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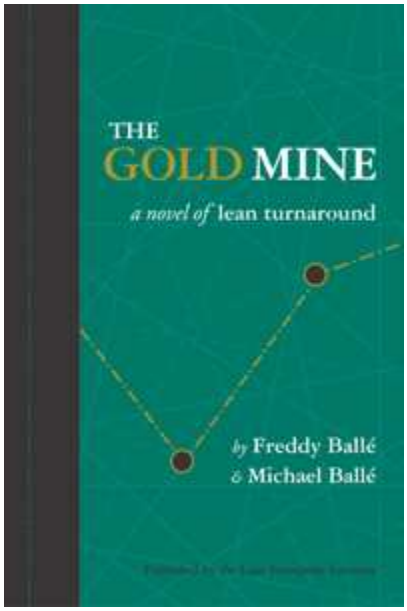

The Gold Mine: a novel of Lean Turnaround

By Freddy and Michael Ballé

Summary

The Gold Mine: a Novel of Lean Turnaround deftly weaves together the technical and human pieces of implementing lean manufacturing in an engaging story that readers will find both compelling and instructive. Authors Freddy and Michael Ballé have produced the first integrated and systematic approach to a set of ideas that have maximized value and minimized waste throughout the world.

At the heart of the *Gold Mine* is Bob Woods, a curmudgeonly sensei coaxed out of retirement by his son Mike to help boyhood friend Phil Jenkinson save his struggling company. Despite terrific products and a backlog of orders, Phil's company cannot generate enough cash from its operations to pay its bills. And so Mike enlists Bob to help his pal fix this crisis.

"You're trying to deal with your mess as if it was a technical problem," Bob tells Phil. "Move this machine here, change this design there, which it is to some extent, but … it's all about people. You have a leadership problem not just a production or business problem." As Phil begins to tackle the key challenges necessary to improve his company's operations, he comes to understand the deeper points of lean. Readers will also draw powerful insights from his journey.

The *Gold Mine* presents all the key lean principles, ranging from well-known ideas such as pull and flow, to lesser-known yet equally important principles such as jidoka and heijunka. The book also reveals lean as a system—using a realistic story to show how the principles are interrelated and how they lead to useful tools such as kanban or 5S.

"*The Gold Mine* is the first book to comprehensively introduce all the lean tools by means of a vivid personal story showing how hearts and minds are won over, said publisher James Womack, LEI president and founder. "It will spark ah-ha's from everyone who has been there and provide profound insight for those who are just getting started."

"Reading *The Gold* Mine is like eavesdropping on a sensei dispensing gems to a client," says co-publisher Daniel Jones, founder of the Lean Academy in the UK. "Readers, especially those individuals working on the shop floor, will gain revelation and inspiration by living through the experiences of the hero. Managers and executives just beginning a lean transformation will learn valuable insights about how to sidestep the technical and people problems that lay ahead. And experienced lean thinkers will discover fresh insights about overcoming resistance to change."

While *The Gold Mine* represents LEI's first book of fiction, Womack envisions it as a natural complement to the workbooks that have established themselves as the leading guides for learning lean. "*The Gold Mine* was created on the premise that people have different learning styles, and that a set of ideas based on the shop floor—where the action takes place—can be grasped intuitively by illustrating how one particular company responds," he says. "It complements our established products by presenting a different but equally vital method of sharing knowledge."

About the Authors

Freddy Ballé worked as a manufacturing and engineering manager at Renault for 30 years where he was manufacturing engineering director and then Industrial Vice President for the Renault truck business, Renault Industrial Vehicles (RVI). He started visiting Toyota plants in Japan in the mid-1970s, where he discovered the power of the Toyota Production System.

On leaving Renault, Freddy became technical vice president of Valeo, where he created the Valeo Production System, based on Toyota practice, which pioneered lean implementation in continental Europe. He was then CEO of the French automotive supplier Sommer-Allibert, where he introduced the Sommer-Allibert Excellence System. He wound up his corporate career as technical vice president of the French automotive supplier Faurecia as it implemented the Faurecia Excellence System.

In recent years Freddy has founded ESG Consultants (www.esgconsultants.com) to advise industrial clients on making the lean transformation described in *The Gold Mine*.

Michael Ballé, business consultant and author, is co-founder of the Project Lean Entreprise (www.lean.enst.fr). This is France's leading lean initiative, conducted in collaboration with Telecom Paris, where Michael is associate researcher. For over a decade, he has focused on the human implications of lean implementation in fields as diverse as healthcare and administrative processes. He has published several books on these topics. He is Freddy's son.

Who Benefits

Organizations at any level of a lean transformation, particularly (though not exclusively) those just beginning will benefit from *The Gold Mine.* Managers, executives, operators, engineers, supervisors, technical support personnel, and change agents just beginning a lean transformation will get valuable insights about how to sidestep the technical and people problems that lay ahead. Experienced lean thinkers will get new insights into overcoming resistance to change.

Q&A with the Authors

"Lean is a practice, not a theory"
An Interview with Freddy and Michael Ballé, authors of *The Gold Mine*

Q. How does The Gold Mine fit in with existing literature that teaches lean thinking or change management?
A. The truth is that part of what makes lean difficult is the linkage between change management and the lean tools. Most books that tackle both lean thinking and change management tend to approach these subjects separately. First they'll describe the lean tools, and then they'll go into change management theory. With The Gold Mine, we've tried to deal with these two themes concurrently, progressing on both fronts at the same time.

This approach also addresses one of the reasons that it's so hard to find any workable lean "recipe," which is that the tools, or at least their level of implementation, must be linked to the management's lean maturity. For instance, we would argue that lean is fundamentally about rigorous problem solving and involving operators in kaizen. Fine. But in most working environments, if you start there, as most TQM or six sigma programs do, you will end up with disappointing results. People will get confused about which problems to solve, how to go about change, and what kind of attitude to adopt when dealing with resistance or recurring problems. In a factory it's usually easier to start a lean program with the basics, such as seven wastes, 5S, red bins for quality, reducing batch sizes by increasing tool changeover, and moving progressively to eliminating variation in the operators' work cycle.

This is why senseis have a hard time giving the whole story upfront. They need to enable people to realize small and tangible results, which they can then build on. This is the only meaningful way to move forward. We've tried to capture this way of learning in The Gold Mine. It's a very different-and effective-approach to change management.

In fact, we had originally planned to write a book about lean and change management, but soon realized that precisely because it does not fit with the accepted theories of change management, we would end up with a heavily theoretical book trying to explain just what the senseis actually do, from a management practice point of view. In the end, we decided the tools and principles would be more accessible if we just tried to describe them in action.

Q. Are you saying that the experience of companies that embark on the path to lean differs from the models set out in the leading literature?
A. Not exactly. In fact, the model of value, flow, pull, perfection, and progression, articulated by Jim Womack and Dan Jones, certainly describes the way that most turnarounds that we've observed unfold. But very few of them start with a shared

understanding among the workers of where they will eventually end up. The turnaround starts by increasing the tension in the system, and then resolving problems as they arise. This process will make the players start by defining value, and then solve the flow problems, move to pull and finally endlessly kaizen the process to perfection. So they do end up following this path. But it's virtually impossible for the change leaders to plan it as such, because you need to move from one practical implementation to another.

In fact, this marks another way that The Gold Mine differs from most change management literature. The story format treats both change and lean techniques concurrently. And the underlying change model, while characteristic of lean, challenges mainstream change management approaches in its dependence on the role of the sensei, who acknowledges progress, certainly, but also provides endless constructive criticism and challenge so that no one stops at the first results, but continues to improve endlessly.

In terms of lean thinking, we don't claim to add much to existing literature of lean tools. We have tried to present the techniques in a slightly different way, however, thereby helping readers see how the tools and principles are tied to one another. Firstly, we do try to point out that just-in-time and the flow techniques such as kanban, heijunka and pull, are only one pillar of the Toyota Production System (TPS), and we re-emphasize the lesser known jidoka pillar, which is equally important. Secondly, we strive to establish the links between the different elements of the system, such as kanban and jidoka. Kanban can't be successful if quality is not already under control, for example, or if employees aren't responsive to problems on the shop floor. A systematic study of the links felt like a daunting task, so we've used dialogue to point out the most obvious links to keep in mind when implementing the tools.

Finally, now that most of the tools are known and published, we've placed less emphasis on the tools per se, and more on their purpose within the lean system. Five S, for example, is not a “clean your room” technique, but a fundamental tool to work on standardization and employee involvement. In this respect, we believe we've occasionally highlighted different aspects of tools that have been already much discussed, and we believe that even the veteran lean practitioner can find food for thought in some of these discussions.

Q. Bob Woods, the gruff lean sensei of this book, stresses that the real challenge “is all about people.” Can you explain? Are people issues more difficult to resolve than technical ones?

A.We find it hard to distinguish “technical” issues from “people” issues. Indeed, the two cannot be separated. And so the real question that matters is this: what does it take for lean to become part of the company's culture? The answer is: a critical mass of people who both think lean and act lean.

Regardless of how much has been published about the topic, thinking lean is not that obvious. Most people who observe their operations conclude that while they might understand this lean concept very well, it just doesn't apply to their particular circumstance. They need help in seeing the connection.

One of the most powerful insights from Womack and Jones is that lean is not simply a toolbox, but a total perspective. In other words, you must trust people to solve their

problems, regardless of the way the problem has been defined. A plant manager, for example, typically defines a problem as, Hit your numbers, keep the factory loaded, and avoid too much union or vendor problems. This effectively forces him to stay in his office, manage by the numbers, run large batches and so on. A lean approach redefines the problem completely. His new goals would be: produce only what has been consumed (or ordered), never by-pass a problem or let an operator face a problem alone and continuously improve all processes. This has dramatic implications for the work of the same plant manager. The only way to solve problems in this lean perspective is to spend most of his or her time on the shop floor trying to understand what goes on, and challenging teams to be more precise and to improve their operations.

So the first real difficulty with lean deals with both technical and people challenges. The change begins by framing the problem, which one recognizes in the factory from a lean perspective.

Q. So how, then, do people actually get started on this approach?
A. They need to, in essence, develop a lean eye. John Shook and Mike Rother's book, Learning to See, refers to the genchi gembutsu, which is translated as “go see for yourself.” The Gold Mine starts from this perspective. Before being exposed to lean ideas, Phil Jenkinson (a co-founder of the example company) has to learn to see his factory in much greater detail and understand how the different elements affect each other.

Developing this discipline remains an extraordinary challenge for all individuals, regardless of their background or the lean level of the plant. This is what folks call a moving target. Consider a plant that has managed to achieve pull, flow, with a supermarket after the cell, a truck preparation area, kanban, and so on. All's well. Right? Now, imagine that the material handler comes to pick up a container from the supermarket with a kanban card, but the box isn't there. The truck still needs to be prepared, so the system now tells her to get the container from the safety stock. This choice, however, would not be using the principle of pull correctly. The properly operating pull system would in fact create the right tension that forces the individual to solve the root cause-in this case, to determine what caused the container not to be there in the first place.

However, it takes a sensei level of lean observation to see beyond what appears to be happening in the flow. Most of us would be impressed by the technique of lean, the kanban, the supermarket, the truck preparation, and not see that all of this is failing to do what it's supposed to, which is solve the problems. So learning to see is a pretty big challenge, both on the technical and people front, at whatever lean level you are.

Q. What else is necessary to produce true change?
A. Realizing that “lean behavior” is a matter of doing as much as understanding. Most people need to understand an idea before they actually act upon it. Indeed, who can blame them? If someone starts with the assumption that they understand the concepts but don't believe they apply, they will never make any progress. This is tricky. In many cases, it's hard to see how the lean concepts presented in the literature apply to each industrial situation. Consider, for example, the whole issue of takt time and standardized work as raised in The Gold Mine. Standardized operator movements come pretty naturally at takt times around one to five minutes. Below that, it's too short, and over five,

the cycles start getting long. The characters at IEV (Phil's company) have a ten minute takt time. In some industries, we could be in a two-hour takt time! So does that mean that standardized work does not work? Of course not. Rather, it means that the application of standardized work is not always so obvious. And each person must develop his or her own understanding of how to make the concept actually pay off. And the only way to gain this insight is to try it and see where you arrive.

A fundamental point about lean implementation is that “all things are never equal” in a factory. If you change one element of the system, chances are that you've changed how every other problem appears. We've tried to demonstrate this in The Gold Mine. Lean learning relies very strongly on the well-known body of knowledge known as “just do it.” Beyond the basics on lean technique, the only way to learn is to try it out and see what happens. Practice, one hopes, makes perfect. But to do so, you must be in a controlled environment that enables you to see what is actually happening. Basic tools such as production analysis boards, red bins and 5S must be firmly in place.

Q. Phil Jenkinson, the company co-founder, seems constantly surprised and frustrated by the resistance he encounters to the turnaround. How realistic is his experience, and what should readers, managers, and leaders learn from this?
A. Our rule of thumb when writing the Phil character was that every plant manager who has tried lean transformation would think: Yep, I've been there. So, yes, we believe that Phil's experience is pretty realistic, although, of course, real-life plant managers will react very differently according to their own personality. Phil's greatest revelation might be that lean implementation ultimately requires a lean attitude. This speaks to the issue of resistance. One of the first things a lean sensei told us was that the greatest weakness of lean was exclusive reliance on the plant managers. True-but, interestingly, we've also come to believe that this very trait is one of the keys of the effectiveness of lean. You can transform your company culture to benefit from lean by creating a critical mass of the right people.

So the key issue is: what proportion of your employees, from top management to operators are lean converts? Pragmatically, there are only two ways of changing this proportion: either you convince people or you replace them, which is exactly the problem Phil is facing in The Gold Mine. As we've tried to show in the novel, it's not an easy issue and should not be dealt with by knee-jerk reactions. In the book, the resistant production manager later becomes a key asset, and so on, but, fundamentally to us the core lean implementation issue is: how do you maintain a high proportion of lean converts in your teams, and how do you continuously challenge them to go further in lean, and not rest at their current level of achievement?

There's another intriguing element to the way in which lean change occurs over time. In hindsight, many participants are surprised to realize that just about every lean concept or practice strikes them as “common sense.” When people experience the moment at which they suddenly “get it,” they will just about slap their forehead and say, Of course as they then see the implications. A plant manager with the epiphany realizes that stocks are better held after the process in a supermarket (as in pull), rather than before the process in the form of components or material (as in push). A maintenance manager who “gets it” suddenly realizes that, yes, the only sure way of knowing why a machine is down half the time, or produces bad parts, is to stand in front of it watching it cycle until

understanding what makes it break down or produce scrap. These are very emotional moments, and we've witnessed many.

These “a-ha” moments are the key to people expanding their understanding of lean. Phil experiences several epiphanies in the book (in his case, they mostly deal with standardization). People who experience one of these “turn-on-the-light-bulb” moments almost always assume that everyone around them also sees this astounding common sense. And so they end up being taken aback by the resistance. The problem is that you can't manufacture a-ha's with the same precision and predictability as you do parts. Each individual has a different point-of-view and history, and generating these insights are an outcome of larger realignments in perspective. They tend to happen one person at a time, one idea at a time. And sometimes only after years of explanations of the same simple idea over and over, such as the formula that margin = price - cost as opposed to price = cost + margin.

Q. If lean is all about seeking perfection, why don't the characters appear to be more happy as they travel the path?

A. Frustration is a common feeling for plant managers engaged in a lean transformation. There are many practical reasons. First, lean results seldom happen in isolation. In order to have a workable kanban system, for example, you must have already achieved some traction in production, logistics, and quality. Every single little action takes a whole lot of convincing, which can be very frustrating. Managers often feel that they spend far more time explaining or twisting arms than actually doing lean. Of course, that's just part and parcel of the process.

Secondly, even when people are engaged and on board, transformation feels like an agonizingly slow process simply because it's such hard work! Reducing tool change, for example, is easy during a single minute exchange of die (SMED) workshop where you often get 40% to 50% reduction with no sweat. But it's a lot harder to obtain shorter tool changes systematically at every change. And then to conduct tool change from last good part to first good part. Taking on comprehensive tasks such as reducing bad start-up parts can be a real headache. It takes a lot of hard work in some cases, to find the pixies in the system, and actually solve problems.

This frustration can be all the stronger when a company has committed resources to lean transformation. In the early phases, when the leaders are getting the basics in place, any pressure for immediate results will only generate disappointment and conflict. As Bob Woods points out in the book, there are many ways to squeeze costs, but in general, cost-cutting happens at the expense of the plant's future, whereas lean achieves cost savings while improving the plant's capabilities.

On top of all this, many of your colleagues, themselves reluctant to commit to lean, might be watching and waiting for you to fall flat on your face. The upshot is that financial results will eventually come, but never fast enough, and rarely directly connected to one specific lean activity. As the plant gets more “lean”, the numbers get better as well. And yes, it is frustrating.

But again, the importance of working with a sensei cannot be understated, in this regard, to keep everyone focused throughout tough times. In the first six months of a lean program, many people are tempted to stop at the low-hanging fruit. Everybody wants a

quiet life. And pushing progress beyond the easy initial gains means challenging the status quo-never a good way to make-or even keep-friends. Part of the sensei's job is to stimulate conflict by pushing buttons, uncovering the taboo areas, and systematically challenging the status quo. At the same time he must make sure that conflict remains constructive by proposing avenues for resolving problems, as well as hints and tips. In The Gold Mine, Bob Woods takes this tack most of the time. But take note that he too falls into the status quo problem himself, and must be provoked not to become complacent. The first challenge comes from his friend Harry, and the second by his old sensei. The point is that no one is immune to giving in to the frustration and resolving it by reducing expectations, rather than increasing the effort. The Gold Mine tries to show that although Bob might come across as formidable to the plant's management team, he's still being needled and coached by his own senseis, at another level.

Q. Can you explain the title?
A. Ah, well, there's a story in that. We were running a lean workshop in India, and the guys were being very clever. They had very good answers and objections to every lean tool we tried to present. The Indian team members were trying their hardest to understand but simply weren't buying it. Their plant was a clear-cut case of people understanding what we were saying, but not seeing that it applied to them.

As the discussion got increasingly heated, one of the guys called up some data on the inventory around the plant. All these parts had already been sold to customers with signed contracts. And the only way to get the cash out of the customer's pocket was to get the finished product to them as quickly as possible. Surprised and frustrated that his own colleagues couldn't see this, the individual finally exclaimed, “Don't you see-we've got a gold mine in this plant!”

This became the turning point of the workshop. And, we must confess, we did flog the gold mine metaphor to death. But as we began writing the book soon after this work in India, the idea fell in place rather naturally, and we actually use the gold digging metaphor in the book, although not as extensively as the Indian team did.

Q. Please share your background with lean and how it led to this book. A. This book is the result of the mix of two very different backgrounds. Freddy has been a manufacturing engineer and engineering manager in Renault for about 30 years, and was one of the early Europeans to get interested in the nuts and bolts of the Toyota Production System, or TPS. He realized very early on that this was the only way to compete in the auto industry, and first started to apply individual ideas to production line design as far back as the mid seventies. He got increasingly frustrated by this piecemeal approach as he realized that the Toyota Production System was, well, a system. Eventually, he got the opportunity to deploy the system in full at Valeo as technical vice president. This was one the first implementations of lean as a total production system in Europe.

Freddy then helped the company participate in Toyota's early European supplier integration program, and was trained with a core team of experts by Toyota's own lean gurus from the Operations Management Consulting Division. Finally, as CEO of Sommer Allibert, he had the opportunity to expand lean from lean manufacturing to a total business system. Today he continues to help a number of companies as an independent consultant.

Michael is trained as a sociologist and was researching the cognitive and social roots to “resistance to change” at the time of the early Toyota experiments in Valeo. Following Freddy's advice, he started studying the program in more detail, and caught the lean bug in the process. Michael had previously been working in supply chain dynamic simulations as a consultant with a big six consultancy in London and had published his first book on the topic (Managing with System Thinking, McGraw-Hill, 1994). At the time he was looking for practical ways of implementing general systems thinking concepts in practice, and had grown disillusioned with the tack the systems thinking movement was taking at the time. From his point of view, TPS was a revelation: the very embodiment of systems thinking in practice. From this point on, Michael studied the appropriation process of TPS by western companies, and developed his own approach to lean implementation, trying to stick as closely as possible to how Toyota did this with its European suppliers.

The book is the result of Freddy's unusual mix of global and detailed understanding of lean, and Michael's take on lean implementation. Indeed, some technical paragraphs were discussed word by word to get the precise sense right, and in some cases, we believe the book does hold a few previously unpublished nuggets (ah, the gold mine metaphor again). The social and psychological structure to the book is an outgrowth of Michael's research in lean appropriation and implementation. The challenge here is not so much to describe lean, but to propose a workable roadmap to build lean in the culture of the company, which we both believe is the ultimate prize of the lean journey, and which also delivers the pot at the end of the rainbow in terms of financial results.

Q. Many readers who purchase this book are hungry for simple, quick, and easy-to-use tools that will fix their immediate problems. Will this book help them?
A. Every lean tool is quick and easy. We mean it. Again, it's mostly a matter of “just do it”. How hard can it be to calculate takt time, draw out a work standard with operators, or talk to operators about how they would improve their workstations? This is, to us, the amazing lesson of many turnarounds. Every tool is easy. The hard part is deciding to use it. Just recently, we've seen a plant manager improve his on-time-in-full delivery rate indicator from a dismal 50% to 95% in one month, just by using takt time! Similarly, a metal stamping plant manager just gained a 10% overall equipment utilization increase on his presses in one week by reacting immediately to every problem, and then went on to stop the weekend shift while maintaining the same production output. The immediate financial gains are dramatic.

The astonishing thing about lean tools is that although everyone moans about how hard they are to implement, occasionally a plant manger wakes up and “just does it.” He trains his or her supervisors, and they're off and running, realizing immediate results. The hard thing is staying motivated enough to persevere through the ensuing challenges. In this respect, we hope that The Gold Mine can help by giving a realistic description of what to expect in a typical lean journey. As regards quick and easy, the results obtained in The Gold Mine are pretty quick, but by all means not as spectacular as some of the things we've seen done. The real question is why these spectacular results don't happen more often.

The Gold Mine should help readers to get a clearer idea of the purpose of each lean tool, and a better expectation of what can happen if you start down the path. In that respect, we believe the story can help readers realize that their experience at deploying

lean is actually more common than they would have thought. In fact, one of the goals of The Gold Mine is to bring back lean to “quick and easy” practices on the gemba, and away from large-scale change programs with their consultants, hierarchies and the usual corporate paraphernalia. All too often people tout the “philosophical” aspects of lean (which are fascinating and revolutionary,) but they don't apply it immediately on the shop floor. As Bob Woods would say, “Lean is a practice, not a theory.” So let's do it first, see what happens, and figure out how to do it better tomorrow.

A Lean Lexicon for *The Gold Mine*

Adapted from the *Lean Lexicon*: an illustrated glossary for Lean Thinkers, 2d edition

Continuous Flow
Producing and moving one item at a time (or a small and consistent batch of items) through a series of processing steps as continuously as possible, with each step making just what is requested by the next step.

Cycle Time
How often a part or product is completed by a process, as timed by observation. This time includes operating time plus the time required to prepare, load, and unload. Also, the time it takes an operator to go through all work elements before repeating them.

Five S
Five related terms, beginning with an S sound, describing workplace practices conducive to visual control and lean production. The five terms in Japanese are:
1. Seiri: Separate needed from unneeded items-tools, parts, materials, paperwork-and discard the unneeded.
2. Seiton: Neatly arrange what is left-a place for everything and everything in its place.
3. Seiso: Clean and wash.
4. Seiketsu: Cleanliness resulting from regular performance of the first three Ss.
5. Shitsuke: Discipline, to perform the first four Ss.

Five Whys
The practice of asking why repeatedly whenever a problem is encountered in order to get beyond the obvious symptoms to discover the root cause.

Heijunka
Leveling the type and quantity of production over a fixed period of time. This enables production to efficiently meet customer demands while avoiding batching and results in minimum inventories, capital costs, manpower, and production lead time through the whole value stream. Roughly, it means “levelization” in Japanese.

Inventory
Materials (and information) present along a value stream between processing steps.

Inventory Turns
A measure of how quickly materials are moving through a facility or through an entire value stream, calculated by dividing some measure of cost of goods by the amount of inventory on hand.

Jidoka
Providing machines and operators the ability to detect when an abnormal condition has occurred and immediately stop work. This enables operations to build in quality at each process and to separate men and machines for more efficient work. Jidoka is one of the two pillars of the Toyota Production System along with just-in-time. It's related to the Japanese word for automation, but with the connotations of humanistic and creating value.

Kaizen
Continuous improvement of an entire value stream or an individual process to create more value with less waste. The word is Japanese for gradual, continuous improvement. There are two levels of kaizen:
1. System or flow kaizen focusing on the overall value stream. This is kaizen for management.
2. Process kaizen focusing on individual processes. This is kaizen for work teams and team leaders.

Kanban
A kanban is a signaling device that gives authorization and instructions for the production or withdrawal (conveyance) of items in a pull system. The term is Japanese for “sign” or “signboard.” Kanban cards are the best-known and most common example of these signals.

Muda, Mura, Muri
Three Japanese terms often used together in the Toyota Production System (and called the Three Ms) that collectively describe wasteful practices to be eliminated.

- Muda: Any activity that consumes resources without creating value for the customer.
- Mura: Unevenness in an operation; for example, an uneven work pace in an operation causing operators to hurry and then wait.
- Muri: Overburdening equipment or operators.

Pull Production
A method of production control in which downstream activities signal their needs to upstream activities. Pull production strives to eliminate overproduction and is one of the three major components of a complete just-in-time production system, along with takt time and continuous flow.

Sensei
The Japanese term for “teacher.” Used by Lean Thinkers to denote a master of lean knowledge as a result of years of experience.

Seven Wastes
The categorization of the seven major wastes typically found in mass production:
1. Overproduction: Producing ahead of what's actually needed by the next process or customer. The worst form of waste because it contributes to the other six.
2. Waiting: Operators standing idle as machines cycle, equipment fails, needed parts fail to arrive, etc.
3. Conveyance: Moving parts and products unnecessarily, such as from a processing

step to a warehouse to a subsequent processing step when the second step instead could be located immediately adjacent to the first step.
4. Processing: Performing unnecessary or incorrect processing, typically from poor tool or product design.
5. Inventory: Having more than the minimum stocks necessary for a precisely controlled pull system.
6. Motion: Operators making movements that are straining or unnecessary, such as looking for parts, tools, documents, etc.
7. Correction: Inspection, rework, and scrap.

Standardized Work
Establishing precise procedures for each operator's work in a production process, based on three elements:
1. Takt time, which is the rate at which products must be made in a process to meet customer demand.
2. The precise work sequence in which an operator performs tasks within takt time.
3. The standard inventory, including units in machines, required to keep the process operating smoothly.

Takt time
The available production time divided by customer demand. For example, if a widget factory operates 480 minutes per day and customers demand 240 widgets per day, takt time is two minutes. Takt is German for a precise interval of time.

Total Productive Maintenance
A set of techniques, originally pioneered by Denso in the Toyota Group in Japan, to ensure that every machine in a production process always is able to perform its required tasks.

Value Stream Mapping
A simple diagram of every step involved in the material and information flows needed to bring a product from order to delivery. The first step is to draw a visual representation of every step in a process, including key data, such as the customer demand rate, quality, and machine reliability. Next, draw an improved future-state map showing how the product or service could flow if the steps that add no value were eliminated. Finally, create and implement a plan for achieving the future state.

Waste
Any activity that consumes resources but creates no value for the customer.

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