Getting ready for the rebound
Bringing ‘lean’ to the EMS supply chain

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About this white paper
This Oracle white paper was written in co-operation with the Economist Intelligence Unit, Arizona State University and Pittiglio Rabin Todd & McGrath (PRTM). The Economist Intelligence Unit wrote an initial draft of the white paper based on input from Oracle executives and experts from Arizona State University and PRTM. Feedback from the participants was included in a revised, final draft.

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Oracle is the world’s largest enterprise software company. Its product line includes enterprise business solutions that extend support for Lean methods to all facets of internal operations and business interactions with supply-chain partners. For more information, visit our website at http://www.oracle.com/industries/high_tech.

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About PRTM
PRTM (www.prtm.com) works closely with leading technology-based companies worldwide to achieve breakthrough results—fast. For over 25 years, we’ve delivered measurable value to our clients, earning one of the highest levels of repeat business in the management consulting industry. PRTM is a recognised thought leader and innovator in the area of integrated supply chain management and Lean concepts.
The ability to master time is a key metric for success in the electronics manufacturing services (EMS) market—never more so than now, as a global economic recovery picks up pace. To make the most of better times, smart EMS companies have been preparing for the rebound by embracing the principles of “lean manufacturing” in order to synchronise production with customer demand and supplier capacity.

Perhaps better than any other manufacturing sector, the electronics manufacturing services (EMS) market understands the impact of the “bullwhip effect”. This term, coined by Hau Lee, a management professor at Stanford University, describes how small changes in customer demand can spur huge variations in orders placed upstream. Customer orders are inflated to ensure inventory availability in times of short supply. Over time, this and other sources of variability, coupled with delays in the transmission of information up and down the supply chain, can cause the entire network to oscillate in violent swings.

Cracking the whip

Avoiding this bullwhip effect by learning to determine customer demand accurately is vital for EMS firms. As service providers, EMS companies need to react quickly to customer requirements. Designs from original equipment manufacturers must be rapidly incorporated into production and supply plans; plant layouts must be adjusted quickly; and high-volume delivery of differentiated products must proceed like clockwork. All this must be accomplished, moreover, while weathering the boom-and-bust cycles of the electronics industry. The ability to speed the flow of information and reduce variability is thus critical to EMS success—particularly now that a global economic recovery is poised to pick up pace.

There’s a lot at stake. EMS has always been a difficult, low-margin business.
Worth about US$90bn in 2003 according to market researcher IDC, each percentage point improvement in margin represents a savings of US$900m. Finding a way to maximise positive results in good times is critical for survival in slim ones.

Peaks and troughs “have been the tradition in the electronics industry for the last 30 to 40 years”, says Dan Shunk, the Avnet professor of supply-network integration at Arizona State University. A return to economic prosperity is highly welcome, but any market swing even when it’s an upswing brings new pressures and challenges. As growth resumes, “shareholders are going to put incredible pressure on CEOs to make money,” warns Dr Shunk, “so companies need to get ready now to make the most of any good times ahead.” As a recent IDC report notes, “2003 and 2004 should prove to be more successful for the EMS industry, but they will also highlight which vendors have positioned themselves well.”

As this forecast suggests, surging demand isn’t always good news, particularly coming in the wake of periods in which spending has been pared to the bone. But it can also be a catalyst for change, says Shoshanah Cohen, a director at management consultancy Pittiglio Rabin Todd & McGrath (PRTM). Seeing light at the end of the tunnel is enabling EMS companies to start focusing on building consistency in their processes before capacity becomes limited again, says Ms Cohen. “EMS companies don’t want to go back to the ‘rush rush rush’ approach that characterised the dotcom boom, and the recent uptick is making them more comfortable investing in the infrastructure that will help them be better suppliers.”

The pressures the EMS industry is facing resemble those that drove the automotive industry to embrace the principles of “lean manufacturing” pioneered by Toyota (see box, page 5). “The high-tech industry, much like the automotive industry in the 1980s, is at crossroads,” says Manish Modi, senior director for Oracle’s Manufacturing Solutions. “Companies in the automotive industry were forced to adopt Lean business practices because of diminishing margins and competitors such as Toyota forcing them to follow suit or face demise,” he says. “Innovation alone will not cut it,” continues Mr Modi. “Companies need to adopt Lean principles and eliminate waste to stay in business.” Of all the companies in the electronics supply chain, Mr Modi observes, EMS companies will face significant pressure.

The EMS industry under fire

Smart EMS companies are already rising to the challenge, by designing processes that will not only allow them
to handle surging volumes, but will ensure their long-term viability in an inherently cyclical market. Some have already embraced the tested principles of Lean in order to optimise production and enshrine continuous improvement as a corporate mission. Others are now considering adopting Lean as a way to gain competitive advantage in a reviving economy, or are pushing Lean out to their extended supply chain in order to address a raft of challenges, including:

- A new demand surge in a highly cyclical market;
- Heightened customer expectations;
- The need for process consistency;
- The rise of new lower-cost competitors; and
- The complexities of globalisation.

**Surging demand.** The EMS industry’s track record at responding to past fluctuations in demand is not encouraging. “Unfortunately, EMS companies provide textbook examples of the bullwhip effect at work,” observes Dr Shunk. “They are so far removed from the end customer that by the time the demand signal reaches them, they’re reacting to a distortion of information that may have originated weeks earlier.” This is why the downturn of 2000-01 left EMS companies, accustomed to severe shortages, holding hundreds of millions of dollars in unsold inventory. For the upcoming cycle, cautions Dr Shunk, EMS firms must anticipate being short on capacity and think ahead about how to allocate that capacity to customers.

**Demanding customers.** In the good old days, EMS companies could afford to be choosy about which customers were worth lavish attention. Boom times spurred heavy investment in production capacity, specialised equipment, and ordering and tracking technology, fuelling high customer service expectations. The subsequent downturn forced EMS firms to pull out all the stops to secure sales, even from customers previously considered less important. “OEMs have come to expect excellent customer service,” explains Jonathan Oomrigar, vice-president of Oracle’s high tech industry. “Ever-shortening product life cycles raise the premium on practices that can ramp products quickly and respond nimbly to variations in supply and demand.” Technology companies want all this, while limiting their inventory exposure and delivering to customers quickly. A reviving economy won’t make them any less demanding.

**Process inconsistency.** Not so long ago, EMS companies were racing to find capacity and expanding at breakneck speed. This resulted in collections of facilities tied together only by a common corporate parent. Assimilating new companies and facilities and achieving consistency in a complex supply chain take time and a great deal
of management attention and are tasks that many companies don’t do particularly well. In the mad scramble to serve surging customer requirements, companies have tended to neglect the refinement of existing processes. Falling demand exposed the weaknesses of disparate processes and systems; these have become limitations to future growth that need to be addressed.

Greater competition. Competition is also unrelenting, with the line between the US$90bn EMS market and the US$25bn original design manufacturer (ODM) market blurring. Some ODMs are hungrily eyeing the EMS market, and pose a new source of competition that EMS firms cannot ignore. That means even greater pressure to respond quickly and efficiently to OEM requirements. “Yet this is an opportunity for EMS companies,” observes Mr Modi. “If they can take a lead position in the industry on the ‘journey to Lean’, they stand to reap the benefits that Toyota was able to reap in the automotive industry.” EMS companies have an important advantage, in that they can draw on the experience of firms in industries more advanced in the practice of lean manufacturing, such as GE, Emerson and Danaher.

Global execution. Cost control is a way of life for the EMS industry. Like many other manufacturers, they have added much of their new production capacity in low-cost locations. Yet here lie hidden challenges. “China sounds great when you have a cost of $0.14 to assemble something there compared with several dollars in Memphis,” says PRTM’s Ms Cohen, “but you need to look at the total cost of doing business there.” Labour is certainly cheaper, but what about transport costs, the need to develop local material suppliers and the lack of skills within a country new to capitalism? The supply chain also gets a lot more complex when you throw in the wild card of distance. “When you move a product to China”, Ms Cohen notes, “you add five to ten weeks to your supply chain, and that means a lot more inventory and a lot less flexibility.” EMS firms need to find ways to manage these added complexities.

Making Lean work for EMS firms

As this litany suggests, a testing ordeal awaits even the most capable of companies. What’s more, companies that are not yet poised for battle don’t have much time left to prepare. “As an EMS firm, I have 12, at most 18 months, to get my act together,” says Dr Shunk. That effort has both internal and external implications—EMS companies are expected not only to operate efficiently inside their corporate boundaries, but also to expand this efficiency to the extended supply chain.
The Lean journey

Born out of the Japanese automotive industry in the 1950s, “lean manufacturing” known throughout the industry simply as Lean is a collection of business principles dedicated to eliminating waste, focusing on customer needs, reducing production times and boosting profits. Over time it has evolved from a set of principles designed mainly for the factory floor into a business approach that can achieve results across a wide range of functions, whether human resources, accounting or marketing, and in a range of industries outside industrial manufacturing. Firms that have reaped the benefits internally often share Lean principles with their partners and extend Lean practices across their supply chains.

In a nutshell, the goal of a Lean enterprise is to do exactly the right thing at the right time in the right place, with as little waste as possible. The Lean approach rests on six core concepts:

**Value focusing on redundancy reduction** ensures that each step in a process adds value. Every operation is scrutinised for its ability to add value, and those under-performing are improved or eliminated. Implementing Lean within a manufacturing process means eradicating activities such as material kitting, looking for instructions, retrieving parts and tools, changing fixtures and manually positioning parts.

**Value stream mapping** allows user communities to draw a picture of the process and identify the value. Once value is identified, users develop a game plan of how to implement Lean principles.

**Flow and balance** means synchronising the various steps of a process to eliminate unnecessary delays. It strives to eliminate any queuing, backtracking, and unnecessary motion and handling, allowing a product or service to proceed smoothly and efficiently from start of production to delivery to the customer.

**Pull systems** enable companies to respond instantaneously to a need while controlling inventory and highlighting material needs. Pull systems keep production in sync with changes in demand; they enable supplying and consuming operations to communicate so that nothing is done until it is required.

**Continuous improvement** is the incremental perfection of products, processes or services in a drive for excellence that encompasses the entire organisation. Continuous improvement begins by establishing aggressive performance objectives and a strategy for achieving them while focusing on step improvements that can be accomplished without large capital investments. The idea is to get everyone involved in an ongoing mission to reduce waste, improve quality and reduce cycle time.

**Housekeeping** is a logical approach to shop floor organisation; housekeeping means every item has an appropriate place, and every item is kept in that place. Removing unnecessary motion and movement through housekeeping further reduces cycle time. With everything in its proper place, time spent searching for tools, work instructions and materials is reduced or eliminated.
Is Lean the answer? Some firms dismiss Lean simply because the concept has been around for decades. Yet experts argue that Lean is appealing precisely because it rests on an abundance of experience, has proven benefits and defined methods, and can offer companies a tailor-made strategy. “There’s a perception that these ideas aren’t cutting edge,” notes PRTM’s Ms Cohen. “But nothing could be further from the truth, especially as state-of-the-art systems technologies continue to advance Lean concepts.” Oracle’s Mr Oomrigar agrees, saying, “Today’s systems take Lean concepts to a whole new level.”

Technology offers tools that can help achieve each of Lean’s six core concepts (see box, Page 5):

- Standard technology platforms can help reducing waste and redundancy. For example, tools can be used to identify when multiple customers using disparate part numbers use the same part. By consolidating demand and supply planning for these parts, the company can reduce redundant activities. Bad data habits such as entering information into a standalone application or not tying the system transaction to a physical move are also easily addressed through a Lean initiative.

- Collaborative supply-chain planning and execution tools can help facilitate collaboration for value stream mapping, as companies extend Lean thinking beyond their four walls to supply-chain partners. Technology facilitates information exchange and instantaneous matching of supply with demand.

- Sophisticated simulation of the path a product takes through the manufacturing process automates flow and balance. Such systems identify queuing points and backtracking, allowing synchronisation of the various steps of a process, elimination of variability and throughput time reduction. Before starting production of a new product, an EMS firm can use technology to run simulations of design features and production processes in order to test the impact of process design modifications.

- Today’s ERP and APS tools can replace physical kanbans (cards, signs or signals that trigger replenishment of a material when it is required to continue the production process) with electronic pull systems that communicate material requirements automatically and provide highly visible cues between supplying and consuming operations. This technology goes far beyond the “repetitive manufacturing” modules of yesteryear that provided backflushing functionality, but not much more.

- Real-time feedback on process performance against established objectives provides a foundation for
Lean in action: A case study

The benefits of a Lean initiative can be immediate and substantial, as is clear from the experience of one test equipment manufacturer. The firm, a maker of large capital equipment that took months to produce, received a large government order and needed to increase capacity dramatically in a matter of weeks.

Production relied on discrete work orders in a traditional assembly line. Production Control issued kits to the line and assemblers spent a lot of time auditing kits and moving materials to the location where they were needed. Management worried that without major changes in the system, they would fail to meet the aggressive delivery schedule. Making large capital investments to expand capacity was not feasible over the short term, so the company embarked instead on a rapid implementation of Lean techniques.

Participants in the Lean initiative analysed the workflow and defined specific tasks required to assemble each product. Production workers assisted in the design and implementation of cross-functional work cells and line balancing. The result was a much smoother flow through assembly by incorporating pull principles with significantly less overall queue time. Highly visual work instructions simplified assembly tasks and standardised work methods. Kanbans were implemented for material storage and presentation.

With very little capital investment, the company met a highly aggressive delivery schedule while achieving dramatic performance improvements, including an 80% reduction in unit cycle times, a 70% reduction in direct labour costs, a 90% decrease in parts shortages as well as significant cost reductions (see charts).
continuous improvement.

- Technology can help extend the concepts of housekeeping to areas beyond the shop floor organisation, especially in the context of inventory management, ensuring that the company will know where inventory is and have it available when needed.

Global standards for processes once they have been “Leaned” can be especially helpful for large EMS firms that are expanding overseas or are struggling to keep their existing international locations aligned. Using a company wide suite of standard business processes and common software applications that everyone has access to, processes can be standardised and accessed from a centralised source.

“You can define a process in Taiwan, document it at headquarters in San Jose, California, and then use it as the standard from Shanghai to Seville,” notes Mr Oomrigar.

Collaboration and synchronisation: Lean in the supply chain

Once Lean methods are applied internally, the logical extension is to the supply chain, where cost efficiencies are often waiting to be reaped. The importance of collaboration between business partners is something Lean leaders such as Toyota realised long ago. In 1992 Toyota opened the Toyota Supplier Support Center (TSSC) in Kentucky to spread the Toyota Production System that inspired the Lean philosophy. Many of the more than 80 manufacturing companies that have studied the TPS programme at the centre have seen double- and triple-digit productivity growth and dramatic inventory reductions.

“Collaboration is mandatory for EMS success,” reports Dr Shunk, “yet companies report mediocre collaboration today.” Technology can help to support collaboration across the supply chain by keeping partners up-to-date on order changes, product availability and delivery schedules. Again, use of standardised business processes and technology platforms can be key. As Gartner noted in a 2001 study, data standardisation can be so important to collaboration between supply-chain partners that only the few companies putting collaborative programmes in place can expect to realise sustainable revenue improvements. “Collaboration is necessary for the financial and operational excellence of the EMS industry,” says Dr Shunk. “Networks must have transparent, real-time collaboration tools to manage the extended product development process.”

The next step after collaboration is the process of synchronisation with supply-chain partners. “End-to-end synchronisation for the entire electronics supply network is the
ultimate desire for all participants,” says Dr Shunk. “To be able truly to synchronise all planning, scheduling and execution functions, is absolutely critical to each company’s success.”

As with the implementation of Lean principles, synchronisation depends on better understanding and management of manufacturing and supply-chain data in all their forms. In a synchronised supply chain, each partner knows in advance when the next partner up or down the chain needs something, boosting on-time delivery, eliminating processing waste and speeding production.

A willingness to share data across corporate boundaries is a crucial ingredient in synchronisation something that firms accustomed to secrecy may find difficult to accept. But if this traditional disinclination can be overcome, all parties stand to benefit. “End-to-end synchronisation requires data, information and knowledge sharing,” explains Ms Cohen. “By sharing selected intellectual property that adds great supply-chain benefits across the organisational boundaries, the overall success rates for the supply networks are much more likely to become reality.”

Successful synchronisation can counteract bullwhip effects, by reducing lead times, ordering products only as needed and eliminating batch processing. It offers other far-reaching benefits as well. According to a Gartner study, “Supply-chain optimisation and collaboration projects can dramatically improve revenue, enhance customer service and accelerate working capital through the reduction of inventories.”

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**Growing fat on Lean methods**

For a sense of the potential rewards of extending Lean to supply-chain partners, the experience of a global communications equipment maker offers a good case study. The manufacturer, which sells 1,000 standards-based communications products to 500,000 global customers, recently shifted from traditional manufacturing to outsourcing, replacing its build-to-forecast approach with a more flexible, demand-sensitive model enabled by Lean flow manufacturing. To make the shift, it chose a single technology platform for electronic communications with outsourcing partners to gain a complete, real-time view of its virtual supply chain and to enable flexible, demand-sensitive planning. Improved visibility into the supply chain has helped reduce inventory by 50% and planning-cycle time by 75%, and contributed to cost savings of US$15m annually, thanks in part to instant sharing of information about changes in demand or supply with outsourcing partners.
EMS companies can learn from this example. EMS firms that adopt Lean internally and build the foundations to extend Lean principles to their supply-chain partners are poised to withstand competition and reap the benefits of a rebounding economy. To succeed requires a combination of cultural change driven by the highest levels of management, corporate-wide education on Lean principles and a far-reaching commitment to identify and eliminate waste, alongside the adoption of appropriate technologies. These measures can’t eliminate the bullwhip effect entirely, but Lean processes can help companies ride market cycles more ably, securing the greatest benefit possible from economic upturns and avoiding the worst of the downturns.