

EMs in the electronics industry are outsourcing manufacturing at a very rapid rate. Companies like Compaq^[1], Hewlett Packard^[2], and Nortel^[3] – traditionally strong internal manufacturers, are outsourcing large parts of their manufacturing, or are seriously considering it. In fact, many large OEMs today are either outsourcing their board assembly or are having high-level management discussions to explain why they are not outsourcing.

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Restructuring of the Electronics Industry Anchors on the Slippery Slope of Outsourcing

A trend can be indicated when more than 50% of the data points show consistency of movement in a given direction – even when 49% of the data points indicate an opposite direction. By that definition, outsourcing today in the electronics industry is not a trend; it is a landslide. Nearly every electronics OEM seems to be headed outside or is thinking about it. There are very few examples of companies going in the other direction.

At the same time, the Electronic Manufacturing Services (EMS) industry is rapidly growing and taking on new responsibilities. These companies are providing not only manufacturing, but also additional services in product design, process design, procurement, and distribution. EMS providers are growing through acquisitions of factories from OEMs, and from internal growth. The OEM customers are expecting the EMS providers to take on more and more of the load regarding advanced process development and new product introduction.

This strong trend creates opportunities for the companies that recognize the change in the value proposition for manufacturing, that know where they want to participate within the supply chain, and that know where they want to be on the slippery slope of outsourcing. This article will describe some of those opportunities, and will offer suggestions on strategic choices that a company should consider.

Driving Forces

The electronics industry overall is driven by two major factors: time and

money. Clearly, in the high-volume product sectors, rapid time to market and shrinking product life cycles are becoming the norm. Companies deliberately introduce new products that kill their existing offerings as a way to remain competitive and to ensure some price premium. On the financial side, dramatic improvements in functional integration at the semiconductor level and the widespread availability of volume efficiencies through distributed manufacturing help provide relentless cost performance improvements in the market place. These same factors are beginning to permeate electronics market segments beyond the high-volume products, although at a somewhat slower pace.

Companies make a decision to outsource for a number of reasons. They could be looking for reduced manufacturing costs, for increased flexibility, for improved return on assets, or simply to get a new product to market quickly without investing in the manufacturing infrastructure needed to do so.

Many of these reasons were also the reasons that companies preferred to manufacture internally in the past. However, the EMS industry has become a much more credible alternative over the last five years. As an example, Solectron has now won the Malcolm Baldrige award twice, and has 23 manufacturing facilities with over 38,000 employees. Industry capability has increased significantly, and companies that have never considered outsourcing before are now being forced to consider it along with internal alternatives.

Another interesting trend over the last few years has been the creation of horizontally-focused companies at different levels of the supply chain. For example, the

IBM of 20 years ago was strongly vertically-integrated, building nearly all of the high-value parts of their products internally. They have gradually sold off many of these manufacturing assets to companies like Solectron and SCI Systems. At the same time, Solectron and others are rapidly acquiring new operations in order to gain scale, build a more diversified customer base, increase their global presence and provide increased capabilities for customers. Similarly, companies like IBM have acquired companies to provide a larger product and services portfolio. This combination of actions is creating a series of strong horizontal layers in the industry (see Figure 1).

Implications

As this trend continues, several things will change for the companies involved.

First, it will become more important for companies at the horizontal layers to standardize within their companies, and with their competitors. A key premise of this model is that the “consuming” companies will want the “supplier” companies to look the same and act the same at an interface level. An OEM does not get the full benefits of a manufacturer unless they can easily build in multiple factories. They would want all of these locations to look the same from a manufacturing and logistics perspective in order to simplify the management of the company within their supply chain. At the same time, an EMS provider is going to want commonality across all of their manufacturing sites in order to capture the opportunity for scale benefits. It appears that these forces will combine over time to cause

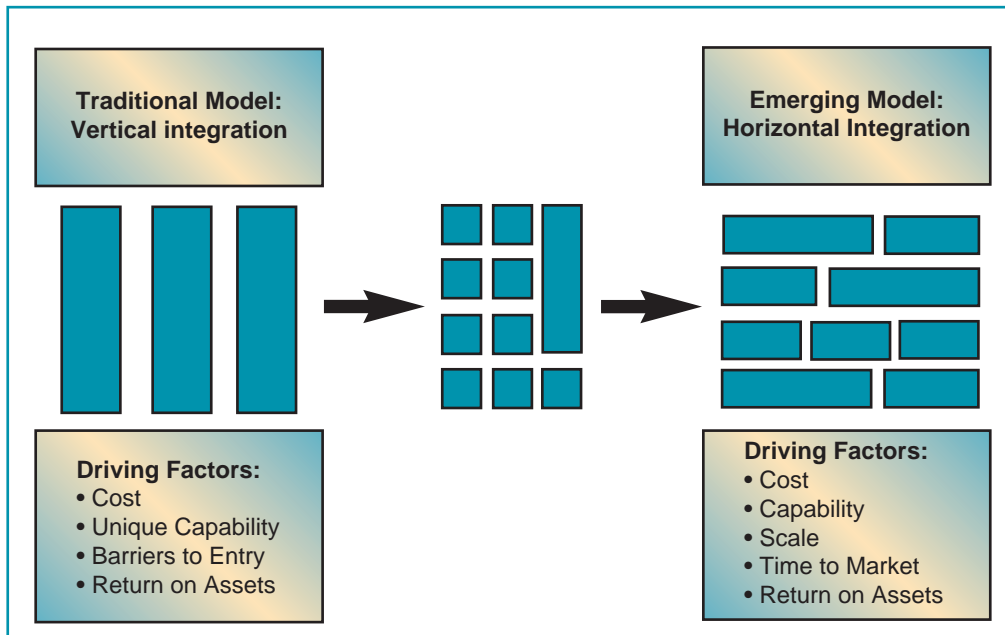


Figure 1. Evolution of horizontal integration.

these individual manufacturing sites to ultimately look very similar. This creates a need for consortia and other groups that can facilitate the development and adoption of standards at these key interface points. NEMI (National Electronics Manufacturing Initiative), the Supply Chain Council, RosettaNet, and others have recognized these needs, and are working to close the gaps.

Second, the underlying technology within these functions will become less important than the way the entire system works together, especially during the transition to a more horizontally-integrated model. Manufacturing costs are already very low for many of these products, and the key differentiators become time to market, supply chain responsiveness, and inventory management.

Third, communication between the companies involved in the supply chain will become very important.

Communications on supply and demand will become critical in order to minimize inventory build-ups along a more distributed supply chain. Communications on product and process technology will be important to make sure that products are designed well for manufacturing, and vice-versa. And standards in both areas will be very valuable in simplifying the communication requirements.

Anchors on the Slippery Slope

The dramatic changes within the industry have created challenges and new opportunities for the OEMs in deciding which manufacturing operations to outsource and under what conditions. There can be many considerations, and a few are listed in Table 1.

It is obvious from Table 1 that many of these benefits will create risks

in other parts of the business. For example, outsourcing can provide reduced costs and access to a much larger manufacturing asset base, but can also add significant risks in the effectiveness of managing the overall supply chain. These risks could increase supply chain inventory and simultaneously reduce responsiveness to new market requirements.

There is not a single correct answer for all companies. Dell has been very successful with a manufacturing strategy that has never included Printed Circuit Assembly (PCA) manufacturing. They are now taking \$35M in orders daily over the Internet (43% of revenue), and they are accomplishing this with six days of total inventory, with goals to drive it significantly lower^[4]. While this manufacturing strategy is clearly working for them, it is not necessarily the right strategy for all companies. We have seen several

examples recently of companies that have tried to outsource their PCA manufacturing and are now returning to internal manufacturing. In all cases, these companies manufacture expensive, customized electronic systems, and primarily need the flexibility that can be obtained with an in-house shop.

It is important for OEM companies that are thinking about outsourcing to consider the importance of each of these factors discussed in Table 1, and verify that the benefits in aggregate outweigh the risks of the different scenarios. Many outsourcing decisions are primarily numbers-driven, and it can be difficult for companies to quantify all of the considerations in order to properly weight each of them. However, without quantifying the benefits and risks, it is impossible to accurately analyze the options.

Companies that have historically manufactured everything inside see a “slippery slope” in these outsourcing discussions. Once it starts going outside, where does it stop? Some companies have been successful in outsourcing the entire package of design and manufacturing to outside firms. Nearly all PC OEMs in the US today are doing this with at least some of their PC laptop products. In fact, this can be a much easier business model to manage than one where only manufacturing is outsourced. Similarly, analysis of the benefits and risks can provide legitimate reasons to keep production of certain products inside. For example, low-volume, high-mix products with high margins and significant customization requirements might be more appropriately kept inside. Analysis of each of these factors for any given product outsourcing

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decision can provide important anchors for this slippery slope of outsourcing.

Opportunities

Despite the risks involved in outsourcing, the explosion in the growth and credibility of the EMS segment can provide significant opportunities for the electronics industry. This section explores some of the opportunities that exist today and could evolve in the future.

Emergence of “Virtual Integrators” as a Business Function/Enterprise

With the fragmentation of the vertical model, the integration role often played by the OEM has changed dramatically. As the OEM divests of the capability to perform this integration, a business opportunity exists for others in the supply network to perform this function. Some argue that the EMS provider is now in the best position to act as the integrator, while others argue that design services companies are the natural inheritors of this work. Already, we see examples of design houses and EMS providers increasing their value by driving the technology trade-offs and playing an active role in constructing the supply chain based on the solutions required.

Horizontal Consolidation Can Provide Economies of Scale and Value Growth

As noted earlier, the electronics industry is beginning to show a strong trend towards horizontal consolidation. OEM companies are divesting of internal manufacturing, and companies are acquiring horizontally at all layers. For example, Solectron has made 17 acquisitions since its founding, primarily to acquire new manufacturing facilities and related services. IBM, while continuing to sell manufacturing facilities to companies like Solectron^[5], has been buying companies that can provide complementary products and services^[6]. This trend towards horizontal consolidation is producing global companies with significant economies of scale.

Role of Consortia as “Strategic Information Pipelines.”

One of the risks noted earlier is the

management of significant changes in technology. Effective technology introductions require a clear understanding between manufacturing and design on the opportunities and risks of the new technology, as well as the specific product needs and opportunities. Designing in a new manufacturing technology too early can add significant risk to a new product, whereas missing a change of this type can create a serious competitive disadvantage for the product. Managing all of this well requires a rich and ongoing dialogue between design and manufacturing. In an outsourced environment, consortia such as NEMI can play a significant role in facilitating these discussions across the supply chain. While roadmapping is one key element of this information flow, business factors must also be considered.

Development of Tools/Services that Reduce Time and Cost in Distributed Manufacturing Environments

Business opportunities exist in the distributed model to facilitate the integration role that was traditionally filled by the OEM. Solutions are being offered by companies such as Agile Software, InterEMS, and Ironside Technologies that deal with product data transfer, management of EMS programs, and e-commerce for business-to-business applications. While these solutions are facilitated by today’s pervasive web based technologies, their value proposition is enhanced by the distributed nature of the supply network. As the transformation continues, we expect to see many other offerings in the market place

that increase the benefits of the distributed manufacturing environment.

Acceleration of Standards to Decrease Risk of Investing in Early “S curve” Choices.

Under the vertical model, efforts such as technology and capacity investments could be orchestrated across the company thus ensuring that the end solution would in fact be utilized for product realization. In today’s distributed model, many suppliers find that one of the biggest risks is “betting” on which solution will be optimum, especially in the early part of the maturity curve. Through industry collaboration between users and suppliers, early standardization can be facilitated to help mitigate this risk for the supplier. While future sales cannot be guaranteed, the supplier

Table 1. Outsourcing factors, benefits, and risks.

Business Factor	Benefits From Outsourcing	Risks In Outsourcing
Global Supply	<ul style="list-style-type: none"> • Can manufacture in all markets without OEM adding “bricks & mortar”. 	<ul style="list-style-type: none"> • Complexity of managing global supply chain (risks in inventory, new product introduction, and/or overall responsiveness).
Flexibility for Changes in Supply	<ul style="list-style-type: none"> • Ability to leverage a potentially much larger manufacturing asset base, provided there are no unique manufacturing requirements. 	<ul style="list-style-type: none"> • Flexibility limited by contractual agreements; potential loss of control over business-critical decisions.
Manufacturing Costs	<ul style="list-style-type: none"> • Ability to reduce overhead costs and potentially gain scale benefits from a larger manufacturing base. 	<ul style="list-style-type: none"> • If partnering, loss of control over future manufacturing costs.
Return On Assets	<ul style="list-style-type: none"> • Immediate benefit from reduction of manufacturing assets or avoidance of adding them – either for capacity expansion or in adopting a new process technology. 	<ul style="list-style-type: none"> • Inventory could increase due to the added complexity of managing a more distributed supply chain.
New Product Introduction (NPI)	<ul style="list-style-type: none"> • For companies without the right NPI infrastructure or without sufficient internal manufacturing resources, outsourcing can provide significant benefits. 	<ul style="list-style-type: none"> • Could be slower or more difficult, due to the significant level of teamwork required in a typical new product introduction. This risk can be minimized through life-cycle partnering.
New Process Technology	<ul style="list-style-type: none"> • Partnering with the right EMS companies can provide access to the necessary technology without having to invest internally. 	<ul style="list-style-type: none"> • Some of the EMS companies are purely “followers” on technology. It might be necessary to develop the technology internally in order to show them how to implement it.
Dependable Source of Supply	<ul style="list-style-type: none"> • Ability to leverage a potentially much larger manufacturing asset base, provided there are no unique manufacturing requirements. 	<ul style="list-style-type: none"> • Potential loss of control; unclear ownership for product issues and certain process issues.
Supply Chain Integration	<ul style="list-style-type: none"> • Outsourcing of the entire supply chain to one partner can minimize the internal overhead required and increase ownership and accountability. 	<ul style="list-style-type: none"> • Outsourcing can create additional layers and complexity in the supply chain, causing risks to flexibility, inventory, and new product introduction. • Reliance on a single source
Protection of Proprietary Manufacturing Processes	<ul style="list-style-type: none"> • If the EMS company provides the proprietary process, the OEM does not have to develop it or protect it. 	<ul style="list-style-type: none"> • These can be protected somewhat through dedicated lines and/or facilities at the EMS providers; however, this will limit many of the other benefits, such as flexibility and asset management.

is at least better positioned to offer a mainstream, high-volume solution.

Summary

The electronics industry is undergoing a massive restructuring that is fundamentally driven by time and money considerations. These changes are causing shifts in the value propositions across the entire span of the supply network. During this period of change, there is a fair amount of turmoil and uncertainty, which leads directly to opportunities for those willing to accept the challenge. Table 2 summarizes a few of the driving forces (primary and secondary) and the implications of these forces, and identifies some of the opportunities that are available. Our message is clear: understand your business factors, weigh the risks against benefits, and develop your strategy for where you want to operate in this evolving world of distributed manufacturing. Finally, with the increased emphasis on creating alliances and developing standard solutions, consider the role of industry partnerships and consortia in your plans. ■

Table 2. Driving forces, implications, and opportunities of industry restructuring.		
PRIMARY DRIVING FORCES <ul style="list-style-type: none"> • Rapid time to market • Shrinking product life cycles 	IMPLICATIONS <ul style="list-style-type: none"> • Need for rapid reconfiguration of supply network (flexibility) • Incremental risk taking on each product cycle • Need for fast and predictable new product introduction and product ramp-up 	OPPORTUNITIES <ul style="list-style-type: none"> • Acceleration of standards to decrease risk of technology/ capital investment
<ul style="list-style-type: none"> • Relentless drive to improve financial performance of supply chain 	<ul style="list-style-type: none"> • Improved asset utilization • Focus on inventory minimization 	<ul style="list-style-type: none"> • Tools and services that reduce time and cost in distributed manufacturing environments
SECONDARY DRIVING FORCES <ul style="list-style-type: none"> • Narrower focus for each element of supply chain (distributed competency) • EMS credibility increasing 	IMPLICATIONS <ul style="list-style-type: none"> • Manufacturing process ownership will continue to shift to EMS and supplier segments • OEMs narrow focus to products/markets 	OPPORTUNITIES <ul style="list-style-type: none"> • Narrower focus can accelerate capability at each node of supply network • Changing value propositions creates new business opportunities across supply chain
<ul style="list-style-type: none"> • Reconfiguration from "vertical" to "horizontal" companies 	<ul style="list-style-type: none"> • Stronger competition at each level of supply chain • Vertical alliances become increasingly important • All levels of supply chain operating in global markets 	<ul style="list-style-type: none"> • Emergence of "virtual integrators" • Role of consortia as "strategic information pipeline"
<ul style="list-style-type: none"> • Market demand for E-commerce and build-to-order capability 	<ul style="list-style-type: none"> • Greater importance of standard solutions, at least at an interface level between companies 	<ul style="list-style-type: none"> • Industry collaboration to develop standards

BIOGRAPHIES

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The electronics industry is undergoing a massive restructuring that is fundamentally driven by time and money considerations.