The benefits are rapidly evolving, and there is a strengthening business case to endorse the implantation as part of a sound corporate strategy.

To many, metal 3-D printing, or additive manufacturing (AM), is way out there on the “someday” horizon. In reality, however, it’s already in use in multiple industries, providing a highly favorable effect on the bottom lines of those that have already embraced it.

Metal 3-D AM takes what used to be solutions made up of multiple parts and creates instead a simple-to-highly-complex metal part. These 3-D parts are rapidly “grown” by taking data directly from digital CAD files and using successive layers of fine metal powder spread across a build plate. The powder layers are fused to the layers underneath them—consecutive layers are added until an entire part emerges. The complete melting of the powder, called selective laser melting, is the job of a high-power laser. Unlike sintering, selective laser melting completely melts each layer into the previous for completely dense metal parts.

Metal 3-D printing enables the simple yet rapid creation of complex and intricately shaped parts that were—with such subtractive techniques as milling or drilling, casting and machining methods—previously impossible. Given the way the parts are built, they can be cooled uniformly, for example, resulting in less stress and greater strength. These benefits eliminate the constraints of traditional manufacturing and the chore of welding parts together. What’s left is a highly optimized, defect-free solution that can be created from a variety of metals.

Metal 3-D printing also enables unprecedented design freedom. The ability to rapidly prototype in days rather than weeks provides design engineers the flexibility to adjust, tweak, optimize, integrate, adapt and otherwise improve their designs on the fly, resulting in early development product improvement rather than introducing new versions down the road.
There are multiple and far-reaching ways that AM provides bottom-line benefits. For some industries, such as aerospace and automotive, weight reduction of components means greater fuel economy and/or appreciable speed gain. To date, estimates are that weight savings of 15–30% are achieved over traditional processes. In other industries, noise removal or reduction can be achieved through the use of hollow construction and the elimination of multiple parts.

### Additional Business Benefits

In addition to the technology benefits and effect to the bottom line previously mentioned, there are more considerations for those thinking of integrating metal 3-D AM into their corporate strategy.

The three-to-six-month process for prototype creation is now as short as three days or less—sufficiently short to implement design variations immediately with time to spare for additional product improvement iterations all the way up to manufacture.

Several important aspects of bottom-line savings provided by 3-D metal AM include:

- In the early development stage, engineers are no longer constrained by traditional machining capabilities. With metal AM, they have the freedom to explore their designs with more depth and complexity without paying the high cost of CNC machining.
- A single, complex component represents the consolidation of multiple parts, dramatically reducing the number of items in an assembly.
- Direct manufacturing eliminates the need for expensive tooling.
- AM integrates with current manufacturing processes, but eliminates steps, time-to-market and, ultimately, expense.
- Features can be sized, hidden, made of a variety of thicknesses, and they can become a part of the one complex component.
- Customization rules, and is enabled, without great expense or time penalty.
- The 3-D process also produces little waste during the fabrication process, as unused powder can be sieved and re-used in many applications.

The effect of 3-D metal AM on the bottom line is seen most dramatically when considering spare parts inventory. With an ability to print and fabricate parts on site, it is possible to do so from multiple sites globally, as digital files can be delivered electronically and printed virtually anywhere a system exists. Products can be printed on demand, eliminating inventory buildup and spare parts to the tune of between 20 to 30%. Some are even utilizing the technology to reproduce parts that are no longer in production, thus unavailable or hard to find for replacement. Retooling will become a thing of the past and subsequent iterations will be customized without incurring more cost. The carbon emission effect of transport, as well as its cost, could be reduced by the flexibility of printing parts closer to use.

### Metal 3-D Adoption in the Aerospace Industry

The strengthening business case of metal 3-D AM can be seen clearly when looking at companies at the forefront of its use, such as General Electric Aviation. GE is on record in its appreciation of metal 3-D technology; while the technology initially costs marginally more money to implement, the benefits and eventual cost savings far outweigh the initial investment.

GE already uses metal 3-D AM for its engine parts, publicly citing increased durability, weight savings of approximately 25%, and a 15% reduction in fuel consumption. With 3-D metal printing, the company claims it has taken a previous design that required the creation of 21 separate parts and their production, shipping and assembly, all the way down to one part.

GE is not alone. Boeing has also announced its use of metal...
3-D-printed parts, including air ducts and hinges for military and commercial planes. Audi announced that it plans to create aluminum parts at Audi’s Department for Technical Development in Gießen, and medical industry corporations are jumping on the bandwagon with such metal 3-D prototypes as hip joints and sleep apnea machine applications.

OEMs are beginning to add metal 3-D AM as a complementary technology and an important part of their production processes. Contract manufacturers are increasingly offering hybrid manufacturing services that combine their CNC experience with their newly acquired additive expertise. All are finding that the ease of use of the technology and the effect on the bottom line are substantial enough now to make metal 3-D AM an important part of their strategy going forward.

The marketplace is further preparing itself. Standards are developing dealing with AM machines, metal powder manufacturers, parts and components companies, and end users—involving all of the stakeholders that will benefit from its use. These standards are ensuring reliability and conformity while promoting greater confidence in the technology’s use.

Early adopters are also finding that, because this is a hot industry, they are attracting and retaining a higher-level talent with their new state-of-the-art equipment. The manufacturing skills gap is especially wide in additive manufacturing as the evolution from traditional design to optimized additive design continues to create a paradigm shift in manufacturing. Universities and third-party AM proponents are also jumping on board with newly implemented educational programs.

The benefits are rapidly evolving, and there is a strengthening business case to endorse its implementation as part of a sound corporate strategy. Those who grasp the basics and possibilities of the technology first will be well ahead of the competitive