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The **10** Principles of Manufacturing

Life lessons for operations management success

Growing old in operations management gives a person the perspective of having seen numerous developments come and go. The authors of this article have been in the operations management field for more than 60 combined years.

We have seen the emergence of such developments as material requirements planning and manufacturing resource planning (MRP II). We have witnessed solutions such as computer integrated manufacturing and flexible manufacturing systems come onto the field with a bang—and, ultimately, go out with a whimper. We have seen enough “one size fits all” solutions presented to know there is no such thing. We have faced too many managers who say things such as, “If I am doing XYZ, then everything will turn out all right.” Consequently, we have seen too many failures where there should have been successes.

Can American manufacturing succeed? As both Karl Marx and Adam Smith recognized, to build wealth, a country must add value, and it can only do so through agriculture, mining, or manufacturing. The disparity in wages and benefits makes it difficult for manufacturers to maintain a presence in the United States. However, it is naive to lay the blame for the decline of American manufacturing exclusively on that inequity.

Failure can occur whenever manufacturers violate 1 or more of the 10 fundamental principles of operations

management. These principles, which follow, are regularly occurring and often ignored.

1 Principle of reality—The theory of constraints (TOC), lean, total quality management (TQM), or any other technique will not solve all your problems. There is no universal solution.

In today’s environment, there is an unfortunate tendency to focus on the tools being used rather than understanding the problems faced. For example, consider a company with inventories growing out of control. Several consultants immediately had concluded the problem of too much inventory could be solved by adopting lean principles. In this instance, the solution was wrong. If the consultants understood the problem, they would have seen that the excess inventory was generated by bad forecasting rather than bad production practices. Reducing setups and run sizes could not make the forecasts better. Here, the tool drove the problem, rather than the problem driving the tool.

2 Principle of organization—All aspects of production must be organized into a coherent whole. Anybody can throw components together and get shipments out the door, but that does not ensure profits. If profits are to be predictable and consistent, then all activities leading to profits must be predictable and consistent with one another.

It has long been recognized that manufacturing is related to systems in that it is an interconnected set of relationships.

Changing one element of the system can lead to unpredictable results.

Manufacturing has suffered from numerous instances of managers failing to recognize this interdependency. For example, one firm refurbished jet engines and competed on speed and flexibility. No matter what engine the customer provided, the company could turn it around faster than the competition. They offered this capability at a premium price. Internally, this strategy imposed a cost in the form of low capacity utilization and high spare parts inventory.

Ultimately, because of its high prices, the firm was acquired by a large conglomerate. The manager assigned to take over this new acquisition saw a way of further improving profitability by increasing inventory turns. As inventory fell, lead times increased and sales suffered. The new leader didn't recognize that excess inventory, which he saw as an evil, was the foundation upon which the company's success was built. Moreover, he forgot that operations managers are the people responsible for ensuring all parts of the system work together.

3 Principle of fundamentals—Strict adherence to the fundamentals is the foundation upon which all effective production is based. Maintaining accurate inventory records, bills of material (BOMs), general system disciplines, and the like will take operations managers 80 percent of the way to success. The other 20 percent comes from adapting solutions, such as TOC, lean, and TQM, to a firm's particular needs.

Manufacturers rely on the fundamentals to survive. But the fundamentals can be boring. After all, they are infinitely detailed and appear to rely on nothing more than common sense.

The only time professionals consider the fundamentals is when something goes wrong. Top managers are seldom interested in measuring fundamentals and their impact on performance; fundamentals just aren't exciting. Managers want to see themselves as innovators, who push the boundaries of technology and practice. Managers assign fundamental measurement to a subordinate, who does not have the authority to enforce the disciplines necessary.

So, while managers lavish time and resources on the "latest and greatest," fundamentals are neglected. The benefits promised by these fads are ephemeral because they were built on a crumbling foundation of fundamentals.

This principle was violated at a firm that subsequently went out of business. Managers wanted to implement an MRP II system, which, at the time, was all the rage in solving capacity problems. Managers were proud their

bills were 99.8 percent accurate, but were unconcerned that they were incomplete. Every bill was missing about 25 percent of the parts. The missing parts typically were high-volume, commonly produced items.

The more parent items in which a part was used, the less likely it was to appear on the BOMs. Managers also overlooked the reality that these parts were produced on already-overloaded equipment and required the same raw material as parts that did appear on the BOMs. To managers' surprise, there were never enough parts, raw material, or capacity.

4 Principle of accountability—People will not put effort into that for which they are not held accountable. Rewards and consequences, on the other hand, will result in great resolve.

As Oliver Wight correctly noted, "You get what you inspect, not what you expect." If managers want something done, they must describe the desired outcome in clear and concise terms. Metrics and standards must be established and used in evaluating performance. Managers must measure actual results against standard results, and they must take appropriate action. Actions include rewards in the case of success and corrective measures in the case of failure. This approach emphasizes accountability, assigns responsibility to a specific person, and holds that person accountable for performance.

Finally, the measurement identifies and defines, in operational terms, what value is. Value is not what is found in the mission statement. Rather, value is based on what is measured.

The disastrous lack of forecasting accuracy in most companies is the result of not holding anyone accountable for forecast accuracy. Forecasting may be someone's responsibility and forecast accuracy may be measured. But there are no consequences for continued inaccuracy; nor are there expectations for improved accuracy.

Many managers recognize two fundamentals of forecasting—forecasts are wrong and forecasts change. Managers use these fundamentals to excuse poor forecasting. Even though forecasts play a critical role in production and capacity planning, managers responsible for forecasting have seldom read a book about it, attended a seminar on it, or hired a consultant to teach it. Ultimately, there are no consequences for inaccuracy. The resulting message is clear to everyone—forecasts don't matter.

5 Principle of variance—Variances are inherent in every process. Lean literature gives the impression that variance is bad. This is too simplistic a view. The value of variance depends on the goals of the system. When the goal is to

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reduce cost and increase system predictability, then variance must be measured, monitored, and ultimately reduced. When the goal of the system is to increase options or enhance variety, then variance should be encouraged.

But variance is more than dimensional deviation. It also refers to procedural variations and variations in thought processes. While dimensional deviation is never acceptable, process variation often leads to improved processes. Variation in thought processes is the source of creativity. If the goal is to foster radical innovation, then variance in thought processes is critical to success. Such variance increases the chances of finding a truly innovative new product. Yet, it is important to recognize that the two approaches to variance cannot be combined.

6 Principle of causality—Problems that managers face often are symptoms. Consider urgent shipments, late quotes, expediting, and the like. Unless the underlying causes of these symptoms are resolved, managers will find themselves continuously fighting residual symptoms. To get rid of the symptom, the root causes must be resolved.

Symptoms, such as late shipments, high scrap rates, and inaccurate inventories, demand attention because they are visible and urgent. Like a thermometer, they indicate the presence of a problem. However, attacking symptoms is ultimately self-defeating because they will either pop up somewhere else or recur later. Many times, treating one symptom—high inventories, for example—creates another symptom—low customer service. The real task is to determine the right level of inventory and what drives the requirement for the excess. Then, eliminate it.

Consider the example of a make-to-stock metal fittings manufacturer. Managers noticed that inventory was going up while service levels were dropping. Every attempt to reduce inventory levels seemed to make the problem worse. When managers finally studied the problem, what they found surprised them. The corporation's leaders had mandated that 30 percent of annual sales come from new products. Inventory had to be produced for these anticipated sales, and that inventory was included in the overall inventory for which the plant manager was responsible. Because he had no control over the innovation inventory, he reduced the service parts inventory to compensate for the increasing innovation inventory. This led to poor service levels.

Ultimately, managers recognized they had to separate the two types of inventory. The root causes for the increasing innovation inventory were different from the root causes driving increases in service parts inventory.

7 Principle of managed passion—Nothing drives a company forward like employees with a passion for their

jobs. Nothing drags a company down like employees just putting in time.

We all have worked with a person who has a passion for his or her job. These people are a joy, and they seem to get more done. Take, for example, the experience of one of the authors, who worked as a janitor while attending college. He worked part time with 11 full-time janitors, who were tasked with keeping clean the home office of a large insurance company. One of the full-time janitors was delightfully obsessive about his job. Whatever he was assigned to sweep, clean, or polish, he did so with joy, flair, and total dedication.

The new guy was assigned to learn the ropes from him and quickly became aware that this janitor was well known throughout the company. If every employee demonstrated as much passion for his or her job as he did, the company could dominate the insurance industry. How did the janitor maintain such enthusiasm for such menial work? The janitor and his boss did not consider his tasks menial. The supervisor set clear expectations and praised the janitor and his colleagues when they excelled.

The janitor's joyful outlook obviously contributed to his outcomes, and no supervisor can control that. However, with effort, every supervisor can instill as much passion into employees as their personalities can accept.

8 Principle of humility—As good as an operations manager is, he or she will never know everything. Managers should not hesitate to admit ignorance, when appropriate, or get help from wherever it may come.

A manufacturing manager is not hired because he knows it all. It is not necessary to be a winner on *Jeopardy* to succeed in manufacturing. Rather, managers are hired to get things done; they are hired to set objectives, implement appropriate measures, allocate resources, and resolve variances when they occur. Pride is not an asset for an operations manager. When a manager encounters something unfamiliar, his company should not pay the costs of having the manager learn through trial and error.

An effective manager should know his limitations. Good managers do not view their limitations as a personal failing. The manager's focus should be on the goal, not on convincing everyone that he knows everything. Ultimately, ignorance is hard to hide. Managers should call for help, learn, and move on.

A manufacturer of motor home chassis was faced by a customer demand for lower costs. The president of the company personally intervened and decided that the frame rails could be manufactured with thinner steel. The frame rail is critical to the motor home because it provides the bulk of the vehicle's support. In spite of warnings from the engineering group that thinner rails would seriously jeopardize

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vehicle integrity, the president insisted, based on his extensive marketing background, such a substitution would work. When the vehicles with these thinner rails hit the road, they buckled and had to be repaired at the firm's expense. The president didn't understand engineering, but he was too proud to admit he didn't know.


9 Principle of success—Define what constitutes success. Markets change; therefore, the definition of success must be revised often. This will require a rethinking of some or all of the aforementioned principles.

Success can be defined in many ways. However, the one way that ultimately makes sense is in terms of customer needs. Managers must identify the critical customer. Every operations management system deals with a chain of customers. Each is different; each makes unique demands on the manufacturing system. They are not equally important. Critical customers must be formally and explicitly identified. Managers must strive to exceed these customers' expectations.

Evaluating the performance of a system should include measuring the experience of critical customers. When managers make changes, they should consider if the critical customers will pay more for the improvements. "Our customers vote every day on our products with their dollars," said Sam Walton, the founder of Wal-Mart.

10 Principle of change—Every manufacturing solution is temporary. Where some solutions fail, others will excel. Consequently, every operations manager must manage for stability in the short term and change in the long term.

No manager should overcommit to any one approach. Henry Ford built a system that excelled on driving out expense. He emphasized cost control and waste management, and his system had those goals nailed. Then General Motors' Alfred P. Sloan changed the goal. Sloan sought to give customers a reason, other than low cost or breakdown, to buy a car. Sloan introduced routine design changes, and the "model year" was born. Ford could not respond because his system took a full year to change over.

Good managers must know how to learn, unlearn old systems, and relearn. Such skills are critical to survive in a world where the principle of change reigns supreme. 

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