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agileFMS™ Factory & Manufacturing Solution

Interpreting the Issues: Idle Inventory, Rising Costs & Sinking Profits

According to the May 2008 issue of IEEE Spectrum, amortizing a $5 billion investment in a fabrication facility (FAB) over a five-year schedule costs more than $3 million per day. Conventional wisdom holds that generating that much money requires all the equipment to run all of the time, even if that means creating large unused queues of – in this example – semiconductor wafers. To justify that scale, manufactured goods must be produced in volumes of at least 5,000 to 10,000 wafers per month.

Why?

Since 1965, technology manufacturing has been predominantly guided by the principles of Moore's Law. Coined by Intel co-founder Gordon Moore, the law predicts technological progress and explains why technology manufacturing has been able to consistently produce products that are smaller, more powerful and less expensive than their predecessors. In short, Moore's Law is an empirical trend which states that the number of transistors on a chip doubles every 24 months; in other words, chips get smaller over time.

To keep up with the torrid pace of shrinking transistors, capital expense budgets of fabrication facilities are increasing at an exponential pace. According to Rock's Law – named after venture capitalist Arthur Rock – the cost of building a semiconductor FAB doubles every four years. As such, only industry giants – such as Intel and Samsung in this semiconductor example – can continue to make such vast investments work in their favor. The majority of corporations within technology manufacturing can no longer afford such inventory backlogs or rising operational expenses.

Due to these very significant capital costs and very high revenue requirements, corporations engaged in technology manufacturing began to strategically align and divest over the past several years. Since 2003, Texas Instruments, Motorola, Philips, LSI Corporation, and Advanced Micro Devices – to name just a few – have either announced a mutual partnership to co-develop future process technologies, spun off their semiconductor operations entirely, or acquired FAB-related companies in order to recover growth and profitability. To date, none of these strategic moves have regained the growth and profitability traditionally found within the technology manufacturing sector.

Understanding a Fresh Approach to Economics for Technology Manufacturing

If a new approach to manufacturing improvement enabled your fabrication facility to increase quality, double capacity, produce a wider variety of models within a given factory, and change the product mix on a dime – all while increasing profits, would you consider using it?

Such a proven approach is available and used with great success across multiple industries. For over thirty years, this particular approach to mass production has produced bountiful results. Recently, this approach has been combined with proprietary manufacturing models and implemented in complex manufacturing environments, yielding similar success.

This newly combined methodology creates potentially profound factory improvements that affect the relationship between the cost of additional product capacity and the average cost per unit. Termed by economists as an "economy of scale curve", this relationship applies to multiple capital-intensive industries such as automobile, semiconductor and consumer electronics manufacturing.

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To illustrate this relationship, consider the semiconductor scenario in Table 1:

Table 1: Economy of Scale Curve in Semiconductor Scenario

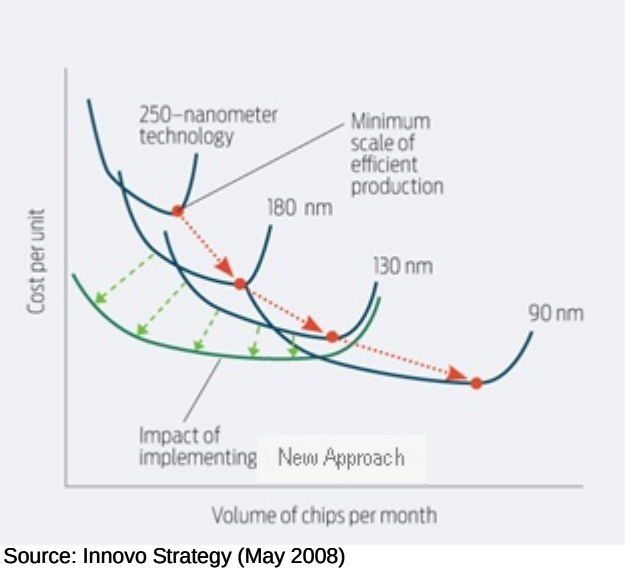
Production Rate	*Average Cost Per Chip*
2000 identical chips	$20.00
4000 identical chips	$12.00
6000 identical chips	$10.00
7000 identical chips	$11.00
8000 identical chips	$16.00

The drop in average cost per chip as volume increases from 2000 to 4000 to 6000 identical chips is primarily due to the rise in operational efficiency and manufacturing yields. And the major reason for increasing plant size is to ensure maximum capacity of the lower unit cost achieved at the higher product volume, also known as economies of scale. Such economies of scale exist when the factory's total capital and operating costs are increasing at a slower pace than production volume.

Diseconomies of scale also occur within a factory as the point is reached when increasing the output makes costs rise at an even faster rate. Within Table 1, that point is reached when volume increases to 7000 identical chips and becomes even higher when volume is pushed to 8000. Typically, this faster rise in costs is attributed to additional layers of management needed as the factory workforce grows to meet volume demand.

In addition to reducing the cost per unit at a given production volume, this newly combined methodology also reduces the minimum number of units a factory needs to be cost effective. In other words, this new approach both lowers and broadens the economy of scale curve. Historically, the only way to move the economy of scale curve has been through the pursuit of Moore's Law, which demands enormous capital investment. Such spending pushes the curve down, but also – unfortunately – to the right. As shown in Graph 1, pushing the curve to the right actually increases (rather than decreases) the minimum volume at which production is most cost effective. In contrast, the newly combined methodology not only lowers the minimum cost but also re-shapes the curve, allowing cost effective production at both lower cost and lower volume.

Graph 1: New Opportunities for Profitable Growth



Source: Innovo Strategy (May 2008)

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And that is the fresh approach to economics within the technology manufacturing sector – providing the ability for production systems to produce units profitably in much smaller volumes. An approach that continues to increase in value as competition drives organizations to shift toward manufacturing a large variety of products in decreasing volume over a shorter period of time – for example, mp3 players and cell phones for the consumer electronics industry.

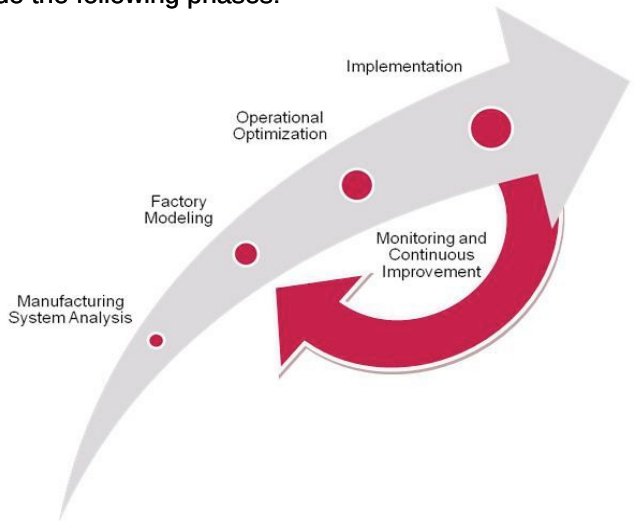
Throughout history, new methodologies providing innovative business models that reduced the minimum effective size of factories have transformed entire industries. The steel industry was transformed by the mini mill's ability to efficiently produce small batches of steel. The business computing industry was transformed by a succession of ever-smaller machines – from mainframes to personal computers to handheld devices. The photography industry was transformed by fully-automated, one-hour film processing machines, which were then replaced by digital photography. And the automotive industry was transformed from needing to sell 1.5 million units of a given car model in 1950 to 250,000 units today at one-tenth of the price. All due to a fresh approach to economics in each respective industry.

Improving Productivity with agileFMS Factory & Manufacturing Solutions

This newly combined methodology – agileFMS Factory & Manufacturing Solution approach – was publicly launched in January 2009 by agileTCP, collaborating with strategic partner Innovo Strategy and select faculty at Harvard Business School. The agileFMS methodology provides dramatic improvement to factory operations, thereby maximizing throughput, minimizing cycle time and reducing cost.

By applying innovative factory modeling and tools to your specific needs, agileFMS collaborative services establish proper cadence in your factory, significantly improving operational efficiencies. Customized to your exact business goals, circumstances, and factory-specific requirements, the agileFMS processes include the following phases:

- Manufacturing System Analysis – best of breed analytics to establish the current state of your manufacturing environment
- Factory Modeling – customized models that identify specific areas within your facility for immediate and sustainable cost reduction
- Operational Optimization – proven tactics to increase work efficiency and improve cycle time
- Implementation – application (alongside key factory personnel) of the systems required to support sustained factory optimization
- Monitoring & Continuous Improvement – tools for ongoing improvement and efficiency



As an example, this methodology was applied to an integrated device manufacturer's logic FAB that primarily survived and prospered by pursuing Moore's Law. However, remaining at the forefront in technology and operational excellence via Moore's Law was turning the FAB into a burdensome capital expense with little profitability despite relatively new equipment within the facility.

In a short seven months, the organization was able to reduce manufacturing cost per wafer by 12% and cycle time (the time it takes to turn a blank silicon wafer into a finished wafer) by 67%. Within that same time period, the variety of products manufactured increased by 50% and production capacity increased by 10%. No new equipment was purchased, no additional investment was needed, nor were any changes made to the product design or technical specification.

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Results across all customers to date are showing similar success, including significantly reduced return on project investment timelines, over 60% reduction in both cycle time and scrap/re-work (respectively) within six months, and net profitability doubling within twelve months.

Optimizing Operational Effectiveness with agileFMS Services

Organizations have the ability to produce within their manufacturing facilities at both a lower cost and lower volume, ultimately reducing cycle time while increasing profitability. To do so, your facility must commit itself wholly to this new approach to technology manufacturing. All manufacturing processes must be examined – both those that work and those that do not – on an ongoing, daily basis by all levels within an organization.

Using a combination of proven manufacturing science, process methodology and proprietary models, agileTCP and its collaborative partners guide you through the analysis, modeling, optimization and tools needed to do just that – establish proper cadence within your manufacturing facility. We call that agileFMS.

about agileTCP

agileTCP (www.agileTCP.com) is a global knowledge management organization based in Austin, Texas that provides technology-driven solutions focused on reducing manufacturing and workforce costs via innovative tools, technologies and methods. Since 1996, agileTCP has been meeting and exceeding the knowledge management and workforce utilization needs of companies worldwide by working with clients to transform, control and package business intellect. Our proven techniques, methodology and subject matter expertise maximize business value for our clients, including increased operational efficiencies of over 80%, reduced cycle times of over 67% and substantially increased revenue across our client base. For more information on agileTCP, please visit www.agileTCP.com or call 512-732-2223.

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