

## Leveraging Your Contract Electronics Manufacturer to Minimize Costs and Meet Time-to-Market Goals

### Design and Manufacturing: Two Peas in a Pod

Realizing cost and time-to-market improvements is the primary impetus for companies to outsource their electronics manufacturing to contract manufacturers (CM). The advantages of outsourcing are increasingly recognized today, including lower direct labour costs, reduced capital investment, improved utilization of assets and access to purchasing consortiums. Despite these benefits, as much as 90% of the cost of an electronic product is determined long before it reaches manufacturing stage. Decisions made during design directly affect a product's manufacturability, but the impact of these decisions may not be known until a product reaches the CM. By that time, design changes are often too costly or may delay market launch too much to allow for implementation.

As much as 90% of the cost of an electronic product is determined by design, but may be invisible until a product reaches the manufacturing stage.

Companies may experience costly delays in product availability or may be forced to alter product marketing strategies when unexpected challenges during manufacturing impact a product's cost. For company with a significant portion of its business dependent on a single product line, such surprises can be fatal. For these reasons, contract manufacturers should play a consultative role in early-stage product design – a role known as design for manufacturing (DFM). Doing so helps ensure that a product can be sourced and manufactured in the most cost-effective manner and can eliminate delays that threaten time-to-market goals.

This short paper examines some widely held myths that most frequently lead to harmful or fatal discoveries during the manufacturing phase, with examples given for each. The paper outlines five top best practices of DFM as a means of illustrating the kind of early-stage guidance that a CM can provide with relatively minimal effort. It concludes by defining a working partnership model for a small- to mid-size company and its contract electronics manufacturer – a model designed to ensure an appropriate balance between product design creativity and manufacturing design best practices.

### Myths that Strangle a Product's Success

The DFM skill set is learned and honed through experience. A CM draws from a pool of real-world experience of manufacturing designers, testers and quality assurance professionals, and its customers benefit from the net wisdom. The following statements capture some common beliefs that have impact on product design, but which manufacturing experience reveals to be inaccurate.

#### **Myth 1: 90% of an electronic product's cost is material cost.**

In fact, in low- to mid-volume, high-mix manufacturing<sup>1</sup>, labour contributes 20%-40% of the cost of a product. Often, these savings can be gained through a single, brief communication with the CM during early design phases. Product designs that minimize manufacturing process steps and manual labour processes can cut those costs by 10%-30%. This is not surprising when one considers that each production run requires setting up machines, assembling the product and performing quality control tasks.

<sup>1</sup> Products manufactured in approximately 50-10,000-piece batches. See OCM Manufacturing's short paper entitled "The Right-Sized Contract Electronics Manufacturer" for more information about the different types of contract manufacturing available.





Take a single-sided, 100% surface mount technology (SMT) product as an example. The company designs the board single-sided, knowing that will require fewer process steps than a double-sided board. SMT (rather than pin through hole technology) will also reduce manual labour required for assembly. But an oversight turns out to be fatal: a single cabling component will require hand soldering, adding 20% additional labour to the cost of manufacturing. Thus, despite all the things done right, if design for manufacturability is not considered early on, the repercussions can be severe enough to cripple a product's marketability.

**Myth 2: Performance trumps manufacturability.**

While a product's performance is critical to differentiating that product in a market, a product that cannot be manufactured within the cost parameters determined by market forces will fail. As seen, the manufacturability of a product directly impacts its cost (see Myth #1). Thus, performance and cost are equally critical considerations during product design and should work in concert for best results.

Frequently, electronic products are over-designed in ways that negatively impact cost. For example, when very small form factor components are used on boards with sufficient space for larger form factors, manufacturing is needlessly more complex. Another example is the placement of components on a board. When manufacturability is not considered, the boards may be impossible to manufacture in panels. Yet, proper panelization can significantly reduce manufacturing cost.

**Myth 3: If it can be prototyped it can be manufactured.**

Commonly, prototyping is used to work out a product's functionality: can we get the product to do what it needs to do? Unfortunately, that usually leads to a major oversight and manufacturability issues must be worked out through a second revision. A prototype should do more than demonstrate functionality. It should also gauge a proposed product's cost, and assessing its manufacturability is key in that calculation.

The ultimate goal of manufacturing is to produce as many boards as quickly as possible while maintaining high quality. Thus, while a few prototyped boards may be useful to demonstrate a product's function, size and proposed packaging, they must be reviewed and assembled by a CM to demonstrate manufacturability. When chosen early, the contract manufacturer can build the prototypes, thereby incorporating DFM from the beginning, when manufacturing input is simple and fast to accommodate. In this way, prototypes will do more than impress: they will affirm the business and marketing model.

**Myth 4: Choice of components isn't a manufacturing issue.**

Although Myth #1 demonstrated that labour cost is a key consideration in electronics manufacturing, savvy component selection is an obvious opportunity to realize savings. The most common error in component selection is choosing a component with a single source.

Single-source parts cause two main problems, either of which can be a show-stopper in terms of a product's ultimate marketability. First, a part with only one source cannot be competitively bid on. Second, a single-source part is at high risk of obsolescence. Part manufacturers strive to differentiate their parts precisely to avoid price wars – and some unique components may be crucial to a product's own differentiation. But as a rule of thumb, the 20% of parts that make up 80% of a product's material cost should always be reviewed by the CM to ensure the most cost-competitive result.

**Myth 5: We'll save money through consignment.**

Aside from avoiding the purchasing power that a CM offers,<sup>2</sup> consignment of parts to a CM can create unnecessary effort and risk. A good CM will have extensive, and often fully automated, bidding processes and reliable supplier relationships in place – these are more than worth leveraging, especially for a small- or mid-

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<sup>2</sup> See OCM Manufacturing's short paper entitled "The Right-Sized Contract Electronics Manufacturer" for more information about how a CM's purchasing power benefits small- to mid-size companies.



size company. But consigning parts involves more than simply buying components. For example, the CM will already have the costs of holding inventory, managing the supplier relationships, quoting, forecasting and more contained within its established supply chain – and this cost is amortized over many customers and many products. Consignment fails to take advantage of this, and actually duplicates these costs.

**Myth 6: Smaller products yield lower cost.**

Not always. In fact, smaller products may simply yield lower – period. Higher density parts are more costly to manufacture because they are more difficult to inspect, leading to lower yields. Often in the push toward high density, very small components are chosen for products with no market requirement for very small footprints. In other cases, very dense parts may be used on boards with ample room for less density. Through a review of the proposed bill of materials and product design, a CM can identify unnecessarily dense components and recommend alternatives.

**Myth 7: Manufacturing can tolerate design defects.**

Good contract manufacturers strive for high quality and to do so they set the quality bar at zero defects. Exceptions are counter-productive to a quality process. If a quality system is asked to overlook known defects, the door is opened to that system overlooking other defects. Ultimately, failing to make a product manufacturable degrades its quality and increases the risk of field failures.

**Myth 8: Testing comes last.**

The focus on a product’s functionality (see Myth #3) often overlooks testability. This situation creates unnecessary complications including reduced test coverage, longer debugging times, defective product “bone piles”, and potential delivery delays. Design for testing in the early stages of a product’s design ensures that it can be tested effectively and quickly. In addition, the more complete the product’s documentation is, the better able a CM is to test the product. Thorough documentation including schematics, functional specifications, bill of materials with manufacturers’ part numbers, assembly and CAD drawings are all important to a CM during test design.

Many aspects of product design impact the ability for a CM to test the product, but one of the most common oversights is the addition of test points. By designing a product so that all nodes can be accessed on one side of the board, the product can be tested most rapidly and thoroughly. When involved early on, a CM can advise regarding how best to design these test points into a product.

**Top-5 DFM Best Practices**

Here, we have collected OCM Manufacturing’s “top five” best practices for design for manufacturing. Talk to OCM directly about how we can participate in your design process to ensure you can meet the marketing and cost goals for your new product.

**1. Choose components with more than one source.** This ensures that competitive pricing can be obtained and minimizes the risk of part obsolescence. Share the initial bill of materials with the CM and allow the CM to suggest alternative parts where it is deemed beneficial to do so.

**2. Design to reduce manufacturing steps.** A board that can be manufactured using a less processes is the most efficient and inexpensive to manufacture. In some cases, the placement or choice of a single component can mean several additional process steps. Involve the CM in early design to ensure efficiencies can be maximized.

**Top-5 DFM Best Practices:**

1. Choose components with more than one source.
2. Design to reduce manufacturing steps.
3. Design for automation.
4. Design for test: where possible, make every node accessible from one side of the board.
5. Plan panelization and consult the CM regarding placement of components, tracks and fiducials.



**3. Design for automation.** Manual labour can be largely avoided or eliminated by designing for today's modern surface mount technology (SMT) processes. One caveat applies, however: the design must not introduce additional process steps. Involve the CM in early design reviews to help ensure the design will maximize use of automated processes in the most efficient manner possible.

**4. Design for test.** Consider how the product will be tested and include test points in the design. For the fastest and most thorough testing, each node of the product should be accessible from a single side of the board. The CM can advise and provide guidance about how to maximize a design for testability, and will specify the documentation necessary to designing a test plan.

**5. Plan panelization.** Panelization – or the manufacture of numerous boards on a single panel at once – is often overlooked during product design, but has significant impact on cost. Panelization determines how a board is carried through the assembly line, and failing to consider it leads to wasted material, higher than necessary costs and may cause quality to be degraded. Your CM can suggest the most efficient ways to panelize your product design and will provide guidance on placement of components, tracks and fiducials for the highest accuracy and least error-prone manufacturing.

## A DFM Partnership Model

As seen above, the function of DFM is to provide the careful balance between design and manufacturing required to achieve the most cost-effective, most easily manufactured product while maintaining high quality. Because DFM skills are gained through experience in an array of manufacturing scenarios, a contract manufacturer can provide the benefit of that experience to a product company – if the CM is involved in early design stages.

At manufacturing stage, a company has a great deal invested in the product, so changes that may dramatically improve manufacturing cost or speed may be impossible to make and still meet a product's market window. Thus, a partnership between the product company and its CM is critical. That partnership should include these elements:

- Commitment by the product company to involve the CM in early design and discussions
- Openness to a CM's recommendations for design changes or component selection
- Advice and guidance from the CM regarding best practices for design for manufacturing as well as specific commentary on proposed designs and materials aimed at improving the design's manufacturability
- Competitive bidding by the CM on the materials and manufacture of the product
- Willingness of the CM to develop the initial prototypes, rather than forcing prototypes to be developed outside the manufacturing environment. Expect valuable DFM input and guidance from your CM.

If you are looking for a high-quality manufacturing partner for low- to mid-volume product lines, please contact us at OCM Manufacturing, at 1-800-268-3961.