Foreword

by Ric Fulop

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I have spent my career launching new technologies, both as an entrepreneur and as an investor. Many of these technologies were focused on making the design and creation of products easier and faster. An important underlying force that made these new solutions possible is the tremendous advancement of digital technologies. Today, every one of us has more computing power in our pocket via a smartphone than the NASA Apollo mission to the moon could marshal. The ubiquity and low cost of computing power, together with new ways of collaborating, is enabling entirely new ways to innovate.

In this book, the authors discuss how two forces – digital design and a collaborative culture – are moving us from the pre-digital age into the digital era. In this new era, these two forces are paving the way for transformative breakthroughs, not only in the speed with which we can prototype, but in the designs themselves and how they are manufactured. These new opportunities will reshape how firms approach design, development, and manufacturing and how they organize themselves and involve others in the process. Cloud-based CAD (computer-aided design) to facilitate distributed collaboration, design optimization via generative design, real-time

engineering analysis, increasingly fast and near-net-shaped custom prototyping and production 3D printing, and exponential growth of collaborative communication platforms like Slack are examples of this trend. The pace is breathtaking. We are living in an exciting time, and the firms that best implement these new technologies and platforms will have a competitive advantage.

At Desktop Metal, we are focusing on all three areas – prototyping, enabling design innovation, and transforming manufacturing. For the design engineer, we offer unique tools to help design and render near-production-strength parts very early in the process. Rapid prototyping for almost three decades was about appearance and form. And while this was extremely important to see the shape of housings or feel the actual size of a device, the usefulness was limited. Plastics have improved, but many of the most important aspects of design and engineering require real material strength. Think of a key structural part of an automobile suspension link or a new propeller design for a boat. Now we can design, have instant checks of critical design elements, and test in the real world in a matter of hours, sometimes even less. And this will only improve. Within five years the cycle time will drop dramatically, as will the cost per unit volume of material. On the manufacturing side, many words are written about the promise of additive manufacturing: desktop factories in every home. While that may be possible one day, we are focused on transforming the factory floor today. Today's manufacturing facilities need to be agile, to reduce changeover time, and to respond to changes in demand and model type. Industrial additive manufacturing can do this, and it has the ability to decentralize the manufacturing process. In this book, Local Motors is given as an example. And their premise of smaller fabrication facilities, in my opinion, is spot on. Design globally and produce locally. Until recently, additive manufacturing has been still slower than many bulk

processes such as casting, but the increasing speed, as well as the quality produced and the ability to custom design for 3D printing, changes the landscape. Not only can we now design parts that can be manufactured only by additive techniques, the first production-scale metal printing systems can also compete on cost. The result: increased strength, reduced weight, improvements in performance. In [chapter 2](#), the authors provide some examples such as an aircraft bracket. Every day we are seeing new examples of this potential being unlocked, with benefits throughout the value chain.

Where do we go from here? In this book, the authors discuss the expanded innovation landscape and how it exhibits four different modes of innovation. Companies need to learn to navigate this new landscape and try new modes of innovation. Each mode requires its own managerial logic but also offers tremendous opportunity for firms, both large and small, new and established. Over the next 10 years, firms will embrace this notion of choosing to play in certain innovation modes, of moving between them over time or purposefully exploring multiple modes in parallel.

We live in a time of rapid change, creating challenges but also hope. The new technologies my firm and others are working on will make the world a better place, enabling solutions ranging from instantly produced, customized medical implants to safer airplanes. It will allow us to shift from centralized manufacturing in low-cost regions requiring carbon-emitting shipping over tens of thousands of miles toward more sustainable, local manufacturing and to shift from large payloads launched into orbit to on-demand fabrication of components in space. The future is coming – and fast. But innovators need to be prepared and embrace – to learn to navigate – this new landscape. Godspeed!

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