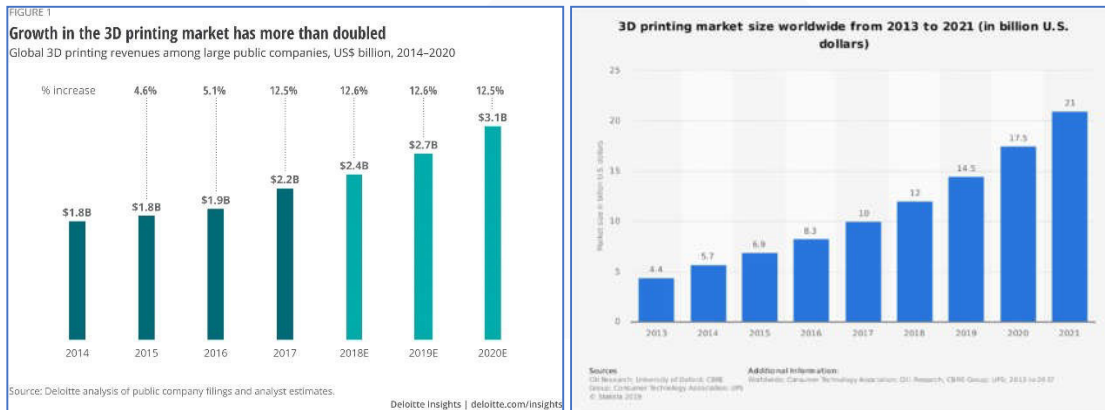
Additive Manufacturing / 3D Printing

ECP's investing rationale highlighted below + interested parties invited to contact ECP.

INTRODUCTION

Additive manufacturing technologies (of which 3d printing is a subset) have intrigued industrial companies and researchers since their early conception in late 1980s at U of Texasⁱ and at MITⁱⁱ. Recent review papersⁱⁱⁱ highlight the explosion of additive technologies (including some former welding processes under the “additive” umbrella) as well as the complexities of leveraging these technologies for practical industrial applications.

Consequently, the total 3d printing market has grown sharply (even explosively) – with several studies showing the classic growth curve (see examples below).



The rapid growth has masked important shifts (increasingly from plastic towards metal) and has masked the shrinkage that occurred some years ago due to overhype^{iv}. Predictions suggest steady double digit growth for additive manufacturing for next several years.

Given this backdrop, it is tempting for investors (and PE firms) to jump into 3d printing / additive manufacturing and purchase an equipment manufacturer or a distributor of 3d parts and plan that “the rising tide will lift all boats”. This may work well for short periods and for some investors. However, it is a strategy that ECP prefers to eschew.

At Edgewater Capital Partners we have always focused in the performance materials space with a critical eye towards differentiation. Over 20 years and 2 downward cycles, we have consistently delivered excellent results to our investors. Our approach to 3d printing will mirror our general investing philosophy – i.e. seeking differentiation.

DIFFERENTIATION EXAMPLES IN ADDITIVE MANUFACTURING

At Edgewater, differentiation in an additive manufacturing means leveraging additive manufacturing to enhance the core competencies of the underlying business. This typically involves adjusting the structure of the materials, the properties of the materials, the processing technologies for materials. Any one of these levers or a combination of these levers bestows enhanced functionality to the component. The resulting innovation improves the profitability and usually the sales of the organization – while clearly separating it from its peer group.

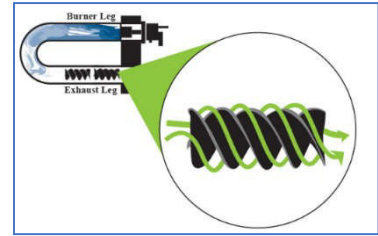
Profitability **A**ccelerated Growth **S**afety **S**ynergy **I**nnovation **O**utovation **N**ew Products®



Materials Outovation® Practice at Edgewater Capital

Examples below illustrate these ideas.

Spinworks, LLC (owned by Saint-Gobain^v since 2018). Spinworks was formed around 2000 to leverage 3d printing to create unique shapes from silicon-carbide ceramic powder. The end application was burners for industrial furnaces. Creating unique shapes allowed Spinworks to increase the surface area, increase the degree of fuel combustion, reduce the NOx from a burner and thereby improve the fuel efficiency for their customers. Many of the shapes created by Spinworks could not be produced by classical ceramic fabrication techniques. Its patented shapes, proprietary binder jet chemistries, and unique proprietary fabrication technologies were all combined with an in-depth knowledge of the industrial heating market. The SPYROCORE™ product was recognized by DOE^{vi} (pics below).



3D Shaped Catalysts from Johnson-Mathey R&D

Johnson-Mathey, a worldwide leader in catalysis and catalyst materials have been experimenting and demonstrating (exhibiting at recent tradeshows^{vii}) novel shapes with unprecedented surface area per unit volume for catalysis. This would accelerate the underlying reactions, alter the fluid flow around catalyst supports and overall improve the economics of the catalysis process for JM's customers. Currently available in proto-type quantities such materials offer the possibility to positively disrupt the catalyst ceramic support market.



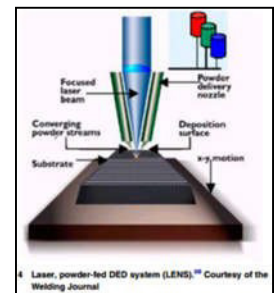
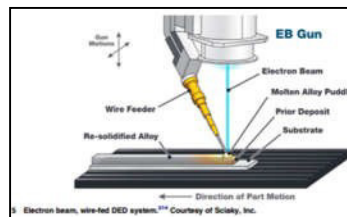
From Johnson & Johnson Brochure A

Spinworks and Johnson-Mathey offer examples of enhanced functionality leveraged by special shapes made possible by additive manufacturing (leveraging the “processing – properties” edge of the materials tetrahedron^{viii}).

LANDSCAPE OF ADDITIVE MANUFACTURING

The ASTM F42 Committee on additive manufacturing (metals) has listed the following process families.

- Powder Bed Fusion (PBF)
 - Selective Laser Melting (SLM)
 - Electron Beam Melting (EBM)
- Direct Energy Deposition (DED)
 - Laser vs. e-beam
 - Wire fed vs. powder fed
- Binder Jetting
 - Infiltration
 - Consolidation
- Sheet Lamination
- Ultrasonic additive manufacturing (UAM)



Edgewater Capital is potentially interested in ALL of these techniques.

Profitability **A**ccelerated Growth **S**afety **S**ynergy **I**nnovation **O**utovation **N**ew Products®



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MATERIALS OUTOVATION® PRACTICE

Practice of ECP focuses on businesses whose core theme for growth relies on leveraging the *composition, structure, properties, and processing* of materials to provide **customized performance** in a material or a component for a specific application. Material families of interest include metal, alloys, ceramics, glasses, polymers, composites, adhesives, coatings, cements, concrete, and others.

EDGEWATER CAPITAL PARTNERS

Edgewater Capital Partners, headquartered in Cleveland, Ohio, is a sector focused private equity firm investing in lower, middle-market performance materials businesses. We have extensive experience and expertise in niche manufacturers of specialty chemicals, pharmaceuticals, and engineered substances. Twenty years of industry specific investing has allowed us to develop a deep understanding of the complexities and nuances common to performance materials businesses. As a result, we believe expertise in our target markets enables us to quickly and comprehensively understand a company's value proposition, customer relationships, and perceived or misunderstood risks.

Experience developed over the last two decades provides us insights that few other sponsors can match. We are strategic, patient capital looking for opportunities to partner with owner-operators and management teams in developing, enhancing, and growing market leading businesses.

ⁱ Carl Deckard, Selective Laser Sintering, U of Texas, US Patent W01988002677, priority date 1986.

ⁱⁱ M. Cima *et. Al.*, 3D Printing, MIT, US5204055, priority date 1989.

ⁱⁱⁱ S.S. Babu *et. al.* The Metallurgy and Processing Science of Metal Additive Manufacturing, ORNL, 2016

^{iv} Duncan Stewart, Deloitte Insights, Dec 2018 <https://www2.deloitte.com/insights/us/en/industry/technology/technology-media-and-telecom-predictions/3d-printing-market.html>

^v <https://www.ceramicsrefractories.saint-gobain.com/>

^{vi} <https://www.energy.gov/eere/amo/spyrocor-radiant-tube-heater-inserts>

^{vii} Ceramic Show May 2019, Cleveland Ohio

^{viii} See brochure titled *Materials Outovation Practice® at Edgewater Capital*