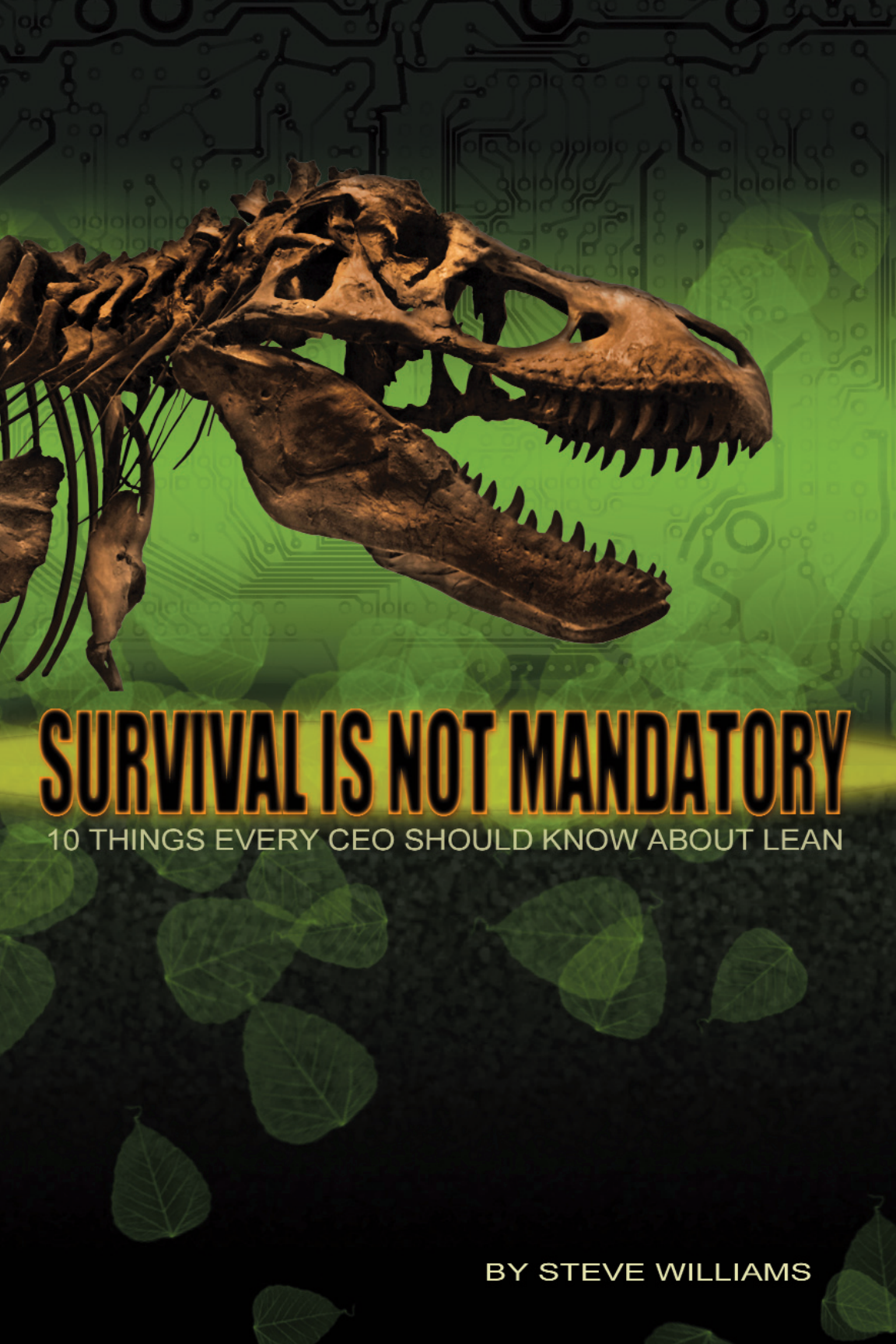

SURVIVAL IS NOT MANDATORY

10 THINGS EVERY CEO SHOULD KNOW ABOUT LEAN

BY STEVE WILLIAMS

ABOUT THE AUTHOR

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”

CHAPTER ONE

SURVIVAL IS NOT MANDATORY

1

INTRODUCTION

In the global economy that is today's business environment, there are no guarantees. In this environment, big-box retailers want to be your one-stop shop, where you can wander through stadium-sized warehouses purchasing anything from enormous High Definition TVs to equally enormous jars of pickles, and everything in between. In this environment, your small neighborhood grocer, drug store and gas station can no longer compete and are being pushed away by the giants of industry. In this environment, the big continue to get bigger through acquisition or elimination of the competition. Never before has US manufacturing had to look over our shoulder as we do now. With the exodus of American products, jobs and technology to Asia proceeding at unprecedented rates, the threat has reached critical mass. Indeed, survival is not mandatory!

THE FACTS

The following information from the CIA's *World Factbook* should scare the hell out of you. Using the metric of Services as a Percent of Gross Domestic Product (GDP), in the year 2000 the United States led all industrialized countries at 80%. Simply put, 80% of our revenue

as a country comes from service-related industries and only 20% from manufacturing. The data provided by the *Handbook of U.S. Labor Statistics* for the percent of the US labor force in each sector are equally disturbing. Using 1950 as a baseline, 60% of US employees worked in the manufacturing and 40% in the service industries. By the year 2000, this mix had changed to only 20% in manufacturing and 80% in service. While these statistics are great news if you are a service provider, they are catastrophic for the once mighty American manufacturing sector. The United States is no longer a manufacturing nation. This information, summarized in Figures 1 & 2, should scare us for two reasons: (1) We have no one to blame but ourselves, and (2) For most of us, this happened on our watch.

It gets worse. In 2007, the United States ranked 168th out of 182 nations in Industrial Production Growth Rate with a rate of .5%. Sudan is number one at 32%, and China is number six at 12.9%. The United States is the largest importer in the world, bringing in close to $2 trillion in goods and services during 2007. The United States had a population of around 300

Country	Services As a Percent of GDP
Industrialized Countries:	
United States	80%
United Kingdom	73%
France	70%
Canada	66%
Japan	63%
Lesser Developed Countries:	
Brazil	50%
Thailand	49%
Peru	45%
India	45%
Ghana	30%

Figure 1. Service as a Percent of GDP. *Source: The World Factbook 2000, Central Intelligence Agency.*

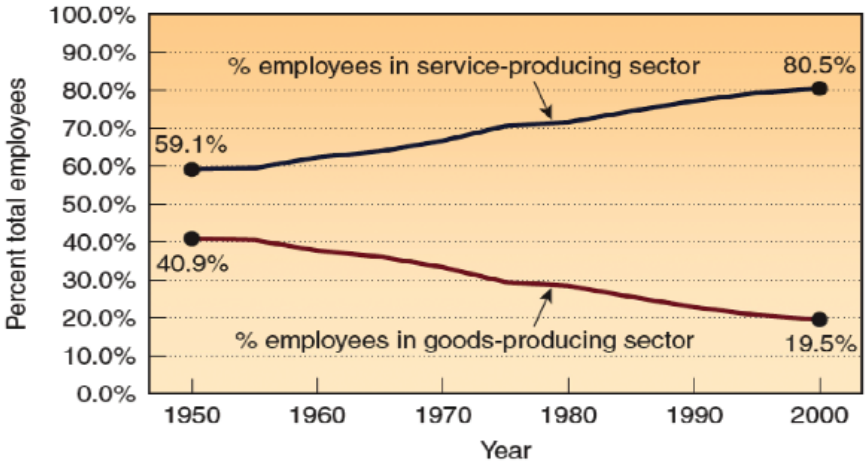


Figure 2. U.S. Employee Breakdown – Manufacturing vs. Service Sector.
Source: Handbook of U.S. Labor Statistics 2001.

million people and a workforce of 153 million in 2007. Compare that to China's population of 1.4 billion people and a workforce of 803 million and it is painfully easy to see why we are where we are today.

BE CAREFUL WHAT YOU WISH FOR

Competition is good, and it has always been around, whether it was the company down the street, across the country, or (now) across the ocean. Competition is the foundation of capitalism and the free enterprise system, two economic principles on which America was founded. Small businesses have never been able to compete from a cost or technology standpoint with the 1,000-pound gorillas of industry, and that has been the case in North America since its inception. Low-Cost Countries (LCCs) have merely shifted the location of this reality to outside our country. Perhaps we embrace

competition only as long as we are winning! I wonder how many CEOs (or any of us, for that matter) apply this logic in their personal lives? Is any one of us really willing to pay twice the price for something that has been "MADE IN AMERICA"? How about consumer electronics? When we go to our local big-box electronics store to purchase the latest big-screen HDTV, what do we look for? Price and features, period . . . and probably in that order. And if we don't get the price we want, we simply go down the street to the competition. I would bet a boatload of beer that "country of origin" is nowhere to be found on most people's purchasing criteria when shopping for personal electronics. We live in an instant-gratification world of our own creation. We want everything right now, we want it to work, and, most importantly, we want it cheap.

QUALITY IS QUALITY

Remember when the label "MADE IN JAPAN" meant inferior products in terms of quality, reliability and reputation? That certainly is no longer the case, not only with Japan but throughout Asia in general. Product quality can be industry-specific, and there are some products manufactured overseas that still fit the inferior label. But across most industry sectors, products made in Asia are of at least equal quality, and many times, are superior to the competing products made in the US and elsewhere. The automotive and electronics industries are examples of two sectors that have risen to the top on the backs of superior-quality products manufactured in Asia.

Toyota will be referred to throughout this book as the gold standard of manufacturing excellence, and rightly so. Over the last few years, the quality of Toyota's automobiles has enabled a foreign company to break into the "Big Three" good-old-boys' private party for the first time in automotive history. I have to believe that Detroit is asking for a recount, as Toyota captured the number-one spot as the largest automobile manufacturer in the world during 2007.

Take a look around your house and I dare you to find a piece of consumer electronics that was made in the US. I remember a time when all the best television sets were made in the good old US of A. Today the very best LCD and plasma TVs are made in Japan, Korea and China. The list of foreign-made consumer electronics is endless: home theater components, cameras, cell phones and iPods—all made in Asia for a fraction of what it would cost to have them made here. The engineering marvel that is the iPod provides a stunning example that China is supremely capable of producing very complex products in very large volumes. Some will argue that consumer electronics have become disposable, which may be true since it is cheaper to buy a new DVD player than to fix it. But that does not diminish the *quality* of the product. Quality is defined as meeting customer requirements, and I believe most consumers would rather replace a $29 DVD player every three years than pay $120 for one that will last five to six. With technology changing as fast as it does, *disposable* is not a bad thing.

THE PRINTED CIRCUIT INDUSTRY

Printed circuit boards (PCBs) are the backbone of most electronic equipment, and printed circuit board manufacturing has, unfortunately, become the poster child for LCC outsourcing. Looking at historical data over the last 20 years provides some interesting perspective on the printed circuit board manufacturing industry. The North American PCB industry has been in a state of decline for the past two decades, as Figure 3 clearly shows. Figure 4 displays the regional distribution of PCB fabricators as of the end of 2005. The mass exodus to Asia, coined by my esteemed colleague Walt Custer the "Asian Shift," began in earnest around the year 2002; however, product has been moving to Asia to some extent for the past decade. Using the raw number of PCB operations in North America as a metric, with 10-year time buckets, the industry lost 331 PCB companies between 1995 and 2005, contrasted with 669 PCB companies between 1985 and 1995.

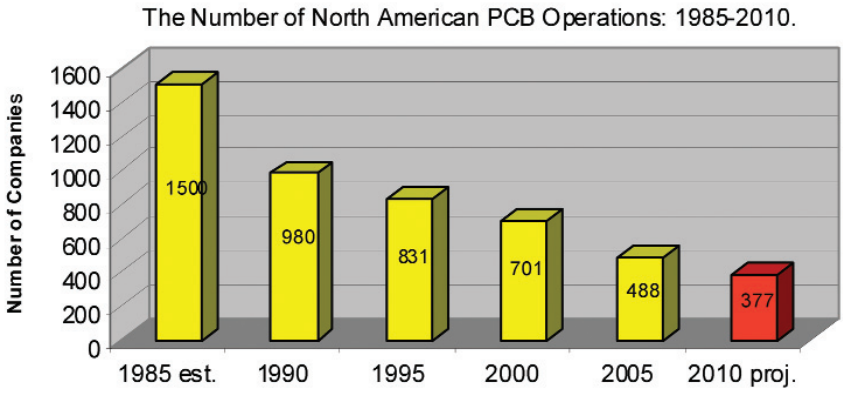


Figure 3. The Decline of the North American PCB Industry. *Source: Harvey Miller FabFile Online 2007. 2010 projection based on 5% reduction/year Steve Williams 2007.*

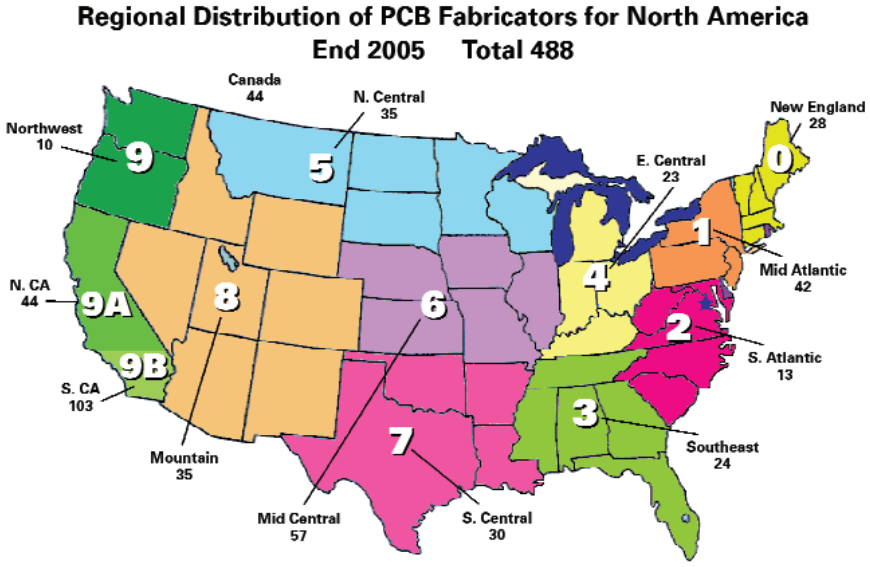


Figure 4. Regional Distribution of North American PCB Fabricators.
Source: Harvey Miller FabFile Online 2007.

This 2x factor seems to invalidate the premise that Asia, or specifically China, is solely responsible for the decimation of the North American printed circuit board industry today. Note that the largest five-year decline came between 1985 and 1990, when the industry lost 520 PCB companies. I understand that there are consolidations, etc., that have impacted these numbers, but consolidations have been a constant throughout the last 20 years. The numbers are what they are.

A MODERN PARABLE

I cannot take credit for the concept of the following tale, but over the years I have made enough tweaks to the story that I can somewhat call it my own. Although totally fictional and told tongue-in-cheek, the moral of

the story loosely reflects the underlying philosophical differences that have led to our loss of manufacturing dominance in the US.

> *A very large American automobile manufacturer and its equally large Japanese competitor decided to hold a canoe race down the Detroit River, with the winner securing bragging rights for the following year. Both teams were given 30 days to develop their strategy and prepare their teams to reach peak performance before the race. On the big day, Team Japan won by a mile. Team America, very discouraged and disappointed, decided to investigate the reason for the crushing defeat. A canoe steering committee of senior managers was formed to investigate the root cause and recommend appropriate action. Their conclusion was that Team Japan had eight people rowing and one person steering, while Team America had eight people steering and one person rowing.*
>
> *Unsatisfied with the internal conclusions and feeling that a deeper study was in order, Team America's management hired a consulting company and paid them a large amount of money for a second opinion. After considerable time and great expense, they advised, of course, that too many people were steering the canoe, while not enough people were rowing.*

Not sure of how to utilize that information, but wanting to prevent another loss to Team Japan, the rowing team's management structure was totally reorganized to four steering supervisors, three area steering supervisors and one steering manager. They also implemented a new pay-for-performance program that would give the one person rowing the canoe greater incentive to work harder. The program was launched with much fanfare and named "Team High Incentive Canoe Kickoff" (THICK), with meetings, dinners and free pens for the rower. There was discussion of getting new-technology paddles, canoes and other equipment, extra vacation days for practices, and bonuses.

The next year, Team Japan won by two miles.

Humiliated, Team America's management laid off the rower for poor performance, halted development of a new canoe, sold the equipment, and canceled all capital expenditures for new technology. The money saved was distributed to the senior executives as bonuses, and the following year the racing team was outsourced to India.

Steve's moral of the story: If Team America doesn't start working smarter in the manufacturing sector, we will be destined to remain a service nation.

CONCLUSION

In the last few decades:

American automotive manufacturers have moved factories out of the US, claiming they can't make money paying American wages. During this same timeframe, Toyota has moved more than a dozen plants inside the US, using American workers and paying American wages. The results?

In 2004, Toyota:

- Had more money in the bank than GM, Ford, Daimler/Chrysler & VW combined.
- Made more profits than GM, Ford, Daimler/Chrysler & VW combined.

During 2007, Toyota passed GM to become the largest automaker in the world (by number of vehicles sold).

American automotive manufacturers are still scratching their heads. A perfect illustration of the GAP between US and Japanese philosophy is that Toyota has been working on eliminating waste for over half a century and they still believe they are only at the tip of the lean iceberg!

CHANGE IS CONSTANT

When Asia started to threaten the North American PCB industry, it began with Japan, which was replaced by Taiwan; now, the current best LCC solution is China, for a broad range of technologies. One thing is certain: A new LCC will emerge in the next five to 10 years to challenge

China—perhaps India, Vietnam or the Czech Republic, and the cycle will continue. To stay in the game, North America needs to reshape, realign, and refocus on supporting the niche pockets that LCCs cannot.

Hopefully, at this point I have sufficiently gotten your attention with all that has transpired in US manufacturing over the last 50 years or so. My intent with this book is to create awareness and spur interest in one of the most powerful tools that companies can use to improve organizational performance, which translates directly to the bottom line. A recurring theme you will hear from me throughout this book is that "it is always about the dollars," and this book is all about helping your organization keep more of those dollars. It is my hope that after reading this book, decision makers will have a high level understanding of how lean can help any organization survive.

“THESE COMPANIES HAVE FIGURED OUT THAT THE LONG-TERM BENEFITS OF REPUTATION, CUSTOMER LOYALTY, AND DELIGHTING THE CUSTOMER MAKE A LOT MORE FISCAL SENSE THAN CUTTING CORNERS TO SAVE A FEW SHORT-TERM DOLLARS.”

CHAPTER TWO A PAINFUL HISTORY LESSON

2

I believe that most unbiased consumers would agree that, in general, the quality of the American automobile has improved significantly over the past two decades. Did the overlords of Detroit suddenly decide to give the customers more for their money? Did they collectively plan to restore consumer confidence in the once-proud "MADE IN AMERICA" label? Unfortunately, the answer is no. The motivation for this dramatic turnaround was far less noble: Foreign competition was kicking their butts. There is a reason that the standard warranty for American automobiles has been stuck at the lowly three years/36,000 miles level forever: Our automobiles aren't built very well. And, by the way, who drives only 12,000 miles a year anymore? No one I know. As a result, the average consumer only gets an effective warranty on a brand-new American automobile of one and a half to two years! With the average cost of a new vehicle exceeding $25,000, shouldn't this be totally unacceptable? Has what typically is the second largest expense for a family (after the house) become disposable, as consumer electronics have?

There is a reason that the competition has been offering seven-year/70,000 mile- and, recently, 10-year/100,000 mile-warranties: On average, their automobiles

work, perform, and last longer than the warranty. These companies are committed to bringing a superior product to market; however, they are equally committed to making a profit. I draw a parallel to the old attorney adage that you never ask a witness a question to which you don't know the answer. Foreign automakers' reliability studies have proven that, statistically, the chance of having to pay out a costly warranty repair on any given vehicle is well within acceptable limits to the organization. It is not luck, or black magic; it is cold, hard science that allows these companies to offer product warranties far above the U.S. industry standard. This is the power of reducing variation and process control. These companies have figured out that the long-term benefits of reputation, customer loyalty, and delighting the customer make a lot more fiscal sense than cutting corners to save a few short-term dollars. As we all know, it is always about the dollars; but in this case, it is about where the dollars are spent.

A LEAN BEGINNING

Contrary to popular belief, the Japanese did not invent all things Lean; many of the underlying principles for what has evolved into current lean practices began in the United States. Figure 5 provides a graphical timeline of milestones in the evolution of lean, the origin of which may surprise you. This is where the "painful" part comes in.

Eli Whitney is most famous as the inventor of the cotton gin; however, this accomplishment pales in comparison to his concept of interchangeable parts. Whitney developed this concept in 1799 when he accepted a U.S.

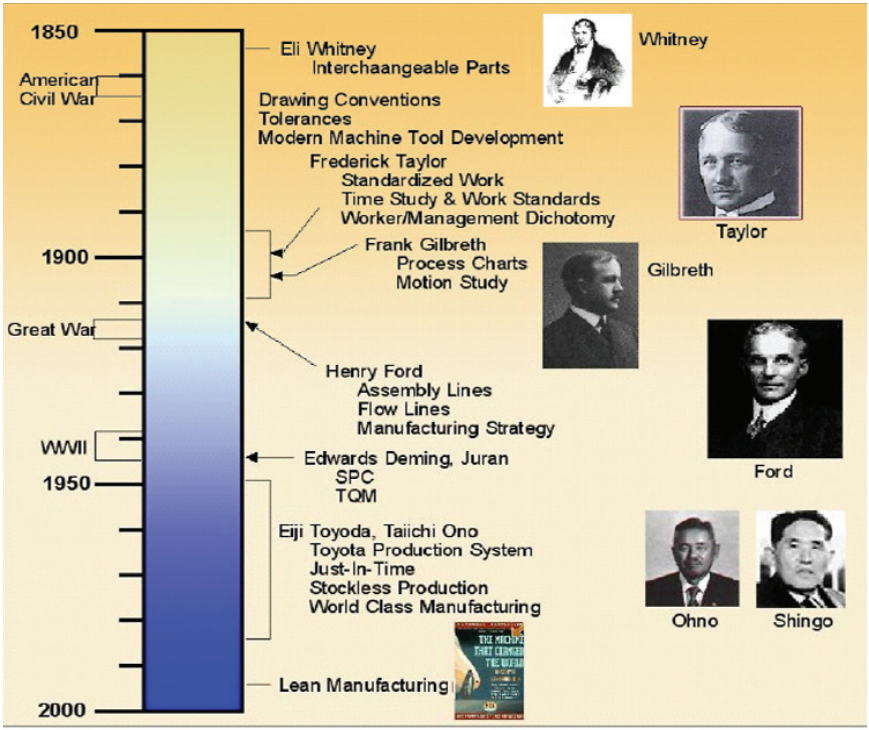


Figure 5. The History of Lean Timeline. *Source: strategosinc.com 2007.*

Army contract to manufacture 10,000 muskets at the preposterous price of $13.40 each. Whitney was able to achieve this unbelievably low price by mass production and standardized parts. This methodology remained unchanged for about a hundred years, when Henry Ford took it to the next level.

Beginning around 1910, Ford was one of the first business leaders to develop a manufacturing strategy for his organization based on increasing efficiency. He broke the manufacturing process down into the fundamental elements of people, machines/equipment, tooling and products. Ford then developed the concept of "flow" manufacturing and arranged these elements into a continuous

manufacturing process for the Model T automobile. This flow manufacturing was refined into the Ford Assembly Line, a manufacturing first, which utilized standardization, specialization, and speed. Ford developed a system for having raw materials delivered to his plant *just-in-time* to be put directly into the assembly line. Henry Ford also hated waste; he was always looking for ways to turn the byproducts of his production plants into saleable products. This desire led to the following bit of little-known product historical trivia: To make use of the waste wood generated by his sawmill, Ford constructed a chemical plant in 1924 to reclaim 600 pounds of charcoal from every ton of scrap wood the plant generated. The charcoal was manufactured into briquettes and sold under the name of Ford Charcoal Briquettes, which was later changed to Kingsford Charcoal Briquettes. For the above reasons, Henry Ford is considered by many to be the father of Just-In-Time and Lean Manufacturing.

SO WHAT WENT WRONG?

Ford's original dream was to build a simple, reliable vehicle that was within the economic reach of the average citizen. This was accomplished through efficient manufacturing and low inventory levels. His strategy worked: Within the first five years, Ford had captured roughly half of the total available U.S. automotive market. However, that's when things began to change. To support his vision of "putting the world on wheels," his philosophy morphed from flow manufacturing to mass production. Lured by the promise of tremendous profits, Ford began to abandon the

core philosophies of lean manufacturing for the pursuit of mass production and volume. His new manufacturing goal was to produce as many automobiles as possible, and let the sales force worry about selling them. Supporting this new edict required a build-up of inventory throughout the assembly line, which signaled the beginning of the end for the lean manufacturing practices that had seen such early success at the Ford Motor Company.

THE TOYOTA PRODUCTION SYSTEM

The holy grail of lean manufacturing is the Toyota Motor Corporation's Toyota Production System (TPS). The Toyota Production System has long been the gold standard against which many organizations benchmark themselves when implementing a lean program. Unfortunately, few companies have duplicated the results that Toyota has achieved and maintained for over half a century.

The Toyota Motor Corporation was founded in 1933 by Kiichiro Toyoda (no, that is not a typo), but the roots of what would eventually evolve into the Toyota Production System actually began at the Toyoda family's Automatic Loom Works factory. Kiichiro's father, Sakichi Toyoda was a highly critical thinker, an inventor who developed a very sophisticated power loom for the textile industry in 1902. He improved on his design in 1926 with a breakthrough feature that would stop the loom the instant a thread broke. Thread breakage had, traditionally, been the source of a great deal of scrap for fabric weavers, and this feature allowed the operator to make a repair or replacement and continue on with the product without

any scrap or waste. Sakichi founded the Toyoda family's Automatic Loom Works factory that same year, anchored by his state-of-the-art automatic loom. Then, in 1929 Sakichi sent his son, Kiichiro, to England to sell the patent rights to his "mistake-proof loom" and used the proceeds (£100,000) to start the Toyota Motor Corporation under Kiichiro's leadership. Adding his penchant for reducing waste to his father's mistake-proof philosophy, Kiichiro developed the early concept of flow manufacturing and wrote a very detailed manual on the subject. These rudimentary ideas were the beginning of the philosophy that would become the Toyota Production System.

The TPS continued to evolve as the economy and changing automotive environment presented new, and formidable, challenges to the company. World War II had decimated Japanese industry, and Toyota could not compete directly with large, established companies such as Ford. Another daunting obstacle was the fact that the sole demand for Toyota automobiles was in Japan. The unique Japanese market demanded that Toyota not only supply small quantities, but small quantities with a high degree of variety. In the United States, Ford had the luxury of selling one model of its Model T in any color you wanted as long as it was black!

Toyota's plant manager, Taiichi Ohno, was given the assignment of catching up with American companies like Ford in productivity at a time when they were behind by a factor of 10. Ohno drew upon a number of ideas imported from the West and a lot of experimentation ultimately to develop the Toyota Production System and is commonly

known as the "Father of TPS." Ironically, one of the influences on Taiichi were the teachings of American quality pioneer W. Edwards Deming, who began teaching his methods to Japanese companies after receiving little interest from American management in the 1950s. Embracing the concepts of eliminating waste, empowering employees and fostering continuous improvement have propelled the Toyota Motor Corporation into the forefront of manufacturing excellence.

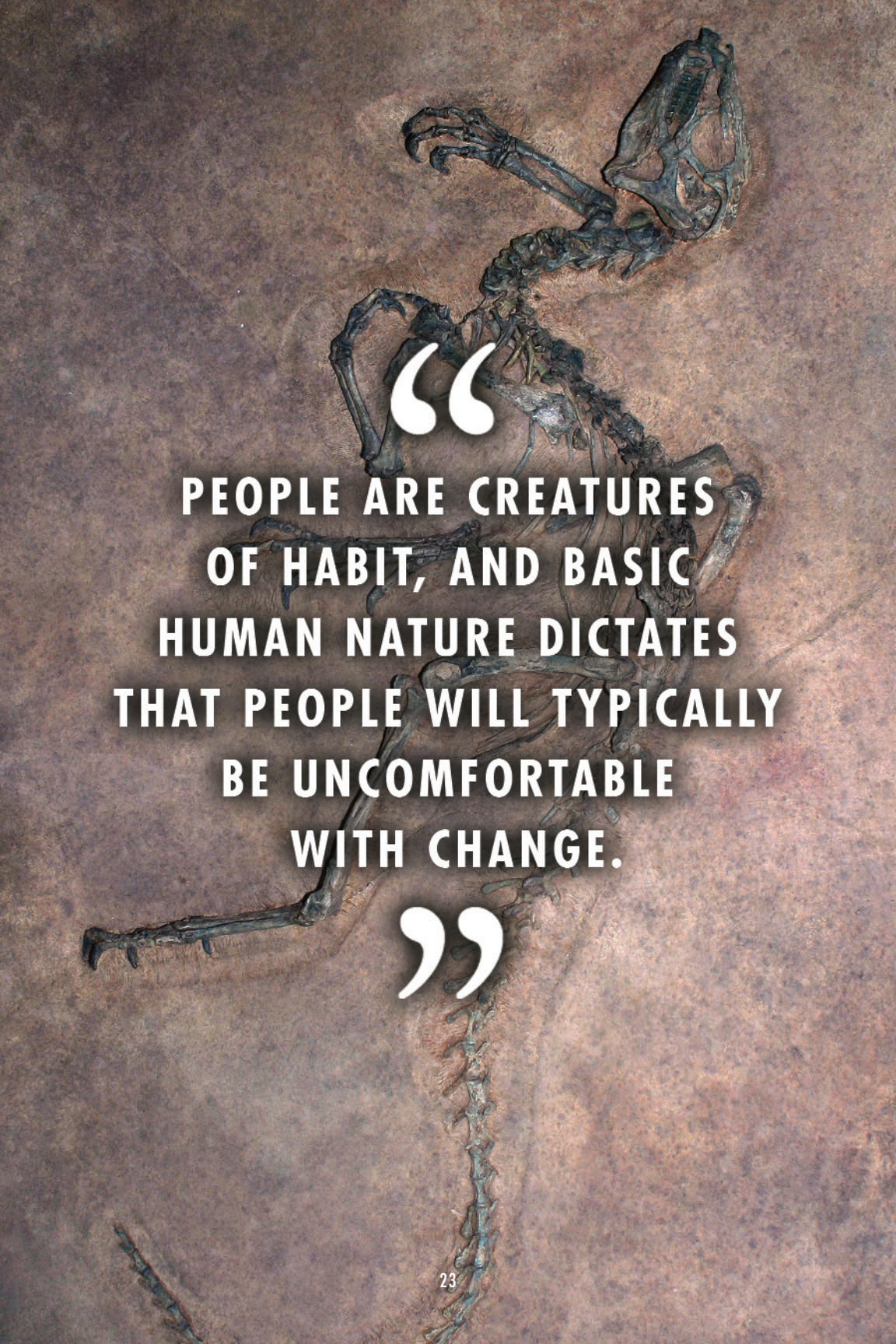
U.S. MANUFACTURING GETS A CLUE

One of the strengths of Asia is to take an existing product, technology, or philosophy and improve it with flawless execution. That is what has happened with the lean movement. First, other Japanese companies began to take notice of the success of Toyota's TPS and tried to duplicate this methodology in their own organizations. A quality crisis began to hit U.S. manufacturing around 1980 as foreign products started to dominate consumer electronics and automobiles. Market share, products, and jobs began to move East at an alarming rate, while consumers were given not only more choices but greater buying power, thanks to the low cost of Asian-made products. American management finally began to sit up and take notice of how successful Japan, and specifically Toyota, had become by utilizing "that lean thing."

PAINT-BY-NUMBERS LEAN

There have been many groundbreaking contributors to the evolution of lean in addition to those previous-

ly discussed, including the statistical quality control practices of Dr. Ishikawa, Philip Crosby, and Joseph Juran. Two books have had a tremendous impact on the acceptance of lean practices in the United States: *The Machine That Changed the World*, written by James P. Womack, Daniel T. Jones, and Daniel Roos, and *The Toyota Way* by Jeffrey K. Liker. Both books are must-read recommendations by this author for anyone serious about implementing lean in his or her organization. Manufacturing strategy is complex, and each industry has its own unique set of products, processes, and problems. While there is no paint-by-number way to implement lean, there are certain principles, tools, and methodologies that should be a part of any successful program. The following chapters in *Survival Is Not Mandatory* will provide something of a lean primer and guideline in these areas for companies that want to take the next step and join the lean revolution.


“
PEOPLE ARE CREATURES
OF HABIT, AND BASIC
HUMAN NATURE DICTATES
THAT PEOPLE WILL TYPICALLY
BE UNCOMFORTABLE
WITH CHANGE.
”

CHAPTER THREE

DRIVE-BY LEAN

3

Before we can talk about how to use lean to improve your organization, we need to talk about how not to use lean. I will attempt to do this in the form of a series of case studies to illustrate some common mistakes that organizations make when first trying to implement a lean program. The case studies are real-life examples from companies I have visited over the last five years that have shared their experiences with me. The names and particulars have been altered, but the integrity of the experience remains intact. Unfortunately, a failed lean implementation can result in bad press from business leaders on the benefits of lean manufacturing practices—or the lack thereof. These perceptions can sometimes result from a half-hearted program launch, but more times than not they are caused by a simple lack of understanding of lean and what it really takes to implement it. I like to call this phenomenon "Drive-by Lean."

IT WON'T WORK HERE (AND OTHER MYTHS)

One of the most commonly recurring themes I run into while either teaching or speaking on lean is the "I know that Lean won't work in my company" attitude. Pessimists are always willing to voice their reason(s) passionately on why this is true: We are too big, we are too

small, our technology is too simple, our technology is too complicated, our employees won't support it, our management won't support it, we have tried it before and it didn't work, this is just another flavor of the month and will fade away like all the others, et cetera ad nauseam. People are creatures of habit, and basic human nature dictates that people will typically be uncomfortable with change. Resistance to implementing any new initiative is natural and expected; however, with proper (1) recognition, (2) understanding, and (3) education, resistance can be overcome and change can succeed. The following case studies will illustrate what can happen if an organization does a poor job of these three components when jumping into a lean initiative.

CASE STUDY 1: COMPANY A

Company A has 1500 employees and manufactures high-volume, low-cost widgets in a very competitive global marketplace. The prior-year profits were marginal, but

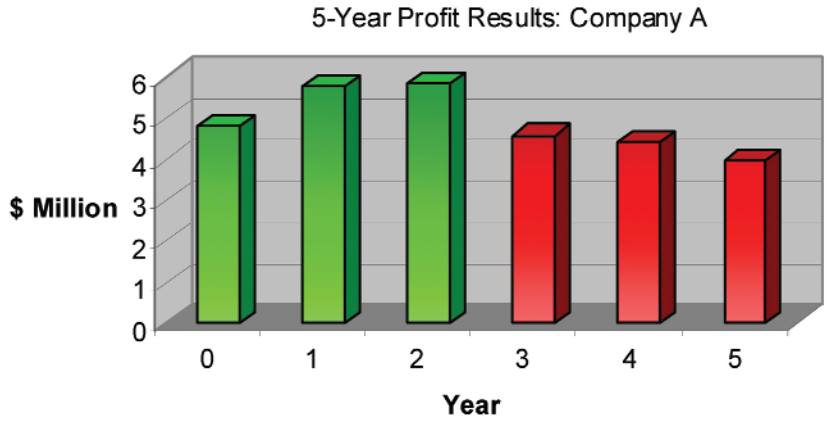


Figure 6. Profit History: Company A. *Source: SUW 2007.*

positive, at $4.83 million on $145 million in revenue (3.3%). The widget manufacturer has just been acquired by a very large company in an unrelated industry who was unimpressed with the new division's performance. Having had great success implementing a lean program, the parent company suggests that Company A investigate implementing lean to improve the division's performance. Company A hires a team of lean consultants for $500,000 over a nine-month period to come in and "do lean for them." Figure 6 represents the five-year profit results after the implementation of Company A's lean program.

POSTMORTEM

So what went wrong? Quite simply, the consultants left! Of course they had done exactly what they were hired to do: They *did lean* for Company A. The consulting team had come in and retooled all the procedures and methodologies, and the program roll-out created enough momentum to sustain itself for a few years. Some training had taken place, but the workforce had no real understanding of why things had been changed or any concept of value vs. non-value activities. The passage of time, combined with employee and management turnover, resulted in things gradually falling back to the way they used to be. In fact, due to the confusion created from all the changes by the consultants, profits began to slip below the pre-lean baseline beginning in Year Three post-lean implementation. Old habits truly do die hard! By the way, in June of Year Six after lean implementation, Company A was closed down by the parent company for underperformance.

CASE STUDY 2: COMPANY B

Company B is a family-owned business with 49 employees who manufacture low-volume, high-end customized widgets at a very respectable profit margin in a domestic marketplace with limited competition. Company B's largest customer approaches them and says, "We want you to implement Just-in-Time (JIT) deliveries on our product, and we are going to help you do this by training you in the lean concept of JIT." Company B's management accepts this challenge, and the customer provides 40 hours of on-site training for five managers at Company B. Company B begins to attempt JIT delivery for this customer over the next nine months, with very limited success. Unsatisfied, the customer again approaches Company B and declares that their JIT program is not working because they are not using a Kanban pull system in their production and offers to train them in the lean concept of Kanban. The owner of Company B responds to the customer that "We have done lean and it didn't work!" and politely declines this latest proposition.

POSTMORTEM

A number of things went wrong here, beginning with the training. The first problem was that the training only involved five managers out of the 49 employees in Company B. Even so, this might have had greater success had Company B implemented a train-the-trainer program to transfer this knowledge across the organization. The second problem was that the training only focused on a few, select lean tools, i.e., JIT and Kanban, and did not

address the major component of lean: eliminating waste from the process. The last obstacle was the owner's lack of commitment and effort in educating himself on what lean is and what is required for it to be successful. Company B was not able to retain their largest customer, and this void resulted in a 25% reduction in their workforce the next year. The owner of Company B was quoted as saying, "Lean manufacturing was our downfall, it doesn't work, and I wouldn't recommend it."

CASE STUDY 3: COMPANY C

Company C has 225 employees and produces a very generic medium-volume, medium-price product. However, because the manufacturing process required to produce these products is very manual and time-consuming, Company C's lead-time is 12 weeks from customer order to delivery. Company C's oldest customer could easily purchase this product overseas at a much reduced price and about the same lead-time but has remained loyal to their supplier. During a business review, the customer explains that they can justify the added unit cost if Company C can reduce their lead-time to eight weeks. Company C's management is open to the concept and commits to investigating lean to reach this goal. Having no experience with lean practices, senior management decides to hire a "lean expert" from their competition to head up this effort.

The lean expert begins a training program for Company C employees, and the first project is to value stream map the manufacturing process. The results of this

activity show that out of the 12 weeks of lead-time, the value-add time (time when someone is actually working on the product) is only 19 days! The lean expert then organizes some 5S activities, a few Kaizen events and a major reorganization of the production line. The net result of this 12-month effort is a reduction in lead-time from 12 weeks to 11 1/2 weeks. Far short of the eight-week goal, Company C's senior management decides that lean is not the answer, fires the lean expert, and heavily invests in automating the process. After six months of operating the automated line, Company C's lead-time actually *increases* to 12 1/2 weeks!

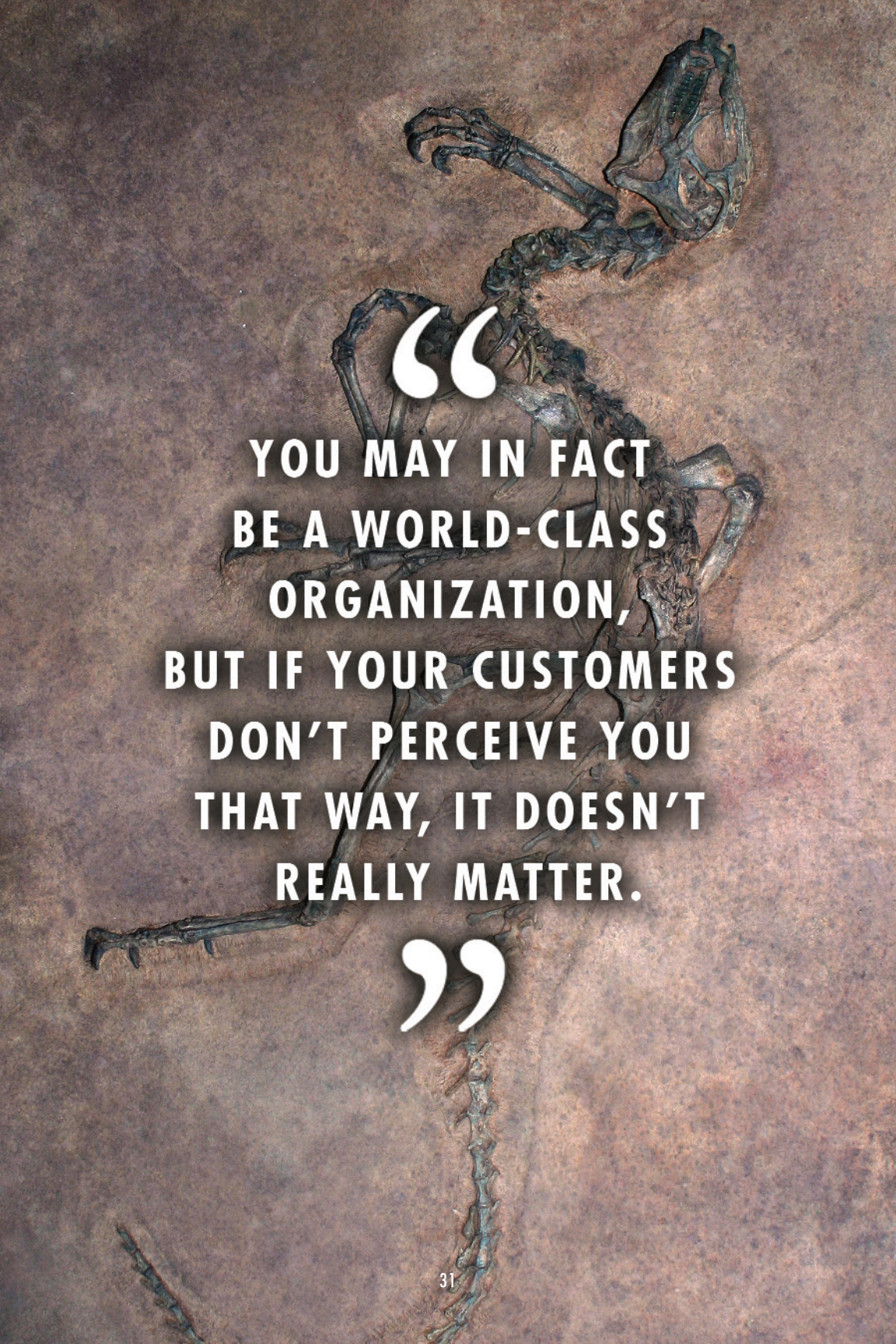
POSTMORTEM

The risk in hiring a "lean expert" from another company is that the person is an unknown commodity. Hiring a person experienced in lean into a solid, established program is one thing. But without a working knowledge and understanding of the basic fundamentals of lean, a manager cannot possibly assess the skill set of someone who will be handed the keys to the lean kingdom. Assuming that a lean program from another company will be a good fit, or even that it is being executed correctly, is a mistake that could sink a company. Senior management also failed to recognize a number of critical considerations before investing in automation. The volume needed to keep automated equipment operating efficiently, plus preventive maintenance downtime, fluctuating customer demand and employee retraining provided the perfect storm that resulted in a lead-time increase. After 18

months, the customer's patience was finally exhausted and the business was moved to Asia. Loyalty has its limits, especially when the customer can enjoy a significant price and lead-time reduction.

OBSERVATIONS

All three companies honestly thought they had done lean, and their failed experience has undoubtedly assured that the concept of lean practices will never be entertained by them again. Even worse, the managers of these companies will probably relay their experiences to anyone who will listen, further perpetuating their false perceptions of the power of lean. There is nothing wrong with consultants—in fact, I do a bit of consulting myself—but relying on consultants to "do something for you" will have predictable results, as evidenced by Company A. Customers have a legitimate right to demand improvements in your process, and many will offer assistance with the best of intentions. No matter what path you take, a basic understanding of lean, of the required resources and expense, and of the level of senior management commitment that is necessary is imperative for a lean initiative to be successful.


“
YOU MAY IN FACT
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”

CHAPTER FOUR

VOICE OF THE CUSTOMER

4

The topic of "Voice of the Customer" always creates some confusion in the context of lean practices. Although there should be no disagreement on the point that everything starts and ends with the customer, people typically have a difficult time connecting the dots between the customer and process improvement during the early stages of lean implementation. But I would argue that before you can define your process defects and opportunities, you need to understand the needs of your customers.

PERCEPTION IS REALITY

Understanding your customers may seem like a no-brainer, but a recent Bain & Co. survey ("Tuning in to the Voice of Your Customer," *Harvard Management Update*, October 2005) reveals just how frequently companies miss the mark. Surveying 362 firms, the company found that 80% believed they delivered a "superior experience" to their customers. But when the customers of these firms were asked about their own perceptions, the survey showed that the customers only rated 8% of their suppliers as truly delivering a superior experience. Having an inflated view of your own organization's ability to meet customers' needs is not uncommon, but a gap of this

magnitude signals a very serious trend that needs to be reversed, and reversed quickly. During the early stages of my career, I had a quote hanging in my office from one of my favorite authors and business gurus, Tom Peters. The quote was, "Perception is reality." Fortunately, I bought into this philosophy from the very beginning, and it has served me well over the years. In his breakthrough book *In Search Of Excellence*, Tom tells the stories of highly successful companies and some of their customer satisfaction secrets. The common denominator in the book is how these organizations had put systems in place to understand, acknowledge, and manage the only perception that matters—their customers'.

Clearly, the question is not what's wrong with 92% of these companies; the key question is what's right with 8%? The answer is painfully simple: They listen to their customers. You may in fact be a world-class organization, but if your customers don't perceive you that way, it doesn't really matter. As the Bain survey shows, it's extremely easy for a company to assume that they're keeping their customers happy. The challenge is in the ability to transform organizational culture into one that is driven by its customers' true needs. No level of performance is sustainable without an occasional adjustment, and the appropriate adjustment in strategy can only be developed after measuring your customers' perceptions. Customer satisfaction is like any other process, and, as I am known to say frequently, you can't improve what you haven't measured. Remember: "Perception is reality."

WORLD CLASS? ASK YOUR CUSTOMERS

The title "world class" rings hollow if you are the only one saying it about your organization. How many times do we see a company promoting themselves as being a world-class manufacturer of widgets, or as having been voted Best-in-Class in customer service? Who voted? Again, the "truth in advertising" dilemma. What often happens is a Dilbert cartoon in the making: A group of senior managers get together and declare, "You know, we do a pretty respectable job in our business; let's begin marketing ourselves as world-class."

What does it mean to be world class? Breaking it down into a single bullet point, it means being on par with the top performers globally in your chosen craft. There are, of course, numerous quantitative metrics that are used to measure this, such as turnover, quality certifications, productivity, and the requisite financial ratios. But perhaps the most important metric is qualitative: How do your customers think you are doing?

WHAT IS VALUE?

One of the first questions that need to be answered is, "What are we providing that is of value to our customers?" And the first mistake that organizations make is trying to answer this question themselves. This question can only be answered by the customer (remember the whole "perception is reality" thing?), and any answer that is not directly correlated to customer input will not improve your ability to satisfy the customer. Understanding a customer's needs goes far beyond product and features; it

includes a variety of subjective attributes such as service levels, key customer satisfaction drivers, and the degree of perceived value from your core business activities.

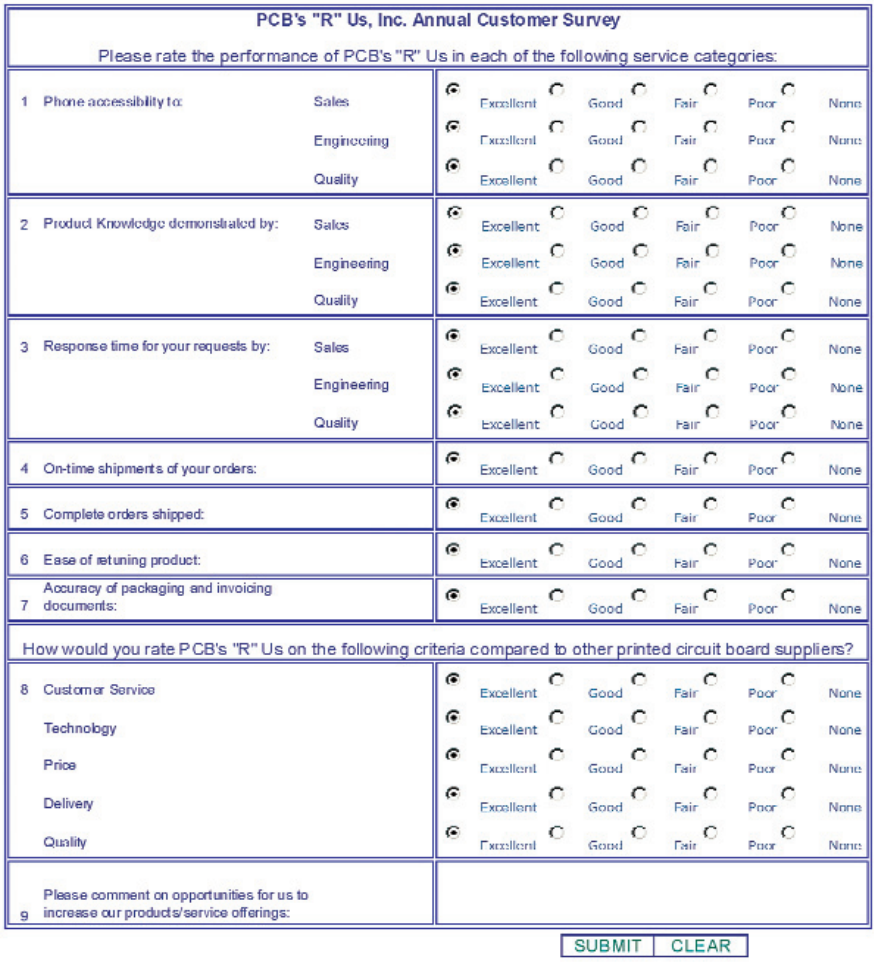
Organizations spend a great deal of money in time and resources on strategic planning to develop the short- and long-term goals that will guide the company going forward. It never ceases to amaze me how often these goals and plans are developed without any input from the customer base. Most senior-level planning sessions are bottom-line focused, with most of the discussions being centered on revenues, balance sheet results, headcount, forecast, etc. Make no mistake—I fully appreciate the need for a bottom-line mentality at the senior management level, but equal time needs to be granted for the underlying foundation that directly affects these numbers: customer satisfaction. When the discussion does turn self-reflective, questions like, "What do we make?", "What market are we in?", and "Who are our customers?" are staples of American management strategic-planning sessions. Missing are questions such as, "How do our customers see us?", "What products and markets do our customers want us to be in?", and "What do our customers think we do well, and more importantly, not do well?" These are the questions that need not only to be answered but acted upon, on a regular basis, for an organization to be able to achieve a quantum leap in their level of customer satisfaction.

DEVELOPING A CUSTOMER SURVEY

There are many tools for soliciting customer input such as focus groups, interviews, customer complaints,

and face-time with the customer, but a well-developed survey can be the easiest way for a company to launch a Voice of the Customer program and begin gathering customer input. I am a firm proponent of KISS: Keep It Simple, Steve (feel free to substitute your adjective of choice for the last S). When designing the survey, making it as easy as possible for your customers to complete is of paramount importance. How many of us have received a survey in the mail with a dollar bill taped to it, and kept the dollar and tossed the survey? Why do we do this? Because it is a four-page paper survey with 40 questions that has to be put into an envelope and taken to a mailbox. No one has time for that. With today's technology, an email or Web-based survey can be completed by a customer at his or her desk in three minutes. Remember—how you invite them to participate, the way you ask the questions, and the survey's ease of use will greatly affect participation rates. Surveying all of your customers will not net the results you are looking for; applying the old reliable 80/20 rule to your customer revenue stream should result in capturing an accurate cross-section of your top customers.

A Web-based methodology is the preferable medium for ease of use, demographic data capturing, and automated scoring/reporting. It can also incorporate automatic email notification to senior management upon receipt of an unacceptable survey rating. Figure 7 provides an example of a Web-based customer survey. When designing the questions to be used in the survey, take care to ask questions that meet the following crite-



PCB's "R" Us, Inc. Annual Customer Survey

Please rate the performance of PCB's "R" Us in each of the following service categories:

			Excellent	Good	Fair	Poor	None
1	Phone accessibility to:	Sales	◉	○	○	○	○
		Engineering	◉	○	○	○	○
		Quality	◉	○	○	○	○
2	Product Knowledge demonstrated by:	Sales	◉	○	○	○	○
		Engineering	◉	○	○	○	○
		Quality	◉	○	○	○	○
3	Response time for your requests by:	Sales	◉	○	○	○	○
		Engineering	◉	○	○	○	○
		Quality	◉	○	○	○	○
4	On-time shipments of your orders:		◉	○	○	○	○
5	Complete orders shipped:		◉	○	○	○	○
6	Ease of retuning product:		◉	○	○	○	○
7	Accuracy of packaging and invoicing documents:		◉	○	○	○	○

How would you rate PCB's "R" Us on the following criteria compared to other printed circuit board suppliers?

		Excellent	Good	Fair	Poor	None
8	Customer Service	◉	○	○	○	○
	Technology	◉	○	○	○	○
	Price	◉	○	○	○	○
	Delivery	◉	○	○	○	○
	Quality	◉	○	○	○	○

9 Please comment on opportunities for us to increase our products/service offerings:

SUBMIT CLEAR

Figure 7. Customer Survey. *Source: SUW 2003.*

ria: (1) Must be within the organization's control, (2) Must be one that the organization is committed to take action to improve, and (3) Will provide a competitive advantage. These sound simple, but many times a company will implement a customer survey, review the data, and let the process end there. The summary data need to be presented to senior-level management for development of an action plan. Progress must be monitored

throughout the year and become the baseline for next year's survey.

HOW NOT TO USE A SURVEY

Your goal with a survey is to gain honest, unbiased input that can be used to improve organizational performance. With that in mind, I would like to share a real-life personal experience that exemplifies how not to do this. After having some maintenance done recently on my truck at a former "big-three" dealership, I received a customer satisfaction survey in the mail asking me to rate the quality of customer service during my visit. The same day I also received a personal phone call from the service technician who handled my truck, who wanted to let me know that any rating less than "Excellent" by me would result in undesirable consequences for him. I returned my survey with my honest critique, noting this conversation and taking exception to the methodology used by the dealership. But how many people would have felt pressured to rate their experience as "Excellent" when it really wasn't? And how valuable is this information to the dealership? From a Voice of the Customer standpoint, worthless, and it sure puts all the customer service awards hanging in the showroom in a different light.

DELIGHTING THE CUSTOMER

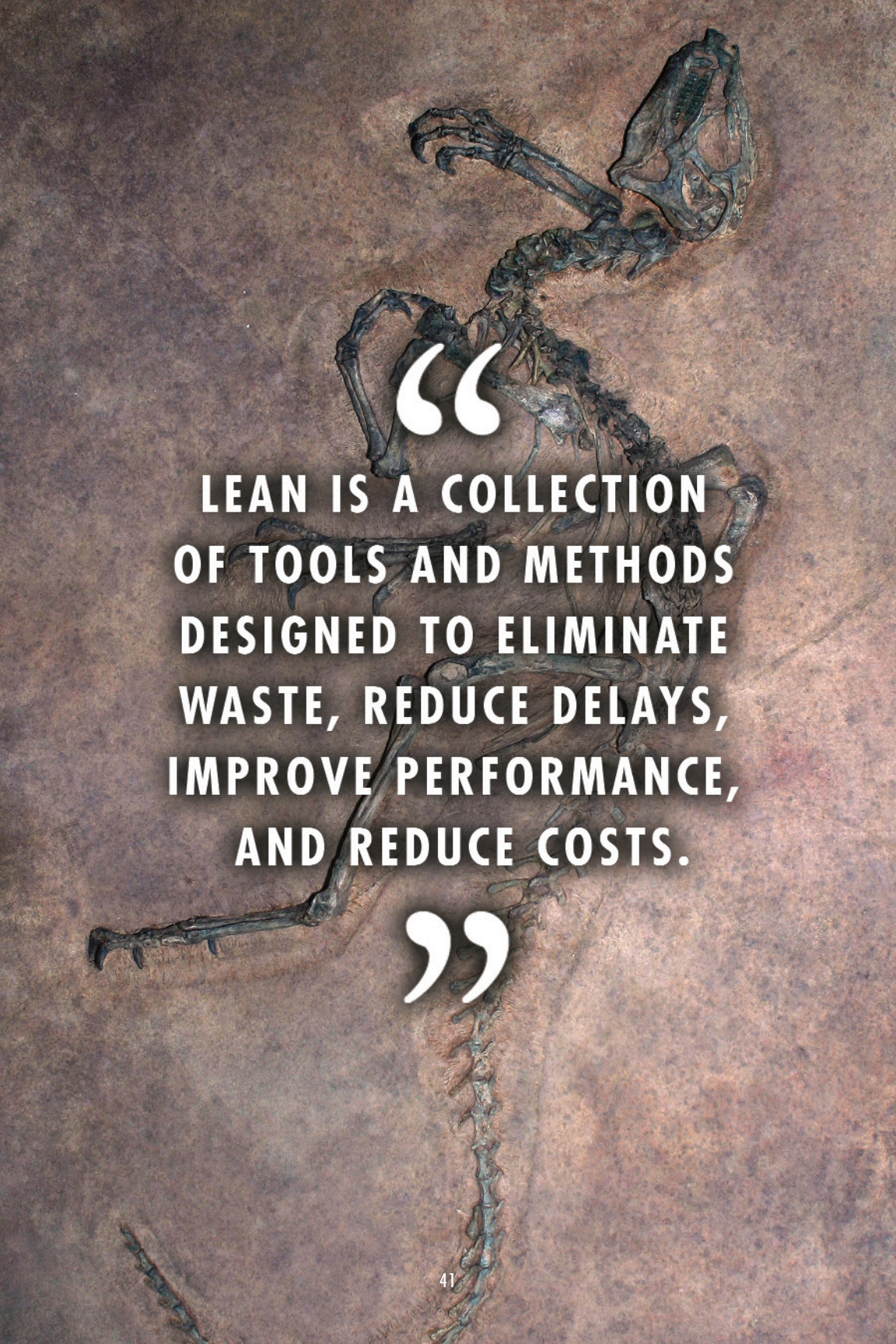
I use this term often and, quite frankly, firmly believe in it. "Delighting the customer" means exceeding his or her expectations, not just meeting them. The term *customer*

service is quickly being replaced in today's business environment with *customer excellence*. As I stated in the opening paragraph of this chapter, all organizational activities should revolve around satisfying the customer, and a sound Voice of the Customer program is a powerful vehicle to assure this result. If you break down organizational performance to its most essential element, all profits come from the customer, not from products and services. An argument could be made that a satisfied customer is just one who is not yet dissatisfied! Although customer service is no guarantee of customer retention, delighting the customer through a Voice of the Customer program is a competitive differentiator. Voice of the Customer must become a strategic initiative, integrated into organizational culture to occupy equal billing with the traditional financial focus of senior management. The value of actually *listening* to the customer is such a fundamental concept that it dates back over 2300 years, when Greek philosopher Zeno of Citium proclaimed, "The reason why we have two ears and only one mouth is that we may listen the more and talk the less."

SAGE ADVICE

I remember having a rather animated conversation many years ago with my good friend Will Rogers about the challenges of understanding and meeting customer needs. Will always had a way of breaking down a complicated situation into its most basic form, and we were discussing the false sense of security many companies have about how happy their customers are. In his

typical plainspoken way, I think Will hit the nail on the head when he told me, "If you're ridin' ahead of the herd, take a look back every now and then to make sure it's still there."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LEAN IS A COLLECTION OF TOOLS AND METHODS DESIGNED TO ELIMINATE WASTE, REDUCE DELAYS, IMPROVE PERFORMANCE, AND REDUCE COSTS.
”

CHAPTER FIVE

THE LEAN PHILOSOPHY

5

"We strive to decide our own fate. We act with self-reliance, trusting in our own abilities. We accept responsibility for our conduct and for maintaining and improving the skills that enable us to produce added value." –Excerpt from Toyota Motor Corporation's internal document titled "Toyota Way"

WHAT IS LEAN?

This opening quote captures the values and ideals of Taiichi Ohno, one of the inventors of the "Toyota Way" who were tasked with transforming Toyota into the world-class manufacturing enterprise that it is today. This chapter is intended to provide an overview of the lean philosophy that became the foundation of what has evolved into one of the most powerful improvement tools available to organizations. If you only remember one thing from this book, remember that *lean is about eliminating waste from your process*. Plain and simple: removing waste. Every activity in a process must add value; waste in any form subtracts from the bottom line and thus is non-value add. Non-value-adding steps must be eliminated, not only in manufacturing processes but also in support (administrative) functions.

Lean is a collection of tools and methods designed to eliminate waste, reduce delays, improve performance,

and reduce costs. Many people use the alternate term "lean manufacturing," but I prefer to use just "lean" because putting the word "manufacturing" into the phrase causes a great number of misperceptions about the application of lean in service organizations. In the beginning of this book, I stated that every activity that happens in an organization is a process, and thus, subject to improvement through lean. Most people tend to think of manufacturing processes when discussing lean, but any process can be broken down into some measurable element that is critical to the activity. I would like to share another personal experience from an unlikely source that validates the benefits of lean in the service sector.

During a recent doctor's appointment, as Nurse Debbie led me down the hall to the little patient room, she said, "Paul" [my APNP] "has moved his office and is now right across the hall from the rooms where his patients will be instead of at the other end of the hallway."

Finding this curious, I said that the move makes sense and asked her how the office came up with the idea. She told me, "We are doing the whole lean thing," and continued to tell me that their supply cabinet had also been moved down to this end of the hall. Nurse Debbie went on to say that some of the younger nurses complained that it was no problem for them to run down the hall for supplies, but she explained to them that this would save a lot of time for everyone when things got really busy. With all the complaints about the wait time during doctor visits, it was rewarding to see one small practice trying to do something about it. They "get it,"

and this small example personifies the essence of how lean can work in the service sector.

Lean focuses on eliminating non-valued-added activities, as opposed to more traditional improvement efforts, which focus on reducing the time in value added steps. I would argue that lean is not a *flavor-of-the-month* initiative; rather, when implemented properly, it should achieve sustainable business improvements based on verifiable financial results. Elimination of the "Seven Deadly Wastes" is the focus of lean principles, and this concept is so critical that I have devoted Chapter Six to this topic. This chapter can be used as a simple guideline during the planning phase for implementing a lean initiative in any organization.

LEAN LEADERSHIP

A fundamental change at the top is required for a lean initiative to succeed, and this is the point of origin for most failed attempts. If you were to poll Fortune 500 business leaders on what their primary responsibility is, I would suggest that the majority would provide a statement that contained the words "increase shareholder value," "profitability," or "financial performance." I have mentioned earlier that there is nothing wrong with a bottom-line mentality in executive management, since "it is always about the dollars." However, lean leadership requires a shift from short-term goals to long-term strategy. Contrast this with the definition of leadership at Toyota: First, get each person to take initiative to solve problems and improve his or her job, and, second, ensure that each person's job is aligned to

provide value for the customer and prosperity for the company. The beauty of lean is that by focusing resources on waste-reducing activities, bottom-line financial improvement becomes much easier to attain.

PENNY-WISE AND DOLLAR-FOOLISH

I mentioned above that traditional improvement efforts have always focused on reducing the time of value added steps—in other words, reducing the amount of time it takes to do something to a product. Let's take a look at a discrete machining operation, for example, where the run time of this operation is three-and-a-half minutes per part. Much effort is placed on fixturing, training, spindle feed and speed, etc., to reduce the three-and-a-half-minute run time. While this is obviously an important activity, we fail to attack the greatest opportunity for improvement: eliminating waste from the process. For example, zero effort has been expended to reduce the average two days of queue time before this product can be machined, the 25 minutes of transportation time to move this large unit to the next department, the two weeks added to the product's lead-time waiting for raw material to arrive, or the nine days of various inspections throughout the process due to inferior quality. Saving seconds at the expense of minutes, hours, days, or even weeks is saving a penny where you could be saving a dollar. And, as I have said, it's always about . . . well, you know the rest.

Now, let's take a macro look at where companies spend their money in terms of the cost of quality. The

"cost of quality" refers to costs related to prevention, appraisal, rework, and scrap. (Customer returns are figured into either rework or scrap.) Figure 8 shows the relative distribution of costs in a typical company, with the largest portion of expense resulting from bad quality (scrap). The traditional business will spend about three times the amount of money on appraisal (inspection) that they do on prevention. When you combine appraisal costs with the exponential amount of dollars that are being wasted on rework and scrap, it is clear that this is not an effective model. Now, contrast that with the lean business model. By allocating a majority of their expenditures to prevention, appraisal costs can be greatly reduced and rework and scrap maintained at minimal levels. Not only are the dollars being spent in the right places: Consider the order of magnitude of total cost. ALL the costs in the lean business model, combined, amount to less than the money a

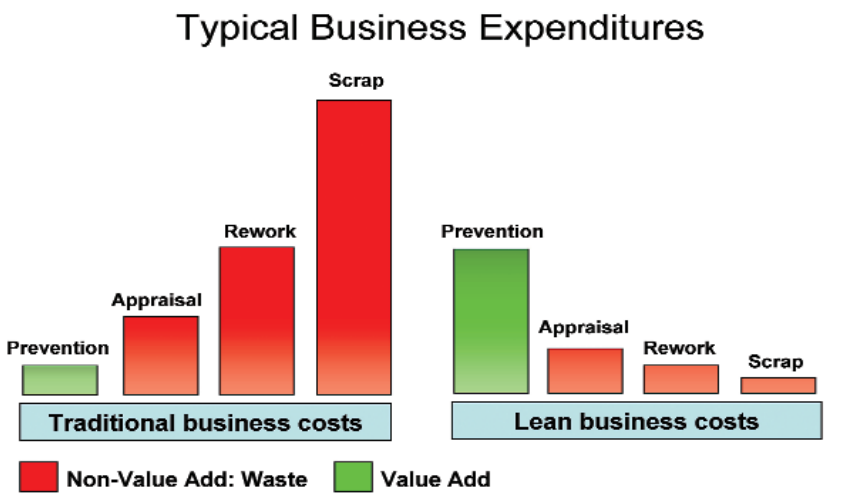


Figure 8. Traditional vs. Lean Expenditures. *Source: SUW 2007.*

traditional company is wasting in scrap alone. Talk about financial metrics—these savings transfer directly to the bottom line!

IMPLEMENTATION TEAM

Once senior management is on board, committed, and educated on the lean philosophy, it has the task of effectively communicating this vision to the management staff. When all the managers are familiar with this vision, a strategy session should be held to select the leader who is the most natural choice to move the company forward. When evaluating candidates for this position, care should be taken to avoid the pitfalls discussed in Chapter Three, "Drive-by Lean." In addition to having the requisite lean skill-set, the person chosen to lead this effort needs to have excellent people skills. Communication and facilitation will be integral to the success of the program, and high-level program-management skills are required to keep the program on track. The ideal candidate will be a skilled lean practitioner with enough charisma and power of persuasion to enlist the entire organization in this effort. This person also needs to hold the rank of a Lean Black Belt as a minimum, with a preferred skill level of a Lean Master Black Belt. These roles will be explained later in this chapter. Whatever the title of this position is, it will need to be on the same organizational level as the other key management roles. This lean leadership position also needs to be full-time; tacking on a title to an existing role (e.g., Director of Quality & Lean Implementation) will result in conflicts, lack of direction, and, ultimately, failure. Running a lean

initiative "in my spare time" is the fastest way I know to a crash-and-burn.

Once the lean leader is selected, he or she will need to assemble a cross-functional group of key people from across the value stream to comprise the lean implementation team. Standard group dynamic and team-building rules should be followed to assemble an implementation team of three to five people from different departments, including at least one member of senior management. This core group of people will be charged with rolling out the program to the organization and overseeing and approving all the lean projects that will be presented by the lean project teams.

TRAINING

The next step is to develop the training program, implementation of which presents the greatest challenge to senior management in terms of the time required to begin to see a payback on the resource expenditures. The training program should be developed by the lean leader and the implementation team, and it should encompass the entire organization. Establishing progressive training levels for each of the lean roles is critical to the success of the program. There are no hard-and-fast rules for how many of each role an organization should have, but there needs to be at least one Black Belt, and each lean project must be lead by a Green Belt. I would argue that the entire organization, every single employee, needs to be trained in the fundamental concepts of lean to provide the excitement and momentum that will allow the required cultural change.

LEAN ROLES

There are five major roles in any lean initiative: Champion, Black Belt, Green Belt, Yellow Belt, and Lean Project Team. A sixth role, Master Black Belt, is not mandatory as this function can be accomplished with professional outside training. (The only additional responsibility of this role that cannot be filled by a Black Belt is the training of the other Black Belts.) The number of people in each role will vary by organization, but each role must be represented for each lean project. The responsibility of each role is defined below.

Champion

- Member of senior management
- Select meaningful business-impact projects
- Create the project vision
- Ensure that adequate resources are available
- Promote and sustain the gains

Black Belt

- Wide area project manager
- Oversee the lean training program
- Use the lean tools to drive improvement quickly and efficiently
- Mentor and train the Green Belts
- Share recognition with team members
- Define additional improvement project opportunities
- Work with Champion to resolve any resource or implementation issues

- Keep Champion apprised of project(s) status and issues
- Help the team learn and understand the lean tools and techniques
- Identify candidates for future Green Belt certification

Green Belt

- Local area project manager
- Lead the Lean Project Teams
- Use the lean tools to drive improvement quickly and efficiently
- Utilize Black Belt resources to assist in project(s)
- Share recognition with team members
- Work with the Black Belt to resolve any resource or implementation issues
- Keep Black Belt apprised of project(s) status and issues
- Help the team learn and understand the lean tools and techniques
- Provide candidate pool for future Black Belts

Yellow Belt

- Completed by all employees
- Gain basic understanding of lean principles, tools, and techniques
- Support Green Belts and Lean Project Teams
- Provide candidate pool for future Green Belts

Lean Project Team

- Learn and implement the lean tools and techniques
- Keep Green Belt informed on any relevant issues
- Conduct experiments and gather data
- Design solutions
- Analyze and solve problems

PILOT PROJECT

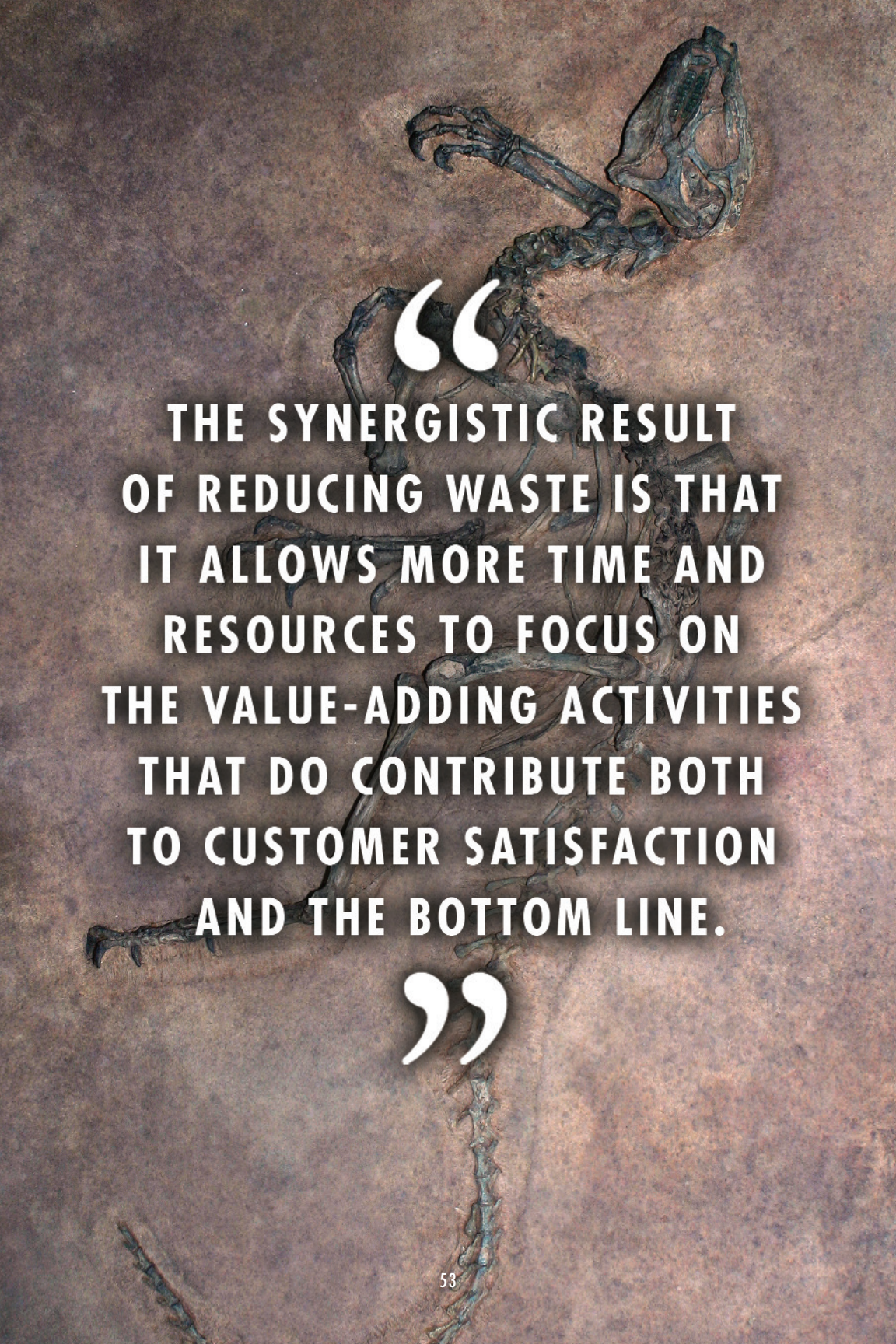
Once enough cross-functional employees have completed the initial training sessions, a lean pilot project should be chosen. The reason I say "initial training sessions" is to remind the reader that lean is a never-ending process that requires ongoing training and awareness to remain effective. The critical concept to remember when choosing the pilot project is to *hit singles, not home runs*. The biggest reason lean programs fail is that the organization selects the wrong project right out of the gate—one that is too large and/or has very little chance of success. The key is to start slowly and identify the low-hanging fruit; in other words, find the projects that will be easy to improve with simple lean tools such as 5S. This will allow employees to see success from their efforts, which creates momentum and sustainability for the program. An organization may want to launch additional pilots in other departments, slowly building upon each success and developing a positive track record.

FULL LAUNCH

Once the pilot project(s) have been successfully completed, and a majority of employees have been through Yellow Belt training as a minimum, a full launch of the lean program can be executed. The key takeaway of lean project selection is that these projects need to support the corporate strategic goals. Using this criterion, along with the anticipated financial payback of the project, the lean program will be assured to remain aligned with the overall direction of the organization. Many companies set a minimum anticipated monetary payback value that a lean project must meet before approval will be granted. A common amount is $50,000; obviously, this needs to be adjusted based on the size of the organization, but a minimum payback metric makes sure that the lean teams are working on the right things.

LEAN TARGETS

Hopefully, after reading this chapter, the reader has gained an overview of the steps required to implement a lean initiative in any organization. The next chapter will define the primary targets for elimination for all of the lean projects in the organization: the "Seven Deadly Wastes."



“THE SYNERGISTIC RESULT OF REDUCING WASTE IS THAT IT ALLOWS MORE TIME AND RESOURCES TO FOCUS ON THE VALUE-ADDING ACTIVITIES THAT DO CONTRIBUTE BOTH TO CUSTOMER SATISFACTION AND THE BOTTOM LINE.”

CHAPTER SIX

THE SEVEN DEADLY WASTES

6

"Mr. Ohno used to say that no problem discovered when stopping the line should wait longer than tomorrow morning to be fixed. Because, when making a car every minute, we know we will have the same problem again tomorrow."

–Fujio Cho, President, Toyota Motor Corporation

I believe there would be little argument from industry leaders if I suggested that the word "car" in the above quote could be changed to any product and make the above statement just as applicable to their companies as it is to Toyota. Although the phrase "do it right the first time" is painfully overused, the basic premise has held true over time, across businesses, industries, and countries.

WASTE DEFINED

What is waste? Waste (*muda* in Japanese) can be defined as anything we do with a cost attached to it that does not add value to the product. Following that logic, and if you accept my definition of non-value as anything that the customer is not willing to pay for, identifying waste becomes a much more manageable task. Hard, quantifiable things like scrap product are just the beginning of waste; any non-value adding activity is waste. So, in very simple terms, eliminating waste reduces activities

that do not add value to the customer and do not contribute to organizational profits. The synergistic result of reducing waste is that it allows more time and resources to focus on the value-adding activities that do contribute both to customer satisfaction and the bottom line. The objective is to maximize value-add activities and minimize non-value add activities.

The "Seven Deadly Wastes" are Overproduction, Inventory, Motion, Waiting, Transportation, Overprocessing, and Defects. Each of these wastes will be defined individually in this chapter along with potential countermeasures for each. All seven of these wastes relate directly to wasting dollars, and, as Figure 9 clearly shows, *it's always about the dollars*.

Figure 9. The Seven Deadly Wastes. *Source: SUW 2008.*

OVERPRODUCTION

Waste from overproduction is one of the largest wastes typically found in organizations, and it can be broken down into two categories: Performance-Driven and Market-Driven. *Performance-Driven Overproduction* results when an organization must build more product than the customer orders to compensate for defects from an inefficient process. While most companies must factor in some level of overage, it is not uncommon for this "scrap factor" to be 10-20% of the customer order, depending on the complexity of the product. *Market-Driven Overproduction* results when an organization produces more product than is required by the market. This can result from inaccurate forecasting, a significant market shift, or fluctuating customer demand. When the market is strong and business is booming, overproduction waste is often overlooked in the chaos of meeting demand, but it becomes painfully evident when demand softens. Overproduction can become a double whammy when bad quality becomes defect waste and excess finished goods become inventory waste.

Countermeasure: Overproduction can be avoided by using smaller batch sizes—ideally, a lot size of one!

INVENTORY

Organizations that are new to lean often have a difficult time calling inventory waste, because in financial terms, inventory is an asset. However, inventory is perhaps the biggest waste of all because excess inventory hides a lot of sins. In Figure 10, inventory is represented

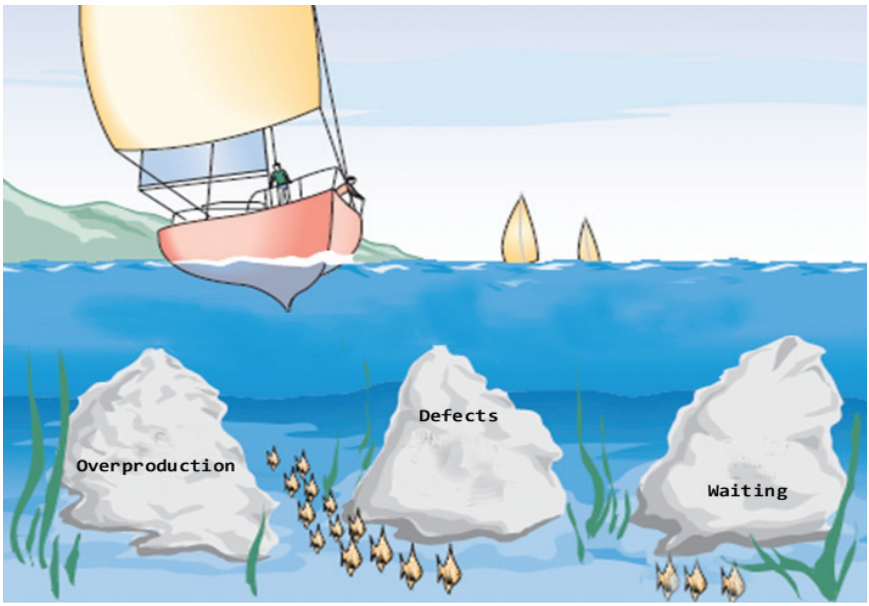


Figure 10. Hiding Waste with Inventory. *Source: SUW 2006.*

by the high water level, which hides other wastes in the process. Inventory is defined as product in various stages of completion that cannot immediately be converted into revenue. There are three types of inventory: raw material, work-in-process (WIP), and finished goods. In addition to the direct cost of the actual product, there are many costs associated with holding excess amounts of inventory, called *carrying costs*. These costs include the cost of space (heating, lighting, depreciation, etc.), handling costs, obsolescence, spoilage/shortages/damage, and insurance. These costs are typically calculated as a percentage of the inventory value, which can range anywhere from 15% to 40%.

Countermeasure: Inventory levels can be reduced by converting from a push system to a pull system based on just-in-time (JIT) principles.

MOTION

The waste of motion refers to any excessive movement by people or machines, including workstation ergonomics. Walking to and from parts bins to retrieve items that could be stored at the point-of-use, or bending to retrieve commonly used tools from an uncomfortable location, are both examples of motion waste. With automated equipment, sloppy programming can lead to the machine wasting time by taking an inefficient path and adding unnecessary travel times between locations.

Countermeasure: Awareness of ergonomics (i.e., bending, stretching) within the process has direct economic benefits. Time studies can be very beneficial in identifying motion waste. Involving the personnel actually doing the job will provide invaluable feedback relating to any motion-related job redesign.

WAITING

Waste from waiting involves periods of inactivity for people, materials, and products. A thorough analysis will normally show that a large portion of any organization's lead-time is tied up in waiting and queue time between operations in the process. Wait time generally results from a poor flow of materials, information, people, or equipment. As a rule, batch style processes are much more susceptible to excessive wait or queue time.

Countermeasure: By improving the flow of material and information, reducing setup time, and minimizing the distance between work centers, productivity increases as costs decrease.

TRANSPORTATION

Waste from transporting product between processes is often considered to be "just part of the job"; however, it adds zero value from the customer's perspective. A common mistake many companies make is to attempt to improve the method and speed of the transportation instead of focusing on minimizing or eliminating transportation from the process. In addition to the wasted time, each material-handling operation increases the opportunity for damage to the product. Inefficient facility layouts are typically the fundamental cause of excess transportation.

Countermeasure: By utilizing the lean tool of Process Mapping (covered in Chapter 7), a facility layout can be optimized for efficient material flow, which will not only reduce transportation waste but can also reduce inventory and wait-time wastes.

OVERPROCESSING

In the Voice of the Customer portion of this book, I stated that value must be defined by the customer. Conversely, I would then define non-value as anything that the customer is not willing to pay for. Waste from overprocessing means giving customers features, quality, or service levels that they are not paying for. The most common examples of overprocessing are unnecessary packaging, over-finishing of parts, or manufacturing to tighter tolerances than required. If the customer is paying for a Cavalier, you wouldn't build a Corvette, would you?

Countermeasure: An effective Voice of the Customer program will identify what the customer

defines as value. By determining what the customer is really looking for, and translating these needs into clear standards and requirements, overprocessing can be eliminated.

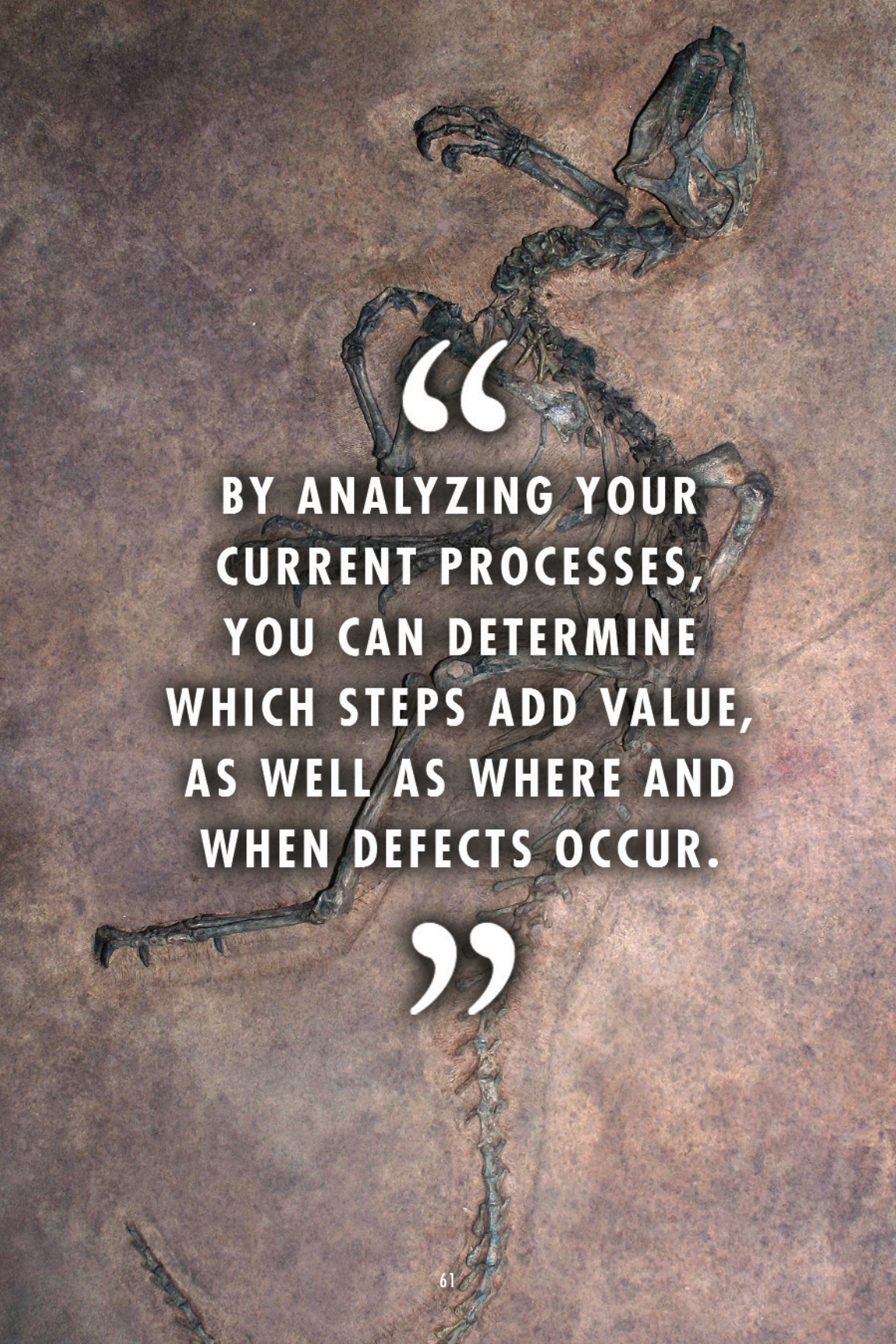
DEFECTS

Waste from defects results when product does not meet customer requirements. Defective product is scrap. Processes not capable of producing product within the required customer specifications are one source of defective product. Defects can also result from not understanding the customer's needs, often mismatching capability to requirements. In addition to the costs of the scrap, the defective product will need to be replaced, resulting in the secondary waste of overproduction.

Countermeasure: Process and quality levels are improved through the use of Six Sigma methodology, training, 5S, and continuous improvement tools.

NEXT STEPS

The first step in eliminating the Seven Deadly Wastes is to communicate a thorough understanding of these wastes throughout the organization via the lean training program. Only then can an organization begin identifying each one within the operation. Chapter Seven includes an overview of the process mapping tools that will provide the methodology for identifying each of the Seven Deadly Wastes in any process.


“
BY ANALYZING YOUR CURRENT PROCESSES, YOU CAN DETERMINE WHICH STEPS ADD VALUE, AS WELL AS WHERE AND WHEN DEFECTS OCCUR.
”

CHAPTER SEVEN

PROCESS ANALYSIS

7

"The most dangerous kind of waste is the waste we do not recognize."

–Dr. Shigeo Shingo, Consultant to Toyota Motor Corporation

Once the Seven Deadly Wastes have been defined and understood, the next logical question is, "How do I identify these wastes in my processes?" The most effective method of identifying wastes is process mapping—from simple, basic process flowcharting to advanced value stream mapping. This chapter will review these process analysis tools and techniques that will help any organization identify the value and non-value activities in their processes.

PROCESS ANALYSIS

Process improvement is the key to achieving both short- and long-term gains, resulting in a significant increase in overall operational performance. By analyzing your current processes, you can determine which steps add value, as well as where and when defects occur. Process analysis is a careful evaluation of each step of the process from the input's perspective as it is transformed into the output. Each step needs to be questioned as to

both why and how it is being performed. Just because "we have always done it this way" does not mean that it is the best way, and this is the part most organizations struggle with the most. Quantum improvement sometimes requires quantum change, and the willingness to approach process analysis with an open mind is critical to the degree of success that can be achieved. Process analysis involves utilizing a team approach to map each of the processes at the appropriate level, and then analyzing each step for its value from the customer's perspective.

Most organizations have many processes that work together to bring a specific product from the point of a customer purchase order through the conversion process and ending with order fulfillment at the customer. The *conversion process* is simply turning (converting) inputs into outputs. From a big-picture perspective, raw materials are turned into finished goods, but within this macro process there are many conversion cycles taking place as each process hands off a partially completed product to the next process. Again, remember that this could be one office function handing off to another just as easily as two manufacturing processes. The entire enterprise must be evaluated, from the problem-solving activity of taking a concept through engineering, the information management activity involving order-taking and scheduling, to the physical transformation of converting raw materials into finished product delivered to the customer.

PROCESS ANALYSIS TERMS

The following terms may be useful to an organization during the activity of process flowcharting, value stream mapping, and analysis.

Blocking: Occurs when the activities in a process stage must stop because there is no place to deposit the item just completed

Bottleneck: Occurs when the limited capacity of a process stage causes work to pile up or become unevenly distributed in the flow of a process

Cycle Time: The average time between completions of successive units exiting a process

Make-to-order: Only produced in response to an actual order that results in minimum inventory levels

Make-to-stock: Process produced to meet expected or forecasted demand, shipped from stock, and results in high inventory levels

Process: Any activity within an organization that converts inputs into outputs

Starving: Occurs when the activities in a process stage must stop because there is no incoming work

Takt time: Setting the pace of production to match actual demand. Takt time = Available work time per day/Daily total customer demand

Throughput Time: The time it takes a discrete unit to go from start to finish in a process

Utilization: The ratio of the time that a resource is actually utilized relative to the time that it is available for use

PROCESS FLOWCHARTING

Process flowcharting is the use of a diagram to represent the major elements of a process—in other words, a picture of the process. There are many symbols used in process flowcharting, but the basic elements are tasks or operations, decision points, queue or storage, and directional process flow (Figure 11). The first step in many process improvement projects is to flowchart the process as it currently exists, which may not have any resemblance to company standard operating procedures (SOP). The realization that how the operation is really running does not reflect their SOPs is generally an "Ah-ha!" moment for the company. Flowcharting also determines the parameters for process improvement since a process cannot be improved before it is understood. Although turning a process into a picture may sound very simple, it is an incredibly powerful tool to see what is really happening in a process. After a flowcharting session, the people actually doing the job are always amazed at the difference between how they perceive the process and what is really going on. A common result is a spaghetti diagram that highlights excessive travel, motion, and redundancy. A picture

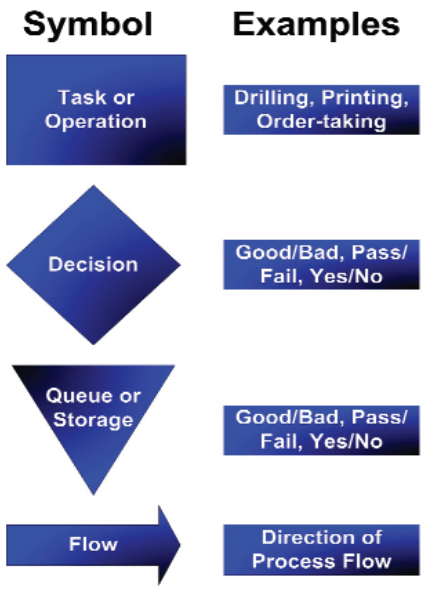


Figure 11. Basic Flowcharting Symbols. *Source: SUW 2007.*

truly is worth a thousand words.

A flowchart should be used when a team needs to: 1) understand how a whole process works; 2) identify the critical points, bottlenecks, or problem areas in a process; 3) see how the different steps in the process are related; or 4) identify the "ideal" flow of a process. As a flowchart example, Figure 12 also details the basic steps that can be used as a guideline by the process improvement team for constructing a process flowchart.

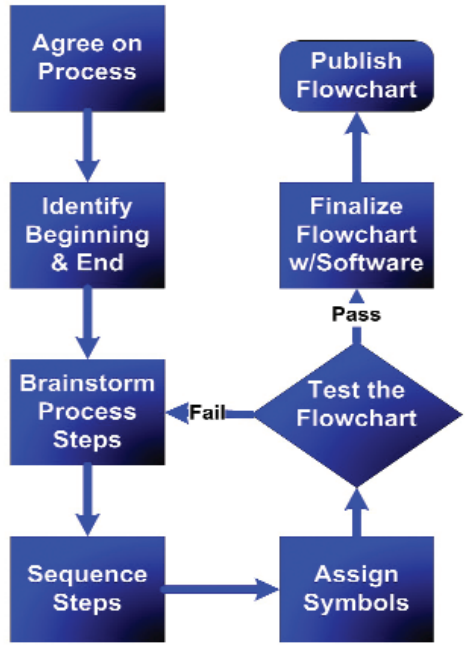


Figure 12. Basic Steps in Flowcharting Process. *Source: SUW 2007.*

VALUE STREAM MAPPING

A value stream map (VSM) takes the basic flowchart to the next level, kind of like a process flowchart on steroids. In addition to the basic action boxes with arrows showing the flow of work, a lot of other information is added, including material and information flow, operating parameters, process lead-times, inventory, a timeline depicting value-added time relative to non-value-added time, and so on. Value stream mapping is the single most effective major process-analysis step to identify the value

stream, and conversely the non-value waste, in your processes. The *value stream* is the set of all the specific actions and activities required from the beginning of a process to the end of a process. Imagine a long and winding deep-blue stream flowing through cities, counties, and states. Next, visualize all the things that the river carries within it: water, fish, minerals, plants, and a thousand other elements that combine to form the stream. Processes are very much like a stream: They flow in a natural direction and carry materials and information within them from one point to another.

The activity of value stream mapping is the core, fundamental method of identifying the areas of waste that can be eliminated within any process. By finding the sources of waste and quantifying them, action plans for reducing or eliminating them can be prioritized. Apart from identification, value stream mapping can also help to streamline a process for higher productivity and efficiency. Each process needs to have the beginning and end clearly identified before streamlining can occur. This sounds simple, but since many of these discrete processes often run together, it is critical to define the boundaries of the process from a value stream standpoint. Only through a detailed process analysis can you identify the non-value added steps that have become accepted, unquestioned parts of the process, which result in "the way we have always done it."

The Value Stream Map Paradox: Value stream mapping is the most effective lean tool for identifying high-payoff opportunities, yet value stream mapping is

the lean tool most likely not to be used by companies doing Drive-by Lean.

VALUE STREAM MAPPING STEPS

Value stream mapping brings together lean concepts and techniques and helps to avoid the "cherry picking syndrome" in which processes that have very little impact on the product or service are chosen because they will be easy to improve. Value stream mapping forms the basis of an action plan (going from current state to future state) and illustrates the linkage between information and material flows. Like most things related to lean, or to any initiative, there are some basic steps to follow when creating a value stream map. The process of value stream mapping is self-perpetuating, meaning that eventually the future state becomes the new current state and the cycle continues (Figure 13).

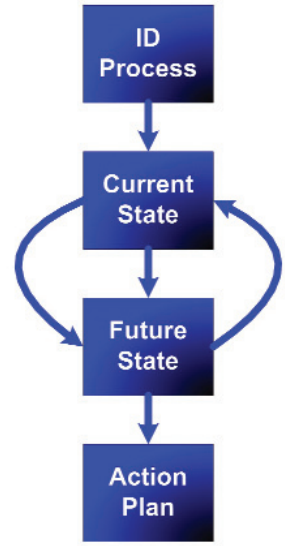


Figure 13. Value Stream Mapping Process. *Source: SUW 2007.*

Step 1: Identify the Proper Process

This step cannot be stressed enough because it is often overlooked by many companies new to lean. Fresh out of training, the VSM team often runs out and starts mapping the first process they see. While value stream mapping anything is better than nothing, efforts should

be focused on the critical processes having the greatest impact on the product.

Let's look at a typical supply chain transaction from the point of a customer order through delivery of the product. This example shows a macro view of the supply chain cycle to illustrate how value stream mapping works. This high-level view would be one way to drive lean down through the supply chain to sub-suppliers. Of course, discrete processes within each supplier would need to be value stream mapped to enable reductions in their respective lead-times. The diagram in Figure 14 depicts a product with an eight-week lead-time; value stream mapping the process reveals that there are only seven and a half hours of value-added time on this product. As unbelievable as these results sound, most organizations experience a similar disparity in their processes. The key takeaway of this scenario? The excessive lead-time has created enough customer dissatisfaction that the business is in jeopardy.

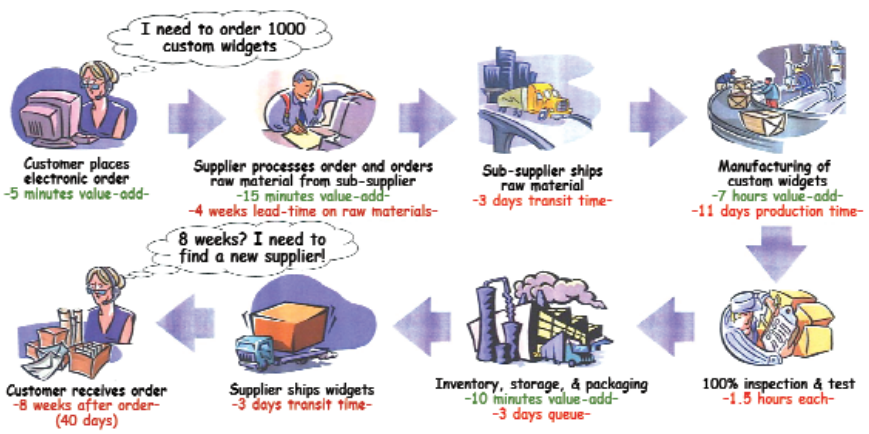


Figure 14. Supply Chain Cycle. *Source: SUW 2008.*

Step 2: Create a Current State Value Stream Map

Now, let's turn this diagram into a Current State Value Stream Map. The original working session for developing a value stream map is very manual, and, as I mentioned earlier, is best done on a white board or with Post-it Notes®. I prefer the flexibility of Post-it Notes®, and a real-world working session using this technique is shown in Figure 15. As you can clearly see, the current state map covers an entire wall, which is typical when defining how a process is really operating.

As the name implies, the goal is to find out how the processing is *currently* operating today, not how the SOP says things "should" be or how it was "designed" to be. The goal is to capture reality onto a piece of paper—the current state. Use a stopwatch for the time studies and determine the actual times where practical. While the VSM will eventually be finalized with software, the initial map should be

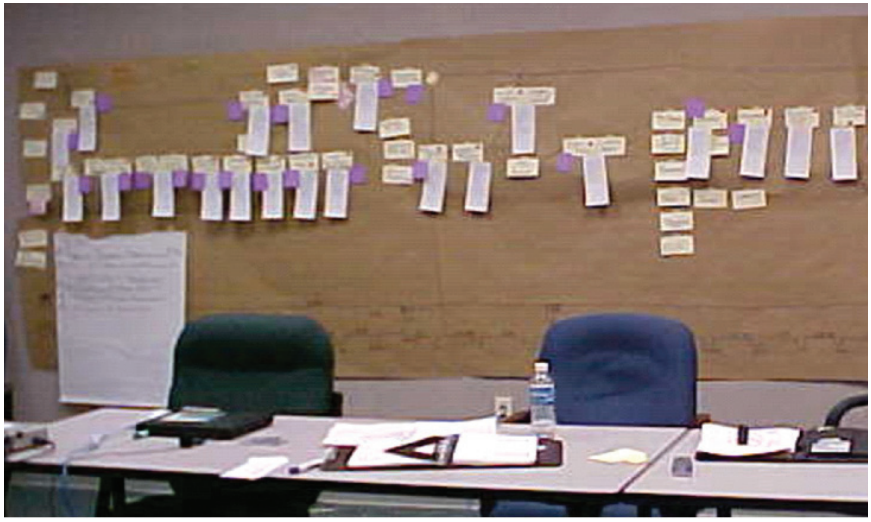


Figure 15. Working Value Stream Mapping Session. *Source: SUW 2008.*

created with Post-it Notes® because there will be frequent changes as the team goes through this process. Once the process has been defined, the Post-it Notes® map can be digitized with flowcharting software. Value stream maps use a variety of unique symbols that are not used in traditional flowcharts and diagrams, as shown in Figure 16. Word® and Excel® can be used for flowcharting, but for ease of use, professional flowcharting software like Visio® should be used. Figure 17 is the result of converting the manual Post-it Notes® value stream map into an electronic one.

Step 3: Create a Future State Value Stream Map

Once the current state of the process has been established—which, by the way, is usually the second

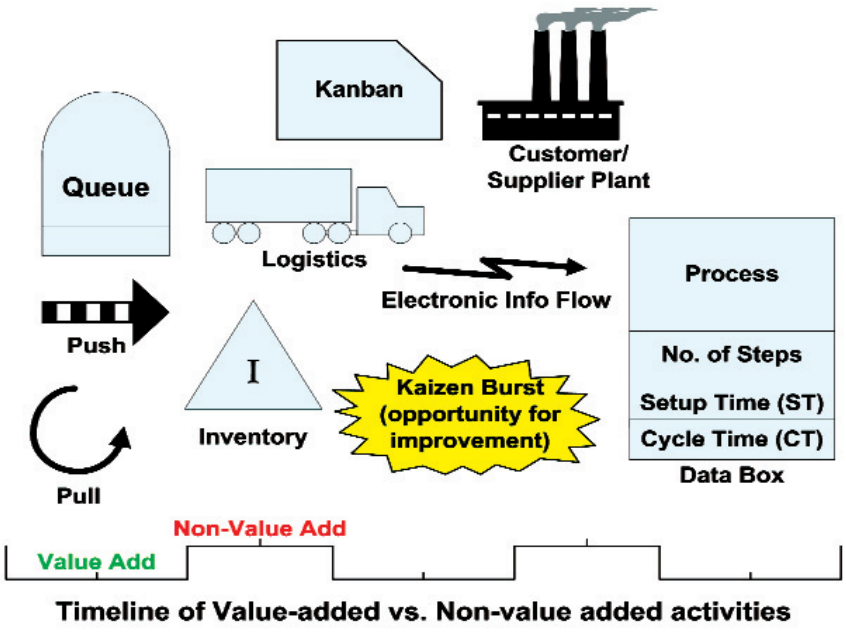


Figure 16. Value Stream Map Symbols. *Source: SUW 2008.*

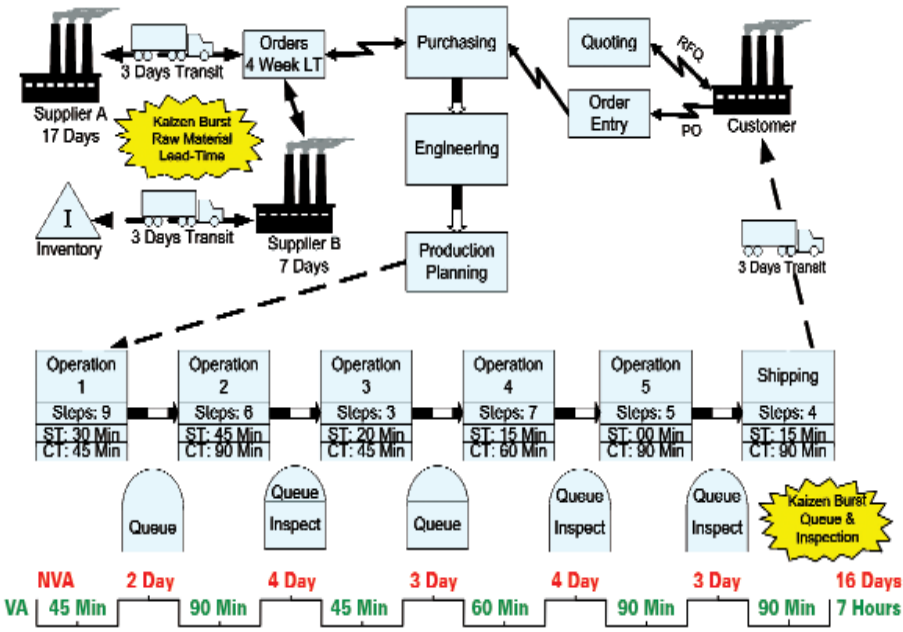


Figure 17. Current State VSM. *Source: SUW 2008.*

"Ah-ha!" moment for the company—the next step is to picture the desired state of the process: the future state. This is the point where waste identified in the current state is targeted for elimination. Find the areas of waste and problem areas and try to eliminate them by looking for low-effort, high-benefit types of activities. Examples of this include 1) reducing unnecessary inventory; 2) pulling materials through visual controls; 3) using 5S to make materials and tools available at the point-of-use; 4) eliminating unnecessary steps; 5) cross-training personnel; 6) standardizing work; 7) reducing setup time; and 8) balancing the work flow (Takt time analysis). Figure 18 illustrates the future state possibilities that can be accomplished by eliminating waste from this process.

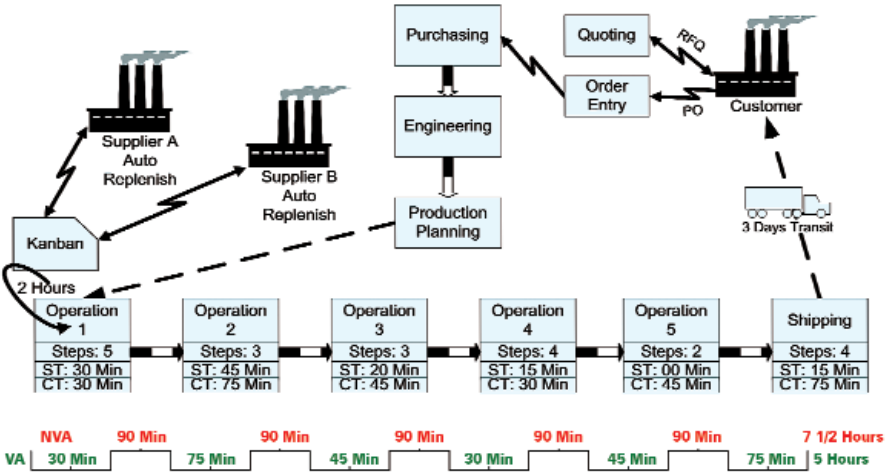


Figure 18. Current State VSM. *Source: SUW 2008.*

Step 4: Create and Execute an Action Plan

An action plan is the method for transforming the process from its current state to the future state. This can be accomplished by using a combination of the Six Sigma methodology presented in the following chapter and the appropriate tools from Chapter Nine. The action plan for this process would result in a dramatic improvement, ultimately reducing the lead-time to the customer from eight weeks to five days. This would be accomplished in a number of ways, beginning with the implementation of a kanban system at the raw-material sub-supplier. Waste could be minimized in the manufacturing process in three ways: elimination of inspection by placing quality responsibility at the source, removing queue time by changing the flow from a push to a pull process, and reducing the number of steps in each process. All of the potential results can be found in Figure 19. As the cycle repeats, further improvement could be achieved by implementing

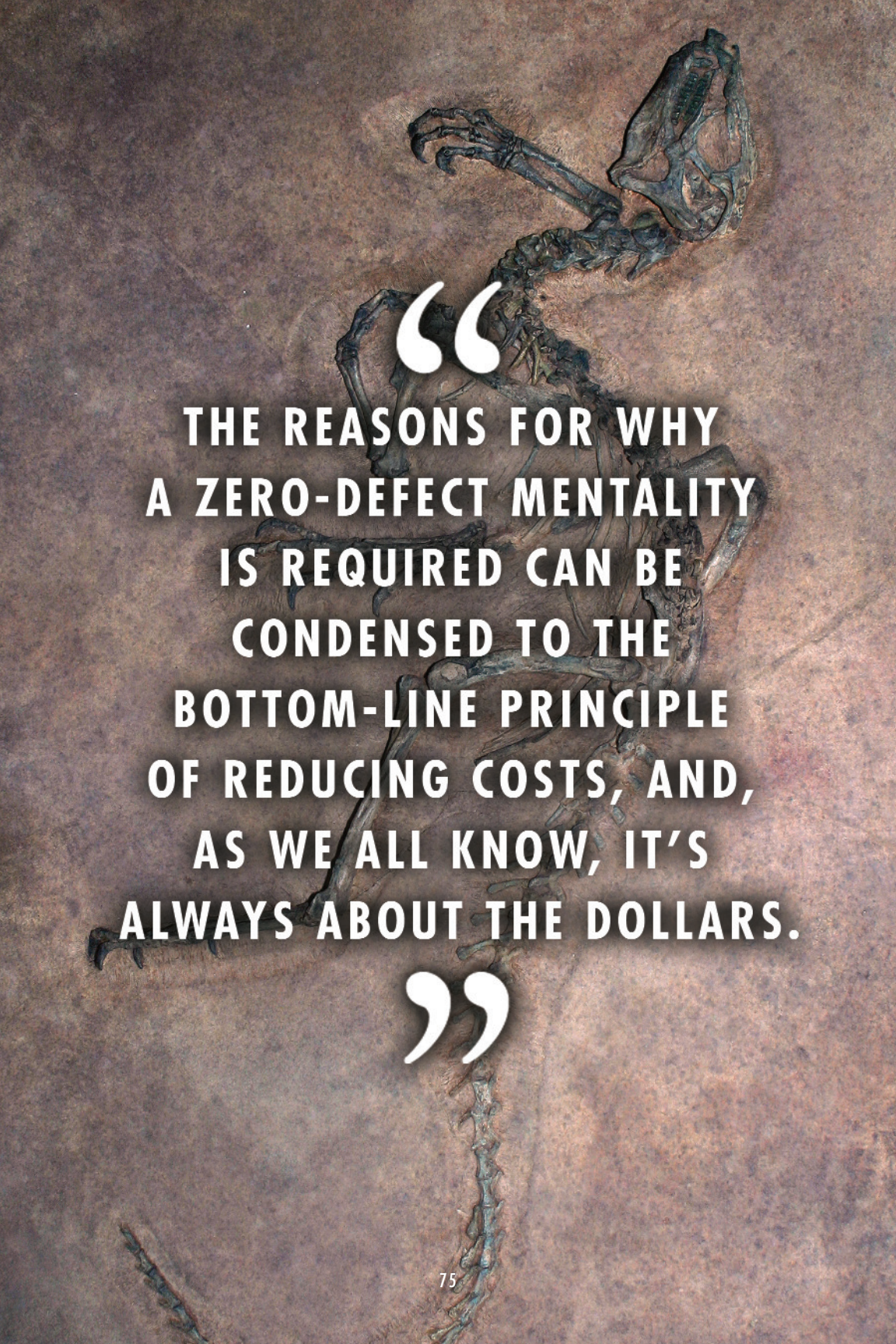
	Current State	Future State
Total LT	8 Weeks	5 Days
MFG Time	17 Days	12 1/2 Hours
NVA	16 Days	7 1/2 Hours
VA	7 Hours	5 Hours

Figure 19. Waste Reduction Results. *Source: SUW 2008.*

a kanban system at the other end of the process (delivery of product to the customer).

VALUE ADD VS. NON-VALUE ADD

One of the most critical steps in the value stream creation process is recognizing non-value (waste) in the process. If we use the definition of value presented earlier in this book, waste will be anything that the customer is not willing to pay for. Value adding activities are tasks that transform (add value to) the product in some way. This transformation can take the form of either hard changes to the product or soft changes such as brand vs. private-label products. Each step of each task of each process needs to be evaluated objectively against this definition to identify wastes that can be eliminated. The following five principles can be used to guide an organization in this evaluation: 1) Define *value* from the customer perspective; 2) Identify the *value stream* for each product family; 3) Make the product *flow*; 4) Create *pull* to build only what is needed, when it is needed; and 5) Strive toward *excellence*. Throughout the process analysis activity, it is critical to remain focused on the right things—activities that impact improvement of the organization's products or services.



“THE REASONS FOR WHY A ZERO-DEFECT MENTALITY IS REQUIRED CAN BE CONDENSED TO THE BOTTOM-LINE PRINCIPLE OF REDUCING COSTS, AND, AS WE ALL KNOW, IT’S ALWAYS ABOUT THE DOLLARS.”

CHAPTER EIGHT

SIX SIGMA – WHY 99% IS NOT GOOD ENOUGH

8

CULTURE SHOCK

Looking back through the annals of U.S. industry, when it comes to quality, we have evolved from a reactive to a proactive mindset. This evolution has led to what is loosely called the Zero Defects Methodology (ZDM). Whether formalized or unwritten within an organization, some form of this methodology is the driving force behind most continuous improvement initiatives in industry today. The "old" gold standard of Three Sigma is no longer acceptable and has gone the way of the dinosaur.

Are zero defects an achievable, sustainable goal 100% of the time? Of course not, but with Six Sigma levels we can come pretty close. Recognizing that we will occasionally fall short of any goal mandates that the goal be set at zero defects. The reasons for why a zero-defect mentality is required can be condensed to the bottom-line principle of reducing costs, and, as we all know, *it's always about the dollars*. Costs are always attached to defective product in the form of inspection/test, rework/repair, scrap, and warranty (customer returns). Reducing these costs results in increased customer satisfaction, and, quite simply, happy customers mean higher revenue.

It is always an interesting study to compare the *advertised* capability of a company to their *actual* capability. The sales force touts world-class quality, which implies that they are operating at a Six Sigma level. However, an objective on-site assessment of their processes quickly separates the bluster from the facts, typically revealing that most organizations are operating at a true yield somewhere between 93% and 99%. Statistics are a wonderful tool, but as with most things in life, you will only get out of them what you put in. It all boils down to what the organizational objective is—superficial window dressing or honest-to-goodness improvement. Inflating process yields by excluding things like rework, customer waivers, or returns does nothing but mask problems and will not result in true improvement. If window dressing is indeed your goal, then I would suggest tossing this book and immediately picking up a copy of *Extinction for Dummies*, by Peter T. Platypus.

WHY 99% IS NOT GOOD ENOUGH

I remember the not-too-distant past when a 99% yield rate would earn you bragging rights (myself included). Looking at what that really means by today's metrics shows that a 1% scrap rate converts to 10,000 defective parts per million (DPPM). As a customer, imagine a supplier striving to give you *only* 1% defective parts! World-class Six Sigma levels allow only 3.4 DPPM. If you are still reading this book at this point, I would hope that you agree with me that 10,000 DPPM is totally unacceptable and that you are prepared to do something about it.

Note: It must be mentioned that the 3.4 DPPM attributed to Six Sigma levels was developed by Motorola and based on the assumption that, over time, a process is likely to have a shift in the mean of up to +/- 1.5 sigma. This potential shift is factored into the 3.4 DPPM. Statistical purists would argue that a Six Sigma level is actually .002 DPPM, but since the Motorola interpretation is universally accepted, 3.4 DPPM is used in this book to represent a Six Sigma level.

When organizations such as Motorola and General Electric began communicating Six Sigma expectations to their suppliers in the early 1980s, what began as a ripple quickly developed into a shockwave throughout the supply chain. To say that this concept was met with some resistance is a monumental understatement. Companies had absolutely no idea how they were going to effect a change of such magnitude that their process defect rate would drop from *10,000 to 3.4 DPPM*. Through a slow and

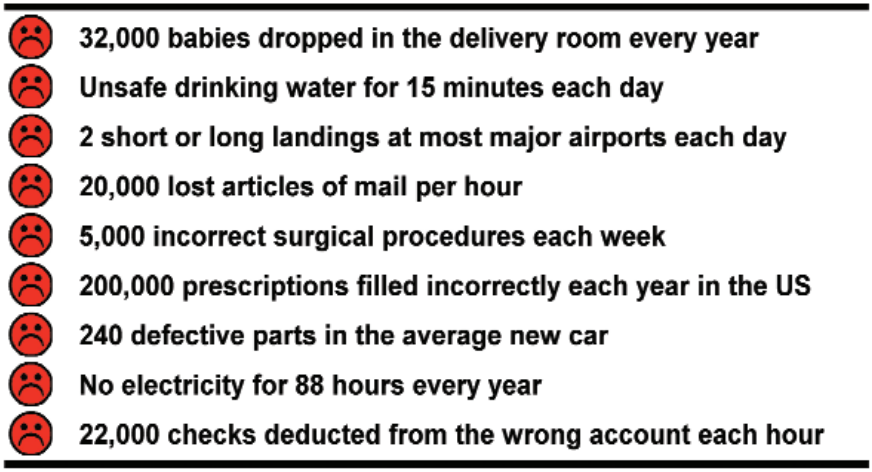


Figure 20. Life at 99% Good. *Source: Elusive Lean 2007.*

painful process, companies began to understand that the way to achieve these quantum paradigm changes was through lean and Six Sigma practices. The paradox is that none of us would accept 99% in our personal lives, so why do we accept it in our businesses? Figure 20 shows what life would look like if we settled for having things right only 99% of the time in some areas we can all relate to. This kind of changes the perception that 99% is "good enough," doesn't it?

Contrast this with a Six Sigma level in which your local weatherperson's forecast would be correct every single day for ***795 years in a row!***

WHAT IS SIX SIGMA?

Sigma (σ) is the eighteenth letter in the Greek alphabet and is defined and used in two different ways: 1) As a mathematical measure of the amount of variation in a process. This is normally referred to as the *standard deviation* of a process; the lower the standard deviation, the better. 2) To describe the quantity of defects a process will produce. This is normally referred to as the *sigma level* of a process and is a measure of process performance; the higher the sigma level, the better. Although statistics are usually associated with Six Sigma, that is only part of it; Six Sigma is the problem-solving methodology called DMAIC (Define, Measure, Analyze, Improve, Control). DMAIC is a method that uses a collection of tools to identify, analyze, and eliminate sources of variation in a process. Six Sigma can be an intimidating concept to grasp, particularly regarding the statistics and math part of the process. The

key takeaway is that to achieve a Six Sigma level, process variation must be cut in half from a three sigma level. This concept will be explained in greater detail later in this chapter. Figure 21 illustrates a high-level view of the DMAIC process.

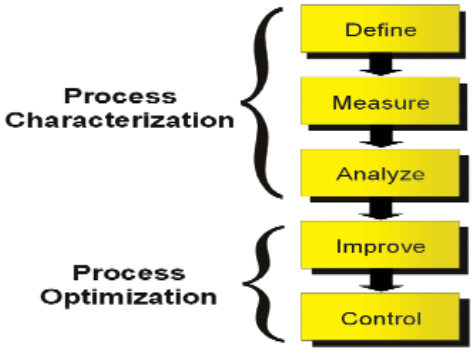


Figure 21. The DMAIC Process.
Source: SUW 2008.

The DMAIC Process

- ***Define:*** Identify the opportunity and the process targeted for improvement.
- ***Measure:*** Validate and implement the measurement system to be used.
- ***Analyze:*** Determine what key factors or attributes have the greatest effect on the results.
- ***Improve:*** Utilize statistical methods to improve the undesirable process identified in the Define mode.
- ***Control:*** Determine what controls need to be put in place to assure long-term process performance.

PROCESS CAPABILITY

I will try to follow my KISS philosophy and stay away from all the scary math stuff as much as possible, so let's begin by reviewing the fundamentals of statistical process control (SPC). It is important to note at this point

that not every process is a good candidate for statistical control, and that in these instances alternate process control methods may be required. The law of statistics dictate that although every single process has variation, once a process is stable, that variation follows a repeatable pattern that is called a *normal distribution*. That means that only some of the product (any process output) will be exactly the same as the process average (mean). It also means that the rest of the product will either be less or greater than the average and will occur in decreasing frequency the further away from the mean the data strays. If you were to draw this product data set in graphical form, it would take the shape of a bell, which is why a normal distribution is also called a *bell-shaped curve*. Another thing that is known about a normal distribution is that the distribution of the product that falls on either side of the mean is predictable. In other words, the data can be

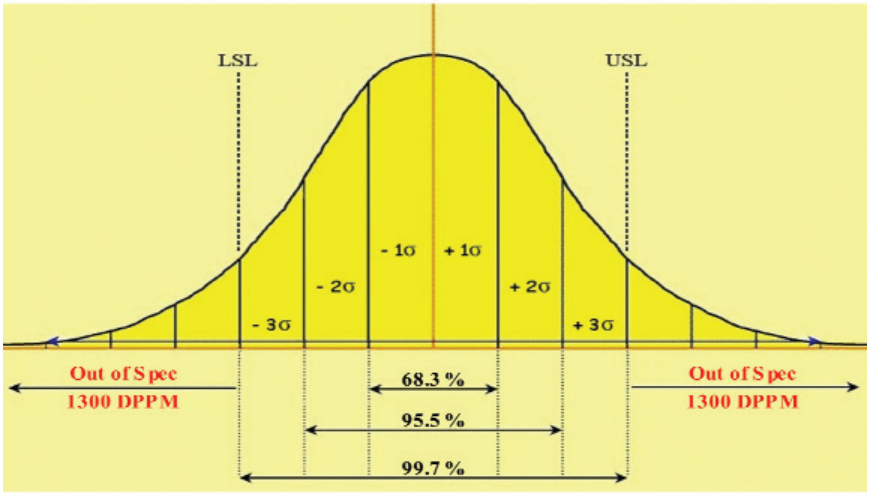


Figure 22. A Three Sigma Process. *Source: SUW 2008.*

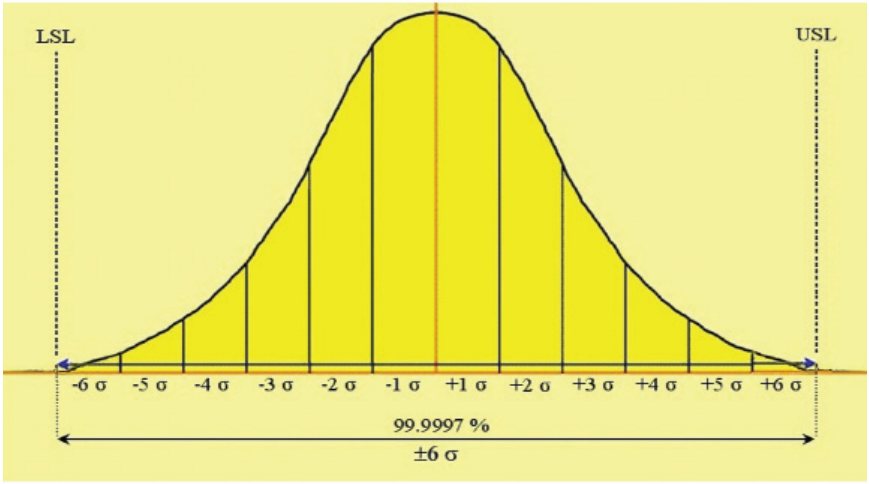


Figure 23. A Six Sigma Process. *Source: SUW 2008.*

divided into groups based on the distance (deviation) from the mean. The term *standard deviation* is used to describe these groups.

Every product has an optimum value, and because every process has variation, every product also has a tolerance. This is defined as specification limits, with both an upper and lower spec limit (USL, LSL) surrounding the optimum value. Simply stated, when a product or process is outside of either of these spec limits, bad product is produced. How well the process variation is centered and contained within these spec limits is called *process capability*. The relationship of this variation to the mean and spec limits is the process capability, or Cpk. The less variation in a process, and the closer the variation is to the mean, the higher the Cpk number. With all the statistical tools available, the formula is not important for this purpose, but what is important is recognizing what the Cpk num-

ber means. It is generally accepted that a Cpk of less than 1.33 would indicate a process that is not capable of consistently meeting customer requirements, while a Cpk of 2.0 would represent a Six Sigma level. The sigma level represents how many standard deviations, or sigmas, it takes to reach the spec limits on either side of the mean. In other words, in a three sigma process it takes three sigmas to reach the LSL and three sigmas to reach the USL.

SIGMA LEVELS

Understanding sigma levels is difficult during the early stages of process improvement, so I will try to simplify this as much as possible. When a process is referred to in sigma terms, we are stating how many sigmas (standard deviations) from the mean it takes to reach the specification limits. Statistical rules state that the amount of variation that falls within each group, or sigma level, is repeatable and can be quantified. It is important to remember that these rules are constant regardless of what sigma level a process is operating under.

Most organizations have not achieved a 99% yield, much less a three sigma level. As Figure 22 shows, in a normal distribution, 99.7% of the variation will fall within +/- three standard deviations, or sigma levels. While that may appear to be a very good yield on the surface, this translates into 2,700 DPPM that will fall outside of the specification limits. The areas outside of the spec limits are called the process *tails*; again referring to Figure 22, we see that these tails fall outside the spec limits and represent defective product. As we saw earlier in

this chapter, a three sigma process results in an awful lot of defective product.

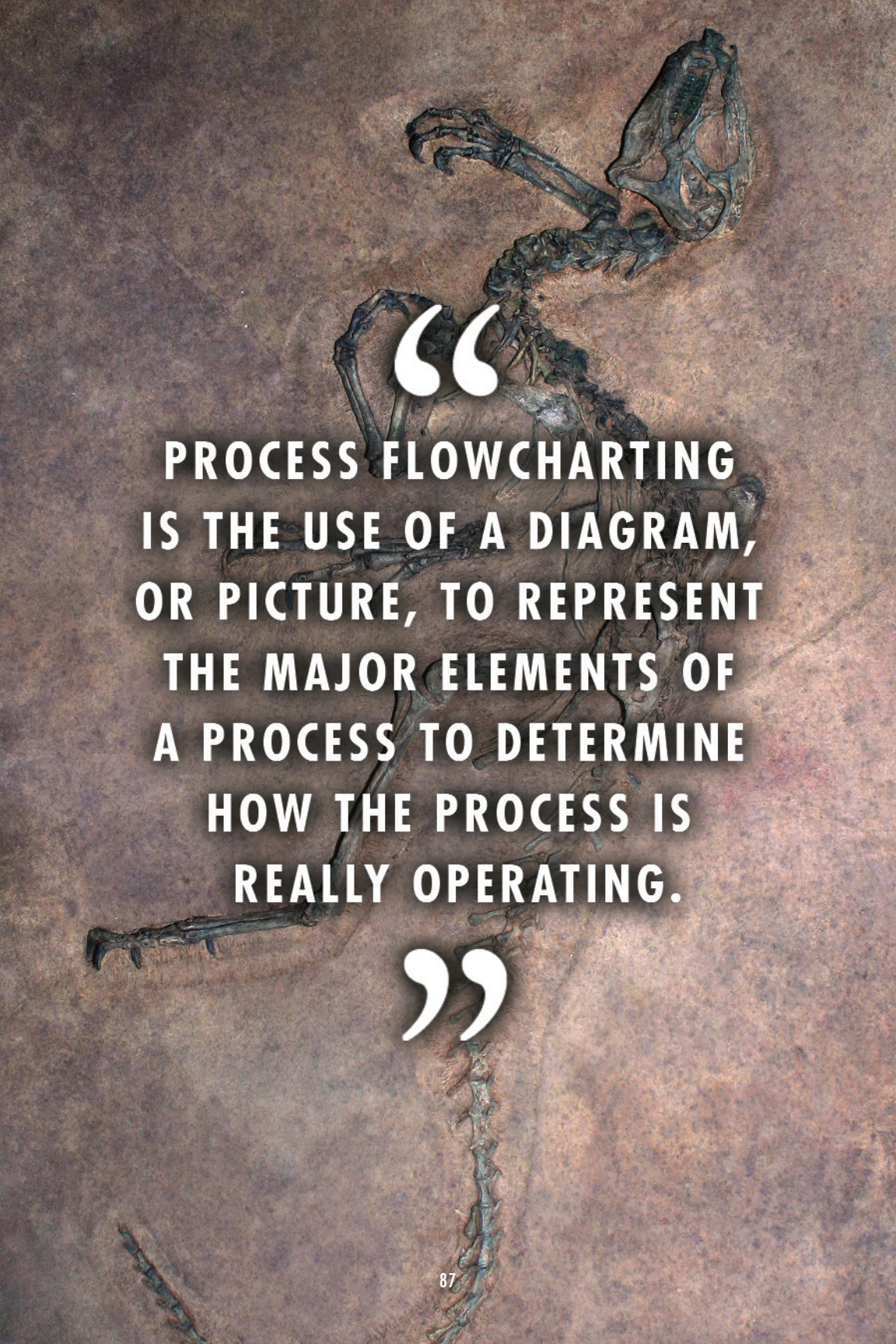
Now let's look at a Six Sigma process, where it takes six standard deviations, or sigmas, to reach each spec limit. Again, statistical rules state that 99.9997% of the variation will fall within +/- six standard deviations, or Six Sigma levels. As Figure 23 indicates, the tails are contained within the spec limits, assuring that virtually no product will be produced outside of specifications (3.4 DPPM, or two defects outside each spec limit).

IT'S OK TO TAKE BABY STEPS

The key takeaway here is that improvement should be taken in steps; don't expect to jump from three to Six Sigma overnight. Sigma levels range from one to six, and legitimate process improvement generally follows a natural progression from the current level up through this range. The first step is to make sure you are at a true three sigma level: Most organizations are surprised to learn that they have a lot of work to do to reach this plateau. The next step is to make incremental improvement to begin moving up the sigma ladder. Quantum improvement can be realized by moving up just a single sigma level; remember that the key to success in lean is to hit singles, not homeruns!

Given the zero-defect goal discussed here, and the general perception that Six Sigma levels are unachievable, I thought it appropriate to close this chapter with the following quote from the chief engineer of Toyota's first Lexus, a man called the "Michael Jordan of Chief Engineers":

"Even if the target seems so high as to be unachievable at first glance, if you explain the necessity to all the people involved and insist upon it, everyone will become enthusiastic in the spirit of challenge, will work together, and achieve it." *–Ichiro Suzuki, Toyota Motor Corporation*



“PROCESS FLOWCHARTING IS THE USE OF A DIAGRAM, OR PICTURE, TO REPRESENT THE MAJOR ELEMENTS OF A PROCESS TO DETERMINE HOW THE PROCESS IS REALLY OPERATING.”

CHAPTER NINE THE LEAN TOOLKIT

9

The lean toolkit is comprised of a set of tools that are used in support of the Six Sigma DMAIC process (Figure 24) presented in the prior chapter. While this toolkit is not all inclusive, the set of tools contained in this chapter will allow an organization to move through each of the DMAIC functions and facilitate any lean initiative.

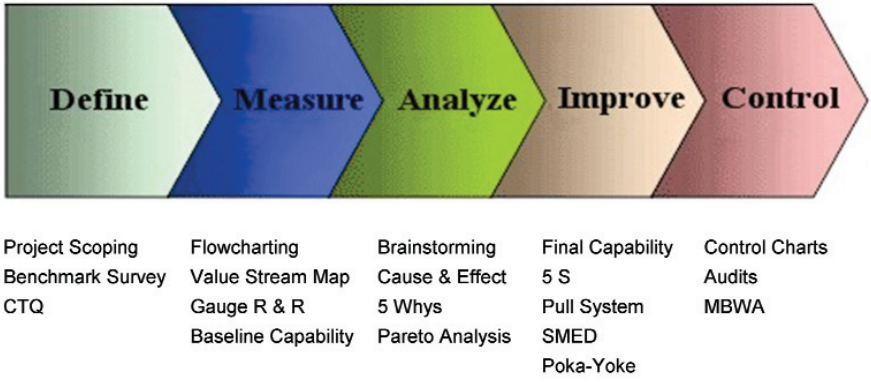


Figure 24. The Lean Toolkit. *Source: SUW 2008.*

DEFINE DMAIC

Project Scoping

Project scoping is the activity of identifying and documenting the process that is targeted for improvement. Defining the project scope is critical; I think we have all been in meetings where two or three people leave

with different impressions of the discussion. Formalizing the project scope is a key way to ensure that everyone is on the same page and gives the lean team the opportunity to review and assess the project before it officially "goes live." This would include the initial process performance evaluation, defining of the team, developing a timeline, and attaching preliminary financial goals for the anticipated improvement.

Customer Benchmark Survey

The customer benchmark survey is part of the Voice of the Customer program that solicits information from the customer base; an example survey was presented in Chapter Four. The ability to understand value from the customer's perspective is a critical first step in the lean process. The information gathered from a benchmark survey can provide valuable input on both short-term and long-term decision-making in support of increasing customer satisfaction. The survey will highlight not only the areas where an organization holds strategic advantages over the competition but also the areas where the competition is superior. As stated earlier in this book, "Perception is reality," and I would argue that you can't improve what you haven't measured. The appropriate lean strategy can only be developed after measuring your customers' needs, wants, and perceptions.

Critical to Quality Identification

Once customer needs have been established through the Voice of the Customer program, an analysis

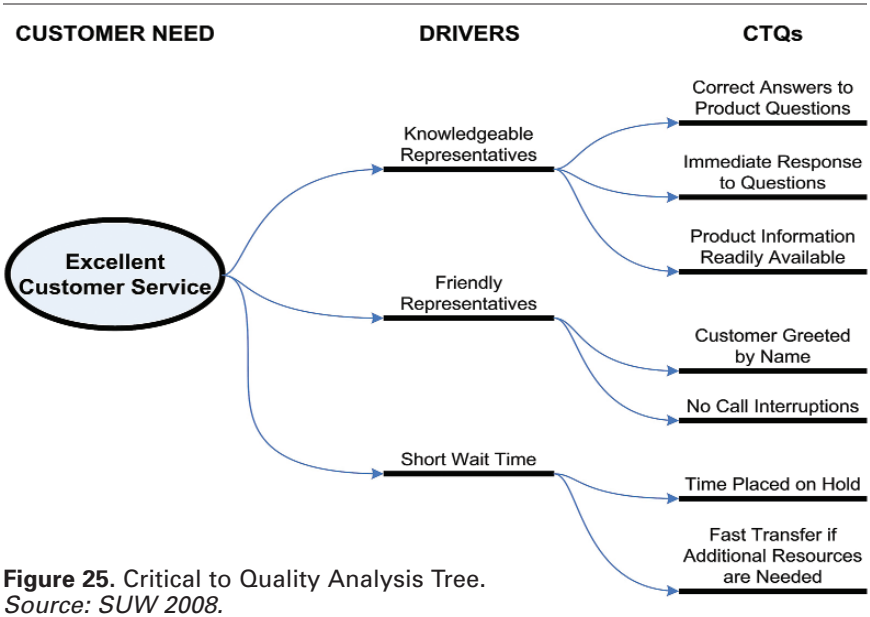


Figure 25. Critical to Quality Analysis Tree.
Source: SUW 2008.

of the product/process characteristics that relate directly to meeting these needs must be completed. These characteristics are defined as being *critical to quality* (CTQ). Figure 25 presents an example of a CTQ Tree that analyzes the customer service process. CTQs are the key *measurable* characteristics of a product or process that directly correlate to a customer requirement. Often a CTQ is not a black-and-white specification; it may need to be translated from a qualitative customer statement into a quantitative requirement.

MEASURE DMAIC

Process Flowcharting

Process flowcharting is the use of a diagram, or picture, to represent the major elements of a process to deter-

mine how the process is really operating. (A process flowchart example was presented in Chapter Seven.) Process flowcharting will define boundaries and constraints and is the first step in measuring the current process.

Value Stream Mapping

Value stream mapping is a lean planning tool used to visualize the value stream of a process; this step takes a process flowchart to the next level. This activity is the core method of identifying the areas of waste within any process. Value stream mapping is a two part process: 1) developing a current state map representing how the process is operating today, and 2) developing a future state map depicting the desired process operation. Examples of both current state and future state value stream maps were presented in Chapter Seven.

Gauge R & R Study

A gauge R & R (repeatability & reproducibility) is basically a capability study of the measurement system used in an organization. I have always believed that a process cannot be improved until it has been measured, and accuracy of the measurement system is of paramount importance. A gauge R & R study is needed for two reasons: There will be measurement variation from person-to-person, and there will be measurement variation from tool-to-tool. A gauge R & R will give you an approximation of the variation of the total measurement system, expressed as a percentage, including its components' repeatability and reproducibility and part-to-part variations. The fol-

lowing are generally-accepted guidelines for quantifying the results of a gauge R & R study:

- ≤ 10%: Satisfactory
- 11%-30%: May be satisfactory, depending on the magnitude of the use, cost of new gauges, cost of repairs, etc.
- > 30%: Unsatisfactory; requires corrective action

Capability Study: Baseline

The capability of the process needs to be established to use as a baseline for future improvement comparison and is accomplished through Cpk analysis. As discussed in Chapter Eight, a Cpk value is an index representing the ability, or capability, of the process to meet customer requirements. To determine process capability, collect process data as you would if you were setting up a control chart, calculate the process mean and variation, and then

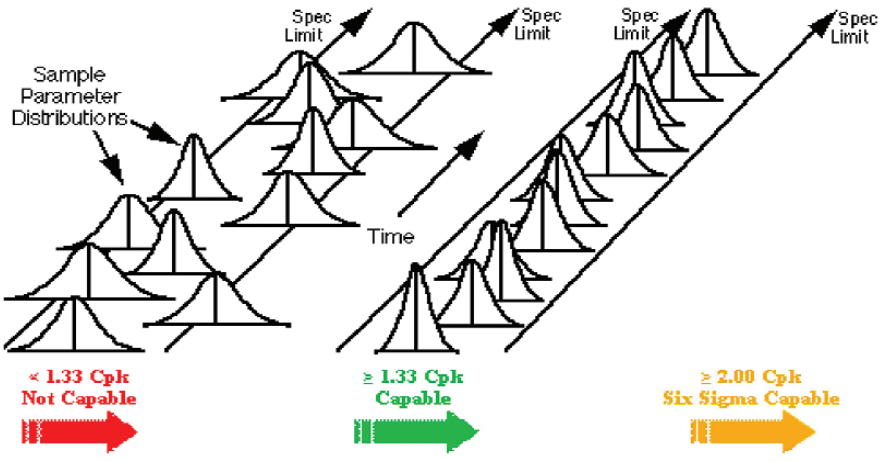


Figure 26. Critical to Quality Analysis Tree. *Source: SUW 2008.*

compare the relationship between these values and the specification limits. Any SPC software, or even Excel, can calculate the Cpk of a process data set. Figure 26 shows the various levels of process capability.

ANALYZE DMAIC

Brainstorming

Brainstorming is a Phase I problem-solving tool that is used to generate as many ideas as possible related to a given problem, with an emphasis on sheer quantity of ideas. Creative thinking should be encouraged during brainstorming, with no judgment or evaluation of ideas taking place during this activity. The goal is to identify as many potential causes of a problem as possible, even if some of these causes seem to be so off the wall that they couldn't possibly apply. While the "crazy" ideas may not be feasible, they often enable a creative environment that stimulates valid ideas that might not otherwise have been considered. This environment should encourage critical thinking about a problem or process to gain a comprehensive perspective of causes, solutions, and potential consequences.

Figure 27. Brainstorming Rules.
Source: SUW 2007.

The brainstorming team should include not only members intimately involved with the process, but also representatives from internal customers on either end of the subject process. This team activity is best done on a white board or flip chart, requiring one person to fill the role of scribe and document *all* of the ideas that are generated by the team. A number of rules should be followed to facilitate a successful brainstorming session, which are presented in Figure 27.

CAUSE & EFFECT DIAGRAM

A cause & effect diagram is a Phase II problem-solving tool with the purpose of analyzing relationships between a problem and its causes. The cause & effect diagram is also known as a fishbone diagram (for obvious reasons) or an Ishikawa diagram, named after its inventor, Dr. Kaoru Ishikawa. In this activity, all the ideas generated during the brainstorming session are evaluated and categorized as they relate to the subject problem. At this point,

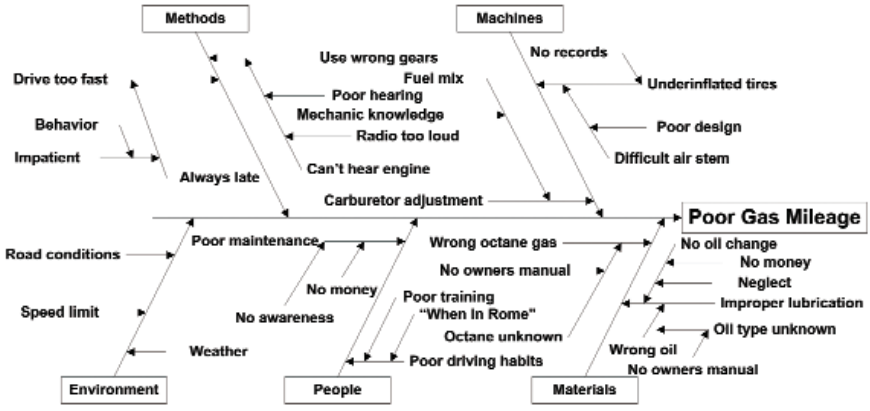


Figure 28. Cause & Effect Diagram for poor gas mileage. *Source: SUW 2007.*

many of the ideas generated during brainstorming may be eliminated, while new ones may be added. The category names can be changed to fit the problem, but common categories are Methods, Machines, Environment, People, and Materials. A cause & effect diagram analyzing the problem of getting poor gas mileage is shown in Figure 28.

5 WHYS

This technique can be used very effectively during the cause & effect analysis to drive to the true root cause. Anyone with small children has firsthand knowledge of this problem-solving tool, although in the business environment, root cause should not end at, "Because I said so!" Although the word "Why?" may be your three year-old's favorite word, it could also teach you a valuable lean technique. By repeatedly asking the question "why" (five times is a good rule of thumb), you can peel away the layers of symptoms, which can lead to the true root cause of

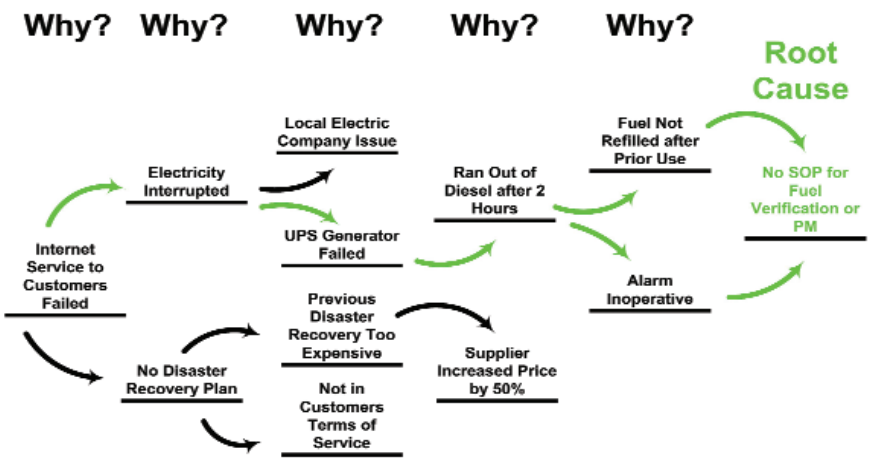


Figure 29. 5 Whys Analysis for Internet Service. *Source: SUW 2008.*

a problem. The biggest mistake that most organizations make in the Analyze phase of DMAIC is trying to fix a symptom instead of the root cause. Addressing only a symptom will result in the root cause manifesting in the form of another symptom, and the problem will continue. Although this technique is called the "5 Whys," it may be necessary to ask the question fewer or more times than five to drive to the root cause in some instances. An example of using the 5 Whys is presented in Figure 29.

PARETO ANALYSIS

Around the turn of the 20th century, Italian economist Vilfredo Pareto made a couple of observations that led him to develop a principle that continues to be a powerful tool in the lean environment of today. He observed that 20% of the Italian population owned 80% of Italy's wealth. He later observed that 20% of the pea pods in his garden produced 80% of his pea crop each year. This correlation led Pareto to postulate that, in most things, a small number of causes are responsible for a large percentage of the effect. In the late 1930's, quality guru Dr. Joseph M. Juran recognized this principle as the "Vital Few and Trivial Many Rule," which was later generalized into "Pareto's Principle" or the "80/20 Rule."

Pareto analysis allows management by fact instead of by emotion; and, as with most things, fact-based decision-making will yield the highest return on investment. The first step is to categorize the problems by type or defect code. Next, generate a simple histogram, which ranks the defects in descending order of magnitude. Then,

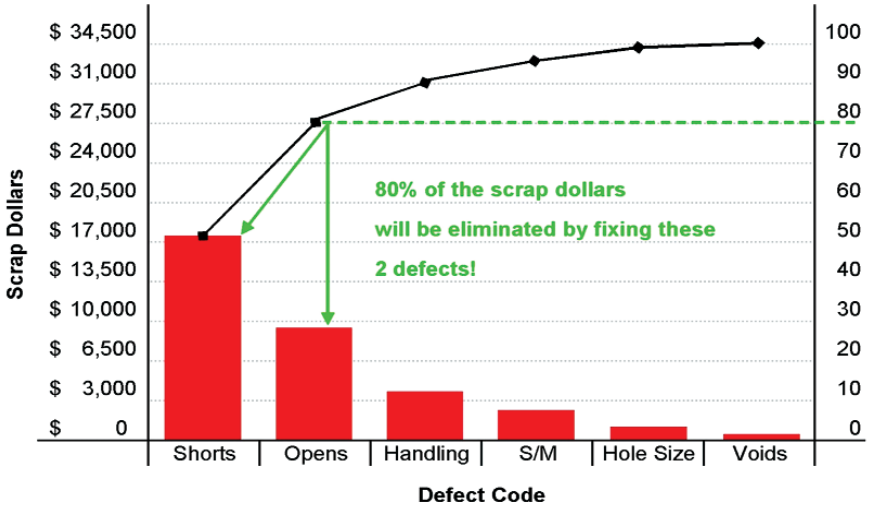


Figure 30. Pareto Diagram of Defects. *Source: SUW 2007.*

using the data set in the histogram, graphically portray the data set in a simple bar chart format. Finally, add a trend line showing the accumulated relationship of the defects to the whole to identify visually what defects make up roughly 80% of the total dollars. Figure 30 illustrates what a Pareto Diagram might look like in a typical printed circuit manufacturing process. The strategy behind Pareto analysis is to identify the areas with the highest improvement potential while minimizing the number of improvement initiatives. What this means in simple terms is *getting the biggest bang (improvement) for the buck (effort).*

Referring again to Figure 30, the improvement team would easily determine that their efforts should be focused on eliminating the two defects labeled "Shorts" and "Opens." Once improvement has been attained in these "80/20" areas, the reporting cycle is run again. The new "80/20" problem areas are identified, and the team

now focuses on eliminating these. The beauty of the system is that, with each iteration, the order of magnitude continuously declines so that the next 80% of the dollars represents a much lower amount, which is the essence of continuous improvement.

IMPROVE DMAIC

Capability Study: Final

The capability study completed during the Measure phase should be performed again to verify the effectiveness of the process improvements that have been implemented. As discussed in Chapter Eight, it is generally accepted that a Cpk of less than 1.33 would indicate a process that is not capable of consistently meeting customer requirements, and a Cpk of 2.0 would represent a Six Sigma level. Referring back to Figure 26 in this chapter, the goal is to improve the process capability from the original level to one in the range of 1.33 – 2.00 or higher.

FIVE S

Five S's are literally five Japanese words beginning with the letter S, which together form a systematic process for organizing a workplace. While this may seem to be a minor tool in the war on waste, the benefits include quality and safety improvements, lead-time reduction, reducing hidden waste, and of course, increased profits. Below we will explore what the Five S's are, and why they are important.

Seiri **–** (Sort) Ensuring that each item in a workplace is in its proper place or identified as unnecessary and removed; getting rid of unnecessary "stuff." Questions to ask: Can this task be simplified? Do we label items properly and dispose of waste frequently?

Seiton **–** (Set in order) Arrange materials and equipment so that they are easy to find and use. Prepare and label storage areas using paint, tape, outlines, or color-codes. Questions to ask: How much time is spent looking for things and putting things away? Can we improve the ergonomics of this task?

Seiso **–** (Shine) Repair, clean and shine work area; "everyone is a janitor" (this is a concept that U.S. workers have a difficult time embracing!) Questions to ask: Do we have a schedule for cleaning, sweeping, and wiping off for each department? Do we have cleaning inspection checklists? Are we seeing the workspace "through our customers' eyes"?

Seiketsu **–** (Standardize) Formalize procedures and practices to create consistency and ensure that all steps are performed correctly. Questions to ask: Does everyone know what they are responsible for doing? Is there a documented process that describes when and how to do it?

Shitsuke **–** (Sustain) Perhaps the most critical of the Five S's is keeping the prior four processes going through training, communication, and organizational structure.

Questions to ask: Does our senior management support this initiative by allocating the appropriate time and resources? Do we create awareness by publicizing and rewarding successes?

Five S projects need to be visual and placed in plain sight of all workers so everyone can understand the status of the system at a glance. Visualizing projects also supports the Shitsuke process of publicizing and rewarding successes. Digital imaging has made documentation of before-and-after improvement easy to incorporate into the documents, posters, and reports that make up a good visual management system.

Pull System

A *pull* system is a method of controlling the flow of materials and resources through a process based on customer demand and consumption. Simply put, this JIT (just-in-time) philosophy means producing only what is needed, where it is needed, and when it is needed. Pull systems employ a balanced process workflow that results in a minimum of waste, including inventory. This is contrasted with a *push* system, in which the flow of materials and resources is pushed through the process with no correlation to demand. This JIC (just-in-case) philosophy results in vast amounts of waste, including large stores of raw material, WIP, and finished goods inventory. The signal to produce more products within a pull system is called a *kanban*. The word *kan* means "card" and the word *ban* means "signal" in Japanese, so *kanban* literally trans-

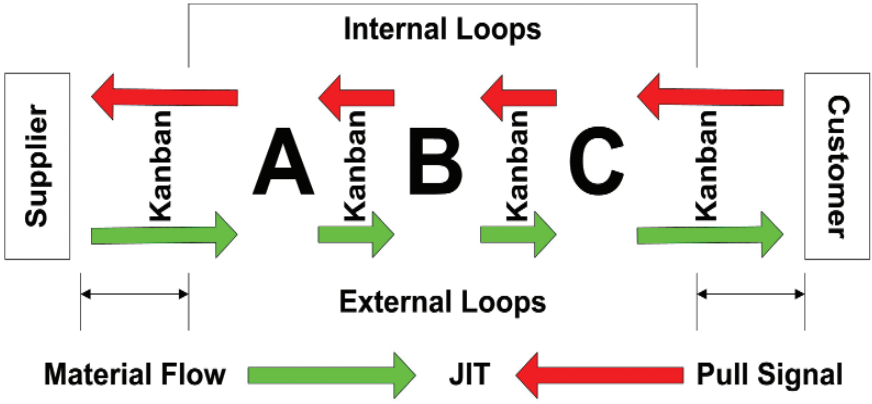


Figure 31. Kanban Pull System. *Source: SUW 2007.*

lates to "signal card." Common examples of kanban systems are cards, bins, inbox/outbox, color-coded floor space/shelves, or electronic signals. Figure 31 shows a basic kanban pull system utilizing the JIT philosophy.

Single Minute Exchange of Die

Single Minute Exchange of Die (SMED) is a method based on the goal of switching tooling from one part to another in under a minute. The term is not to be interpreted literally but refers instead to the activity of reducing setup time in a process operation. A more realistic objective would be a setup changeover in less than ten minutes—a single digit. SMED reduces waste in a process by providing a rapid and efficient way to convert from running the current product to running the next product. This rapid changeover is key to reducing lot sizes, improving process flow, and increasing flexibility.

Poka-Yoke

Poka-yoke is the Japanese word for mistake-proofing (for us ancients, the pre-politically correct term was idiot-proofing), and there's an interesting story of its origin. One day, Shigeo Shingo was explaining *baka-yoke*, literally translated as fool-proofing, which had been created and implemented by workers on the Toyota factory floor. A young woman started to cry.

> "Why are you crying?" he asked.
> "Because I am not a fool!" she answered.
> "I am truly sorry," Shigeo responded, and at that exact moment he changed the name from baka-yoke to poka-yoke: mistake-proofing.

Poka-yoke is not a new concept; some variation of this method has existed for as long as people have been producing products. Mistake-proofing, error-proofing, fool-proofing; whatever label is attached to it, poka-yoke is any method that eliminates the possibility of doing something incorrectly. Poka-yoke is, in essence, designing out the error. Common poka-yoke solutions

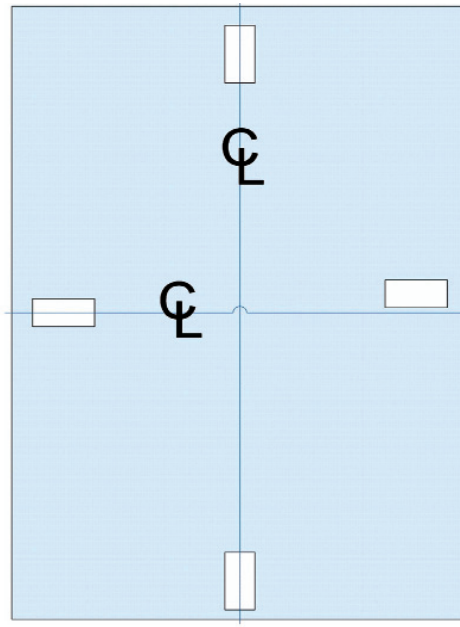


Figure 32. Offset Tooling Poka-Yoke Example. *Source: SUW 2007.*

include checklists, dowel and locating pins, fixtures, error and alarm detectors, limit or touch switches, etc. An example of an offset tooling poka-yoke solution is presented in Figure 32. A properly designed poka-yoke will catch the errors before manufacturing defective product virtually 100% of the time. The three rules of poka-yoke are: 1) Don't wait for the perfect poka-yoke; do it now!; 2) If your poka-yoke idea has better than a 50% chance to succeed, do it!; and 3) Do it now; improve it later!

CONTROL DMAIC

Control Charts

Control charts are a graphical representation of the current state of a process and should be implemented at the operator level to maximize effectiveness. A control chart's true function is to provide real-time feedback to control and improve a process, which means that the data displayed on the charts must help front-line operators make better process decisions. All control charts have three basic components: a process center, or mean; an upper and lower control limit; and an upper and lower specification limit. In a stable process, data will be randomly centered around the process mean and contained within the control limits. Data between the control limits and the specification limits signal that a process adjustment is needed. Data exceeding the specification limits would be considered out of acceptable limits and defective. The most common form of control charts is the X-Bar and R chart. X-Bar refers to the *average* of the data in

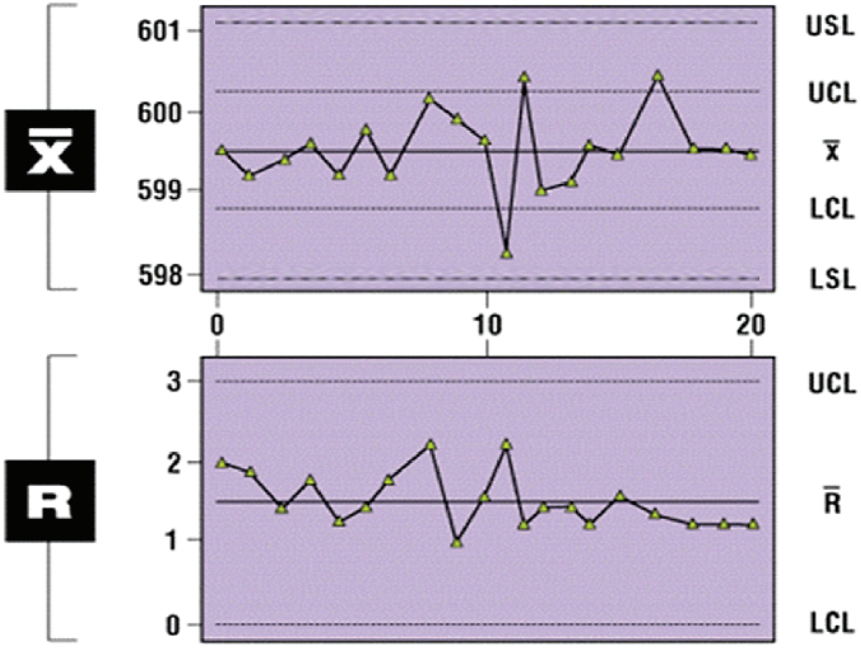


Figure 33. X-Bar and R Chart. *Source: SUW 2008.*

each sample and is plotted in the top half of the chart, and R stands for the *range* of the data in each sample and is plotted in the bottom half of the chart. An example X-Bar and R chart is shown in Figure 33.

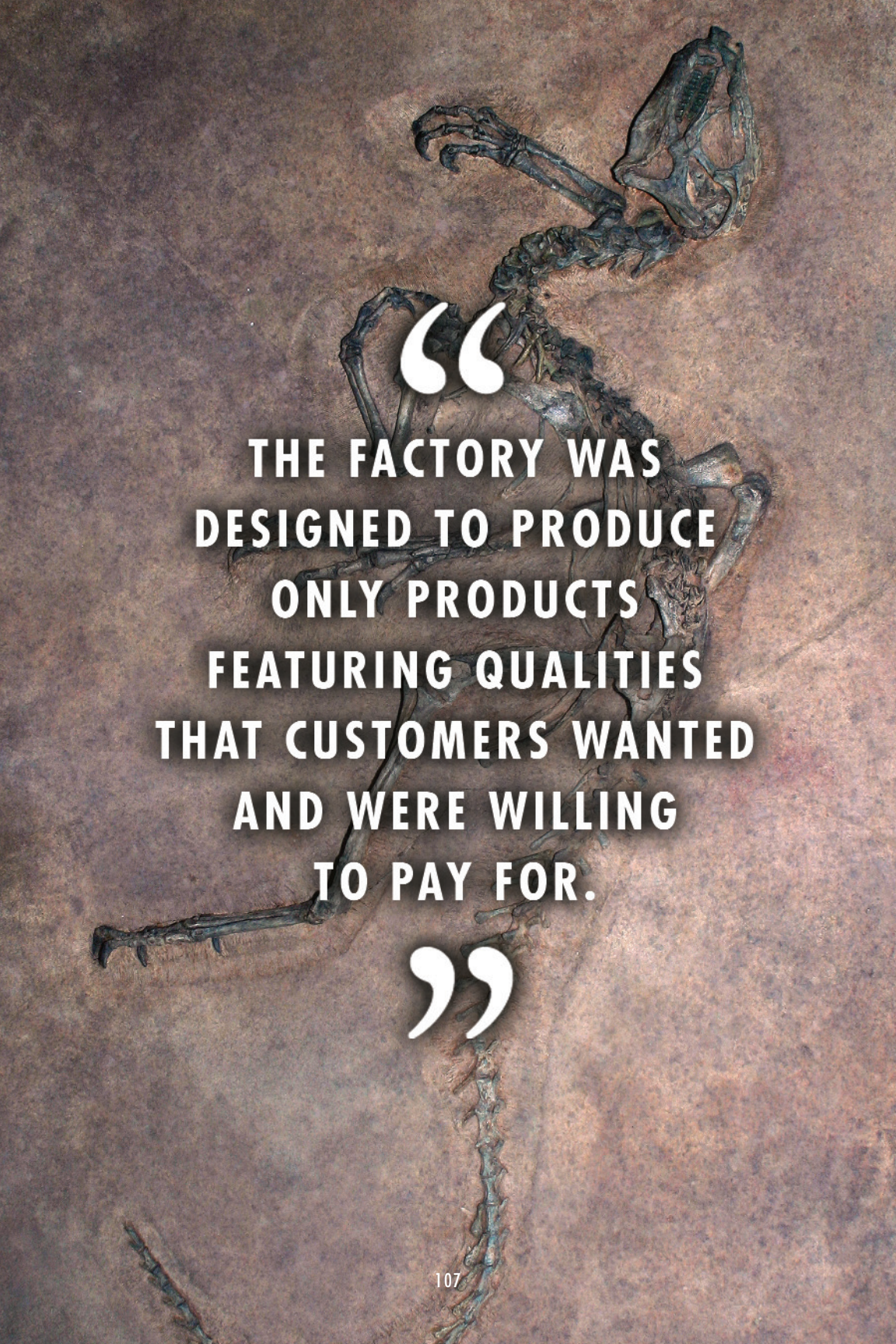
Audits

Developing a robust internal auditing system provides a methodology for monitoring and maintaining process improvements and sustaining the momentum created by a lean initiative. The audit program should include all lean process-specific functions as well as areas such as training and quality system compliance. It is also a key tool for minimizing (or eliminating) undesirable findings during an external customer or quality system

audit. With a solid program and skilled staff, an internal audit system will assure the success of lean efforts and operational excellence.

"MANAGEMENT BY WALKING AROUND"

Tom Peters, author of the "Excellence" series of books and one of my favorite management consultants, coined the phase MBWA (**M**anagement **B**y **W**alking **A**round). This is another of those concepts that seem so obvious, but how many of us actually do this? This is a rhetorical question, but really, how often do we go out on the shop floor and just observe what is going on? I don't mean tracking down orders and making sure people are working, but rather: How does the facility look? Do the workers look happy? Are we working smart or overcompensating by working hard? What would I think if I were the customer? You can't answer these questions sitting in your office!


“
THE FACTORY WAS
DESIGNED TO PRODUCE
ONLY PRODUCTS
FEATURING QUALITIES
THAT CUSTOMERS WANTED
AND WERE WILLING
TO PAY FOR.
”

CHAPTER TEN

IF WILLIE WONKA CAN DO IT, SO CAN YOU!

10

As mentioned earlier, there is a wide and limitless supply of excuses for why lean will not work in "my" organization. One of my favorite ways of illustrating that lean *will indeed work anywhere* is to take a lean look at a very unlikely organization: Willie Wonka's Chocolate Factory. The inspiration for this case study came from one of my students, who told me that while she was studying diligently one evening, her son was watching the video "Charlie and the Chocolate Factory." She said "Professor (I love it when they call me professor!), as I sat there listening to the underlying ideas behind the chocolate factory, I got distracted in my reading and realized I was watching a show that is formulated on the idea of creating a lean factory."

As we discussed this in great detail, she presented a very compelling argument to support her position. So, that following weekend I purchased the DVD and sat down with a bowl of popcorn, a cold Budweiser, and my notepad and turned a critical lean eye to Roald Dahl's classic tale. What follows are the results of that session, which led to the development of a lean case study that I now use both academically and professionally.

Willie Wonka Case Study

I – THE NEED FOR LEAN

Competition

The Willie Wonka Chocolate Factory was infiltrated by industrial spies trying to steal Wonka's secret recipes and manufacturing technology. This espionage resulted in a proliferation of copycat low-cost products flooding the market, which, while inferior to the Wonka quality, were quite successful as consumers made their buying decisions based on price. The Willie Wonka Chocolate Factory was devastated and could not compete with these low-cost candy bars, which resulted in the closure of the factory and the loss of thousands of jobs, including Charlie Batch's Grandpa Joe. Grandpa Joe was a lifelong employee of the Wonka factory and approaching retirement when the factory closed down. In a related storyline, Charlie's father had also been downsized recently at the local toothpaste factory after being replaced by a robot in an effort to reduce costs. Consumer pricing pressure had certainly caused the Batch family to fall on hard times.

Side note: This part of the story was based on personal experiences from Dahl's childhood. The two largest British candy firms, Cadbury and Rowntree, sent so many moles to work in competitors' factories that their spying became legendary.

II – REDUCING COSTS

Outsourcing

After closing the factory, Willie Wonka traveled the world looking for a low-cost country in which to reestablish his business—one that would allow him to become competitive again. He was beginning to lose hope, but then Willie reached LoompaLand, where he discovered an entire population of highly skilled and dedicated workers, the Oompa Loompas, who were destined for extinction by the monsters of their native land. So, instead of bringing the factory to the low-cost country, Willie brought the low-cost country to the factory!

III – ELIMINATING THE SEVEN DEADLY WASTES

Defect Waste

Jidoka (built-in-quality) was evidenced throughout the process, my favorite example being the team of squirrels performing quality-at-the-source verification in the nut-shelling department. Years of continuous process improvement had resulted in the development of a chocolate waterfall, which provided an automated, low-cost chocolate mixing system that produced Wonka's world-class "light and frothy" chocolate. Robust *statistical process control* and *capability study* programs allowed continuous process improvement that resulted in the factory's ability to achieve and maintain the current Six Sigma level of performance.

Motion Waste

All of the manufacturing processes were designed to be highly automated, with each having an advanced technology control center requiring minimal manpower to operate. Through the *5S* methodology, all materials and tools were stored at the source to eliminate internal travel time waste. Every task within each control center was also ergonomically designed for the Oompa Loompas so that every control, gauge, and monitor was within easy reach.

Waiting Waste

Given the vast size of the operation (the largest in the world), moving people and product around the factory was quite the task. Queue time (waiting waste) was virtually eliminated with the Wonka-invented flying elevator, which quickly transported employees and WIP throughout the factory. Lean practices were evident throughout the operation, and the art of chocolate making was developed into a continuous flow manufacturing process. A hovering spaceship sucked up thousands of gallons per hour of WIP from the chocolate river and transported it throughout the factory for real-time subsequent processing.

Overprocessing Waste

The factory was designed to produce only products featuring qualities that customers wanted and were willing to pay for. Understanding customer needs and preferences was accomplished by performing a *critical to quality* analysis of Wonka's products, based on *Voice of the*

Customer feedback. The fantastical manufacturing technology employed by Wonka was all developed in-house in the Inventing Room, the organization's R&D lab. Driven by data mined from his *Voice of the Customer* program, Wonka was also concerned with eliminating waste for his customers. The invention of the Three Course Dinner stick of gum was intended to reduce waste in the home, as food and cooking time (and kitchens, for that matter) would all be eliminated by a single stick of gum!

Inventory Waste

Inventory was minimized through the organization's *just-in-time* program, which had been implemented both internally and externally. All manufacturing processes utilized a *kanban pull system* that minimized work-in-process inventory by only manufacturing what was needed, when it was needed. This system had also been implemented with Wonka's raw material suppliers, who had eliminated raw material inventory through electronic data interchange transactions and supplier-managed inventory programs. Kanbans had also been set up with Wonka's retail customers so that product replenishment was driven by consumption, not by forecast.

Overproduction Waste

Overproduction waste was minimized in a variety of ways at the Wonka Chocolate Factory. First, the Wonka *Voice of the Customer* program assured that the factory was only making products that customers wanted, eliminating finished-goods obsolescence. Next, the *kanban pull* contin-

uous flow manufacturing system minimized the work-in-process inventory that had normally built up between operations. Finally, the *Six Sigma* process performance level kept defects to a minimum, and the *just-in-time* kanban system eliminated raw material and finished goods inventory at the Wonka factory.

Transportation Waste

Transit time waste was greatly reduced by utilizing a very impressive global logistics system to distribute Willie Wonka candy bars from the factory to retail outlets throughout the world. Order fulfillment was accomplished via a massive, well-oiled freight division that utilized company-owned ground and air transportation. A cutting-edge "Television Chocolate" technology under development would transport a chocolate bar through the TV to customers all over the world, thus completely eliminating transit time waste.

IV – LIFE IMITATES ART

Or does art imitate life? In the end, Charlie's dad got his job back at the toothpaste factory as a robotic technician, keeping the machine that replaced him operating. One of the biggest fears people have of lean is that they will no longer be needed. Charlie's dad was retrained and redeployed at a new position that was much more personally enriching, which happens every day in the real world. Willie Wonka's processes were very environmentally friendly, with many of the by-products edible and

biodegradable. So, the bottom line is that yes, Willie Wonka was a lean visionary and his chocolate factory a study in the ultimate goal of lean: manufacturing perfection!

Although this is obviously a very tongue-in-cheek look at a fictional company, the concepts and theory liberally applied by the author's imagination are technically sound and based in fact. It then follows that, if lean can be successfully implemented in the fantastical setting of Willie Wonka's Chocolate Factory, it most certainly will work in your company.

CONCLUSION: LEAN WORKS

I would be willing to take it a step farther and state that I can guarantee that lean will work in any industry or organization if the following two conditions are met: (1) Senior management must fully buy into the program, and (2) It must be implemented correctly. As with any new program, initiative, or philosophy, management buy-in and commitment are mission-critical. Lean is not free, or even cheap, when you consider the time and human resources that must be expended on a regular basis. It takes money to save money, and an organization can't realistically expect to improve performance significantly without investing in training, organizational infrastructure, and cultural evolution. Sure, it costs money to implement any training program, but the initial training is only the tip of the iceberg. The major expense in a lean program is the ongoing cost of human resources. If management is not willing to allocate the appropriate time for

employees to work on lean projects, the program is sure to fail—and fail spectacularly. The good news is that the hard-dollar payback of a solid program can be equally spectacular. According to Charles Waxer in his article Six Sigma Costs And Savings*:

- GE has reported saving $12 billion over five years and adding $1 per share to its earnings.
- Honeywell (AlliedSignal) has recorded more than $800 million in savings.
- Motorola has reported over $15 billion in savings over the last 11 years.

Lean is a concept whose time has come because, in my humble opinion, American manufacturers in general are far past the need for a crash diet. We have, as a whole, failed to embrace the lean philosophy that has permeated our foreign competitors across all industries and market segments. This paradigm shift has not only allowed them to capture the majority of manufacturing jobs and products, but it has also armed them sufficiently to continue this domination for the foreseeable future. My supply base pushes back, contending that lean is just another "flavor of the month" quality initiative that will soon fall by the wayside. They ask, "If I am providing you product on-time and of a high quality, why do you care about lean?"

My answer is simple: price and flexibility. The former is about cost, and one way or another, as a customer I am paying for your process inefficiencies. The latter is about lead-time. In the highly dynamic environment that

we all play in today, one of the major drivers is flexibility, and the biggest constraint on flexibility is lead-time.

My closing advice would be to *do something now*! Waiting for a plan to be perfect will only ensure that it never begins; doing something now is always better than doing something later. I will close this book with a quote from Karen Lamb, courtesy of my friend Tom Peters: "A year from now you may wish you had started today." It is my hope that this book will stimulate decision-makers to embrace the methodology and practices of lean and that it will become a valuable resource for any organization that is serious about improving operational performance and all the wonderful things that go along with that improvement. And remember, *it's always about the dollars*.

**Waxer, Charles, (2008). Six Sigma costs and savings: The financial benefits of implementing Six Sigma at your company can be significant. www.isixsigma.com*

APPENDIX A: A LEAN GLOSSARY

A

Andon Board: A visual management control device in a production area, typically a lighted overhead display, giving the current status of the production system and alerting team members to emerging problems

Autonomation: Automation with a human touch. Refers to semi-automatic processes where the operator and machine work together while allowing man-machine separation.

B

Balanced Flow Production: All operations or cells produce at the same cycle time. In a balanced system, the cell cycle time is less than takt time.

Batch-and-Queue: Producing more than one piece of an item and then moving those items as a batch (lot) forward to the next operation before they are all actually needed there. Thus, items need to wait in a queue.

Benchmarking: The process of measuring products, services, and practices against those of leading companies.

Bottleneck: Any resource whose capacity is equal to or less than the demand placed on it.

Best-in-Class: A best-known example of performance in a particular operation. One needs to define both the class and the operation to avoid using the term loosely.

Blitz: A fast and focused process for improving some component of business—a product line, a machine, or a process. It utilizes a cross-functional team of employees for a quick problem-solving exercise, where they focus on designing solutions to meet some well-defined goals.

C

Capacity Constraint Resources: Where a series of non-bottlenecks, based on the sequence in which they perform their jobs, can act as a constraint.

Cells: The layout of machines of different types performing different operations in a tight sequence, typically in a U-shape, to permit single piece flow and flexible deployment of human effort

Change Agent: The catalytic force moving firms and value streams out of the world of inward-looking batch-and-queue.

Constraint: Anything that limits a system from achieving higher performance or throughput

Continuous Flow Production: Means that items are produced and moved from one processing step to the next one piece at a time. Each process makes only the one piece that the next process needs, and the transfer batch size is one.

Covariance: The impact of one variable upon others in the same group

Current State Map: Helps visualize the current production process and identify sources of waste

Cycle Time: How often, in time, a finished product is completed from a process—i.e., a cycle time of 17 minutes means that one automobile comes off the assembly line every 17 minutes.

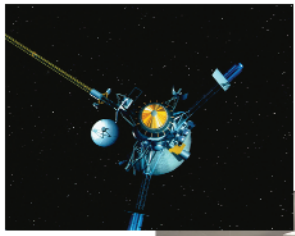
D

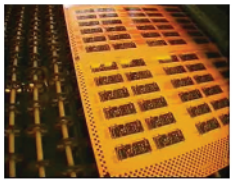
Dependent Events: Events that occur only as a reaction to a previous event

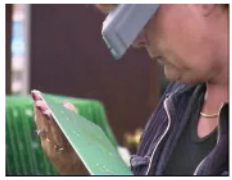
DMAIC: The Six Sigma problem-solving methodology of Define, Measure, Analyze, Improve, and Control, that uses a collection of tools to identify, analyze, and eliminate sources of variation in a process.

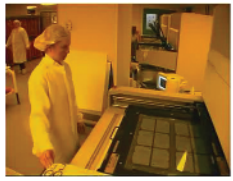
When good enough... is *NOT* good enough!

Match the Mission to the Manufacturer









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E

Error: Any process or product failure

F

Finished Goods: Inventory made up of completed product that cannot be immediately converted into product revenue

Five S or 5S: Five terms utilized to create a workplace suited for visual control and lean production. Seiri (Sort) means to separate needed tools, parts, and instruction from unneeded materials and to remove the latter. Seiton (Set in order) means to neatly arrange and identify parts and tools for ease of use. Seiso (Shine) means to conduct a cleanup campaign. Seiketsu (Standardize) means to formalize procedures and practices to create consistency and ensure that all steps are performed correctly. Shitsuke (Sustain) means to form the habit of always following the first four Ss.

Five Whys: A root-cause analysis problem-solving technique that repeatedly asks the question "Why" five times to peel away the layers of symptoms that can lead to the true root cause of a problem

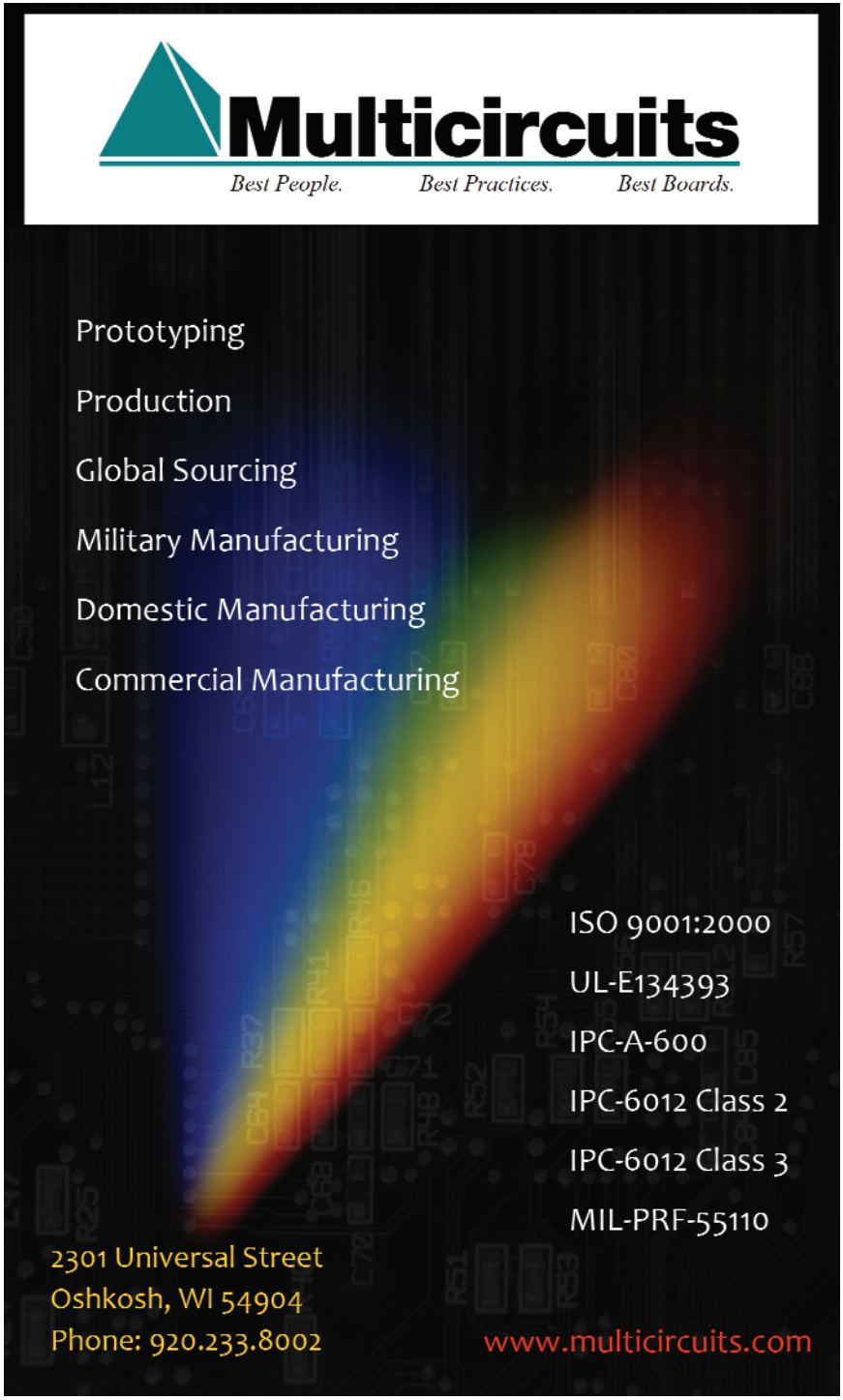
Flow: A main objective of the lean production effort, and one of the important concepts that passed directly from Henry Ford to Toyota. Ford recognized that, ideally, production should flow continuously all the way from raw material to the customer and envisioned realizing that ideal through a production system that acted as one long conveyor.

Functional Layout: The practice of grouping machines or activities by type of operation performed

Future State Map: A blueprint for lean implementation. An organization's vision, which forms the basis of the implementation plan by helping to design how the process should operate.

H

Heijunka: A method of leveling production at the final assembly point that makes Just-in-Time production possible. This involves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averaging both the volume and sequence of different model types on a mixed-model production line.

Hosin Planning (HP): Also known as Management by Policy or Strategy Deployment. A means by which goals are established and measures are created to ensure progress toward those goals. HP keeps activities at all levels of the company aligned with its overarching strategic plans. HP typically begins with the "visioning process," which addresses the key questions: Where do you want to be in the future? How do you want to get there? When do you want to achieve your goal? And who will be involved in achieving the goals? HP then systematically explodes the whats, whos, and hows throughout the entire organization.

I

Inspection: This non-value adding activity compares product against specifications to determine compliance with the requirements. Also known as EVIL by the author.

Inventory: The money the system has invested in purchasing things it intends to sell

J

Jidoka: Stopping a line automatically when a defective part is detected

Just-in-Time (JIT): A system for producing and delivering the right items at the right time in the right amounts. The key elements of Just-in-Time are Flow, Pull, Standard Work, and Takt Time, which work together to eliminate waste, simplify processes, and reduce set-up and batch-size.

K

Kaizen: Continuous, incremental improvement of an activity to create more value with less waste. The term "Kaizen Blitz" refers to a team approach to tear down and rebuild a process layout quickly to function more efficiently.

Kanban: A signaling device that gives instruction for production or replenishment of items in a pull system. Can also be used to perform kaizen by reducing the number of kanban in circulation, which highlights line problems.

L

Lead-Time: The total time a customer must wait to receive a product after placing an order. When a scheduling and production system is running at or below capacity, lead-time and throughput time are the same. When demand exceeds the capacity of a system, there is additional waiting time before the start of scheduling and production, and lead-time exceeds throughput time.

Lean: A philosophy for removing waste from all operational processes, resulting in less human effort, capital investment, floor space, materials, and time.

M

Muda: Anything that interrupts the flow of products and services through the value stream and out to the customer; waste

N

Non-Value Added: Activities or actions taken that add no real value to the product or service, making such activities or actions a form of waste

O

Operating Expenses: The money required for the system to convert inventory into product revenue

P

Pacemaker: Any process point along a value stream that sets the pace for the entire stream

PDCA (Plan, Do, Check, Act)
A set of four continuous activities developed by W. Edwards

Deming to provide a continuous feedback loop, allowing managers to identify and change the parts of a process that need improvement. **Plan** means to design or revise business process components to improve results. **Do** means to implement the plan and measure its performance. **Check** means to assess the measurements and report the results to decision makers. **Act** means to decide on changes needed to improve the process.

Perfection: The goal of always optimizing value-added activities and eliminating waste

Poka-Yoke: Commonly referred to as Error-Proofing or Mistake-Proofing. The aim of poka-yoke is to design devices that prevent mistakes from becoming defects by giving the earliest possible warning to enable response to abnormalities. Poka-yoke devices sense abnormalities and take action only when an abnormality is identified, or they eliminate the potential for error.

Process: The flow of material in time and space. The accumulation of sub-processes or operations that transform material from raw material (inputs) into finished product (outputs).

Pull System: A downstream process that takes only the product needed and pulls it from the producer. This pull is a signal to the producer that the product needs to be replenished. The pull system links accurate information with the process to minimize waiting and overproduction.

Push System: In contrast to the pull system, product is pushed into a process regardless of whether it is needed. The pushed product goes into inventory, lacking a pull signal from the customer indicating that it has been consumed. More of the same product could be overproduced and put into inventory.

Q

Quality: Meeting the expectations and requirements, stated and unstated, of the customer.

Quality Function Deployment (QFD): A visual decision-making procedure for multi-skilled project teams, which develops a common understanding of the voice of the customer and a consensus on the

final engineering specifications of the product, having the commitment of the entire team. QFD integrates the perspectives of team members from different disciplines, ensures that their efforts are focused on resolving key trade-offs in a consistent manner against measurable performance targets for the product, and deploys these decisions through successive levels of detail. The use of QFD eliminates expensive backflows and rework as projects near launch.

Quick Changeover: The ability to change tooling and fixtures rapidly (usually in minutes), so multiple products can be run on the same machine.

Queue Time: The time a product spends in a process waiting for the next operation or task to be performed

R

Raw Material: Inventory made up of material that is to be used in the manufacture of the core product of the organization

Reengineering: The engine that drives Time-Based Competition. To gain speed, firms must apply the principles of reengineering to rethink and redesign every process and move it closer to the customer.

Resource Utilization: Using a resource in a way that increases throughput

Right-size: Matching tooling, equipment, and people to the job and space requirements of lean production

S

Sensei: An outside master or teacher who assists in implementing lean practices

Seven Deadly Wastes: Taiichi Ohno's original catalog of the wastes commonly found in any process. These wastes are Overproduction - producing more than demand requires; Waiting - waiting for materials and/or the next processing step; Transportation - unnecessary transport of materials and/or people; Overprocessing - producing quality or features not paid for by the customer; Inventory - excess materials and

products that cannot immediately be converted into revenue; and Defects - production of defective parts.

Single Minute Exchange of Dies (SMED): A series of techniques designed for changeovers of production machinery in less than 10 minutes. Obviously, the long-term objective is always Zero Setup, in which changeovers are instantaneous and do not interfere in any way with continuous flow.

Single-Piece Flow: A situation in which products proceed through a process, one complete product at a time, through various operations in design, order-taking, and production, without interruptions, backflows, or scrap.

Six Sigma: Six Sigma is defined and used in two ways: (1) As a mathematical measure of the amount of variation in a process. This is normally referred to as the standard deviation of a process. (2) To describe the number of defects a process will produce.

Six Sigma Quality Level: A level of process performance that equates to a maximum of 3.4 defective parts for every million produced

Standards: Established norms or requirements, usually in the form of a formal document that establishes uniform engineering or technical criteria, methods, processes, and practices

Standard Work: A precise description of each work activity specifying cycle time, takt time, the work sequence of specific tasks, and the minimum inventory of parts on hand needed to conduct the activity

Sub-optimization: A condition in which gains made in one activity are offset by losses in another activity or activities, created by the same actions creating gains in the first activity

Supermarket: In lean manufacturing terms, a tightly managed amount of inventory within the value stream to allow for a pull system. Supermarkets, often called inventory buffers, can contain either finished items or work-in-process. They are used to handle finished-goods inventories being replenished from a continuous flow pacemaker process, between a continuous flow process and other manufacturing processes that are shared by other value

streams and for incoming parts and material being pulled from supplier locations.

Supply Chain Management (SCM): A business strategy to improve shareholder and customer value by optimizing the flow of products, services, and related information from source to customer. SCM encompasses minimizing inventory via a product deployment strategy that benefits all supply chain parties.

T

Taiichi Ohno: Born in 1912, he developed the Toyota Production System using the quintessence of Japanese reasoning. He was an excellent originator of new ideas in the industrial world, with a unique management style. His Japanese production system made planning for the manufacture of automobiles the most modern process in the world.

Takt Time: The available production time divided by the rate of customer demand. Takt time sets the pace of production to match the rate of customer demand and becomes the heartbeat of any lean system.

Task Time: The time a product is actually being worked on in a machine or work area

Theory of Constraints: A lean management philosophy that stresses removal of constraints to increase throughput while decreasing inventory and operating expenses

Throughput Time: The sum of all of your product's individual process times accounting for value added and non-value added activities

Time-Based Competition: An operational strategy focusing on compressing total throughput time in an organization. Compressing time has a cascading effect on quality and cost. Time-based competition is the extension of JIT into every facet of the product delivery cycle.

Total Productive Maintenance (TPM): A preventive maintenance strategy to ensure that every machine in a production process

is always able to perform its required tasks so that production is never interrupted

Toyota Production System (TPS): The manufacturing strategy developed by Taiichi Ohno of Toyota, widely regarded as the first implementation of lean manufacturing and the gold standard for all other lean systems

V

Value: A capability provided to a customer at the right time at an appropriate price, as defined in each case by the customer

Value Added: Activities or actions taken that add real value to the product or service

Value-Added Analysis: With this activity, a process improvement team strips the process down to it essential elements. The team isolates the activities that, in the eyes of the customer, actually add value to the product or service. The remaining non-value adding activities ("waste") are targeted for extinction.

Value Chain: Activities outside of your organization that add value to your final product, such as the value-adding activities of your suppliers

Value Stream: The collective value-adding activities required to transform a customer order into delivered product

Value Stream Mapping: Highlights sources of waste and eliminates them by implementing a future state value stream that can become reality within a short time

Visual Control: The placement in plain view of all tools, parts, production activities, and indicators of production system performance so that everyone involved can understand the status of the system at a glance

Voice of the Customer: A program to solicit customer information as a means of understanding how your customers define value, their needs, and their perceptions of your organization's performance

W

Waste: Anything that uses resources but does not add real value to the product or service

Work-in-Process (WIP): Inventory made up of product in various stages of completion throughout the process

World Class: An organization that is operating at a Six Sigma process performance level

Y

Yield: Produced product related to scheduled product; the percentage of good product out of total product produced