Zemax

WHITE PAPER

Designing for Manufacturability

Bring optical systems to market more quickly and cost-effectively through a streamlined engineering workflow.

It is no secret the optics and photonics market is booming. The production of core components is a global enterprise spanning more than 50 countries and employing more than one million people. According to SPIE, in 2016 global annual revenues exceeded $225 billion[1].

To meet this explosive market demand, companies producing optical products are under enormous pressure to deliver innovative new products more rapidly and cost-effectively than ever before. Concurrent engineering has become the de facto approach to getting to market quickly. But aligning the simultaneous efforts of diverse engineers can be a difficult assignment.

In this white paper, we explore some of the roadblocks to optimal manufacturability faced by engineering teams, and we demonstrate how having the right software products can make the process smoother and faster.

Workflow inefficiencies create significant barriers to manufacturability.

To turn an idea for an optical system into an actual physical product requires close coordination between teams of engineers, including optical engineers, CAD users, manufacturing engineers, and other professionals. Unfortunately, the standalone tools these experts use are not well-integrated, making it exceedingly difficult to share complete specs and details.

As a result, people expend a lot of energy in iterative design cycles in order to get things right. This is compounded by the fact that, because optical and mechanical designs are developed concurrently, adjustments on one side of the house create the need for further revisions on the other. Equally important, engineers often need to create procedures for routine tasks manually, which can extend project schedules and delay how quickly you can get to market.

> The limiting factor is not the talent of the team, but the limitations of the tools they use.

Following are a few of the ways specific engineers can be bogged down in inefficient processes.

Optical engineers

Optical engineers are tasked with creating designs that are insensitive to manufacturing defects, but commonly used tools do not allow them to optimize for the highest manufacturing yield. As a result, they must engage in repeated optimization/tolerance cycles in order to produce designs that meet performance specifications and can be manufactured at high volumes with high product yield. The need to perform common tasks manually can be exceedingly time-consuming and frustrating. In addition, optical designers often must drop what they are doing to provide CAD users and manufacturing engineers with clarification about design parameters. This can significantly affect their productivity.

[1] "Optics & Photonics Industry Report 2019," SPIE, 2019.

CAD users, mechanical engineers, and optomechanical engineers

One of the unfortunate realities for CAD users is the need to manually recreate optical designs within their native CAD environments, a process which can take hours if not days. During optomechanical assembly, they're often not given the insights needed to perceive how their packaging choices will impact optical performance. This requires them to engage in numerous back-and-forth conversations with optical engineers and iterate multiple times on their fabrications. In addition, current methodologies make it difficult for CAD users to share their work with manufacturing engineers. As a result, they must manually create ISO drawings and share optical parameters with manufacturing engineers in one-on-one discussions.

Manufacturing engineers

Manufacturing engineers are given designs in a file format that is overly restrictive for their needs, inhibiting their ability to simulate manufacturing and alignment defects effectively. Without access to all the optical data, they must repeatedly ask questions to confirm measurements and clarify other parameters, a process which is time-consuming and disruptive for everyone involved. And they often end up needing to produce multiple physical prototypes to arrive at the best manufacturing solutions.

To summarize, due to poorly integrated tools and inefficient systems, schedule delays and the need for multiple prototypes are all too frequent. Further, there may be significantly lower yield at the back end because of components that do not make it through compliance. While ultimately the best designs may be created, the process can be arduous and expensive.

How Zemax streamlines the workflow to help you achieve better manufacturability.

Manufacturability is a team effort. To produce groundbreaking optical designs efficiently, engineers need to be able to work together in a way that protects the integrity of the designs and avoids unnecessary rework and costs. Zemax provides tools and capabilities that unify your engineering experts, empowering them to work faster and smarter both as individuals and as a team.

A suite of integrated products facilitates coordination between engineers.

To eliminate the roadblocks that get in the way of true collaboration, Zemax offers an integrated suite of products that streamline the entire optical design-to-manufacturing process:

- **OpticStudio** for optical design engineers
- **OpticsBuilder** for CAD users, mechanical engineers, and optomechanical engineers
- **OpticsViewer** for manufacturing engineers

These products have a common language, which enables product engineering teams to share more complete design data, as well as analyze performance from within their own native environments. This limits the number of designs and physical prototypes needed, saving time and money. It also eliminates redundant work and minimizes errors.

One benefit of the common language is that optical engineers can see the impact of their designs and adjust them accordingly. And they can safely share their complete designs with essential optical data included.

By automatically converting optical designs into CAD parts, OpticsBuilder gives CAD users access to the precise lens geometries intended by the optical engineers – thereby saving time and increasing design fidelity. If the optical design needs to change, CAD users can simply update their files within OpticsBuilder without losing the work they have put into building the mechanical packaging. Another advantage for CAD users is the ability to run stray-light, spot-size, and beam-clipping analyses themselves, cutting down on iterations with the optical designers.

For their part, manufacturing engineers can load any sequential file with all design data included, streamlining how they verify that designs meet the stated specifications. Additionally, engineers downstream can alter files only in ways that pertain to their area of expertise, ensuring that original designs are protected from inadvertent changes.

High-Yield Optimization and tolerancing creates the best possible results at scale.

Traditionally the optimization of an optical design has focused on improving the performance of a nominal system in the absence of manufacturing and assembly errors. Assessment of the as-built performance, including errors, is left to a subsequent tolerance step in the design process. This can lead to designs that are more sensitive to errors, resulting in increased assembly time and/or reduced product yield, not to mention additional design work.

The High-Yield Optimization operand and tolerance tools in OpticStudio desensitize optical systems to manufacturing degradations during the design process rather than as a post-design step. This produces designs that meet tight performance specifications and provide a higher manufacturing yield, while also decreasing the need for multiple prototypes and accelerating the project schedule.

API reduces the need for design iterations and speeds time to market.

The ZOS-API available with OpticStudio improves manufacturability by automating repetitive tasks – making it possible to do serial computing of all use cases seamlessly. When done manually, this work can take days, but with the API, repetitive calculations are programmed, vastly speeding up project schedules. The API also makes it easy to integrate designs into third-party products.

More specifically, with the ZOS-API, you can create standalone applications, build your own analyses, and control OpticStudio externally using C#, C++, MATLAB, and Python, as well as any language that communicates with the .NET framework. And custom DLLs allow creation of any surfaces, objects, sources, and scatter functions.

Take the next step to improved manufacturability.

Using the suite of Zemax products, engineers can work more productively, even in the face of tighter timelines and budgets. With greater efficiency, people can more readily try out new ideas and develop innovative ways to break new ground.

Learn more about how Zemax can solve the workflow issues standing in the way of getting your products to market more quickly and cost effectively. Please visit www.zemax.com.

Support is available at MyZemax.com, where users have access to knowledgebase articles, community forums, and support cases.

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