

Outsourcing for Design Engineering and Manufacturing of Complex Capital Equipment

By Randy Curtis

Foreword

Outsourcing has become common for two major reasons. First, companies have realized they need to focus on their core competencies and strategic advantages. Second, suppliers are focusing on being outsource providers and are doing a better job at those specialties that are non-core to the client. In so doing, there are now many success stories of outsource relationships. The key to these strategic and long-term partnerships is in the ability to structure an

agreement that is win-win for both parties. Aligning the suppliers' goals with the customers' goals achieves this.

Owens Design Inc. (Fremont, CA) started in 1983 as a "custom machine designer," or "factory floor automation company." After many years of ups and downs, Owens Design reinvented itself as an outsource provider of design engineering and manufacturing, with a strategic focus on serving original equipment manufacturer (OEM) suppliers in the biomedical, semiconductor

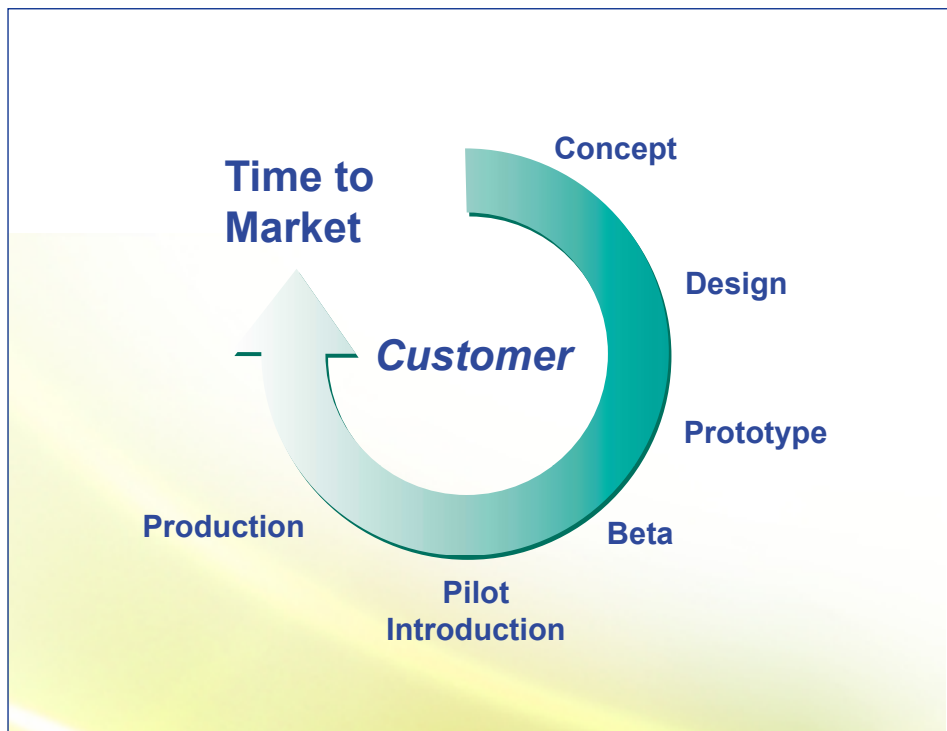
and data storage industries. This article is meant to detail the many lessons learned from this transformation, and is a compressed discussion of what works and does not work in this outsourcing niche. There is a special focus in this paper on the outsourcing of engineering (intellectual property) and what that means to both the supplier and the customer.

The outsourcing agreement becomes even more strategic when the element of product design (an intangible of intellectual property) is added into the mix.

The Deliverable

At face value, the deliverable can be viewed as a final product; in Owens Design's case the product is a complex electro-mechanical machine. Although that is the tangible part, the real deliverable is the process to achieve this desirable outcome in a planned and organized manner. Setting realistic goals, qualifying all stakeholders, and early and regular communication are all important aspects of a successful outcome.

In a design collaboration, the importance of partnership and aligned goals cannot be overemphasized. Basically, the partner must be willing to become a part of your engineering and manufacturing team. The client's goals become the supplier's goals. Early stage involvement is always a desired element as the supplier will want the freedom to influence, the design direction and not get locked into a poor architecture. A clearly written project scope and timeline



are always a part of early discussions. Changes in a design project are inevitable, but with written requirements specifications to benchmark the expectations, the potential for disagreement after launch is reduced.

In dealing with uncertainty of a particular part of a machine development, it has proven beneficial to incorporate a feasibility phase or even a physical breadboard to verify critical process capabilities. If the feasibility phase is not successful, the project can be discontinued without spending resources on other parts of the design. The feasibility phase is also useful to define system architecture, resolve trade-offs in the design approach, and to identify important specifications, major components, sequence of operation, software requirements and manufacturing costs.

There are a few areas to watch closely for risk mitigation. "Scope creep" is a term used to define the changing direction of a design that adds both cost and schedule impact. An experienced program manager

will identify scope creep early and make sure that the impact is discussed immediately. "Science unknown" is another potential trap. This is where a certain part of the machine is not defined, perhaps waiting for process improvement or definition. This part of the project needs to either be dealt with separately or defined prior to project launch.

Occasionally, there can be a poor technical fit between the client and the outsource supplier based simply on past projects. An open discussion of what the core competencies of the supplier are and how its past projects detail some technical fit for the project at hand will alleviate this problem. A discussion of what the supplier does not do well is also in order. A check of two or three prior project references may shed some light on the supplier competencies as well. Lastly and simply, it is vital to ensure that your project will be important to the supplier in terms of size and schedule versus its other customers and projects.

has often been demonstrated to generate significant cost reductions. As the technology is non-core, it is often not staffed with the client's best resources, whereas the outsourced provider has made the continuing investments to be the expert in this area because it is its main business. The opportunity to generate increased revenues results from an extension of the product line to own an up- or downstream process. Outsourcing the line extension allows it to take advantage of the selling, service and field infrastructure already in place without adding new capabilities to its development/manufacturing team. The business solutions that outsourcing has provided to clients include:

- To extend their product line
- To validate or calibrate their product
- To update a legacy product
- Develop a non-core subsystem
- Address customer specials

Clearly, not everything should be outsourced. The key question of whether to outsource or not relates to business strategy and starts with the query, What is it that only we can do — the reason our customers come to us? Once the OEM has made the strategic decision to outsource, there is nearly always a "time-to-market" factor. Usually it has taken so long that the OEM is realizing the revenue lost on delaying the project. In today's economy, companies have trimmed back their development staffs so drastically that certain skill sets are no longer in-house and engineers are simply overloaded.

Reasons to Outsource Complex Design Engineering and Manufacturing

Only 10 years ago, typical machine OEMs would probably not have outsourced complex design and manufacture for their products. "That's what we do," they might have said. So why do they outsource now? It is too simple to say that OEMs only outsource when they lack the resources to do all of their own designs internally. Generally, the most powerful reasons driving outsourcing are either a dramatic cost reduction or an opportunity to generate greater revenues. Outsourcing non-core technologies

Why Outsourcing Complex Design is Different from Other Outsourcing Models

In the high-volume world of electronic manufacturing services (EMS), the deliverable is usually a very tangible part or small subassembly that the OEM is already making in volume. With complex equipment, it likely begins with nothing more than a manual process or a vague concept. Complex equipment is very multidisciplinary in nature, incorporating mechanics, electronics, software and fluids. It is also produced in low volumes relative to EMS.

The Design Problem

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Typical volumes may be several hundred over a four- to five-year life cycle.

Machine design outsourcing offers the following differences and challenges:

1. Machine design is very collaborative. There is often a high degree of dependence between the process requirements and the design. A high level of communication is required that can either be accomplished by working with a local supplier or by effective use of long-distance collaboration tools. Preference should be given to the local suppliers as the collaboration tools, while getting better, are still not a substitute for face-to-face interactions.
2. Multiple design approaches must be considered to achieve a truly excellent outcome. Initially there may be sketches, preferred architectures and key components defined, but these will change once the project is underway. Many changes will occur along the way. An important part of achieving a superior outcome is to synthesize the competing interests of the various stakeholders into a single product vision.
3. Design content can be produced by all parties: customer, supplier, or even a third party. Software is a good example; sometimes this is best done internally or by a third party, depending on who has the core competence and long-term support considerations. In these cases it is

especially important to be clear about who is responsible for the entire project's success.

4. Different stakeholders have input at a machine OEM. Who will be responsible for defining the product from engineering, marketing, manufacturing, field service, sales, etc.? Who will champion the product vision so we can be ultimately successful?
5. "NIH" (not invented here) can be a perceived threat, especially in bad economic times. Sending work outside while the company is downsizing can seem demoralizing to the remaining employees.
6. Very difficult to multi-source. There is a certain "leap of faith" and trust in a supplier when the first project is started. Look for one that aligns itself with your goals and can profit from helping you succeed. The cliché "win-win" has to be present for a successful long-term relationship.
7. Design ownership. In most cases, the client who is paying for the NRE (non-recurring engineering charges) will end up owning the design.
8. Sole or dual source responsibility. A potential problem can arise when one company designs the product and another manufactures it. A philosophy based on over 20 years of experience is that the best way to ensure that design goals and manufacturing goals are both met is to use a single turnkey source.

The advantages are that one company is accountable for the manufacturability and cost issues. The ramp to revenue can also be compressed as changes resulting from the market introduction can be rapidly cut into production. This makes the transition from prototype to volume much more seamless.

Once the design has stabilized and changes are minimized, it may then make economic sense to transfer the manufacturing to a lower-cost manufacturing site, perhaps offshore. The technical complexity, customization and volumes of the machine must be considered when making this decision.

Summary

A complex design outsourcing relationship can be successful for both parties when a committed partnership is formed with an alignment of goals for the current and future projects. Early project involvement, clearly laid out expectations, and frequent and consistent communications will all contribute to the successful outcome.

Randy Curtis has 20 years of experience in high-tech sales and marketing positions. He is currently vice-president of Sales and Marketing at Owens Design Inc. (Fremont, CA). He holds a B.Sc. from California Polytechnic State University (San Luis Obispo, CA) and an MBA from San Francisco State University (San Francisco, CA). 