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A Comparative Study of 3 Product Development Models: Internal, CDM, or Design Engineering Firm



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INTRODUCTION

When approaching a new product development project, companies have options regarding how they will address the challenge. Depending on the needs and internal capabilities of an organization, most companies will consider one of three options:

- **Internal** - doing everything in-house
- **CDM (Contract Design and Manufacturer)** - fully outsourcing all design, development, and manufacturing to a CDM
- **Design Engineering Firm** - outsourcing some or all the design and development to a specialized Design Engineering Firm, usually in conjunction with a contract manufacturer (CM).

While the range of options is essentially a continuum, we'll examine these three models in detail.

WHAT TO CONSIDER

To evaluate these models, we will consider 6 key factors:

- Intellectual property protection
- Short-term vs. long-term development team cost
- Market knowledge vs. technical skills
- Control vs. specification
- Development cost vs. manufacturing cost
- Relationship complexity vs. process flexibility

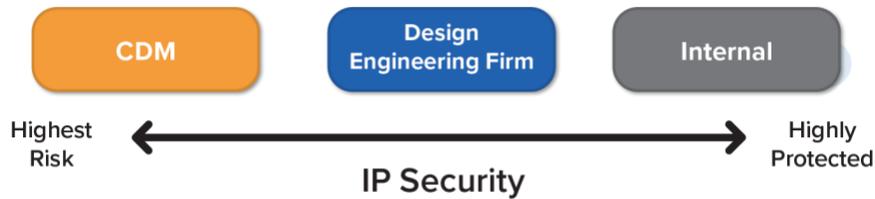
1. INTELLECTUAL PROPERTY PROTECTION

If intellectual property (IP) protection is important for the success of your product, then it's important to consider the impact of your development model's ability to protect intellectual property.

The closer you keep your IP, the safer it is. Keeping all product development and manufacturing internal is the safest way to go. The realities of your current business's capabilities and staff might invalidate that option, however. If you do outsource, one way to safeguard your IP is by separating design from manufacturing. This provides a firewall, keeping your manufacturer from knowing everything needed to fully replicate your product.

For example, a 3D-printer company chose a low-cost manufacturer in China for production, yet they

chose a Design Engineering Firm to develop the firmware and electronics for the product. To provide an IP firewall, the Design Engineering Firm designed a separate set of firmware for use on the manufacturing line. This firmware provided only the functionality needed to verify printer functionality before shipping the product. The actual product firmware was downloaded by the user during the initialization process. This kept the manufacturer from having everything needed to produce extra units outside of the printer company's visibility.



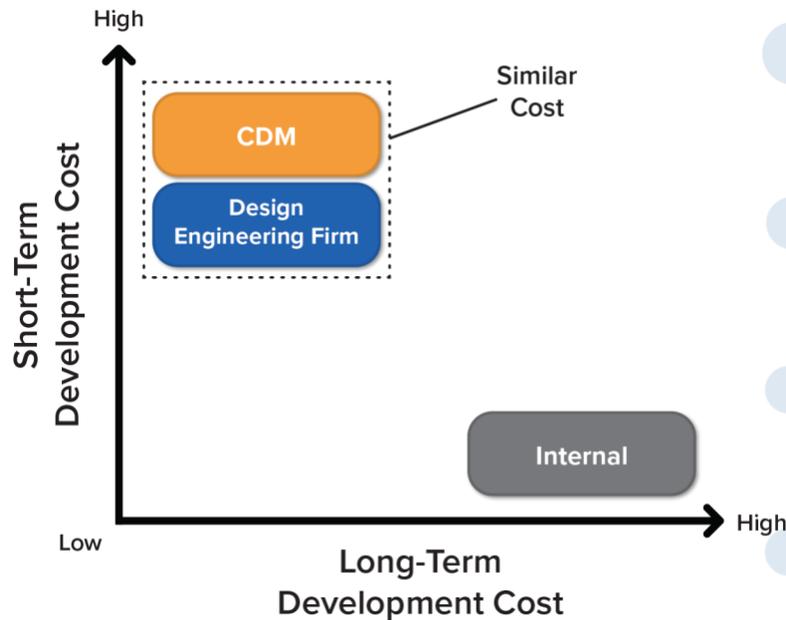
Where does your IP security fall on this chart?

2. SHORT-TERM VS. LONG-TERM DEVELOPMENT TEAM COST

A key tradeoff for any company looking to design a product is the cost of the development team. Successfully shipping a product requires a myriad of skill sets in various engineering disciplines. In addition, most products require at least some engineers with additional specialties to overcome key technical hurdles. Building and maintaining a high-quality team takes significant time and budget. If your company is going to be producing a series of products based on similar technologies, then it makes sense to staff up internally to avoid the markup associated with outsourcing work.

However, if the product under consideration is peripheral to your company's long-term needs, is important but lower priority than other development, represents a short-term workload peak, or you don't want to hold up design engineering until you are internally staffed, then internal development is likely not the prudent option.

While using an external firm's engineers may cost more per hour than an internal resource, having that cost disappear at the end of the project represents a long-term cost savings. In addition, Design Engineering Firms likely have the technical talent you need on staff TODAY, letting you avoid the time and expense of the candidate search and hiring process. Of course, you can just build up the team internally, then cut everyone at the end of the project. That might work once, but if your company builds a reputation of hiring and firing, you'll find it harder to hire quality talent in the future. Finally, a Design Engineering Firm will be around in the future, providing continuity of knowledge of your design if you want to work on version 2.0 at some point in the future.



Where will you spend your development budget?

In many cases, a CDM will offer steeply reduced or even free engineering design services. Obviously, that changes the picture above. As with all things in life, there is no such thing as a “free lunch”. Items #5 and #6 below address the trade-offs of using a CDM’s “free” engineering design services.

3. MARKET KNOWLEDGE VS. TECHNICAL SKILLS

Your company is developing a product for a market you know well — a market you and your customers think about every day. The only other companies that know the market even close to as well as you do are your competitors. If market understanding is critical for *all* of your design engineers, then you should probably keep your development in-house.

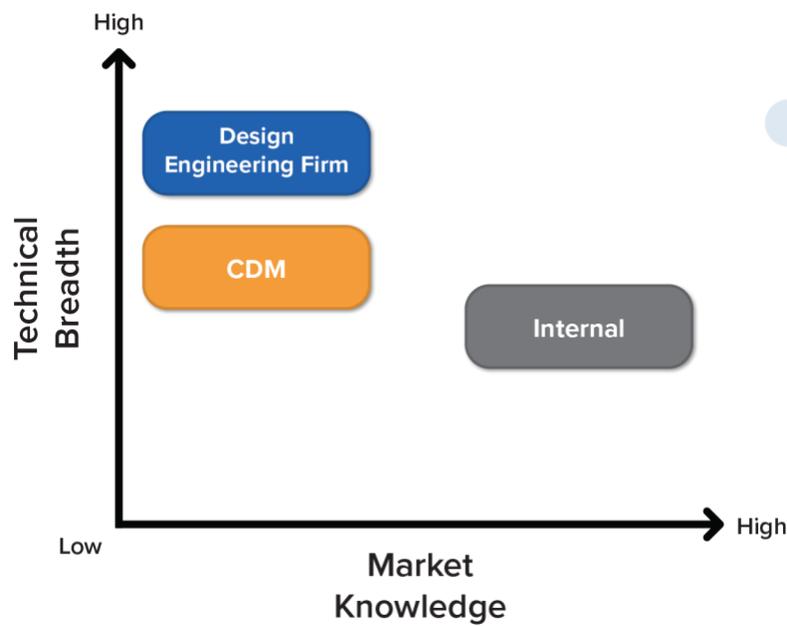
When you need additional technical skills that you don’t have within your company, you may want to consider bringing in outside design help. Design Engineering Firms will often specialize in a few key markets or technologies, particularly when it comes to complex product design engineering. If you are able to find a Design Engineering Firm that maps to your industry, you could well have the advantage of technical breadth AND market knowledge.

The nature of the CDM business model is a focus on contract manufacturing, the “C” and “M” in “CDM”. That is always going to be their core technical expertise, as that is where the bulk of their revenue is generated. The design, the “D”, is an add-on service to capture additional revenue. CDM’s typically find it difficult to retain a staff of senior engineering design personnel. If you are considering using a CDM for design, be sure to carefully vet their engineering design team as a separate consideration from their

manufacturing capabilities. Remember, you don't have to use the CDM's design services just because you do want to use their manufacturing services.

If your product design needs aren't particularly complex, it's likely sufficient to have a product requirements document (PRD) that defines requirements and acceptance tests, in conjunction with an internal marketing product owner that can interface with an external design team. Both Design Engineering Firms and CDMs can be successful in delivering the right product for your market if the correct documentation and guidance are provided.

Also, a Design Engineering Firm likely has experts in a broader range of technologies than your internal talent and may be able to bring better solutions to the table for your product.



Internal, CDM, or Design Engineering Firm: Where does your enterprise's expertise lie?

4. CONTROL VS. SPECIFICATION

Related to the discussion of market knowledge and technical specialization above is the concept of design control compared to the work required to create high-quality specification documents. If you manage the project yourself with internal resources, you'll have very fine-grained control of the work and the final product with little additional management effort. In addition, you can likely get away with less detailed specifications, as an internal team will have a better feel for what's required. Note that it's still highly recommended that you create detailed requirement and design specification documents. The act of just writing things down does wonders for clearing up miscommunications.

To successfully outsource work, it is critical to have detailed requirements specifications. The

requirements specification document will be your primary means of conveying the needs of the product to the developer. Creating a detailed specification can take a lot of work. It's a good idea to review and iterate on the document with the design team. Also, realize that there will be new requirements discovered as you learn more about the design. It is much better to be flexible and iterate than to shoot for 100 percent completeness out of the gate. Some Design Engineering Firms provide quality assurance specialists that can own vetting and refining requirements throughout the specification development process.

Once the specification is written, the workload on the internal team will go down significantly and free up valuable internal resources to focus on the projects most critical to your business. If you are unable to generate a detailed requirements specification document, it will be critical to remain highly engaged with the engineering design team throughout the process to make sure that your product's true requirements are being properly communicated to, and internalized by, the engineering design team.

5. DEVELOPMENT COST VS. MANUFACTURING COST

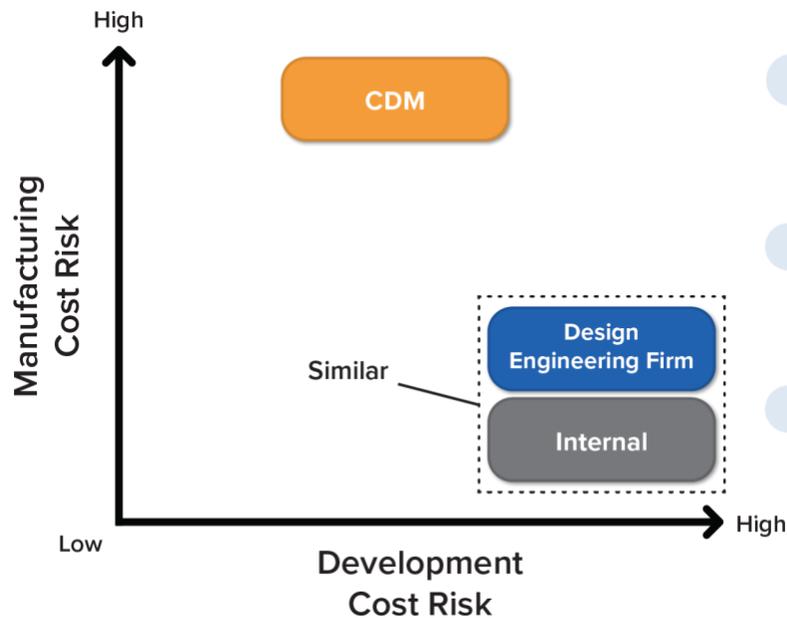
A common tool for [reducing financial risk](#) in developing a product with a CDM is to share the development costs and product revenue. In this model, the CDM offers steeply reduced rates on the development engineering in exchange for guaranteed production volumes and possibly a cut of the product revenue. If the product is successful, both organizations win. If not, the financial downside has been shared, too.

While this type of arrangement with a CDM does reduce one type of financial risk, it increases [other risks to your company](#):

1. You're locked into a single supplier for your manufacturing. It's very difficult to get all the development knowledge transferred to another manufacturer. Often part of the free services provided includes assembly fixturing and process development. Those often exist outside of the product development contract, and thus are owned by the CDM. Even if you have access to all the engineering drawings, manufacturing process documentation, etc., the team that has intimate knowledge of the project is likely no longer accessible to you. This makes the transfer of production difficult and risky.
2. It can be very difficult to realize cost reductions in manufacturing. This is the fabled "fox watching the henhouse" problem. Without an objective observer to keep an eye on the manufacturing costs, CDMs have little incentive to pursue cost reductions, or design around component cost increases. In fact, there is a conflict of interest, where increased manufacturing costs add to the bottom line of the CDM and help to recoup their development costs.

Using a Design Engineering Firm that specializes in product design and design for manufacturability in conjunction with a contract manufacturer provides a different risk profile. A Design Engineering Firm

can't offer the reduced development costs as there's no back end to make up lost margin. However, that same firm has a vested interest in making sure the client is happy with the manufacturing costs and can act as a trusted third party to keep the CM manufacturing costs in check.



Determining where the cost risk lies on your project can greatly inform the process.

6. RELATIONSHIP COMPLEXITY VS. PROCESS FLEXIBILITY

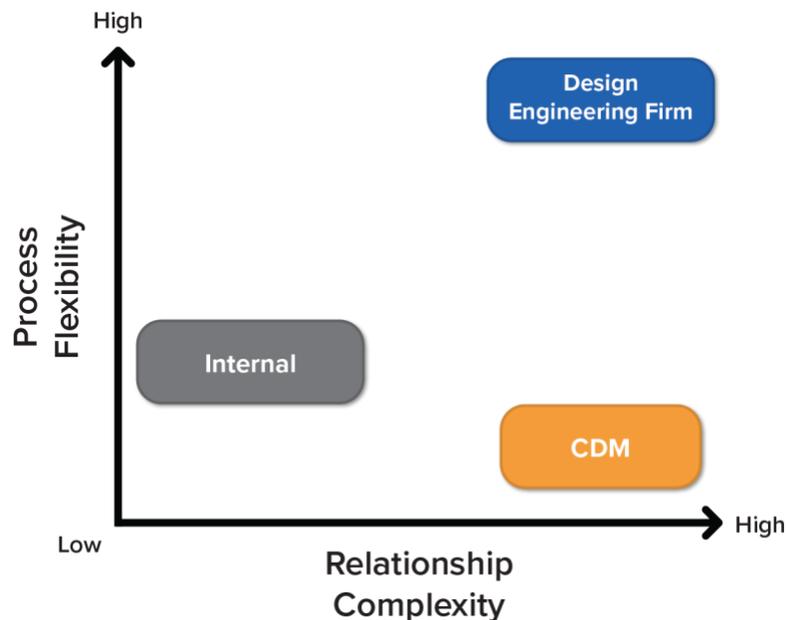
CDMs have an intriguing value proposition. They are the “one-stop shop” for all your design and manufacturing needs in a single business relationship. Plus, their design and manufacturing engineers can work together side-by-side. It seems reasonable that there will be reduced barriers to communications within a company. In practice, the one-stop shop may not be all it's cracked up to be:

- Running a prototyping/machine shop and/or a manufacturing line is very different than running an [engineering design team](#). The core business of any CDM is the manufacturing business. That is where the vast majority of their revenue comes from. Manufacturing is a capital-intensive business. To get a return on that investment, high utilization is required. Design simply doesn't get the same focus as manufacturing, and design is tasked with keeping the manufacturing side of the business busy.
- Access to the equipment is likely not as readily available as you would hope, as it must be kept busy. Of course, the flip side is that high availability comes with a cost. If you tour a facility and see lots of idle equipment, consider the overhead costs to cover that expense, and who will be paying for that cost.
- No single company can afford to have the latest and greatest equipment for every possible

manufacturing process. However, a one-stop shop has a vested interest in keeping its equipment or production lines busy. This leads to a potential conflict of interest where your product may not benefit from using the optimal manufacturing process because that is the equipment your CDM needs to keep busy.

Simply put, no single company can be best-in-class at everything. Any firm that specializes should be best-in-class. Choosing a top-notch Design Specialist ensures focus exclusively on the design of products. A Design Engineering Firm's reputation is built around the quality of their engineering, so they recruit and retain the best design engineering talent possible.

Design Engineering Firms often work with other specialty design firms for aspects of product design where they aren't best-in-class themselves, forming a design consortium of sorts to ensure delivery of a product that is leveraging core skill sets from trusted best-in-class partners. For example, a Design Engineering Firm may partner with a mobile app development firm to provide both a product's hardware and the accompanying mobile app. Similarly, Design Engineering Firms often help select and onboard a contract manufacturer (CM) early in the design process to maximize Design for Manufacturing efficiencies and hand-offs. The best companies, both design and CM, are great at communication because their success depends upon it — the feared barriers just don't exist.



When it comes to precision execution, a Design Engineering Firm performs better than companies that attempt to perform all of the tasks in the product development cycle.

WHAT IS THE BEST DEVELOPMENT MODEL FOR YOU?

We've discussed several factors that should be considered when selecting the development model for your product. **Following is a summary of the advantages and disadvantages of each model.**

ENGINEERING MODEL	ADVANTAGES	DISADVANTAGES
Internal	<ul style="list-style-type: none"> • IP is protected • Lower development cost if there is a stream of work • Best market knowledge • No manufacturing process lock-in 	<ul style="list-style-type: none"> • High development costs if team is not utilized • Difficult to retain specialists with low utilization
CDM	<ul style="list-style-type: none"> • Lower design engineering cost (loss leader to secure manufacturing) • Simplest business relationship 	<ul style="list-style-type: none"> • IP may be less protected, can be in jeopardy if relationship changes • High manufacturing cost risk • Less process flexibility and design may be constrained by manufacturing capabilities • Low market knowledge • Potential bias based on existing capital investment
Design Engineering Firm	<ul style="list-style-type: none"> • IP better protected • Lower long-term development cost • Ability to provide a large, diverse team rapidly • No manufacturing process lock-in • Reduces manufacturing cost risk by providing check on CM cost increases. 	<ul style="list-style-type: none"> • Higher short-term development cost • No risk sharing

CONCLUSION

For some projects, completing the design internally is the way to go. For other projects, outsourcing your design will make the most sense. In still other cases, a combined internal/external approach where retaining internal teams to manage certain design or business aspects while relying on outside resources to fill knowledge or technical gaps, might be best. It should be noted that many large firms deliberately retain a design firm and a separate CM to optimize output based on the more specialized core-competencies of each.

Each project and company is unique and will have its own set of challenges. Ultimately, the most important factor should always be the finding the right trade-off between quality of the final design, development and manufacturing risk, and your overall budget. Finding the right design team to achieve the desired outcomes takes diligence and flexibility. Considering the relative importance of each of the trade-offs discussed in this paper should help you to make an informed decision for the best possible design engagement model for your product development.

ABOUT THE AUTHOR

[Doug Harriman](#) is the Chief Technology Officer of Simplexity Product Development. Simplexity is a Design Engineering Firm as defined by the models in this paper. Doug has over 20 years' experience in the development of mechatronic systems and feedback controls for products ranging from low-volume wind turbines to high-volume consumer 2D and 3D printers.

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