



Better by design

On the face of it, the term 'design for manufacture' would appear to be redundant. Surely, you might ask, every product is designed to be manufactured. And the answer to that is yes. But there is a qualification; not everything that is designed can actually be made.

The reasons for this are many and varied – everything from poor design practices in the first place to poor manufacturers at the end of the process.

In the silicon world, design for manufacturing – or DFM – has become one of the central design concepts. And that's no surprise, bearing in mind the huge and increasing cost of creating chips.

But DFM, along with design for fabrication (DFF), design for test (DFT) and design for assembly (DFA), are terms which are finding increased use in more traditional areas of the electronics industry – and in pcb design and manufacture in particular.

John Isaac is director of system market development with Mentor Graphics' systems design division. He said the company realises there are a few areas where it can help to improve the ability of its customers to produce products at lower cost, higher quality and faster. But, noting that DFM is of increasing importance, he noted: "That not only relates to some of the activities we have going on now, but also to future developments."

Steve Hughes, Mentor's pcb product manager, added: "Over the last couple of years, DFM for pcbs has become a more critical part of the design flow. Before, most of this effort was in managing and using third party tools, but customers now want to keep ownership of manufacturing data."

Illustration: Don Seed

Better decision making tools for pcb designers should mean better boards. By **Graham Pitcher**.

Previously, a manufacturing data set could be sent to a number of manufacturers. "Each could take this data," Hughes noted, "and, depending on their tolerances and so on, would modify this to suit their process. They would find violations and then enter an open circuit loop, asking which to fix and which to leave, whilst also fixing some of them without asking. When the boards came back, they should be identical, but they usually weren't."

The consequence of this is an effort to move DFM back into the design phase. "Hopefully," Hughes continued, "this will allow companies to identify and resolve issues before the board is sent for manufacture."

Mentor's work in this area started with a UK customer, Hughes noted. "We sat down with three of its manufacturers and came up with a set of rules they could all use. We took these and prioritised them, which allowed us to develop specific DFM for PCB functionality."

Isaac pointed to the increasingly global nature of electronics. "You create a product in one place and outsource manufacturing – even part of the





The manufacturer's point of view

Contract manufacturer ACW Technology has wide experience of pcb manufacture. Engineering and quality manager Keith Stone noted boards are getting more complex. "There's a lot

more bgas on boards. We're seeing some with more than 30 bgas and they take up a lot of real estate and testing becomes difficult."

Nevertheless, Stone says the general quality of pcb design is improving. "Some time ago, there were problems. Today, designers are getting better at layout and component selection. The main problem we face is ensuring the design is stable for test."

According to Stone, he talks to designers as early as possible to make sure they put components on the right side of the board and even use the right components. "We're also advising on the use of break off strips and so on."

But it's not all about board manufacture. "We have a team looking at test development and the best ways to test. We also like to have input on the mechanical design because most products are designed by electronics engineers. This means the 'box' is left to the end."

Although designers have, in general, got to grips with RoHS, Stone says there are still problems. "Some component manufacturers have

introduced other components, so the designer has to be aware of this. And materials for bare boards have to resist higher temperatures. The higher temperatures also mean soldering is more difficult, particularly for large boards with heavy components."

Whilst the design side is under control, test leaves some problems. "Designers are under pressure to get prototypes out. We'll build prototypes, which work, but there needs to be test pads for bed of nails testing in production boards. But there's no time to respin the board to provide more test pads."

Stone's advice to pcb designers? "Don't present us with a finished design; for example with bgas on both sides of the board opposite each other. Do get involved in talking to component suppliers and provide for test. If you come to us, you'll talk with a process engineer, a test development engineer and maybe even a mechanical engineer and someone from materials. Every customer wants cost reduction and they're looking to us to help."

design. This has amplified the need for DfX checks."

Isaac uses DfX to cover a range of techniques. Not only does this include design for manufacture, there's also design for test and even design for assembly. "It's taking what used to be done at the manufacturing stage and bringing it back into the design process."

"We're looking to embed more and more design rules and best procedures in the design process."

John Isaac, **Mentor Graphics**

The result of this move is to offer designers the ability to make – essentially – manufacturing decisions. Hughes said: "It's providing a range of values which the user can input. It's about risk analysis and manufacturing yield. You don't have to fix every violation, but you can

analyse the results and make a call based on manufacturing tolerances and so on."

Mentor is calling this approach Design for Fabrication, or DFF. "Users can set up rules," Hughes continued, "based on multiple manufacturing sites. They can design a board, decide where to have it made and then choose the appropriate set of rules." And he added the DFF approach also includes DFA and DFT.

Isaac picked up the theme. "We're looking to embed more and more design rules and best procedures in the design process. As you're routing a board, the more extensive set of rules prevents you from introducing errors or problems that will compromise yield. Our aim is a single pass design process."

But this is just one strand of Mentor's vision, which also includes providing more capable and more constructive links between all people in the pcb design and manufacture chain.

The tools will help to ensure that DFM starts at the very beginning of the design process. "It's not something that's an extra," Isaac concluded. ☺

