# Two-Day DfAM Course Outline

Many industries approach additive manufacturing (AM) as a drop-in replacement for conventional manufacturing technologies. This approach, however, does not fully utilize the unique possibilities that additive processes offer. This course attempts to impart some practical guidance on how to design parts to gain the maximum benefit from what AM can offer. Additive manufacturing technologies are a godsend to innovation as they allow designers and inventors to quickly test out ideas to see if they work. For over thirty years, AM has been extensively used as a rapid prototyping technology. AM also removes some of the traditional manufacturing constraints that have become a barrier to creativity, and allow users to get real products to market without the normally high costs that can become a barrier to innovation.

When using the technologies for manufacturing, however, it should be noted that AM does not remove all manufacturing restrictions. It, instead, replaces them with a different set of design considerations that designers must take into account if they wish to successfully use the technologies to add value to their products. Otherwise AM can easily become a slow and uneconomical way of manufacturing products or parts.

It is also of great importance to understand that, despite much of the marketing hype over the past few decades, AM is not an “easy” technology that can make absolutely anything. It requires a good understanding of the different technologies and how to design for them. In fact, printing parts in metal, for example, can be downright hard, and the use of AM to manufacture metal parts should only be considered if the process truly adds value to the product.

| Date | Topic | Details |
|---|---|---|
| Day 1 | | |
| 8:30-8:45 | Introduction | Introduction to the course and attendees. |
| 8:45-11:00 | State of the AM industry and Intro to design for AM | Recent AM growth trends and developments around the world. Benefits of AM in the context of DfAM, how AM is being applied, and how certain parts can be designed for AM. |
| 10:00-10:15 | Break | |
| 11:00-12:00 | AM design optimization exercise | Thought processes behind DfAM. In this exercise, we will design a hydraulic manifold while considering print orientation and support material. |
| 12:00-12:30 | Lunch | |
| 12:30-13:30 | Topology optimization | Designing topology-optimized parts for AM, and creating light-weight parts using software such as Inspire from solidThinking. |
| 13:30-14:15 | Economics of AM | When does it make sense, or not make sense, to use AM for production quantities? What determines AM costs and can we design to minimize cost? |
| 14:15-14:30 | Break | |
| 14:30-16:00 | Design for AM of company part | Hands-on exercise to redesign a course attendee’s company part. The part will be redesigned to make it as easy as possible to print. |

| Day 2 | | |
|---|---|---|
| 8:30-10:00 | Designing for metal AM | Specific issues and guidelines around designing for metal AM, including anisotropy, process constraints, general guidelines related to wall thicknesses, hole sizes, tolerances, angles, etc. Close look at metal AM post-processing and material properties. |
| 10:00-10:15 | Break | |
| 10:15-10:45 | Designing for metal AM (continued) | Specific issues and guidelines around designing for metal AM, including anisotropy, process constraints, general guidelines related to wall thicknesses, hole sizes, tolerances, angles, etc. Close look at metal AM post-processing and material properties. |
| 10:45-11:15 | Lattice structure exercise | A solid part is transformed into a shell filled with a lattice structure. |
| 11:15-12:00 | Tooling applications of AM | AM beyond direct part production: Tools for injection-molding, sheet-metal forming, cutting and drilling, extrusion, jigs and fixtures, etc. Adding fixtures to parts to ease mounting on CNC machines for more efficient post-processing. |
| 12:00-12:30 | Lunch | |
| 12:30-14:15 | Design to reduce residual stress | Redesign of a metal AM part in order to minimize the potential residual stress that would cause distortion |
| 14:00-14:15 | Break | |
| 14:15-15:30 | AM in the future | Looking at where AM and design software tools are headed in the future and the implications they will have on DfAM. |
| 15:30-16:00 | Closing | Questions / discussion |

DfAM

Design for Additive Manufacturing