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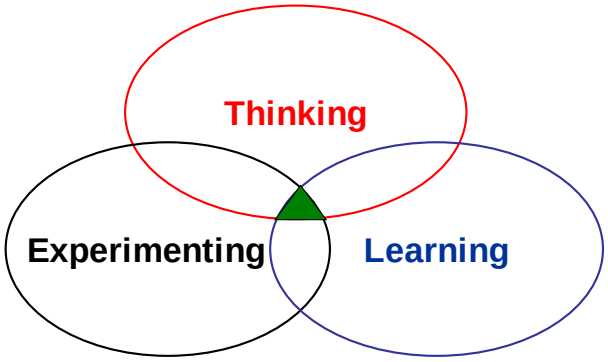
Lean Transformation: Thinking, Learning, & Experimenting For Today's Complicated Operating System



By Matt Zayko

This year marks the 20th anniversary of the initial publication of *The Machine That Changed the World (TMTCtW)*. This groundbreaking book uncovered the true competitive nature of a manufacturing system with unique operating principles. By using evidence-based, data-driven studies, the book described how the "lean" automakers were outperforming the industry titans in the critical business elements. What has happened since then?

There have been many books, workshops, and conferences. Recent years have seen a shift from the lean "tool age" to lean management and leadership-focused topics across numerous industries. The original lean automakers have continued to offer higher quality, shorter development cycles, improved productivity, and competitive pricing, while two of the original titans became insolvent and restructured following many lagging years. And after an abrupt halt to years of steady growth and easy access to credit, many organizations have awakened with a hangover to realize how complex of an enterprise they have created and must now simplify and improve in order to survive.

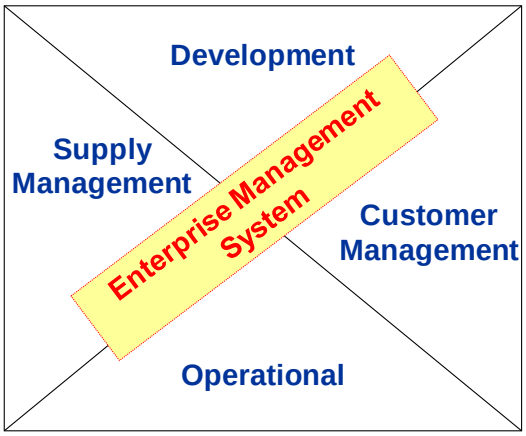
Unfortunately, most organizations that have tried to implement lean have fallen short in their efforts. So, since the first coining of the term "lean" based mainly on Toyota Business System principles two decades ago, what are some of the lessons learned

about how to head down the path of successful transformation that we can pass to the next generation?

Key Questions to Think About:

- What is the performance problem you are trying to solve?
- What are you doing to simplify your operating system activities?
- What are your organization's improvement capabilities?
- What is your improvement approach?

What is the problem that you are trying to solve? *Start with need (& a walk!)*
As explained in *TMTCtW*, many organizations are made up of five business system elements, as shown below. All five are interlinked with strong dependency to each other and cannot be treated in isolation. The discussion in this paper will center mainly on the *Operational Value Stream*, the final touch point to the customer or end-user and the typical beginning point for lean transformation. An operational value stream may be the end-to-end material & information flow through manufacturing, a patient journey at a hospital, a billing process in an office environment, and more.



Most organizations have at least one thing in common—the desire to improve their competitive position. One approach may be cutting cost, which is perceived as reducing waste and improving by boosting the bottom line of the short-term balance sheet. Cutting costs is an important part of your operational value stream activity. However, it cannot be the primary focus. If the value stream is not effectively meeting customer needs, then the cost reduction is meaningless and potentially destructive.

Other organizations may try to copy from the behavior that results in performance improvement that they desire when looking at other organizations or through benchmarking. Unfortunately, imitation does not reliably result in sustained

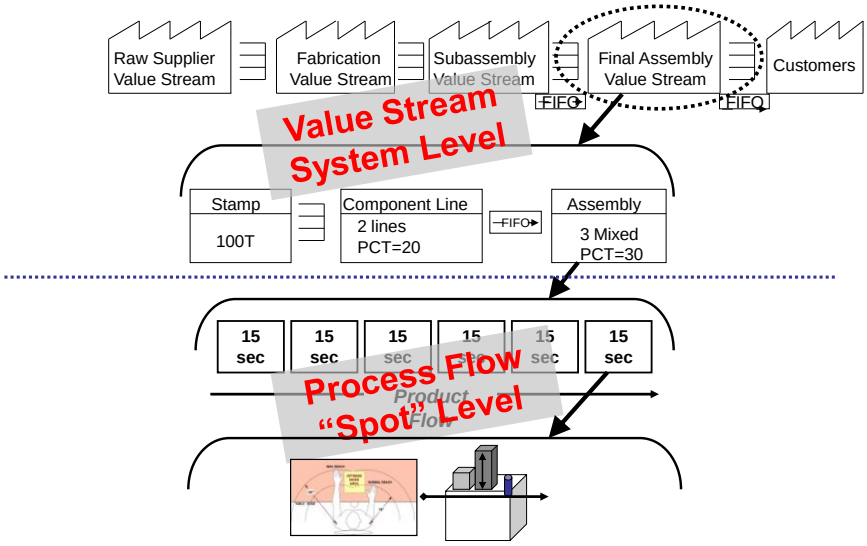
improvement if there is no thinking to the actions. An example of this is implementing a lean tool for the tool's sake, much like finding a nail for a new hammer.

Another approach may be to improve from a longer-term performance mindset of value and delivery to the customer, which seeks to solve problems that are hindering competitiveness and to develop the capability of the people. Cost reduction will be one outcome, but it is not the first objective. Improving performance is the initial goal of lean organizations, but it is also the end result. *What is the process of improving performance?*

Your Operating System: *It's Complicated!*

Processes as they are traditionally defined may be thought of as mechanistic or a series of actions and operations, lending themselves to reductionist thinking and oversimplification if not framed properly. A better way to think of performance improvement is not as the output of a *process* but as the output of the current operating *system*. The example below gives an image of one type of operational value stream and its various elements. The approach that you utilize to work and improve in this value stream is your *operating system*.

Example: *Operational Value Stream*

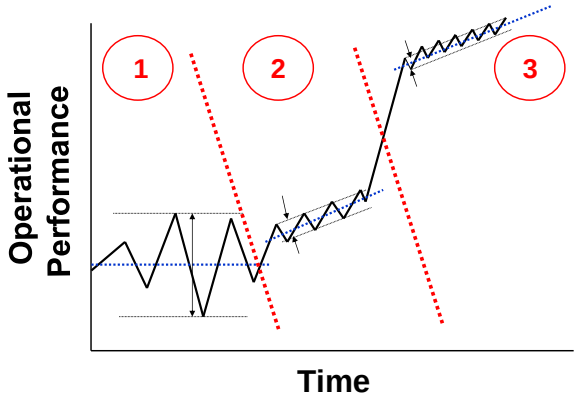


It is difficult to truly define *operating system*. The word "operating" is used to signify the fact that most organizations have an operational value stream for goods or services, even though they may not have physical production or manufacturing. Partly, the operating system is your organization's framework of concepts and methods to add value to the customer at the best quality, lowest cost, and shortest lead-time through elimination of the sources of waste.

This waste will occur at the spot-level, system-level, and management policy-level. Another aspect of operating system is the current way of thinking and properly using the framework of concepts to improve performance. Lean principles emerge that guide operational behavior along a shared performance vision. And since the thinking should be an evolving practice, this makes any definition immediately outdated.

Because the operational value stream has this system underpinning, there are important system design principles to understand. One principle is the *Improvement Curve*. Systems will display incremental change over time, including increases and decreases in output or performance. As time progresses, if there is real sustained improvement in performance it tends to follow the S-Curve, which will take on different shapes depending on the rate of improvement.

The Improvement Curve



Source: Don Runkle and Dave Logozzo, Lean Enterprise Institute

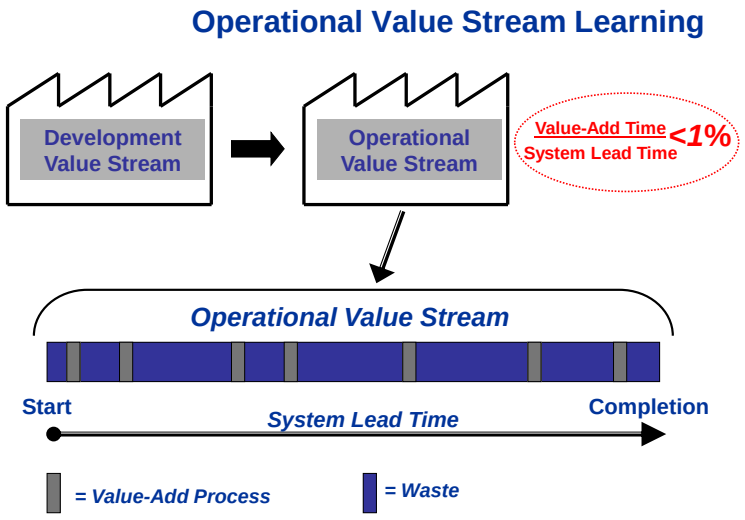
With lean organizations, this improvement curve may be broken into three areas (Levels 1, 2, and 3). Since many initial operational value streams are adding value less than 1% of the time, there are ample opportunities for eliminating the root causes of the remaining waste. Most of this waste is self-inflicted over time as functions sub-optimize, technologies change, and workarounds spring up and so forth, which results in an overly complicated system. One UK-based hospital observed the process of discharging a complex patient case and learned that there were over 250 handoffs between staff members.

Level 1 (spot improvement) focuses on local, isolated efforts which build stability and spot efficiencies. It is not uncommon to see modest initial work area improvements with regard to productivity, floor-space, lead time, and more. A medical device manufacturer improved their productivity by 35% and first-time quality by 65% in one operational cell

with creative methods design and equipment modifications. As the enthusiasm for quick, tangible improvement in spot areas takes hold, the operational team may start to get overwhelmed with requests to improve all areas without spending the time to get to the root causes of the waste.

Level 2 (flow improvement) begins to take a systematic approach to waste reduction across the value stream by connecting the spots of activity in a logical manner. The initial improvements focus on effectiveness aspects, such as delivery, quality, and lead-time, while also incorporating capacity and resource management. The same UK-based hospital mentioned earlier did a later study of sample testing processes of blood work through their pathology value stream flow and found that it took 309 steps and over 24 hours to complete the work, leading to numerous improvement activities. An industrial machining products company reduced their system lead time from 74 days to 21 days for a critical product family's value stream.

Level 3 (system improvement) is where the operating system step-change will occur. Waste is eliminated and avoided using a systematic approach to root out the sources of the non-value added activity. Organizations that reach this level continue to consistently improve their value streams as they evolve the operating system. Over an eleven-year period of company-wide lean transformation, one office furniture builder was able to reduce overall lead times by 82%, increase space utilization by 228%, and improve productivity by 6% annually.



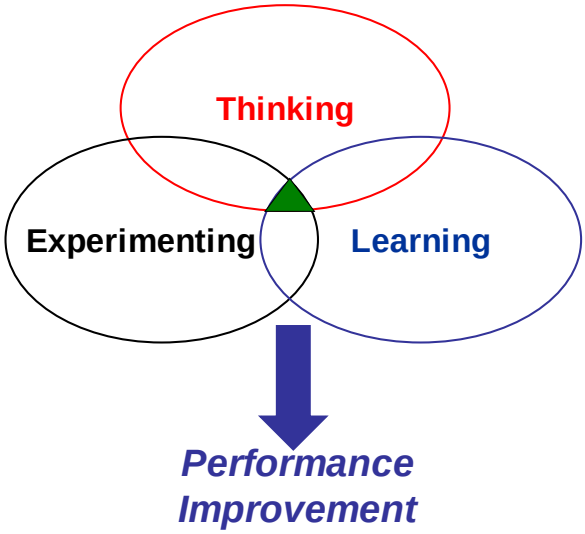
The measure of performance improvement is the outcome of the system, which is made up of sub-processes and their connections. Highly sophisticated management systems are required to link and align enterprise-wide planning, collaborating, and executing across the disciplines. But the bits of the system do not improve on their own accord--

the people and structure within the organization are the ones that are responsible for the actions to improve the performance capability.

Critical Aspects of Performance Improvement: People Capabilities

The Improvement Curve from earlier has also been referred to as the *Learning Curve*. Learning can be thought of as organizational learning or operational learning, but it is embedded within the individual. Because learning will precede improving, learning is certainly one of the critical operating system capabilities for people. *Thinking* and *Experimenting* are two other important disciplines. The following questions frame the three capabilities together:

- What is your improvement consciousness?
- What is your current thinking pattern?
- What is your current learning level?
- What is your current experimenting approach?



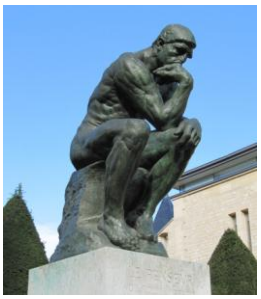
Improvement Capability: Thinking

Purpose: Value-Consciousness
Principles: Value Specification, Value Stream Design, Flow, Pull, Perfection
People (Key Role): System Architect

Thinking occurs at the mindset-level. Repeated actions and experiences over time will lead to developing a set of principles. In *Lean Thinking*, Womack & Jones introduced five core thinking principles common to lean organizations, with an emphasis on delivering value:

- Specify value from the customer's perspective
- Identify & design the value stream that delivers the defined value
- Flow through the value-adding steps
- Pull connectivity
- Perfection

The thinking requires setting short-term target conditions based on a longer-term vision. Lean thinkers understand that there is no static state—the current performance is either improving or regressing. Certain individuals will have an ability to view things from a system perspective by understanding how the pieces all fit together and how to manage breaks in the flow, but not necessarily having the expertise to optimize the individual bits. This key role of a *system architect* is valuable in top-level value stream design, guiding the plan with a team from its initial concept through the final stage of completion using entrepreneurial-style skills.



Rodin's *The Thinker*

Many processes mature over time with no intended course or vision, resulting in deep embedded problems and increasing "detours" that try to avoid them. In the case of the UK hospital mentioned earlier with the blood work sample processes in the pathology value stream that took 309 steps and over 24 hours, a re-design of the end-to-end flow of work resulted in an initial future condition requiring 57 steps (81% fewer) and less than 3 hours (88% reduction).

For effective thinking, there is a deep problem consciousness. A problem is any performance other than desired at a given time. Problems must be directly observed at the gemba or workplace. Problems are opportunities for learning and improving competitiveness for survival. Finally, an awareness of the gap between current and desired levels of performance is an initial step in improving the current condition.

Key Questions for *Thinking:*

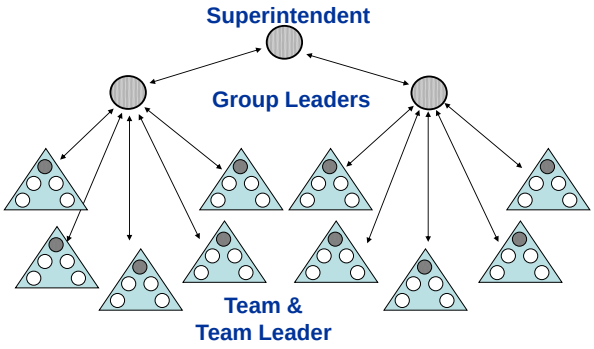
- What is the current system performance?

- What is the long-term operating vision?
- What is your problem consciousness?
- What is the next target condition?

Improvement Capability: Learning
Purpose: Wisdom
Principles: Levels of Learning--Data, Information, Knowledge, Understanding, Wisdom
People (Key Role): Mentor / Mentee, Mentor / Protégé

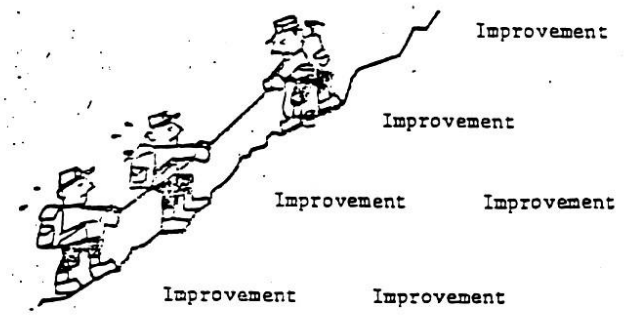
Learning is part of personal development. An individual is only capable of learning on his or her own, but the process of learning can be made more effective through a proper mentor / mentee approach using the A3 management process. The mentor structures problem solving activities and opportunities in order to enable a higher chance of increasing the mentee's knowledge and understanding. Learning may occur in multiple forums, including on-the-job (OTJ), classroom, improvement projects, and self-guided. Toyota's assembly plant learning structure is one example of this mentor/mentee approach.

Example Plant Learning Structure



Source: John Shook, Lean Enterprise Institute

For highly specialized functions, the approach may be better described as a mentor / protégé relationship. An example of this is the *Rolex Mentor & Protégé Arts Initiative*, in which outstanding emerging artists are matched with a great master in their field. For one year, the pair will collaborate in a shared artistic experience with the aim of learning and growing. Another example is the attending / resident physician relationship from the medical profession.



Source: Managing to Learn, Lean Enterprise Institute

An interesting way to view the levels of learning is based on the late Russell Ackoff's research on the topic. Ackoff argued that there are five increasing levels of learning for individuals:

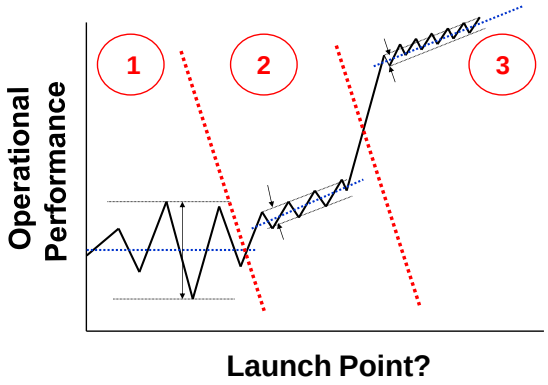
- Data (symbols)
- Information (descriptions; answers questions such as *what, where, who, when, how many*)
- Knowledge (instructions; answers question of *how-to*)
- Understanding (explanations; answers question of *why*)
- Wisdom (concerned with value of outcomes and effectiveness)

Traditionally, learning is defined as acquiring knowledge or skill, and this is where most organizational efforts focus. Yet this alone is not enough as an organization must be effective and efficient in order to survive. Ackoff stated that the best way to learn is to make mistakes, identify them, determine their source, and correct them. Furthermore, people learn more from making their own mistakes than from the successes of others. The challenge is to get people to learn the way they learn naturally.

If an individual has the motive, means, and opportunity, then learning provides the mechanism to challenge existing mental models in order to understand how to move and adapt toward the next target condition. The higher learning level of understanding is the ability to see patterns of interdependencies. Wisdom is the ability to interpret signs that are present in the now, yet unrecognizable to most. Only wisdom allows one to "see into the future."

Strong organizations leverage this understanding and wisdom from their people for new products, processes, and services by launching at higher levels of performance from the start by designing out the waste. This sets them up for an accelerated improvement curve *(see graphic below)*.

Where Will You Launch At?



Key Questions for *Learning:*

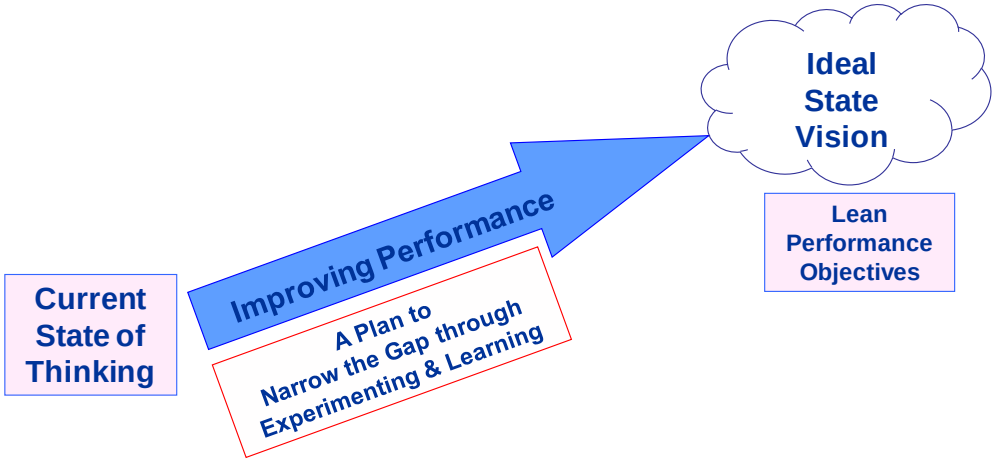
- What is your current understanding of the gap in performance?
- What is your long-term development process and path?
- What is your next target experience?
- Who will mentor you and help structure opportunities and reflection?

Improvement Capability: Experimenting
Purpose: Action
Principles: Scientific Method
People (Key Role): Work Designer

Experimenting needs to take place in a learning laboratory where, through trial-and-error, the understanding will deepen by developing hypotheses based on the vision, testing them through experiments, and reflecting upon the results. This is done utilizing a problem solving approach based on the scientific method, such as Plan-Do-Check-Act *(PDCA)*.

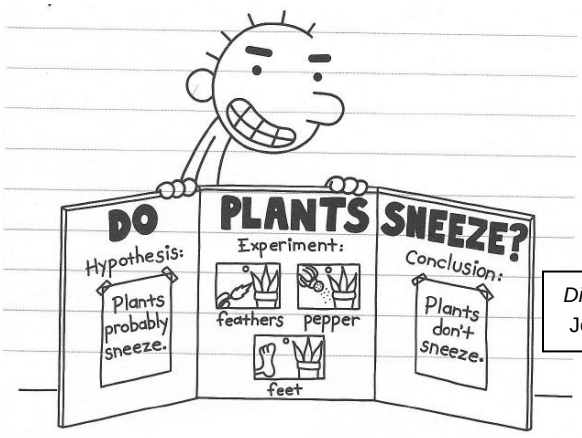
The learning laboratory will occur in any environment and is frequently thought of as the model line or area at the work place. Experimenting may be done with teams at first since they are the core learning unit in most organizations. Through repeated practice and reflection, the thinking continues to evolve. When done in balance with a personal development plan, experimenting will support fast learning cycles, which in turn may lead to rapid performance improvement.

Developing the Operating System for the Ideal State



Recently, a traditional, pre-depression designed steel facility in the US made up of six "mini-mills" selected one product family for its model flow. Through a series of experiments to improve value for the customer, team members also learned that steel slabs weighing up to 10 tons each were specially handled 51 times over the course from raw material-to-steel coil conversion. A set of team members identified the root-causes, brainstormed countermeasures, and developed an action plan to test the hypothesis to reduce this to a short-term target of 21 times without major re-design or expense.

One valuable yet frequently misunderstood concept that fits within the experimenting discipline is standardized work. Standardized work is the baseline for operations to occur in the most effective and efficient manner using current known processes and techniques. Another way to define it in terms of the scientific method is that standardized work may be the null hypothesis that is constantly tested and improved through experiments.



Diary of a Wimpy: Rodrick Rules, Jeff Kinney

Key Questions

- What is the hypothesis that you are testing?
- What is your problem solving approach?
- How will you know if the countermeasure works?
- How will you capture and share the learning?

How Do You Start Actually Getting Deep Improvement?

Varying conditions will lead to different starting points and concepts to utilize, but the core lean principles as listed in *Lean Thinking* are the same, as well as the improvement approach. Mr. Yoshinobu Yamada, former Toyota manager, outlines the improvement framework for an organization into four steps:

1. Big Vision
2. Spot Improvement
3. System Improvement
4. Innovation

Step 1 requires a clear vision and aggressive planning, yet not too large of a scope with a disciplined, step-by-step approach of implementation in a model area or value stream. If planning is too narrow, then the result will be poor. *Step 2* utilizes the improvement approach (summarized below) that stresses creativity before capital. Experiments are run on specific process flows ("spots") in the model area. *Step 3* begins to connect the "spots," improving the operational value stream performance and creating the initial operating system. *Step 4* moves upstream in the enterprise to development and the other business system elements. This strengthens the linkages and improves value for the organization and key partners through innovative thinking and actions.

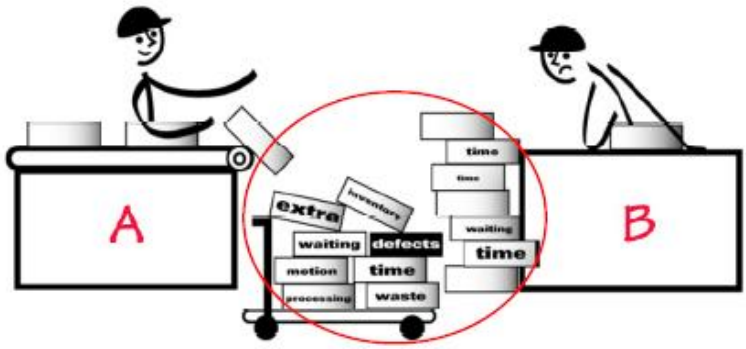
Furthermore, Mr. Yamada summarizes the improvement (kaizen) approach for a process into the following steps:

- Observation
- Standardization
- Kaizen—Flow & Process ($)
- Kaizen—Equipment ($$)
- Kaizen—Layout ($$$)

The purpose of observation is to see the reality at the workplace, collecting not just data but also facts in order to grasp the situation and determine root-causes. Countermeasures will next be evaluated to support standardized work and stability, the

baseline for any improvement activity. Flow & process kaizen will entail motion or activity improvement, material movement, interruption reduction, and more. These are simple and cheap, yet valuable activities.

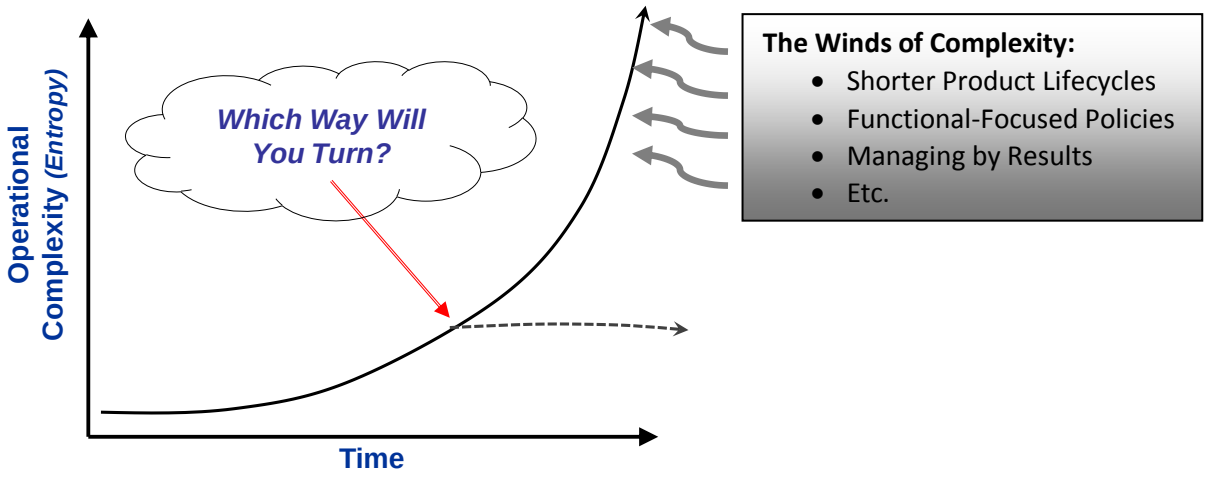
Equipment kaizen is higher cost and looks to reduce changeover times for smaller-lots, simplify operator-machine interface, improve footprints, and other activities. Layout kaizen from a facility perspective is probably the highest cost, so it is important to have done the first two steps in most cases in order to understand the best process or facility layout. If there is a jump to layout kaizen too quickly, the risk is high of creating "fake flow" *(see below)*—work moved closer together, yet still incorporating most of the original waste.



Source: *Learning to See*, Lean Enterprise Institute

Why Is There a Need to Improve?

An important final systems principle is entropy theory. Entropy is the potential of disorder in an isolated system. The theory states that the disorder or chaotic nature of a system will tend to increase or remain the same over time, inhibiting overall performance. It will never decrease on its own. In other words, the complexity of your current operational value stream will constantly be attempting to increase, whether it is through introducing an inappropriate planning system, unreasonable sourcing strategy, improper technology countermeasures, or other factors.



Most people and teams in the organization will be battling this complexity throughout the lifecycle, trying to maintain, if not decrease, the current level of disorder. While it is essential to work on immediate issues in the workplace, there must also be a focus on fundamental system improvement or the short-term fixes will potentially re-emerge as even larger problems.

In order for the lean organization to survive in the longer-term, it must continually work on minimizing this pattern of added complexity by simplifying and adapting its operating system and connectivity to the business system. This work is enhanced by developing the three core disciplines within people that are necessary for performance improvement: *thinking, learning, and experimenting*. Capital assets may be designed to be flexible, but only humans are adaptable.

Final Questions Summary:

- What is your shared understanding of improvement & operating system?
- What is your current operating system *thinking* of value & vision?
- What is your framework for increasing people's understanding and *learning* within the operating system?
- What is your action-based method for *experimenting* within the operational value stream?
- How will you approach system re-design to reduce operational complexity?
- What is your improvement approach?

About the Author:

Matt Zayko is a Lean Enterprise Institute (LEI) faculty member and an associate with both the Lean Transformations Group and the TWI Network of lean practitioners. He currently spends his time researching and developing lean principles with systems

thinking, as well as working with companies to understand and develop their own operating systems. Matt works with organizations in multiple industries that are developing people and transforming their operations, engineering, and development capabilities towards a future vision using lean principles and concepts. You can reach him at: mzayko@umich.edu , or through LEI 617-871-2900.

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