QUANTUM LEAN

Taking Lean Systems to the Next Level

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FOREWORD

One of the privileges of working in a university environment is being surrounded by and working with some of the most gifted academics in the world. An additional benefit of being a dean, particularly in a school of business, is being surrounded by and working with some of the most gifted practitioners in the world. I have often observed that academics and practitioners do not always appropriately value each other's contributions to education, research, and the practice of business. However, it is vital that serious scholars continually push the knowledge discovery envelope and that dedicated practitioners put that knowledge to the test in the real world. It is rare to find individuals who bring together the thought process that is typically associated with academics and the vast experiences of long-term practitioners. Sean Fields is one of those rare individuals.

While reading *Quantum Lean*, I was not surprised to find that the author would take a process with which he is very familiar, analyze it thoroughly, look for improvements, add his observations and experiences from years of consulting work, and ultimately turn that process on its head. I was not surprised because the author, Sean Fields, has been a lifelong improver of processes. I know this because Sean is my younger brother. From a very early age, his brilliance and inquisitiveness were evident. He was always thinking, reading, and learning. In high school, when most young people just wanted to take their classes and hang out with their friends, Sean actually took summer school classes so he could free up time for math and science courses during the regular school year. When he had taken all of the math classes that were available in our district, his math teacher (herself an engineer) created advanced math independent studies for Sean to take for no credit during summer vacation. In his undergraduate and master's programs, he was a curve-busting engineering student. Across my 30 years in the academy, I have known many astonishingly smart people. I have yet to meet anyone who has greater native intelligence or natural curiosity than Sean.

Some academically gifted individuals who become experts in a chosen field have *challenging* personalities. Not only is Sean an academically accomplished individual with an impressive practical background, he is also an amazingly down-to-earth man. As you read *Quantum Lean*, you will see this attitude reflected through his tone and concern for all parties in the company—from people who work on the shop floor to high-level decision makers. Make no mistake, he does hold strong opinions and convictions. But these convictions are shared in the way that an accomplished teacher shares information—by being thorough, organized, and evidence-driven.

Sean displays an appreciation and understanding of traditional lean theoretical foundations. However, the focus of *Quantum Lean* is on the product rather than on waste minimization, like is so often seen in business. As mentioned in Chapter 1, some practitioners might be tempted to say that this difference of focus is a "difference without a distinction." Nothing could be further from the truth. Sean provides logical arguments associated with his expertise in traditional lean to show that by following Quantum Lean principles and being product-focused, firms may also ultimately achieve traditional lean objectives including waste reduction. Additionally, he uses his 30+ years of industrial engineering consulting experience with companies in a variety of industries to describe and assess the effectiveness of numerous lean tools. He lays out the pros and cons of popular tools such as 5S, drum-buffer-rope, kanban, and huddle boards. His assessments take into account the potential impact for tool usage as informed by both the manufacturing particulars and the human elements facing decision makers in the real world. In short, *Quantum Lean* provides an uncomplicated, straightforward decision-making framework for potentially realizing all of the promised results that have previously eluded the many believers in and practitioners of typical lean.

L. Paige Fields
Dean, H.D. Price Professor
University of Kansas School of Business

PREFACE

WHY THIS BOOK?

With all of the books about lean manufacturing, you might wonder what possible benefit one more could bring. If I were in your place, I would be asking the same question. However, since we are wondering about the same thing and great minds think alike, wouldn't it stand to reason that you would want to read this book? Further reinforcing our common ground is the fact that I, and in all probability you, have experienced the following:

- When someone says to think outside of the box, *in-the-box* thinking is about to follow
- The moment someone tells you that things will be different, you can be sure that things will be the same
- When someone tells you that things will be the same, you can bet that things will be different
- When you hear businesses say that people are their most valuable resource, you will find that these precious assets are the first to be unloaded when times get hard
- When your work area was changed, you were asked for input, but you will find that your advice was completely ignored

As you can see, we have a lot in common! And the fact that the aforementioned situations are so common is a key motivation for this book. Although no explanation has been found, societal discourse is replete with mixed signals. Whether it's politics, religion, or business, hypocrisy rules the day. This aspect of everyday living is so time-honored that it is the basis for the fairy tale *The Emperor's New Clothes*. On the rare occasion when someone tells it like it is, most people feel an immediate sense of relief and validation. In our minds, we think, "Maybe I'm not so crazy after all!"

With lean as a case in point where one thing is said but something else is done, the goal is to tell it like it is and communicate an interpretation of lean

systems that cuts to the chase. If you have studied this subject, this book will be different from what you're used to. And regardless of your background, I am confident that you will be pleased with what you read.

THE BACKSTORY

"This doesn't work!" This was the thought several years ago when implementing lean at a job shop for custom products. As one example of how the standard approaches weren't fleshing out, the lean team had developed a *value stream map* that revealed nothing. It was all there with the correct symbols, but there was no indication of where any waste existed. All it showed was a sequence of operations, minimal work-in-process (WIP) inventory, and little else. While it was otherwise obvious that the operations were inefficient, one would never know it from the diagram.

To make a long story short, the team relied on common sense in lieu of lean doctrine. While some excellent ideas resulted, it caused a serious reassessment. With job shops constituting a significant portion of the manufacturing sector and my client base, I realized a new angle was essential. And knowing that I couldn't rely on every future group to come up with their own answers, this new approach would need to work in a wide variety of situations.

With logic, inspiration, and real-world application, a new system was developed to implement lean systems. For these situations, it is easy to apply, accurately identifies opportunities, and indicates corresponding solutions. Every. Single. Time. Even better, it can be used in practically any business environment—whether it's mass production, job shops, or services. In order to help others adopt this approach, this book was written to provide explanations, examples, and key details to facilitate the implementation of this system.

INTENDED AUDIENCE

This book is intended for people who work in all economic sectors including service, manufacturing, and government. Some of the types of people who will be interested in this book include:

- Executive level personnel—CEO, COO, president, vice president
- Business owners
- Operations managers
- Plant managers
- Production managers

- Consultants
- Engineers—industrial, manufacturing, production, quality
- Supervisors, lead men, superintendents, foremen
- Rank and file employees

BOOK STRUCTURE

Like any broad-based framework, this fresh approach called Quantum Lean (QL) is an integrated system with the following key pillars:

- *Framework*—to lay a sound foundation, a reexamination of lean principles is presented along with the benefits it brings. To demonstrate QL's power, several pictorial examples are reviewed in order to highlight the waste elimination made possible by the new framework. Where conventional methods might identify two or three forms of waste, the new approach will typically find at least six. By internalizing the QL paradigm, a practitioner will have the grounding to successfully apply QL.
- *Product path diagramming*—with a new view of lean, the next step is *learning to see* using product path diagramming (PPD). For those exposed to value stream mapping (VSM), PPD might seem similar, except that PPD has several edges. Among other things, PPD works. Compared to VSM with its many symbols, PPD is simpler and only has three. In addition, easy-to-follow rules allow rapid prioritization and selection of improvement techniques.
- *Lean tools*—with a new view of lean and knowledge of PPD under the belt, frequently used lean tools are reexamined in light of the new framework. By doing this, one gains an enhanced understanding of the rationale behind lean tools, how they reinforce each other, and when to apply them. Best of all, an understanding of when to avoid lean building blocks is acquired. The tools that will be revisited include:
    - *Product-based layout*—where many businesses lay out shops departmentally (lathes with lathes, mills with mills, etc.) to maximize resource utilization, product-based layout is arranging resources so that product flow is facilitated.
    - *One-Piece Flow (aka Make One-Move One)*—to reduce lead time, this practice immediately moves a product to the next stage of production once an operation is finished.
    - *Kanban*—as a way to regulate inventory levels and flow, kanban signals what to buy/build, when to do it, and in what amount.

- *Drum-buffer-rope*—this approach for scheduling to the pace of an operation's bottleneck improves shop floor control and minimizes lead time.
- *5S*—organizing and cleaning up the workplace.
- *Andon*—a method for signaling the state of the product or process so that responses to breakdowns, parts outages, or slowdowns can be addressed in a timely manner.
- *Quick changeover*—many companies require significant time to switch production from one product to another. Quick changeover seeks setup times so low that they have no influence on a production schedule.
- *Cells*—product-based layout on steroids.
- *QLM (Quantum Lean maintenance)*—harmonizes a lean tool called total productive maintenance (TPM) to the QL framework so that maintenance is subordinated to QL objectives.
- *Work balancing*—distributing work among resources so that efforts are equalized.
- *Standardized work*—improving work methods so that variation in time and quality are minimized and speed is optimized.
- *Quality@Source*—optimizing processes to eliminate product variation and improve quality.

While the first chapters cover the pillars, theory needs know-how. To address this, the chapters that follow include deeper dives into lean tools and other topics that will have tremendous influence on your implementation:

- *QL versus other approaches*—although QL gets a great reception, there will be holdouts who can't see the difference between QL and typical approaches. To help address this, important differences among the systems are elaborated in further detail.
- *Inventory*—a lack of necessary material is a literal showstopper. Techniques to assure a reliable supply of inventory are covered.
- *Shop-floor control/logistics/scheduling*—improper shop-floor control aggravates virtually every efficiency problem an operation will encounter. For a functioning system, groundwork in scheduling, procurement, sales, production, shop-floor control, and inventory control is needed.
- *5S (workplace organization)*—although 5S is spelled out in the S's, reading between the lines is key. Limiting yourself to the 5S script can leave you with equally limited results. To avoid this, guidance is given to get the most from this vital tool.

- *Kanban*—the deep dive on this topic is using this building block in support of inventory control.
- *Quick changeover*—in QL, the criticality of proper scheduling can't be overstated. Without it, efforts at improving efficiency amount to nibbling around edges. At companies with lengthy changeovers, the same can be said about setup reduction. Quick changeover in QL is similar to a technique called *single minute exchange of dies* (SMED). The QL approach is covered in detail.
- *QLM*—by diffracting TPM through a QL lens, the benefits of a maintenance program can be elevated while minimizing the liabilities. The elements of this system are explained along with implementation tips.
- *Standard work*—as QL implementations progress, there comes a point where standardizing work shows up on the radar. In addition to reducing labor costs, substantial benefits can accrue from variation reduction. This chapter covers variation reduction techniques to improve consistency and using the product path diagram to increase speed.
- *Work balancing*—one good way to elevate efficiency is by adopting an assembly line or cellular production. However, like anything worthwhile, legwork is necessary. To cut things down to size, this chapter details a structured approach for efficient and effective work balancing.
- *Cellular production*—of all the concepts that get missed about lean production, cellular flow stands apart. In this deep dive, the power of cellular production is highlighted along with two critical principles to assure that this building block achieves full potential.
- *Quality@Source*—as this lean tool often requires statistical knowledge, coverage is provided on the necessary body of knowledge to maximize this lean tool.
- *Lean implementations*—ask a practitioner about the success rate of lean initiatives (other than theirs) and you might be surprised at how low it can go. Depending on the source, failure rates as high as 95% have been claimed. However, it shouldn't be too surprising since implementations have obstacles that can stymie the most seasoned professionals. Although there are no guarantees, this deep dive offers food for thought on ways to improve the odds.
- Potemkin lean—in a lot of workplaces, all kinds of tools are deployed with the nominal goal of improvement. However, many of these *aids* are just a distraction from productive efforts. At the same time, they are sometimes used to paint a pretty picture that is at odds with a gritty reality. As a way out, an approach that gets great results and maintains appearances is outlined.

ABOUT THE AUTHORS

SEAN FIELDS

Sean Fields, P.E., LSSBB, MSIE, has over 30 years of experience in a wide variety of industries, including oil field equipment manufacturing, food processing, and job shops. As a seasoned industry professional, he has worked in all phases of business, including the shop floor, quality, safety, and engineering. Over the years, he found himself in a great deal of situations where he was expected to implement lean approaches in environments where conventional lean methods were impractical. However, by returning to the fundamentals pioneered by Henry Ford, Fields found that lean could be sustainably applied in practically any setting. With successful implementations in the most challenging environments, he now wants to share his experiences, ideas, and approaches for businesses to reach the next level of success.

In addition to being an active lean practitioner, Sean is a network member of the non-profit organization BeehiveFund, that assists companies with production scheduling, inventory control, and developing quality management systems (ISO 9000, AS9100, and API Q1). He is also a columnist for the Lubbock Avalanche Journal, a licensed professional engineer in the state of Texas, a certified Six Sigma Master Black Belt, and a certified QMS auditor. He resides in Lubbock, TX, with his wife and has two adult daughters. For further information, please refer to his LinkedIn profile: https://www.linkedin.com/in/sean-fields-21290b45/.

Acknowledgments

I have been blessed by so many outstanding people in my life that I can't give proper acknowledgment to any one person without short selling someone else. With that being said, I couldn't imagine a better family (including in-laws!) than the one I have. They are better than any mortal deserves. On top of this, I have so many colleagues, mentors, coworkers, and friends who have influenced my thinking and helped me through thick and thin that I can't extend enough gratitude. You know who you are, it's all remembered, and will always be appreciated.

MICHAEL SANDERS

Michael Sanders, PhD, LSSBB, MBA, is the cofounder of BeehiveFund, a nonprofit organization dedicated to assisting industry. Michael has worked in every phase of the supply chain at a wide variety of companies, including serving as CEO and president of food, energy, distribution, and high-tech firms. Along this journey, he and Sean have collaborated extensively to refine the Quantum Lean framework and successfully deliver their lean methods to numerous companies.

In addition to his work as a seasoned executive and practitioner, Dr. Sanders is sought after for his expertise in negotiation, organizational psychology, Six Sigma, quality systems, and regulatory compliance. He has delivered speeches worldwide on topics that include global supply chain optimization, lean and beyond lean production systems, quality and regulatory systems, optimal and effective leadership, product-centered sustainable growth, organizational culture transition, and emerging technologies. Michael has a PhD in Industrial Engineering and an MBA from Texas Tech University. In addition, he holds a certification as a Six Sigma Master Black Belt. He resides in Houston, TX, with his wife, two sons, and one daughter. For further information, please refer to his LinkedIn profile: https://www.linkedin.com/in/dr-michael-sanders-8049a290/.

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My deep gratitude also goes to my coauthor, Sean, whose persistence and strong belief made this book a reality. I have learned invaluable lessons from Sean over the years that have validated many of my organizational improvement approaches and methods that have resulted in unprecedented successes. Finally, my thanks to all of my family members and friends who have supported me unconditionally over the years, making it possible to field-test and confirm my theories on organizational improvement.

This book has free material available for download from the Web Added Value™ resource center at *www.jrosspub.com*

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Downloads for *Quantum Lean: Taking Lean Systems to the Next Level* include a/an:

- Overall Equipment Effectiveness Data Collection Form—A form to facilitate data collection for overall equipment effectiveness.
- Time Study Data Collection Sheet—A form to facilitate data collection for time studies.
- Lean Assessment Sheet—A customizable spreadsheet to benchmark an operation against Quantum Lean standards
- Job Information Sheet—A form to document the inputs necessary for developing standard work methods. It also serves as a memory jogger to assure due diligence in developing consistent methods.
- Standard Work Priority Method—An instruction sheet to assess jobs and determine priority for developing standard work methods.
- Reorder Point Spreadsheet (Data Poor Cases)—To aid in estimating reorder points, this spreadsheet generates random usage data based on triangular distribution. Using this data, maximum usages can be estimated for various lead times.

CHAPTER 1

DEFINING QUANTUM LEAN: PART 1

"Lean is a way of thinking, not a list of things to do."

Shigeo Shingo

Before implementing lean, you need to know it; and in order to really know it, a consistent understanding is critical. When lean is mentioned, everyone imagines a different picture. Think about the inkblot tests psychologists give. The image is only a random splash. What's seen says everything about the patient and nothing about the inkblot. Similarly, interpretations of lean vary according to individual motivations. This inconsistency poses a barrier to effective execution. To address this, Quantum Lean (QL) operates from one ironclad viewpoint. However, before embarking on a QL journey, consider the following example to help establish your baseline mindset regarding lean.

Imagine a business where customers contact the company for information by phone. In one situation, an employee picks up the phone and handles the caller's inquiry (see Figure 1.1).

Figure 1.1 Human versus automated: human

In the second case, an automated answering system greets the customer, and the caller navigates a menu until they address their problem or reach someone who can (see Figure 1.2).

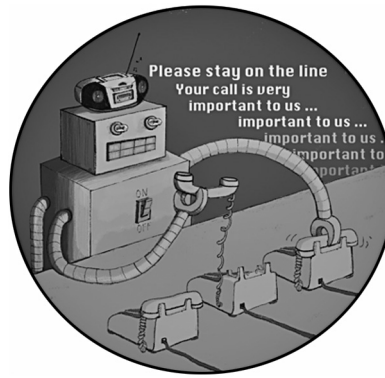

Figure 1.2 Human versus automated: automated

Which system is lean? While QL provides an answer, baselining perceptions is the object for now. Make a note of which scenario you consider lean and why. As you make your way through this book, you might change your mind! With your interpretation established, it's time to introduce the QL understanding of lean and contrast it with more conventional approaches.

In a nutshell, QL's mission is to minimize the time required to give the product what it needs. As an illustration of this idea, consider the movie *Castaway*. In this film, Tom Hanks plays a FedEx employee who gets stranded on a desert island. While the entire movie is worth watching, the part that speaks to my inner lean practitioner is a scene where Tom enters a FedEx facility. Upon his arrival, a kid hands him a package, which is then opened. And what is in this package? A clock that shows 72 hours. In other words, Tom mailed himself a clock to determine how long a package spends in the FedEx system. With a 24-hour turnaround being the goal, the fact that this shipment had taken three times as long was a pretty bad sign.

Think of your company in the same way. If you dropped material to your shop floor and placed a timer on it, what would it say when the order is ready to ship? In this book, I will argue there is no better measure of the health of your business than *time*. If it takes a long time to finish a product, you are inefficient. If the product moves quickly, you probably run a tight ship. Ultimately, the goal should be for the product's clock to show the lowest possible number. In a perfect world, it would register zero.

Expanding on this point, lean has been described as: *eliminating waste through flowing the product*. Too often, typical approaches stop with the first two words—eliminating waste—and ignore the rest. By contrast, QL focuses on minimizing a product's time in the system by flowing the product (see Figure 1.3).

	Typical Lean	Quantum Lean
Definition/ Objective	Eliminate waste to minimize cost	Eliminate a product's time in the system to eliminate waste and minimize cost

Figure 1.3 Typical versus QL

Although the QL wrinkle might seem like a distinction without a difference, it's a subtle twist that allows for a radical improvement in simplicity and effectiveness.

While confronting waste head-on might seem like the best way to eliminate it, QL leverages the fact that wastes share time as a common denominator. The idea is similar to a strategy that contributed to winning World War II. Rather than munitions, weapons, transportation, and other military assets, the Allies prioritized ball-bearing facilities as a target. By eliminating the one thing upon which everything else depended, the Axis war machine was ground to a halt (see Figure 1.4).

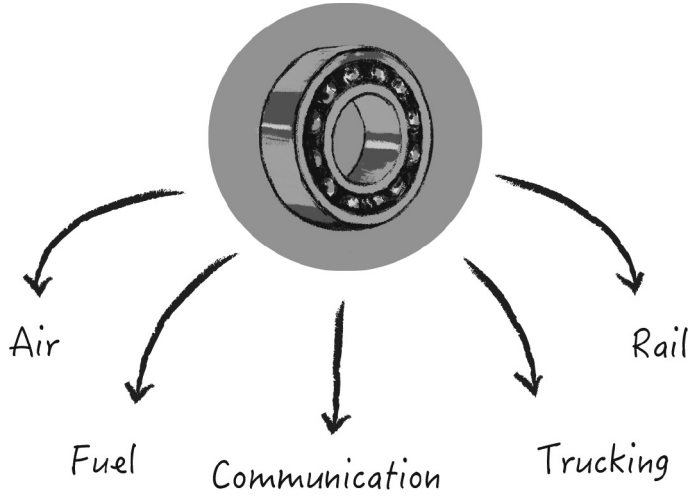

Figure 1.4 Bearings and products

In other words, victory became simpler. Similarly, by attacking a product's time-in-system, addressing waste is simpler as well. Time-in-system is the fuel that feeds waste. You can attack waste in its multitude of forms, or you can focus on one thing (see Figure 1.5).

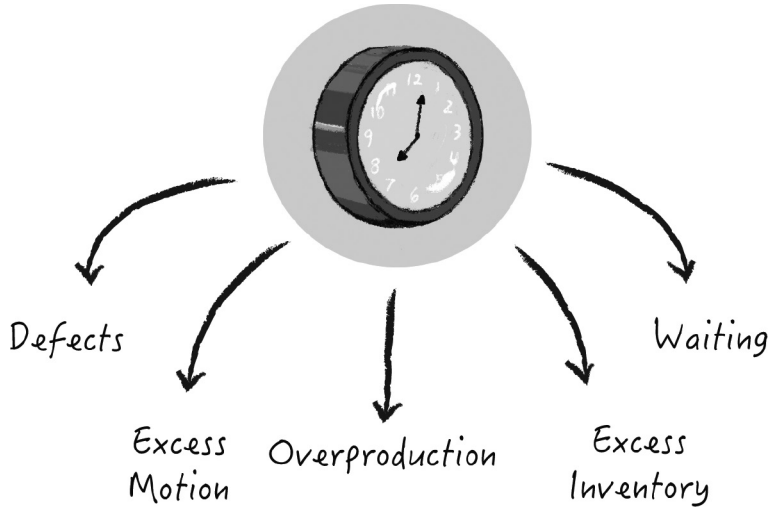

Figure 1.5 Time and wastes

While either method works, minimizing time is faster, easier, and more effective. Not only is QL a simpler approach than traditional lean, it is also the difference between *lean and mean* and *skinny and pissed*. Typical lean initiatives can become so cost-obsessed that customers, employees, and shareholders get shafted. QL avoids this trap. As a case in point, consider the airline industry.

Out of all the airlines, one consistently earns a profit, maintains high customer satisfaction, and has excellent employee relations. Which one? Southwest Airlines. As of 2020, Southwest has achieved 47 consecutive years of profitability. By comparison, other airlines lose money and go bankrupt with astonishing frequency. In addition, Southwest consistently comes out at the top of customer satisfaction rankings. Furthermore, Southwest is frequently rated as one of the best places to work in America. The company heralds a track record of zero lay offs and zero pay cuts since its inception.

How is this done? Southwest focuses on flow and time-in-system while the other airlines are waste-obsessed. When a Southwest plane lands, the overriding goal is to unload, load, and take off as quickly as possible. By contrast, other airlines squeeze in more customers and employees while remaining indifferent to gate times.

During a lengthy layover with one of Southwest's competitors, a plane arrived at my gate three hours before my departure. When a fellow passenger asked if I thought that was our flight, I replied that it wasn't possible. No airline would allow that much idle time. As it turned out, it was our flight!

If you are wondering why this matters, one major benefit from quick turnarounds is that freed-up time allows more flights to be scheduled. Since airlines make their money at every departure, Southwest maximizes the number of times they can earn. In addition to increased cash flow, this unique approach optimizes the company's cost structure.

Like many breakthroughs, Southwest stumbled onto this. In the beginning, they owned two planes and borrowed one to serve three cities. Eventually, the loaner's owner wanted their plane back. With a smaller fleet, Southwest faced a dilemma. Lacking capital, they couldn't acquire a plane. On top of this, they couldn't afford to cut their service. Instead, they investigated how to handle their routes with the remaining planes. In the end, they found that minimizing gate time enabled just that. In this happy ending, Southwest served all their customers with two rather than three planes. In other words, they achieved the same sales with two thirds of the overhead. Doing so converted a moderately profitable business into an industry leader.

In addition to increasing profitability directly, minimizing time-in-system accomplishes indirect benefits as well. When flow is achieved, the following benefits occur:

- *Customer satisfaction increases*—facilitating the product is another way of prioritizing the customer. Even if the two never meet, an employee indirectly serves the customer by serving the product.
- *Employee morale increases*—if the product is truly prioritized, barriers to employee effectiveness are minimized. The job gets easier and innate satisfaction comes with a job well done.
- *Shareholder morale increases*—with more money from increased cash and reduced cost, how could it not?

Real-world examples, like Southwest, demonstrate how QL enables employees, shareholders, and customers to share in the benefits for a win/win/win situation. When following the central organizing principle that time is money, much can be accomplished. In addition to being conceptually sound, the fact that practically everyone agrees on this point makes for a unifying principle. Ironically, even though most agree with the phrase: *time is money*, few can explain why this is true—and this should be expected. Since most of us have been exposed to this notion from infancy, it's not human nature to question long-held beliefs. However, to implement QL effectively, it's essential to grasp this point on an

intellectual, not just visceral, level. With illustrations of the power behind this adage, you will gain this understanding along with a renewed gut-level appreciation for this phrase.

SIDEBAR—WHY DO WE RESIST CHANGE?

Investigating a new idea is ultimately entertaining the possibility of change. At the same time, for all that we explore, isn't it amazing how few of us take the next step? Taken further, it could be argued that people resist change at every turn. Why? All kinds of reasons are offered:

- *Comfort zone*—people are in a groove and want to continue in it
- *Discipline*—the effort to sustain a change is too great
- *Fear*—change is unknown and people fear this
- *Company politics*—turf battles block change
- *Apathy*—people don't want to be bothered

While all of these explanations are valid, what's annoying is that they are offered to the exclusion of the elephant in the room: change is bad. By an overwhelming margin, changes typically offer no benefit or they create massive burdens. Sometimes, they offer both. Consider:

- Do bills generally increase or decrease?
- How often is the new plan better?
- When an employer changes a business, how often does it bring better customer relations, an improved workplace, or increased employee morale?
- How often do beloved products and services get discontinued?
- After an election and regardless of who wins, do the people not lose?

There is more, but the most likely reason that people resist change is due to its bad track record. If you doubt this, consider a winning $100,000,000 lottery ticket. Upheaval is in store for anyone who accepts it. Hasn't everyone heard about lottery winners who consider it the worst thing that ever happened to them? Despite the barriers to *buy-in*, what's the chance that someone would decide to go ahead and buy a winning ticket? Conservatively, 100%! Even though this option plows uncharted territory for most and will shake a person out of their comfort zone, who wouldn't jump on this with both hands and feet? Obviously, the reason is that this particular change is perceived as beneficial. To this point, if a plan offers a credible prospect for low risk, high reward, and minimal cost, buy-in is not nearly as difficult. The frequently mentioned reasons to resist change remain, but the biggest reason for pushback will disappear.

And the good news is that lean systems offer overwhelmingly positive change when done correctly. The key lies in an approach called QL that casts aside the tired approaches that come with typical programs. This book presents an explanation of this system, what makes it tick, and the benefits that it offers.

CHAPTER 2

DEFINING QUANTUM LEAN: PART 2

"The longer an article is in the process of manufacture, the greater is its ultimate cost."

Henry Ford

"Time isn't the main thing. It's the only thing."

Miles Davis

While it's one thing for a stranger to say that time is money, none other than Henry Ford made this idea the basis for his success. The key insight that drove Ford's approach is that the longer a product stays in production, the more it will cost. Although the idea may seem obvious, few can explain why this is true. Ironically, as little as people ponder this, there is a lot of science to back it up. Consider an equation called Little's Law (see Figure 2.1):

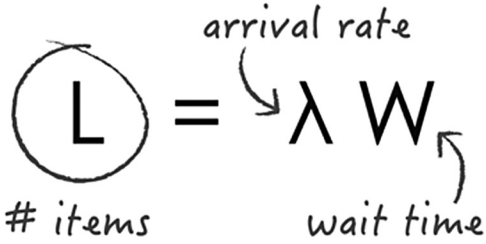

Figure 2.1 Little's Law

We can think of this formula in terms of a town's population:

Population of a town =
(arrival rate of new citizens) × (average time that citizens live in town)

For example, if 1,000 people arrive per year and each person lives there 10 years, this means that the average number of people living in the city is 10,000:

Population of town = (1,000 people/year) × (10 years) = 10,000 people

For a business, the amount of money tied up in production can be thought of as is depicted in Figure 2.2:

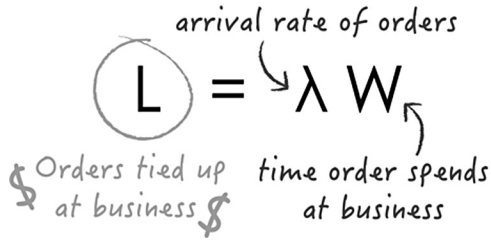

Figure 2.2 Little's Law explained

Orders that stay at a company longer mean that more orders will be tied up at any one time. Since orders are denominated in dollars, that also means more money is tied up, resulting in greater costs. Since you may be wondering how this translates into cold hard cash, a few tangible illustrations will drive the point home.

TIME IS MONEY

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

Shigeo Shingo

Tires

In the correlating photo (see Figure 2.3), tires accumulate on carts at a tire retread facility. Once a cart is full, it moves to the next stage of fulfillment. Thinking of the buildup on the cart as a batch where tires wait to be moved to the next step, it's clear that the first tire will be there awhile. In other words, this accumulation represents time. Why does it cost money? Here are two common answers that people will give:

- *Carrying cost*—a frequent answer is that the excess work-in-process (WIP) inventory represents tied-up money. Although accurate, how much does this matter when interest rates are low?

Figure 2.3 The tires

- *Sales lag*—people might also respond that delaying the semi-finished product means a slower turnaround on sales. While true, this affects cash flow and opportunity cost, but not operating expense.

Once these answers are given, most people will be at a loss to come up with more. Let's dig deeper:

- *Handling*—when WIP inventory accumulates, handling follows. Picking up, putting down, stacking, unstacking, and counting are a few possibilities.
- *Aggravated defects*—if the operation underway was done improperly, that means the entire cart will be bad. By contrast, if a completed subassembly could be sent to the next station right away, how much bad product might be prevented? In addition, other risk-related costs from this WIP include:
  - *Disposition*—obviously, evaluating bad product requires time, paperwork, and effort
  - *Scrap/rework*—lost material in the case of scrap and squandered man-hours are experienced in the case of rework
  - *Storage*—storage in the form of cabinets for the scrap, disposition, and rework records and extra office space for the cabinets must be provided

- *Cart*—the carts that carry the tires didn't miraculously appear; someone had to buy the materials and build them. Other costs include:
  - *Maintenance*—anyone who has used a shopping cart has probably been annoyed by casters with wobbly wheels. The carts in the picture have casters that need periodic replacement.
  - *Miscellaneous*—the casters on these carts are too small. Combined with the joints that concrete floors have, these carts get stuck.
  - *Safety*—with such a narrow base, the cart might occasionally fall over when it gets stuck.
  - *Space*—the excess WIP occupies excess space.

Stampings

Looking at the basket brimming with fabricated pieces (see Figure 2.4), the pieces that are at the bottom are going to be there quite a while. How does this represent money? Consider some of the added expenses that are related to this:

- *Baskets*—baskets aren't cheap.
- *Cosmetics*—as the parts rub together while they sit in the basket, cosmetics are compromised. Some additional costs from this include:
  - *Rework*
  - *Scrap*
  - *Lengthy Debates*—when cosmetics enter the picture, debates soon follow. Since appearance standards are typically vague, dispositioning questionable parts has a way of degenerating into a back-and-forth between production and quality. To make a long story short: some good product gets scrapped, some bad product gets sent, and employees waste a lot of time in discussions in order to arrive at this ideal outcome.
- *Material handling equipment*—since the baskets are too large for an employee to pick up or drag around, a material handling device like a forklift is necessary. On the one hand, there are many costs associated with forklifts, including capital expenditure, safety risks, training, fuel, and maintenance. On the other hand, some businesses might try to avoid using forklifts by equipping the containers with casters or using a less expensive device like a pallet jack. These options are not free. For the basket with casters, the wheels need to be periodically replaced. For the other option, the business has to buy the pallet jack.

Figure 2.4 The baskets

- *Safety*
  - To get parts at the bottom of the basket, people must stoop. This means awkward body mechanics that increase the odds of injury.
    - To address this, some companies might invest in a lifting and/or tilting device. Again, the devices cost money.
  - When stooping, people will lean against the baskets and increase the chances that the baskets collapse.
  - Since material handling equipment is necessary, forklifts entail elevated safety risks due to power and mass.
  - If a pallet truck is used, pallet trucks are trip hazards.
  - If a pallet truck or wheeled basket is used, manually driven transportation requires exertion which always adds risk.
- *Space*—empty or full, additional room must be made for:
  - *Baskets*
  - *Pallet trucks*—if they are used.
- *Handling*—besides the full baskets, empty baskets must be dealt with. If space is limited, someone must collapse the baskets so they can be stacked higher and free up space.

The Gathering

In many plants, the sight of a room cluttered with baskets, trays, and carts (see Figure 2.5) is extremely common. As WIP is built up, it has to be sent somewhere to wait. In addition to all of the costs that were enumerated in the previous two scenarios, there could be further costs:

- *Misplaced material*—anyone who has worked in even the smallest facilities knows that misplaced orders are a fact of life. Adding insult to injury, scattered WIP compounds this problem with the following side effects:
  - *Late delivery*—while most jobs will eventually be found, the time spent retrieving necessary parts increases the prospect for a late delivery
  - *Effort*—personnel must be assigned to and paid for finding the lost orders
  - *Write-offs*—occasionally, jobs aren't found and the materials must be written off
- *Pilferage*—just as no one is likely to notice when a small quantity of material or a small item is stolen, it's much easier to steal from a crowded space than it is from a clear one. And no matter how trustworthy a workforce may be, the chance of pilferage remains because a company has no control over the integrity of outsiders.
  - *Added security*—if the merchandise is valuable enough, businesses will invest in personnel and/or equipment to secure and to insure their valuables

Figure 2.5 The gathering

- *Handling*—beyond the normal handling, baskets must be moved out of the way to get to the load an operator needs; and then must be returned to their original positions.
- *Damage*—the longer that product sits in storage, the greater the chances of deterioration, damage, or obsolescence. To address this, some companies might apply coatings or wraps for protection which entails:
  - *Labor*—the time required to coat, wrap, or otherwise protect the parts
  - *Protectant*—the applied protectants cost money
- *Materials management*—there is a significant amount of manpower necessary to track orders, maintain traceability, and account for quantity and location

The Tote

In the corresponding figure (see Figure 2.6), a company handles subassemblies by the tote bin. While it may seem harmless enough, there are costs.

- *Tote bins*—the cost of the tote bins must be considered
- *Safety*—having so many parts in one tote bin results in a heavy container, which increases the chance of injury when it's lifted
- *Product*—being so heavy and girthy, there is a chance that a bin will be dropped every now and then resulting in possible:
  - *Product damage*

Figure 2.6 The tote

- *Injury*—when parts fall from an elevated height, the chances of foot injury significantly increase
  - To address these types of risks, a business might require steel-toed shoes, which entails expense

The Partial

In the photo depicting a stockpile of partial orders (see Figure 2.7), a company wanted to improve delivery by producing components ahead of time, storing them until an order came in, and then assembling them into finished product. As the thinking went, the lead time would be reduced and on-time delivery improved. But, at what cost?

- *Transportation*—to put the components in hibernation, they have to be moved into storage.
- *Obsolete product*—what if you build it and no one comes?
- *Skid*—in this case, a skid is necessary for efficient movement. And no matter how you slice it, skids cost money. In particular, free skids are expensive as they are often in poor shape and break, thereby damaging product, property, and people.

Figure 2.7 The partial

- *Mishaps*—is it possible that these skids have been spilled?
  - *Time*—someone has to put the pieces back together
  - *Safety*—falling product puts bystanders at risk
  - *Product damage*
- *Stretch wrap/straps*—to prevent spillage, some companies might want to use strapping or stretch wrap. Strapping requires straps, an application tool, and the labor to install. In addition, straps are often over-tensioned and fly away when cut. This causes safety issues. If stretch wrap is the choice, consider some of the costs:
  - The stretch wrap itself
  - Manual stretch wrap applicator
  - Excess stretch wrap when applied manually
  - Time to apply stretch wrap
  - Time to remove stretch wrap
  - Box cutters to remove stretch wrap
  - First aid when people cut themselves using box cutters
  - Gloves to avoid cuts from box cutters
  - Disposal cost of stretch wrap
  - Automatic stretch wrap machines are often purchased after employees tire of manually applying stretch wrap and management grows weary of excessive stretch wrap usage (although these machines are very efficient, they are costly and must be maintained)
- *Rework*—these skids are stored outside. When the metal pieces rust, the rust will have to be removed before assembly can take place.
- *Protectant*—to prevent rust, protectant may need to be applied.

The Staging

In the Buddhist faith, it has been said that monks painstakingly carve intricate figures out of butter and let them melt in order to reinforce the idea that all things are temporary. Whether or not this is true, I choose to believe it because I want to make a point. Like the carving, the skids in the staging photo (see Figure 2.8) represent a significant time investment. And, like the butter, this work will melt away when it's time to load trailers. However, unlike the Buddhist handiwork, insult is added to injury as an equal amount of time and effort will be required to undo all of the staging. Based on the previous examples, are you starting to see the cost implications of handling, floor space, product damage, investment, and workplace safety?

Figure 2.8 The staging

TIME AND WASTE

In the previous section's examples, costs weren't enumerated repeatedly. Instead, new costs were identified in every case. Like the proverbial onion, the interplay between costs and time often results in a staggering number of layers underneath the surface. Although it's not critical to be able to recite all of the expenses that accrue from time, an appreciation of this relationship is crucial. The beauty of Quantum Lean (QL) is that while focusing on minimizing time, its application imparts an ability to reflexively identify waste.

While time is money, what makes matters worse is that once time is allowed a toehold, the resulting wastes feed off of each other and require even more time, creating a vicious cycle. Fortunately, when time is drained, this vicious cycle reverses itself and becomes a virtuous cycle. A visualization of how these elements feed off each other is shown in Figure 2.9:

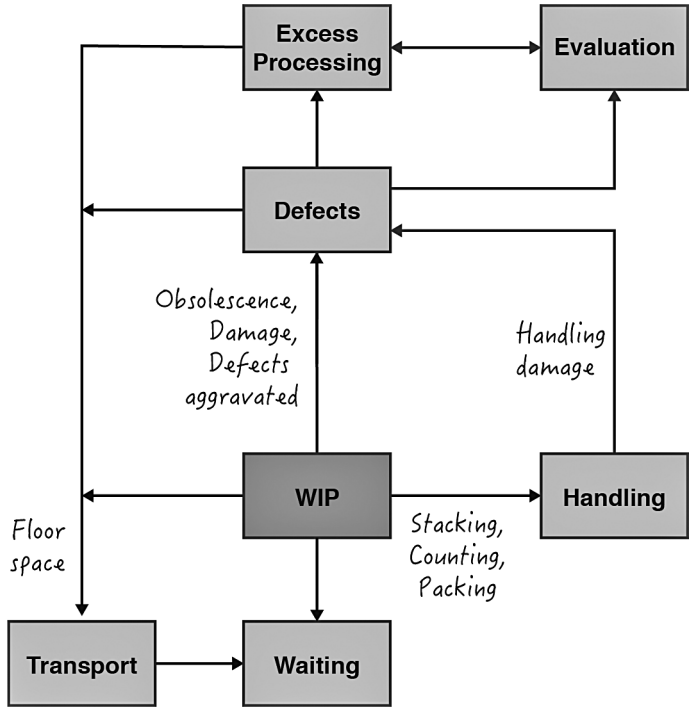

Figure 2.9 WIP and waste

The common factor behind these wastes that feed off each other is time. As was stated before, *attack time and the wastes go away*!

QL FOUNDATION

With a gut-level understanding that time is money, it follows that QL's mission is minimizing the time required to give the product what it needs. Ultimately, the goal should be for a product's clock to show the lowest possible number. In a perfect world, it would be zero.

When minimizing time, categorizing it will help prioritize your efforts (see Figure 2.10). In QL, a product's time in fulfillment is classified in one of three ways:

- *Conversion*—this is when the product is being transformed by a resource into a configuration that is closer to finished form. Although typical lean approaches use the term *value added*, QL uses the term *conversion* for reasons that will be explained later.

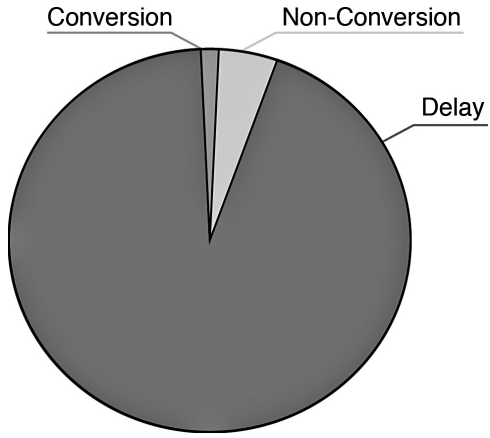

Figure 2.10 Time-in-system pie chart

- *Non-conversion*—this is when the product is being attended to by a resource but is not brought closer to the finished form. For simplicity, QL limits this category to moving, handling, rework, and inspection. If the resource is doing anything outside of these four activities, it is classified as conversion.
- *Delay*—the time when no man, machine, or any other kind of resource is expending effort on the product is delay. Put another way, delay is when the product is collecting dust.

When you consider time, remember that this is all strictly from the standpoint of the product. That is, you should only concern yourself with the resource's time when it is serving the product. From the pie chart in Figure 2.10, you can see that most of the time a product spends at an average business is in a delay mode. This means that the product is sitting with nothing being done to it. However, the good news is that this common situation allows a lot of opportunity for improvement. While time should be minimized regardless of its form, it pays to focus on where most of the time is spent. As the saying goes, hunt where the ducks are. If most of the time lies in conversion, prioritize reduction in conversions. If most of the time is tied up in non-conversion, try to eliminate that instead. However, in most cases, delays should be attacked first since they typically consume most of the product's time. Here are some additional reasons why delays are a great initial target:

- Where there is a delay, it often creates the need for a non-conversion activity. If you can eliminate the delay, you generally get rid of non-conversion at the same time. It's like killing two birds with one stone.

- Delays impair the efficiency of conversion operations. When delays are eliminated, conversion steps tend to get quicker. At the same time, as delays cause the lion's share of your workforce's frustrations, employees will appreciate life being made easier.
- Too many businesses initially look at conversion to make efficiency improvements. In a sense, this amounts to blaming the workforce for a business's shortcomings. By attacking delay first, the focus is on a system that is probably victimizing its employees. In addition to being the most effective initial step, focusing on delay rather than on conversion shows a vote of confidence in your people.

I cannot emphasize enough that the objective of the QL process must be minimizing the time required for a product to get what it needs. While typical explanations of lean revolve around the idea of *eliminating waste* until only *value-added* processes remain, nothing should be considered off limits. After all, if you could drain a *value-added* process of all its time and still get the same quality product, why wouldn't you? Again, as long as the product gets what it needs, the whole mission should be to eliminate time, regardless of its form. The only question is where the richest opportunities lie. In the absence of hard data, the order of attack should be:

- Delays
- Non-conversion
- Conversion

Although the idea is simple enough, QL is a comprehensive framework that provides a foundation that supports the objective of giving the product what it needs as quickly as possible.

SIDEBAR—CAUTIONARY TALE

When attacking time-in-system, avoid the trap that Schlitz Beer fell into back in the 1970s. Many years ago, Schlitz consistently occupied one of the top two spots in the United States market. However, along the way, Schlitz started tampering with their processes to reduce brewing time. Early on, a lot more beer was produced from the same plants and the margins reflected this. The downside was that all the production changes added up to plummeting quality. Over time, Schlitz fell from its lofty perch and, by the 1980s, had to close their flagship Milwaukee plant. Shortly after, they were acquired by another company and have remained insignificant ever since. Schlitz never recovered from shortchanging the product. Don't make the same mistake!

CHAPTER 3

DEFINING QUANTUM LEAN: PART 3

To realize Quantum Lean's (QL's) full potential, we must first establish its foundation. This solid foundation, in turn, allows the implementation of QL to undergird other initiatives that can be used to bolster an organization. In order to understand how QL fits in a comprehensive management system, it is critical to describe each foundation stone and the sequence in which each one is laid—known as the QL Hierarchy—in order to usher in the best possible outcomes (see Figure 3.1).

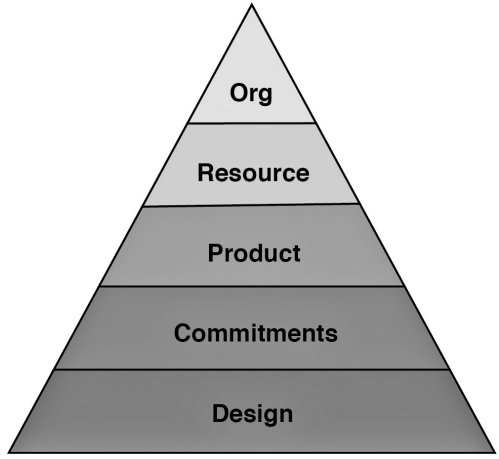

Figure 3.1 QL Hierarchy

CLARIFICATION OF EACH FOUNDATION STONE

Design

Product design has a significant impact on every other aspect of an organization's ability to serve customers. Improper specification, inadequate design

criteria, and indifference to downstream processes enshrine inefficiency and alienate buyers. A design that ensures maximum function while using minimal resources lays a perfect foundation for effective sales and operations.

Commitments

A company is only as good as its ability to fulfill commitments. If deliveries are late, quality is suspect, or service is inadequate, the first order of business should be getting these shortcomings addressed. However inefficient it may be, a company should institute immediate action to reestablish its solid footing. With the customer base secured, time can be bought to achieve sustainable improvement.

Product

Ideally, with commitments kept and design under control, QL is introduced by prioritizing, analyzing, and optimizing a product's time-in-system. As a contrast, typical organizations often obsess over labor hours at the expense of the time that a product spends in a facility. Since the money spent on facilities, material handling equipment, transportation, and product damage is dictated by a product's time-in-system, this all-too-typical approach bypasses some of the biggest and best targets for improving efficiency and reducing costs.

Process

Once a product's time-in-system is on the way to being minimized, QL's next priority is optimizing processes for reduced cycle times and improved consistency. In particular, process stability and capability are critical for uninterrupted flow and quality.

Resource

Once a product's time-in-system has been substantially reduced and processes are largely stable, QL's next priority is increasing resource utilization and minimizing operating costs. These efforts may include automation, software applications, and other resources to optimize the results achieved in the previous QL stages.

Organization

Since prior foundation stones have largely been laid at this point, additional improvement is made possible by harmonizing the remaining portions of the organization that have not been aligned to the QL system.

While it's entirely possible to pursue every foundation stone simultaneously, the QL hierarchy represents an ideal order of attack for enhancing an organization. Although it is unlikely that any company can follow this hierarchy precisely, the main point of describing this scheme is to suggest an orderly, staged approach to thinking about improvement. Again, perfection is not expected, but having a proper framework from which to work will provide guideposts on the path to excellence. Ultimately, the good news is that maintaining product centricity offers great prospects for success regardless of the sequence in which improvements are carried out.