

**Appendix A: DEFINING A MANUFACTURING
STRATEGY IN A START UP ENVIRONMENT ©**

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Introduction

This Appendix is written primarily for the start up company with a leading edge product that requires construction of hardware.

Speed and agility are the way to the next huge success story. If you get your "new" technology out there first, you can win big! Getting to market quickly is the key. Contract Manufacturing has now become almost ubiquitous and a necessity for maintaining competitive pricing and appropriate times to market. Few small companies can claim manufacturing as a core competence. There is little motivation at present to develop in-house manufacturing capability given the amount of capacity available for hire. However, it is imperative to understand the dynamics of outsourcing, and that is the focus of this Appendix.

Identifying your Manufacturing Needs

Regardless of what solution your end product itself delivers; management of your business model is different than any other company and your product will have very unique manufacturing requirements. Some of these requirements will be technology related and some will be business related; understanding those requirements and ensuring that you have the most comprehensive operations plan is extremely important to your future success.

The following questionnaire is a useful tool to help the development team think about manufacturing issues, using it in a brainstorming session. It will bring up areas and concerns that had not been previously recognized. These kinds of sessions are essential to creating "buy-in" by everyone on the team.

This analysis considers many factors, including product type, marketing strategy, technology, and company culture. A product that will be sold into an already established market, with an accepted technology will have different manufacturing needs than a leading edge product that is pushing the envelope. Some examples to think about are included.

- **Understanding your goals**

Numerous products from startup companies may be based on a hardware platform but most of the Intellectual property resides in the software or firmware. Some companies are able to find a pre-existing hardware platform to run their software and can use off the shelf components to create their system solution. This is certainly a viable short term solution, especially if the hardware is stable and there is a guarantee the company which designs and builds the product will be around long enough to support your product. If this is not the

case, the company may have to design its own hardware. If new hardware will be required, *the company must decide what its manufacturing strategy will be throughout the product life cycle.*

Before going further, it is useful to review some definitions for the numerous acronyms that will be encountered in the CEM industry. In some cases, the acronyms will be familiar but they will have different meanings. There is still much room in this industry for standardization, but many EMS providers see these terms as a way to differentiate themselves from a marketing standpoint. So, don't be afraid to ask for clarification when you are discussing these areas with your potential EMS provider.

ACRONYM

DEFINITION

EMS	Electronic Manufacturing Services
CEM	Contract Electronic Manufacturing
CM	Contract Manufacturer
PCBA	Printed circuit board assembly
ICT	In circuit test
NDA	Non Disclosure Agreement
NPI	New Product Introduction
MSA	Manufacturing Services Agreement
PM	Program Manager
BOM	Bill of materials
ODM	Original Design Manufacturer
SMT	Surface Mount Technology
BUM	Business Unit Manager
TK	Turnkey

To identify the manufacturing needs, the following summary breaks down the questions and considerations you will want to discuss as a management team. Please take the time to peel back the layers and ask a lot of questions. Don't be afraid to play the devil's advocate. Contingency plans are essential to avoid catastrophic schedule changes later on.

Management Brainstorming Questions

Market Issues

Customer Base

Identify your customer base and then discuss the following aspects as they relate to the market.

Short term goals:

If **time to market** is more critical than cost then you might look at a shorter term solution using a company that specializes in managing the complete NPI process from start to finish. This requires a very strong EMS partner that will act as an extension of your company. This requires an internal team that can effectively manage that process. Start with someone who knows the EMS industry and can set reasonable expectations.

- Don't be a guinea pig for a EMS provider unless the risk is low
- Choose a partner who is committed to your product; this means a high level of commitment from EMS executive management
- Understand your escalation path within the company to get things done
- Insist on daily or weekly project schedule updates
- Clearly define deliverables and manage to those expectations

Limited geographic market segment:

If the product will be launching into a limited geographical area, leveraging the presence of an EMS that is located in that geographic area should be considered. Example: Product will be shipped to distribution hubs primarily located in North America. Consider finding a partner in North America who also has a global presence and can build product for you in other areas as the need arises.

Extended geographic market segment:

Launching product into an extended market region may require the support of a global supplier that can offer a duplicate solution for each area. Although all tier I EMS providers can offer global support, it is usually not an easy process.

- Make sure any hidden costs associated with doing business in another region or country are understood, including:
 1. Additional travel
 2. Time zone differences
 3. Freight associated with moving material around
 4. Customs and duties
 5. Communication challenges (different languages, infrastructure)

- North America If the product will be distributed in North America, the options are to build it in the US or use a company in Mexico to achieve lower cost.
- Asia Pacific If the product is going to be distributed in Asia, an Asian source should be considered right away. There are some concerns in the industry about sending product to Asia only to have it show up under someone else's name a year later. This should not be an issue using a reputable company that is a US corporation. A good NDA is essential. Just be prepared to support the time difference from a communication standpoint.
- Europe All geographic regions offer their own unique challenges. Deciding whether or not to build in Europe requires a thorough analysis of the supply chain and a clear understanding of what it buys. Europe heavily taxes incoming product but they also tax the raw material as well. Sourcing the BOM in Europe will get the best cost.

There is significant idle capacity in the EMS market today and firms will appear to be competitive. They may have the technical capability and they might meet your cost targets but a key metric is support. Do they have good communications tools, how are they structured from a customer service standpoint? How much authority does the customer advocate have to get things done? Do they believe in the company and the product or is the company too small to get their attention?

Selling Strategy?

How you plan to sell the product will have a tremendous influence on what the best manufacturing solution might be. How long is the sell cycle? How long is the supply chain? How much visibility is there into the customer decision process? How well do sales and operations communicate?

- Distribution requirements-
Manufacturing and inventory control are closely linked. The distribution channel requirements need to be matched to supply chain and unit volume controls.
- Identifying the channel-
Key to selling the product and sizing the manufacturing effort: some examples
 - Retail-This is the most challenging method in terms of managing the supply chain. It is very important to have contract agreements in place and to have defined liability. Exposure to product returns that have not "sold through" to end users is very high. Retail requires

micromanagement and complete visibility throughout the sell cycle. Just because Fry's buys 5000 units does not mean they will sell 5000 units and they only pay for what they sell.

- Value Added Reseller-A VAR can be considered an end user; however, they may have a longer sell cycle and visibility into their sales channel is crucial. The VAR can't be accumulating unsellable product.
- Direct-Most EMS providers can manage front end order management or partner with a logistics partner that can do this. The front end demand should be driving the manufacturing and planning horizon. This is sometimes referred to as "box build"; the EMS builds, tests, and ships to the end user.

These are some other things to consider in all of these scenarios; freight, insurance, packaging, returns, and a solid contract spelling out who owns what inventory and when. In addition to the above, some additional considerations are important for International customers; customs, duties, federal government qualifications, international packaging, international returns, etc.

- Effect on manufacturing forecasting
 - Build-to-Order- If demand comes directly from the end-user, build-to order works with mutually agreed lead times. This does not usually work in highly competitive commoditized markets. In that case consider the next option
 - Build-to-forecast and/or Stock- If demand comes directly from the end user and delivery is expected within days. This is extremely important to your EMS partner. If this forecast demand goes away, expect to be held responsible for all the material the EMS provider purchased against your forecast. Accurate forecasting is a critical part of ensuring a healthy relationship with the EMS provider. Few of them will put up with customers who continually over/under forecast and expect the CM to jump through hoops to fix the problem.
 - VAR/Build-to-Forecast - This is risky because there may be little visibility into the sell cycle and product may be sitting on shelves and not selling at all. Contractual agreements with the end customer which spell out inventory liability are essential here.

Effect on manufacturing needs:

If the product will be sold into Europe or Asia, a global EMS partner will probably be required. Some of the metrics are:

- Short term- NPI and volume requirements. Depends on the list the list of required services.
- Long term -Supply chain logistics, volume requirements. This should be the long term partner who can support end of life requirements as well as next generation product.
- Materials logistics- Define the supply chain. Will all material be outsourced on a turnkey basis or will some components be handled in-house?
 - Identifying key components-Parts critical to the product; frequently custom or sole sourced and may be on the leading edge from a technology standpoint
 - Ensuring supply-How can material supplies be guaranteed?

Analysis of various material models:

There are Pro's and Con's with each model.

- Turnkey model. Pro-someone else is managing all material; should be able to leverage total material purchases from CM; don't have to pay for it until product is shipped improves cash management. Con-less visibility into the supply chain and less control. However, if EMS provider is doing a good job of managing the supply chain this should not be an area that requires much time anyway. Good test of EMS competence.
- Consignment model. Pro- total control over the supply chain and the pipeline. Con- fund all the material up front and tie up cash that may be needed for other expenses; more expensive because buying less than an EMS provider would. Resources and staff to support this must be added with little value add.
- Prime/Distributor model. Pro- One organization that is securing supply and managing the bulk of the BOM line items. Con- Parts that are not franchised by the distributor partner will be more expensive with less control over the pipeline. This works for a start up that needs tremendous flexibility and does not have high volume requirements.
- Hybrid model. Pro-someone else is managing all your material for you, you should be able to leverage total material purchases from your CM, you don't pay for it until your product is shipped so you free up your cash. Con- you don't have visibility into the supply chain; you lose control over the supply line. You still have to manage some portion of the BOM, usually expensive

parts that require you to pay up front for them and then consign them to the EMS provider.

- Cost targets-
This needs to be a combination of engineering, operations and marketing input.
- Developing a target price-
You should develop a target price that is based on known market factors, material pricing and the overhead associated with transformation. This changes as the market changes and it is dangerous to take historical information and use it as a basis. The information should be as recent as possible.
 - Short term cost targets- You will have different cost targets in the beginning of your program because of volume and time to market challenges. You should prepare for them and if you come in under your budget then you are ahead of the game. Coming up with an unreasonable target price and then expecting a partner to achieve it when they have no control in where it came from is only setting everyone up for frustration and unrealistic expectations.
 - Long term cost targets This should be reasonable and achievable over a period of time and it should reflect improvements in manufacturing, yield, material cost and any design changes that can be incorporated over time. You should partner with someone who is very open and willing to help you achieve these cost targets. Most EMS providers will try to hide some profit in their raw material cost so you will need someone in your organization who understand the component industry and can keep an eye on pricing trends. It is not unreasonable to let a CM partner keep some % of material cost savings from quarter to quarter; assuming they continue to offer you some agreed to cost reductions.
- Long lead time components:
Lead-times in our industry change constantly and should be tracked on a regular basis to avoid getting into trouble. The same person you have internally that tracks pricing trends should also track lead time trends.
- Allocation:
Although we are not currently seeing serious allocation issues it will return. It is cyclical and will happen again. Tracking lead-time can help but it is imperative that someone in your organization take ownership of this.
- Field Service Support:
Many companies don't even consider this aspect of the equation until they are servicing customers and have them ask about it. It is very important that you discuss this and understand it as you choose your manufacturing strategy. This area can cost a lot of money and result in unhappy customers if there is an issue. Ideally

you don't ever want returns, but they will happen. Discuss how you plan to support that requirement.

- **Advance replacement** If you plan to offer advance replacement you will need to plan for some number of units to be available for that process and held in a refurbishment inventory location. The returned units can be reworked and put back into this area and used for advanced replacement but you need to be prepared to start that process with new units.
- **Local support** If your customers are not local to you will you be supporting them from a local office. Many customers expect some kind of local support, even if it is an address on the continent that they can ship the damaged unit back to. There are numerous logistics providers who offer this service on a contract basis; but you might be able to do this with your *CM* partner. At least ask the question.
- **Failure analysis** How will you collect the failure analysis data if you choose to have an *EMS* partner manage the returns
- **Spares and Upgrades** How will you plan and manage this

Understanding your Options

Once you have identified what your manufacturing strategy will be your next step will be to identify those specific services you will require during the course of your product lifecycle. You will then be able to analyze your over all project requirements from development to end of life. You may find that your needs cannot be supported by one supplier. You may actually find that the best strategy is to have a short- term solution and a long term solution based on different criteria. Although most EMS providers will try to convince you that they can offer you everything you are looking for you need to be careful of this approach. We will go into some of the pitfalls later on in this discussion.

Some additional questions for consideration:

What is your core competency?

As a company you should identify this very early on. Will you be a hardware developer, a software developer, or both?

Where should you spend your dollars?

Does it make more fiscal sense to pay someone else to do the job or to hire a full time employee?

Can you afford to miss your market window to save money or is it more important to hit critical dates?

Engineering-

Will you hire your own engineering organization to design all aspects of the product including industrial design, mechanical, power supplies, PCB's? There are many companies who can support some or all of these requirements so you need to understand what you will be outsourcing to ensure you are not wasting your money or time.

Agency approvals-

There are many companies who will handle this process for you and they can sometimes be a real asset as they already know the ropes inside these agencies and have the relationships necessary to get things done.

Packaging-

History is full of delayed product launches due to this aspect of the process. Someone forgets to have a label designed or they don't realize there is a lead- time associated with printing or replicating CD's. Also, if your product will be shipped overseas you need to consider your shipping requirements, customs, duties etc.

Manufacturing-

PCBA, System Level, Configuration, Final Test

Test Development-

Will you do your own test development internally or will you outsource this.

End order fulfillment-

Where will you fulfill orders from? How will you manage the order placement, invoicing, shipping, installation etc?

Field Service Repair-

How will you manage this? How will you gather failure analysis data?

Sustaining Engineering-

ECO management, tools and resources

Identifying companies that are a fit-

When the economy is weak you will find that every EMS provider is interested in your business. Whether or not they will take care of you when things turn around and they need capacity is something you will have to consider. There may not be a "one stop shop" for your company, although there are numerous EMS providers who will sell you that concept. A good rule of thumb is to find someone who is small enough that you will represent between 5-10% of total business but is growing at the same rate that you are so you will always maintain that level.

- Coming up with a list-Once you identify location, capabilities, size and any other areas of importance you should put together a short list. Not more than 5.
- Sources for information-LIST SOURCES
- Looking for a partner-REFERENCE QUESTIONNAIRE AND LIST
- Understanding strengths and weaknesses- Don't be afraid to ask hard questions. Finding a partner that will be open and communicative might be more important than demonstrated capabilities in some areas. The EMS industry as a whole has evolved as a result of customer partnerships and mutual relationships where both sides benefit from the business. This type of loyalty can go a long way when you need favors.
- NDA's- Make sure that you sign a mutual NDA with any companies that you want to engage in dialogue with.
- Pre qualification survey- The IPC 1720 can be an excellent time saver and tool to do this. If there are any areas that you feel are not covered adequately for your business then you can add an addendum to this.

Industry standards- IPC class 2 and 3. Class 3 will cost you more and not many EMS providers run facilities that will conform to these standards. If you have any manufacturing requirements outside of these standards you will need to identify them up front and be prepared to pay extra for them,

- Developing your own survey-Can be costly and usually a waste of time and money
- Developing a cost model-

This should be done very early in the business planning stage and not when you are going out for quote. Understanding both your expectations and your potential partners expectations can save a lot of time and energy. It will give you a stronger negotiating position if you have a clear understanding of various models being employed by companies.
- Managing a cost model-

Once you have developed your model and have gone through the RFQ process with an EMS provider you need to establish a way to manage your business to these goals, and work with your EMS provider to do the same.
- Keeping to a budget-

Have clear understanding between yourself and your EMS provider about additional costs associated with their business model. A huge bill at the end of the month for ECO activity can put a real strain on the relationship. It is appropriate to expect that some reasonable number of ECO's are included in your unit production price.
- Selling yourself to an EMS provider-

This can be a very strategic process. You want your partner to believe in your product as much as you do. You want your EMS provider to see themselves as an extension of your company and your manufacturing arm.
- Negotiating a Manufacturing Agreement-

This will take some time and it is normal for an EMS provider to request some type of temporary agreement that acknowledges your liability for money spent on your behalf. It is not a bad idea to include your contract with the RFQ to ensure the EMS provider is in agreement with your requests. The MSA can often become the tactical roadmap whereby business will be conducted.

- Legal Assistance-When you need someone in this area you need to think about how to use outside counsel if that is your strategy. Having someone who understands the CM world will cut the negotiating time down considerably.
 - What really matters? Schedule flexibility, material management, quality, communication, willingness to bend rules occasionally and accountability.
 - Intellectual Property- Protecting yourself legally and how to audit confidentiality
 - Cost reduction expectations-Set reasonable expectations and allow your partner to receive some benefit from the activity
- How to manage changes in organizations-
Contingency planning and ensuring access to the decision makers in the organization will mitigate risk during periods of change

It should be evident by the questions and thought process used how important the design of your manufacturing strategy is in relation to the overall business plan. Choosing the wrong manufacturing partner or plan for your business model can be disastrous in the end. On the other hand, developing a manufacturing strategy that will complement the design team and act as a partner can have a tremendous positive impact on overall success. Having a CEM that shares the vision of the company is critical to success in outsourced manufacturing.