

Turning raw materials into finished products

Manufacturing must be an integral part of your business strategy, operating in harmony with technology, finance, and marketing.

Ultimately, you have to deliver what you have sold. If you don't know manufacturing, you're not in the game. In this article, I present a perspective that can help you formulate a winning strategy. I discuss what manufacturing does, what makes it work, and how manufacturing is likely to evolve as your company grows. In today's economy, you need to develop a clear understanding of what customers want, then optimize the organization's ability to get those customers to buy from you.

It takes time to build a manufacturing infrastructure. People in manufacturing develop and refine procedures to keep things going. Using a computer as an analogy, you can think of people's hands and the machines on the factory floor as the hardware, with people's minds and procedures as the software that make the hardware work. Companies with the same machinery can achieve vastly different results. The difference is in the "software." Because it takes time to get the bugs out of software, you want to build manufacturing capability early in your growth cycle.

Manufacturing is managing the flow of material and information to turn raw material into finished products. The machines and the people need the right materials, the right components, and the right information at the right time. It may surprise you to learn that direct labor costs (not including overhead) account for only 1.5% of the selling price in the test instruments division of one of the San Francisco Bay Area's most successful companies.

To understand what people in manufacturing do, visualize component

parts moving on the factory floor getting produced and assembled. When a bottleneck occurs, you identify the cause, develop a procedure to unclog the flow, and document the fix so the same bottleneck won't happen again. Invariably another area won't be able to keep up with the higher speed, so you have to unclog that area, too. Each situation calls for different tactics based on technology, methods, or management techniques. You might design a new tool or test fixture, invest in an automated machine, buy a com-

puter system, or just have people do things differently.

puter system, or just have people do things differently. Thus manufacturing is about procedures and the people who develop, document, and carry out the procedures. To keep the machines on the manufacturing floor humming, you have to plan, coordinate the flow, and document your procedures. You make improvements constantly, and you find a unique and optimal solution for each bottleneck. If you think you've found a generic solution, you've stopped optimizing.

overhead), or simply force people to keep busy while they're waiting for parts to arrive.

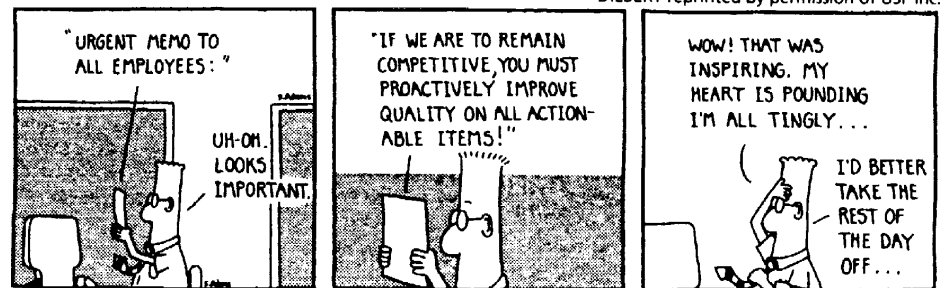
Manufacturing resource planning, just-in-time manufacturing, total quality, Kanban, and demand flow are all techniques that can help you develop procedures that can help you optimize performance in your own specific situation. There is no silver bullet in manufacturing; the value one creates is in the collective knowledge and in the way people interact (see "Performance incentives pay off").

The concept of flow can help you understand the real impact of your decisions. Analyze your make-vs.-buy decisions on the basis of how the various alternatives affect the flow, bearing in mind that additional steps or delays will extend your lead time. Longer lead times increase your costs: they can increase investment in inventory, reduce the number of products you can ship per month (thereby giving you fewer products over which to spread the

Prepare early for growth

Life is simple in the beginning. But as the business grows, manufacturing becomes more complex. My earlier experience at another startup company provides a good lesson in what to avoid. Most of us, including myself, had only a foggy understanding of manufacturing, and by the time we recognized the need to build the manufacturing organization, it was already too late in the growth cycle. We had to hire a significant number of "professional" manufacturing people at a time when the operation had already become chaotic.

Building an operational system when you already have hefty sales is like fixing your car while it's doing 55 miles an hour. Without a clear definition of what we needed, we looked for "the superhuman who can do the job" and found people that by and large had the attitude of "Leave me alone so I can do my job." Manufacturing became an isolated black box, and it was never possible to optimize the whole company.



Unfortunately what happened in that instance tends to be the rule, not the exception.

You'll save a lot of headaches if you develop a manufacturing vision early and foster the discipline to build structure from the start. Build into your operation enough flexibility to allow for growth (in sales volume and the number of employees) and to accommodate the increased market demand for customization. Invest in a computer system early, as soon as you're confident that your strategy is on the right track.

Optimize the whole

We look to manufacturing for on-time delivery of well-built products we can sell at a competitive price. But the best way to solve a "manufacturing problem" might involve other areas of the business. For example, suppose the sales department says sales would increase sharply if manufacturing could shorten the delivery time from three weeks to two weeks. You could solve that problem within manufacturing by increasing what's on the shelf. But cutting delivery from three to two weeks might require a threefold increase in inventory.

Rather than tying up working capital in inventory, would it be better to provide creative incentive for customers to wait a bit longer? Or to invest in a new design to reduce assembly time, a new manufacturing technique to reduce cycle time, or even a totally new product that people would stand in line to buy? Good management decisions involve making tradeoffs between marketing, finance, R&D, and manufacturing in order to optimize results. Your business is an organic whole, and you need to consider all the interdependent variables.

Eliminate waste everywhere

So much of business is about applying common sense and paying attention to details. In last month's article on marketing, we used the concept "staple yourself to an order" to help you trace every customer interaction with the company in order to please the customer completely. Here, you may want to "attach yourself to a component" — trace the flow of the component from the time you plan a manufacturing run until you deliver a product to a customer, in order to

achieve efficiency. Anything that hinders the flow, or any action that's wasteful or superfluous, will add to your cost.

As you follow a component through the manufacturing cycle, think about these issues: how much you pay for the component, how much it costs to inspect the component and put it in the right bin, how long it sits on the shelf, how many times people handle it before it gets assembled, how many setups it requires, how long it sits between stations, how much it zigzags across the factory floor, how often the machine that makes it breaks down, how often the component breaks during shipment, how the customer uses or abuses it, and how to make the customer happy even if, for any reason, a component has to be returned for repair. Then tackle the waste associated with each of these issues.

As an example, we used to think we could cut costs by relaxing mechanical tolerances. Now we know better. It's often penny wise and pound foolish to relax tolerances because an imperfect fit between parts can cause delays on the assembly line and failures in the field. Disruptions to the flow and costs for repair can far outstrip the initial savings.

Instead, you tightly control the quality of component parts, so you can discover problems well before they interrupt the flow. When your sales are small, you check every part before assembly. As your volume grows, you spot check and use statistical methods to discover any problems in a batch. You can then correlate your test results to what happened in the production line that produced the parts. By feeding that information back upstream, you can improve the quality of components — even if those components come from

Performance incentives pay off

Years ago, Uniphase set up a helium-neon laser manufacturing plant in the Sierra foothills of California to take advantage of lower rental and labor costs. Scrap and rework rate was nearly 10%, of the manufacturing cost; that was the industry norm at the time. The company examined each step of the manufacturing process, built automated test stations to catch any error before a laser left the factory, and also paid close attention to what people were doing.

On the basis of what it learned, Uniphase decided to provide cost-control incentives. It implemented an extensive training program and put big charts on the factory floor plotting the cumulative cost of scrap and rework to the day. Every month, it distributed a percentage of the savings from reduced scrap and rework to all the employees. In about a year, the company reduced these costs below 1%.

By paying attention to performance and cost, management conveyed a powerful message to employees to modify their behavior in whatever they do. The company was able to sell its lasers for a price below the manufacturing costs of a major competitor. Eventually that competitor sold its helium-neon busi-

ness to Uniphase, and one of its divisions became an OEM customer!

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The point about people is that you need a clear measure of performance. You want to make the feedback visible and immediate so people can use the information to modify their behavior quickly. Then you want to be fair to people by sharing the fruits of their labor so they have a reason to keep on improving.

This strategy works particularly well in manufacturing because you can measure performance clearly and make a direct connection between action and reaction. On the other hand, the quantifiable nature of manufacturing can make life difficult, precisely because it's so much harder in manufacturing than in other departments to sweep mistakes under the rug. Uniphase was able to turn that "curse" into a blessing.

your suppliers. In manufacturing, you learn to do things right the first time.

Mistakes of all kinds can disrupt the flow and introduce waste. That's the main reason why you document all your manufacturing procedures. On the other hand, because you're dealing with many variables in manufacturing, you have to be on the alert to eliminate procedures that once served a useful purpose but became "waste" when changes in other parts of the company rendered them unnecessary.

Develop the organization

Good manufacturing people are hard to find. Manufacturing is hard work. Furthermore, manufacturing is one of the more exacting jobs in the company because there's no room to hide errors or delays. When a product doesn't ship on time or doesn't work right, everyone in the company knows about it.

At New Focus, we were fortunate to start with top engineers who took an interest in business and wanted to get into manufacturing. We were strong in science and long on our culture of teamwork and customer focus, but low on specific manufacturing skills. We struggled to build the manufacturing system. Some of our people even took classes and got certified by the American Production & Inventory Control Society for resource planning skills.

As our products gained acceptance in the marketplace, our rate of learning wasn't fast enough to keep up with the business's rate of growth. So, drawing on our hands-on experience,

we defined the requirements for success in manufacturing, then recruited experienced professionals who could do the job. Some of the new people were long on specific manufacturing skills, but brought with them traditional ways of thinking. They were accustomed to structure and definition and often felt uncomfortable taking charge without authorization. They never became comfortable with our culture and eventually left.

I'm not, however, suggesting that you hire people like yourselves. Rather, you want to boil down the requirements to their essence and build an organization of people with complementary skills and a culture appropriate for the size of the business.

People in all areas at New Focus, including manufacturing, respond well to our philosophy of trusting their judgment and providing them with enough resources to succeed. We build structure to achieve professionalism, but we encourage individual thinking—we want people to develop enough wisdom to know when to break the rules.

A personal note

A career in manufacturing is a challenge because you have to be technically broad and because you need people skills, patience for routine and details, and the ability to deal with uncertainties. You'll also have the satisfaction — for that matter, instant gratification — that comes with a direct connection between your actions and their results.

There are tangible benefits, too. Great manufacturing people are rare,

and in the free enterprise system, rarity is usually well rewarded. Jobs in manufacturing are plentiful, and you run less risk of technology obsolescence. Instead, you gain value as you become older, wiser, and more able to get organized and to deal with people and situations.

Electro-optics is an enabling industry, people tell us politely. What they're really telling us is that we can't succeed on our own. As an industry, we've never learned cost-effective manufacturing. Too many sacred cows are not being challenged, such as the belief that low volume justifies high costs—witness what you have to pay for most lasers today. And laser manufacturers are not the only culprits; the entire industry shares that belief, and therefore the responsibility, including decision makers, engineers, and the people in companies that supply the components to build lasers. The ability to manufacture efficiently is an important challenge we must take on to keep our industry healthy. □

FURTHER READING:

Robert H. Hayes and Gary P. Pisano, "Beyond World-Class: The New Manufacturing Strategy," *Harvard Business Review*, Jan./Feb. 1994, p. 76.

Ravi Venkatesan, "Strategic Sourcing: To Make Or Not To Make?," *Harvard Business Review*, Nov./Dec. 1992, p. 98.

"Quality: How to Make it Pay," *Business Week*, Aug. 8, 1994, p. 54.