Why, what & how of Design for Excellence

DFx or Design for Excellence is the method of designing or engineering a product to proactively address and minimise manufacturability, assembly, serviceability, quality, sustainability, and costs related issues early in the design stage. The article discusses some of the methods and challenges in DFx implementation.

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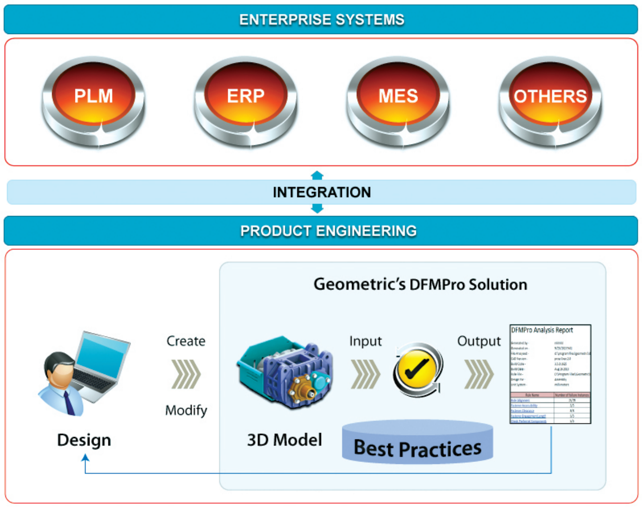
More often than not, design engineers are not familiar with all the manufacturing process requirements and downstream related parameters. Decisions made by engineers during the design stage have cascading implications on product cost, quality and time to market.

As a result, engineering changes happen too late in the cycle when issues are detected during manufacturing or assembly when it's very expensive to modify the designs. Various studies have proved that an error detected and rectified during the design stage costs almost one hundred times less than when rectified at the manufacturing stage. The studies also proved that the actual cost incurred during



DFx includes an interactive feedback loop from suppliers/internal manufacturing back to design engineers to take immediate corrective actions

the design stage is the lowest, but its influence on the product cost is the highest.

Sometimes, if the error gets passed into production when the product is launched, the cost of a design change not only increases 100 times, it can also have a direct impact in the form of costly product recalls and loss of confidence amongst customers and shareholders.

On a global average, 30% - 35% of engineering effort is spent on rework due to late design changes occurring because of downstream manufacturability and assembly issues. This can be avoided when Design for Excellence methodology is followed as an integral part of the product development process. It is essential to incorporate various DFx guidelines early in the product development phase to reduce defects, cut down rework, eliminate waste, shorten time to market and save costs.

Current practices and challenges

Though many organisations have advocated DFx practices, there are several hurdles to a successful implementation. The following discusses some of the methods and challenges in DFx implementation:

DFx checklist and handbooks: Most organisations incorporate DFx practices in a checklist, which is manually verified by designers before submitting the final design. However, with limited time and resources, manually reviewing designs for hundreds of design guidelines is difficult, time-consuming and error-prone, and there is a risk of missing important design guidelines altogether. Also, as the organisation's process capability improves over time, the guidelines need to be updated accordingly. Many times, this information (guideline) is locked within a department or with local suppliers.

Expert discussion and reviews: Another commonly followed 'practice' leverages expert discussions - the interaction between design engineers and manufacturing engineers/suppliers to review the design and rationalise it from the manufacturability point of view. However, with geographically distributed design and manufacturing/supplier teams, it is difficult for DFx review to happen effectively. Designs that require multiple iterations between supplier and OEM will often lead to delays in production schedule and an increase in overall costs.

Dedicated validation teams: Organisations have practiced DFx by forming such dedicated teams with the objective of improving designs, part quality and reducing costs.

All the above manual DFx implementation methods are time-consuming, error-prone and ambiguous.

Success factors for effective DFx implementation

DFx is most successful and effective when review of design against an organisation's set of DFx guidelines is automated and includes an interactive feedback loop from suppliers/internal manufacturing back to design engineers to take immediate corrective actions.

Knowledge capture and reuse: DFx primarily deals with process knowledge, which is generated continuously in the product development process. It is important that the necessary knowledge and learning produced during the design process is efficiently captured, structured and made available for reuse by design engineers and other product development teams. A good knowledge management system is required to help capture this organisational knowledge and best practices in a suitable format for digital usage and independent of the people who contributed to such knowledge.

DFx automation within CAD: CAD and CAM have revolutionised design and manufacturing fields through use of computer enabled technologies. Effective implementation of DFx is most successful when review of design against an organisation's set of DFx guidelines is seamlessly integrated and automated within the CAD tool such that designers can perform DFx validation immediately and within a familiar environment.

Feedback mechanism: An automatic verification mechanism is required to ensure feedback from suppliers is captured and incorporated in the design. Many times, feedback from suppliers and manufacturing engineers is sent back to designers over phone or email, and not captured effectively to ensure past mistakes are not repeated.

Integrated DFx validation software

Geometric DFMPro™ is best-practice-driven design for excellence software that enables engineering to make informed design decisions by identifying and addressing downstream manufacturability, assembly, serviceability and quality related issues during the early design stage. It facilitates the implementation of DFx methods and guidelines in a systematic manner and improves the design process.

Automated DFx review through seamless integration with CAD—Geometric's DFMPro™ works with all major CAD platforms, and automates and formalises the design review process. Seamless integration into the CAD environment allows user to work in a familiar environment and run DFx analysis during the early design stage. It evaluates CAD models for various DFx guidelines and suggests corrective actions based on its out-of-the-box library of 150+ design guidelines.

Enables best practice knowledge capture and dissemination—Geometric DFMPro™ provides a knowledge-driven framework to capture an organisation's design best practices and industry standards in the form of DFx guidelines, and enables designers to easily use these guidelines during the design stage. With the recent addition of Additive Manufacturing, out-of-the-box industry best practices are available in the form of DFM rules for major manufacturing processes like machining (milling, turning, drilling), plastics/injection moulding, sheet metal fabrication, welding, casting and assembly. A new module for forging and composites will be available in future releases.

Comprehensive 2D and 3D reports to improve design collaboration and drive effective reviews—Detailed reports (both in 2D with visuals and 3D) can be shared with suppliers or subject matter experts to explore design alternatives and make informed decisions.

The way forward...

By bringing automation to the DFx implementation, process effectiveness will increase considerably as knowledge gets captured and reused appropriately, and location proximity and iterations of designs between engineering and manufacturing is minimised. DFMPro™ can help in better understanding of downstream requirements at the right time – that is, when the design is being created. It further promotes collaboration of design with manufacturing, and captures the right understanding of supplier capability to design parts the very first time. This drastically reduces the review time and avoids rework in design. Using DFMPro™, you can improve engineering productivity by over 15%.

Today, the rules are captured from past incidents and experiences, manually documented, and then programmed into rules. With the acceleration of the Internet of Things (IoT), the near future could have information from downstream captured, processed and heuristic-based rules formed automatically. Based on the correlation between events and design, process and other parameters, a predictive model could be made to validate existing designs against future failures. Such rules shall be available to design engineers at the time of design so that they take right decisions. □