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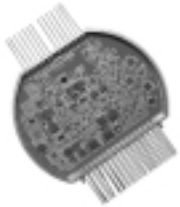


Defense

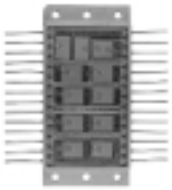
RF/Microwave

Satellite

Fiber Optics

Medical

ATE



Power Hybrid

DC to DC

Microelectronics Manufacturing Solutions:

The Benefits and Considerations of Outsourcing

NATEL ENGINEERING CO., INC.

The Fine Balance Between Design, Manufacturing, and Cost

While no two companies are just alike, they all share one thing in common: the desire for a perfect balance between design, manufacturing, and cost. This means finding an efficient, cost-effective method of getting a high-end hybrid module from the drawing board to final production, while ensuring product quality and on-time delivery.

Outsourcing: A New Era

As producers of advanced modules for fiber optic, telecommunication, military/aerospace, and other high-tech industries search for ways of lowering costs, improving product quality, and strengthening their core business, "outsourcing" is becoming an increasingly popular solution. Outsourcing, a practice that has been in existence for over a century, involves taking your design to an outside manufacturer for production. This practice offers an alternative method of production that has been proven to work for many companies. The following white paper will give you an insider's look into the world of outsourcing, offering a brief overview of the concerns surrounding top level microelectronics manufacturing, a detailed guide to the many benefits that outsourcing can provide, a series of questions that will help you determine if outsourcing is right for you, and valuable tips on how to choose the right manufacturer for your needs.

Current Trends:

With outsourcing on the rise, it seems that nearly every big company is outsourcing at least part of their business. The current manufacturing push is to minimize costs and increase productivity, so companies are using outsourcing as a way to reduce production costs and cut in-house operations. This trend is being seen in both high- and low-end markets, as more companies turn away from vertical integration. If you are just starting out, or have been debating the logic of in-house manufacturing, you may want to research other companies in your industry. Don't look to reinvent the wheel—see how they are meeting the need for time- and cost-efficient operations, and consider their example.

Concerns in Microelectronics Manufacturing

The bottom line is that everyone wants their modules manufactured to the highest quality standards by someone who offers industry expertise, and can produce the part on-time at a reasonable cost. In many cases, outsourcing meets these needs, but that does not mean that outsourcing is right for everyone.

Some companies feel that in-house manufacturing is the way to achieve the quality control they need, which leaves the question of costs open. They are still devoting staff resources to manufacturing, making large investments in equipment and manufacturing space, and taking time away from their core business of design and marketing to get these parts through production.

Other companies who are just starting, and may be considering in-house manufacturing, are concerned about volume. They often feel that their volume needs are too low to outsource. However, it is important to note that there are many outside vendors available, and one can usually be found to handle any production amount. Given the high cost of capital equipment and other production-related costs, outsourcing can be a more financially viable option for start-up companies.

Another important consideration for those deciding between in-house manufacturing and outsourcing, is the delay that putting an in-house manufacturing infrastructure in place will have on their module's *time-to-market*. Setting up an in-house manufacturing department involves one of the longest lead times, due to the need for preparing adequate facilities, purchasing equipment, implementing necessary quality control measures, obtaining required certifications, training staff, and more. It is important to consider the effects that this will have on your production schedules.

So, what's the right choice for your high-end module? Following is a series of questions you should ask yourself before you consider outsourcing as a manufacturing solution.

Did You Know:

Design companies usually have a higher gross margin than manufacturing companies. Manufacturing companies are responsible for large capital equipment purchases, higher overhead, and other costs associated with manufacturing. If you decide to bring manufacturing in-house, the overhead required will reduce your company's gross margin. With these lowered margins, your company may be perceived as having a lower value.

Is outsourcing right for you?

Carefully consider the following questions to determine if outsourcing is a viable option for you. Even if you are just starting out, and are not sure what is involved in the actual manufacturing of your design, review these questions carefully, answer them as best you can, and when researching outside vendors, include them as part of your decision making process.

Define your design

- Do you believe your design requirements are too complex to be handled by an outside source?
- Do you have drawings readily available?
- Do you need packaging and design assistance?
- Do you need prototypes?
- Has your design been bread-boarded?
- Do you perceive that your design will have issues with manufacturability?

What are your manufacturing requirements?

- Do you understand the design rules for manufacturing your module?
- Can all or part of the manufacturing process be automated, or does it have to be done manually?
- Is a particularly complex process involved in manufacturing your module?
- Does your module need to be made in a clean room or a unique environment?
- Do you require specific vendor qualifications, such as ISO-9001, telecordia, or military certification?

What are the assembly requirements for your design?

- Can you define your assembly requirements?
- Does your design require unique equipment and/or processes?
- Are there other secondary operations required?
- Do you want secondary operations to be completed at one location, by one source?

What are your testing requirements?

- What tests and quality control measures are required?
- Is unique equipment needed for your testing requirements?

What are your needs in terms of volume and scheduling?

- What are your volume needs for:
  - Prototypes?
  - Pre-production?
  - Full production?
- Are your volume needs such that meeting them in-house poses a significant challenge?
- Are your volume needs such that they justify the existence, or creation of an in-house manufacturing department? (This can include hiring additional personnel, equipment purchasing, ISO certification, and much more.)
- What is your required *time-to-market*?

If you are currently manufacturing in-house, will you be able to continue meeting your customers' needs?

- Do you have the latest equipment, software, and peripheral technology?
- Does your facility meet your current manufacturing needs and future goals?
- Do you have adequate manufacturing space?
- Is your staff fully trained and qualified?
- Are you over- or under-staffed?
- Will you be able to continue to meet the quality, on-time, and price requirements of your customers?

Will outsourcing help you create a balance between the price of your process versus the price of your product?

- Is the cost of keeping manufacturing in-house more than the cost of outsourcing?
- Will the costs associated with in-house manufacturing decrease your gross margins?
- Would the manufacturing space you currently use be more beneficial or more lucrative if used for a different purpose?

Hint:

For best results, select a vendor before you create prototypes and work with them to ensure the manufacturability of your module.

Outsourcing Benefits

For most companies, the most beneficial aspects of outsourcing with a reliable manufacturer are cost savings, improved quality, and quicker *time-to-market*.

Production Cost Savings

Outsourcing has been proven to be one of the most cost-effective methods of production available. The reason for this is inherent to the nature of outside production; namely the reduction of overhead, reduced headcount, and elimination of capital equipment and software investments.

Strengthening Your Core Business

Turning the production of a complex module over to an outside vendor leaves you free to focus on your core business and lets you reallocate your time and space to research and development or strengthened marketing efforts.

Higher Yields

Vendors with automated equipment provide greater efficiency and process repeatability for higher yields.

Superior Repeatability

The latest trends in high-end microelectronic module manufacturing involve automated lines that are not only faster, but improve lot-to-lot repeatability. Products are produced in exactly the same manner from day to day, resulting in greater consistency. When the process repeats as described, the end product is virtually error-free and provides higher first test yields and little or no rework.

Better Resources for a Better Product

Microelectronic vendors typically have highly trained people and better equipment, resulting in better upfront product characterization and production methodology.

More Representative Prototypes

Most outside manufacturers will provide prototyping services. Since these prototypes are produced using the same materials, processes, and equipment that will be used for final production, the prototypes are more representative of the end product. This allows for the elimination of false starts and for faster *time-to-volume*.

Reduced Cycle Times

Because many microelectronic vendors provide automation, they are able to decrease cycle times with reduced manual operations and faster manufacturing processes.

Lower Inventory and Inventory-Related Costs

With reduced cycle times and increased efficiency, vendors offering automation provide lower inventory and inventory-related costs.

Quicker Turnaround

With their automated equipment, increased efficiency, and ability to focus solely on manufacturing, these suppliers are able to provide quicker turnaround. This includes, not only faster *time-to-market*, but faster *time-to-volume*, as well.

Equipment Purchasing: Are You Prepared?

When buying equipment for microelectronics manufacturing, the choices are virtually limitless. There are machines designed for every aspect of production. In order to choose the equipment that is right for your module, expertise in the field of equipment purchasing is necessary. It is important to know your current manufacturing needs in terms of volume, product characteristics, and delivery. Additionally, you must predict your future needs so that the machines you buy are adequate down the road. And, of course, as new technologies emerge, the chance of one's equipment becoming obsolete is always present. Even with all of the choices available, you may feel that nothing meets your specific needs, in which case, you may need a custom machine. Are you prepared to make these choices?

For many, outsourcing is the ideal way to eliminate the concerns surrounding equipment. A quality vendor already has the expertise needed to determine which pieces of equipment will meet your needs. Since manufacturing is their core business, they are involved in the latest technology and trends. When you trust an outside vendor to handle the purchasing, maintenance, and operation of equipment, you can save time, money, and frustration, leaving you free to focus on your core business.

Consider the following:

Volume — *some machines are designed for volumes as low as 500 per month, others can produce up to 50,000 per month. Do you know your current volume needs, and will you be able to predict your future needs?*

Characteristics — *equipment can be purchased with specific features that will give your product certain characteristics. Can you anticipate what your product's characteristics will be both now and in the future?*

Speed — *different machines provide different speeds of production. What are your time-to-volume and time-to-market needs, and will they change in the future?*

Resources — *equipment buying takes the focus away from your core business. Can you afford to expend the personnel resources required?*

Domestic vs. Offshore

Even after deciding that outsourcing can meet your needs, you are still faced with question of choosing a domestic manufacturer versus an offshore vendor. In the past, those that chose outsourcing over in-house production often turned to offshore vendors. These vendors frequently provide cheap labor, but fall short as a complete solution. Lost revenue on delayed deliveries from offshore facilities, inflexible scheduling, difficulty in implementing design changes that affect production, and inferior quality are just a few of the difficulties that have plagued offshore manufacturing.

Unfortunately, even with these difficulties, many domestic manufacturers were still unable to compete with the cost-saving benefits of an offshore vendor. Until now.

With the emergence of "super lines", many domestic vendors have found a way to compete with offshore manufacturers. These super lines are highly automated assembly lines designed for high volume and efficient production of a wide range of products and processes. Processes include wire, ribbon, flip chip interconnect, precision component placement, fiber alignment, and hermetic package seal. Super lines meet the need for advanced assembly technology in the United States, while addressing many of the concerns surrounding offshore manufacturing.

Helpful Guidelines:

Here are a few guidelines that will help you determine whether a domestic or an offshore vendor will be best for your needs:

Define the complexity of your design. *If your design has stringent production requirements, intricate parts, and would require a great deal of hands-on, or face-to-face involvement with a manufacturer, then a domestic vendor will usually provide the best service. The nature of offshore manufacturing presents greater challenges in terms of constant communication, scheduling, and design revisions.*

Calculate your expected volume needs. *If your volume needs are exceptionally high, then chances are, an offshore vendor is going the be the most affordable solution. However, as noted, domestic companies with a super line may be able to offer effective lower prices. Inventory costs, including storage of raw materials, storage of the finished products, and shipping, must also be considered.*

Decide what aspect of manufacturing is most important to you. *If you are more concerned about overseeing quality, receiving direct design assistance, or are dealing with proprietary issues, look to a domestic manufacturer. If timely delivery or an easily accessible manufacturing location is important, then you should also consider a domestic vendor. However, if you have very high volume needs, and a very low cost BOM, then offshore manufacturing may provide the best solution.*

Choosing the Right Manufacturer

For outsourcing to be successful, the outside vendor must know your industry, share your values with regard to quality and service, understand your design, and offer expert manufacturability assistance. In short, will your vendor act as a manufacturing extension of your own company? When researching vendors, carefully consider the following questions:

Technical Services

- Does the manufacturer offer process design assistance?
- Do they check manufacturability of the part before production?
- Do they provide prototyping?

Quality control

- Is the supplier ISO-9001 certified?
- Do they meet specific industry standards?
- Do they have the technical capabilities necessary to adequately test your product?

Production Capabilities

- Can they meet complex design parameters?
- Can they handle both high and low volume requirements?
- Do they offer the latest technology, such as super lines and unique high frequency processes?
- Can they meet your quality requirements?
- Can the assembly equipment they have meet your manufacturing needs?
- Do they have clean room facilities?
- Are they able to provide the secondary operations that your design may require?

Customer Service

- Does the supplier offer quick turnaround and on-time delivery?
- How quickly can they ramp up to full production?
- Is the vendor the right size to match your production needs and will they give you the attention you deserve?

Experience

- How long has the vendor been in business?
- Does the staff provide sufficient process engineering and manufacturing expertise?
- How many products are they currently manufacturing?
- What is their experience with products similar to yours?
- Can they provide you with a client list?

If the manufacturer you are considering can meet the major goals you have set for your product, and they share your desire to see it succeed, then the end result will be a top quality part with cost-savings and on-time delivery.

About Natel

Natel Engineering Co., headquartered in Chatsworth, California, offers over 25 years of microelectronics experience with advanced capabilities for a wide range of products and industries, including hands-free assembly for modules, hybrids, MCM, and chip-on-board. As experts in high frequency manufacturing, Natel has pioneered the processes and capabilities necessary for high frequency products such as DWDM, clock drivers, transmitters/receivers, and limiting amplifiers. In addition, Natel provides ISO-9001, telecordia, and DESC certification, and is qualified to Mil-PRF-38534 (Mil-883). Natel's manufacturing facilities include a combined total of 117,000 square feet, with 30,000 square feet of advanced clean room area, all equipped with the latest manufacturing and testing equipment.

Natel has participated in the most dramatic changes that have taken place in the manufacturing of products for fiber optics, opto-electronics, defense, medical, and RF/Microwave industries. Their dedication to IQS (innovation, quality, and service) resulted in one of the first super lines. It allows for product completion in hours, as opposed to days or weeks, once the product is characterized. The result is decreased *time-to-market*, rapid *time-to-volume*, and the highest levels of lot-to-lot repeatability available.

With a reputation for quality and responsiveness, Natel is committed to providing top level manufacturing. Their highly trained engineers and manufacturing experts can build virtually any high-end microelectronic module. Fast, efficient prototyping, innovative process engineering, and precision testing capabilities help your design get to final production quickly, affordably, and with the highest level of quality possible.

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