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Process Intelligence
Six Tenets of Intelligent Process Improvement

Applications for Supply Chains and Manufacturing Operations

Introduction

The Westfield Sydney to Melbourne Ultramarathon was first run in 1983. At a distance of 875 kilometers, it was going to be one of the most challenging ultramarathons in the world. Most entrants knew that to be competitive, they would need to run 18 hours each day, while sleeping only six hours.

A 61-year-old man named Cliff Young showed up to run the race wearing worn-down overalls and worn-in work boots. When asked if he had ever run in a marathon before, he replied, "See, I grew up on a farm where we couldn't afford horses or tractors, and the whole time I was growing up, whenever the storms would roll in, I'd have to go out and round up the sheep. We had 2,000 sheep on 2,000 acres. Sometimes I would have to run those sheep for two or three days." The runners all laughed. Young was clearly not up to the standard of these world-class athletes.

Amazingly, though, the 61-year-old underdog won the race, beating the record for similar races by 40 percent, or almost two full days![1] How was this possible? Young didn't "know" what everyone else knew — that he had to sleep—so he just shuffled along each night at a slower pace while all of the pro runners dreamt soundly. His win catapulted him to fame in Australia—the race thereafter was named the Cliff Young 6-Day Australia Marathon—and launched a new era of ultramarathon running. Now that world-class runners "know" that it's possible to run days at a time without sleep and that they can conserve energy by adopting an easy shuffle jog, they have a new way of approaching ultramarathons.

Business process improvement today is in a similar state as ultramarathons were before Young's feat — people often "know" which process improvement methodologies work, and they approach those methodologies the same as they have for decades. Yet despite those decades of history to learn from, companies are still struggling to realize success from their process improvement efforts.[2]

Why do some process improvement efforts succeed and others do not? This paper outlines six tenets to help companies think beyond what is currently "known" and bring more "intelligence" to process improvement.

[1] "The Legend of Cliff Young: The 61 Year Old Farmer Who Won the World's Toughest Race," Elite Feet for Runners, December 30, 2007, http://www.elitefeet.com/the-legend-of-cliff-young.

[2] "3rd Biennial PEX Network Report: State of the Industry, Trends and Success Factors in Business Process Excellence," PEX Network, Fall 2013, http://www.processexcellencenetwork.com/downloadContent.cfm?ID=1697.

Tenet #1: Challenge conventional wisdom

Many organizations are constrained by conventional wisdom, much like the world-class runners in Australia. For example, some companies are moving away from Six Sigma as a methodology for process excellence because they believe they lack high quality data to effectively support a Six Sigma based approach. This may explain why the methodology has steadily declined since 2005[3]. Instead, companies may take a flexible approach to process improvement, allowing teams to pick and choose methodologies and toolsets.

Is flexibility a good thing? Not necessarily. Companies that stick with a consistent approach realize an average of 40 percent more benefit than those that don't.[4]
A demonstrated and time-tested approach to process improvement includes the following five steps:

- Clarify the problem and set a goal for improvement.
- Measure performance levels today.
- Uncover the root causes of the problem.
- Figure out ways to address those root causes.
- Make it stick.

These steps happen to be the same logical and time-tested approach employed by Lean Six Sigma, currently the second most widely used methodology in the process improvement tool kit, only behind Lean.[5] It's also quite flexible, as it can be applied to a variety of problems of various sizes. It's an "intelligent" approach that has been effective and efficient in problem solving, even without significant levels of data and statistical analysis.

Manufacturing companies tend to approach the design and manufacturing process the same way they have for many years, often constrained by the geometries of traditional manufacturing processes (casting, machining, etc.). These "constraints" can limit the potential performance of products (heavier, weaker, quality defects, etc.).

One of the keys to the DMAIC process (Define, Measure, Analyze, Improve, and Control) is to sometimes think outside of the box when it comes to improving a process. One such way to think outside the box during the Improve phase is to use innovative technologies to remove traditional manufacturing constraints and thus improve the functionality of the end product.

Additive manufacturing, often referenced as 3D printing, is one such innovative manufacturing process that can change the conventional wisdom behind the design and manufacturing of a product. By using additive manufacturing, geometries that were once impossible to fabricate or just cost prohibitive are now feasible and can improve the functionality of a product.

Example

One of the largest drivers of cycle time in the injection molding process is the time it takes for a part to cool. This cycle time is influenced by channels in the injection mold that flow cooling material around the part to increase the rate of cooling. These channels that conduct the cooling material are typically straight because traditional machining processes don't allow for curves and tight angles. Additive Manufacturing, however, enables the tooling to be manufactured with free-form cooling channels that can more closely mimic the same shape as the part being created. This can provide more homogeneous heat transfer, yielding improved cooling characteristics. Through faster heat removal, some companies have seen a 60 percent reduction in the cycle time for injection molding.[6]

[3] "3rd Biennial PEX Network Report: State of the Industry, Trends and Success Factors in Business Process Excellence"

[4] LSS Aberdeen Six Sigma Report

[5] "3rd Biennial PEX Network Report: State of the Industry, Trends and Success Factors in Business Process Excellence"

[6] "3D Opportunity in Tooling: Additive Manufacturing Shapes the Future", S.S. Bobby and S. Singamneni, "Conformal cooling through thin shell moulds produced by 3D printing," Australian Journal of Multi-Disciplinary Engineering 9, no. 2 (2013): pp. 155-164, http://dx.doi.org/10.7158/N13-GC04.2013.9.2.

Tenet #2:
Stretch beyond process mapping

Another commonly accepted practice is to use process mapping as the core tool in process improvement. Process mapping is an important tool, but it has limitations. Process maps show how people think a process typically works or how it should work. How the process actually works often is quite different.

Various advanced analytical tools can provide much richer insights and "intelligence" related to actual process performance. For example, Deloitte's Process X-ray™ is a process analysis platform that that reconstructs the actual process execution based on data from a company's underlying technology. It enables users to ask up to 10,000 questions to find the variants and root causes of problems in the process. Similarly, Detailed Value Stream Analysis recreates actual process performance at a handoff level of detail, enabling process improvement teams to identify which steps in the process are not adding value.

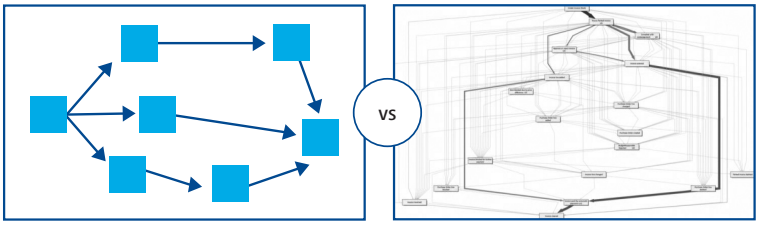
The "intelligent" insights gleaned from these analyses help generate breakthrough improvements that are hard to realize when process maps alone are used. As companies increase focus and investment on workflow automation and data analytics (big data), supplemental analytical process intelligence tools will become increasingly more important in driving toward solutions. [7] [8]

Like many industries, manufacturing companies utilize numerous complex processes. Understanding how processes truly work is a key to identifying improvements. Mapping these processes step by step by shadowing people is a good start; unfortunately, how individuals think the process works and how it actually works can be very different. This approach can also be limited as it is difficult for a single person or group of individuals to fully understand all of the processes utilized at a manufacturing company due to the sheer number and size of all of the business processes.

A different approach involves purpose-built tools that follow the data in a company's underlying technology to map the process. Deloitte's proprietary tool called Process X-ray is designed to reconstruct what really happens and provides organizations with the capabilities to isolate root causes.

Gaining insight into how work is actually being done enables leaders to determine an efficient work flow, establish guardrails to guide behaviors, and more effectively train knowledge workers.

Figure 1: Traditional process mapping versus analysis of actual process using Process X-ray



Example

An aerospace and defense company was struggling to stabilize their production environment with targeted improvements not yielding desired results. Process X-ray was recommended as an approach focusing on people, process, and technology that enabled the company to map the current business processes from order to cash to identify barriers in stabilizing the production environment. By taking all of the data available in the company's underlying technology and analyzing it, Process X-ray was able to identify that when looking at the top 10 patterns from order to cash, over half of the process steps were considered to be some form of rework. Example findings included frequent sales order changes, deliveries shipped after confirmed delivery dates, etc.

[7] Ibid

[8] Deloitte internal analysis

Tenet #3: Follow the facts

There is typically no lack of opinions when it comes to business improvement efforts. But when teams act on opinions, they often jump to the wrong conclusion. A more "intelligent" approach is to convert opinions into hypotheses and test them with data before acting on them.

"Data is what distinguishes the dilettante from the artist."[9] According to a study conducted by the University of Pennsylvania and MIT, "data-driven decision making" achieved productivity that was 5 percent to 6 percent higher than could be explained by other factors.[10]

A well-structured set of hypotheses provide an organized framework to evaluate and act on options for business improvements. Furthermore, it can help avoid common pitfalls during improvement projects such as addressing only symptoms or being swayed by the strongest or most senior person in the room. As a result, instead of basing actions on guesses or hunches, companies can have more confidence that their actions are driven by facts. Hypothesis testing also lays the foundation for controlled continuous improvement as hypotheses tested and data collected can be used for future endeavors.

Making process improvement decisions based on data-substantiated facts rather than opinions and perceptions may take a little longer, but over the course of time it helps foster alignment among people with different opinions and can lead to superior results.

Manufacturing companies gather vast amounts of data, from customer demand to supplier and operational performance. Process intelligence provides a more intelligent approach to harnessing this data and using it to test hypotheses instead of just basing decisions on opinions.

Many times, companies can be asking the right questions to improve the business but without fully utilizing the available data improvements, they can be limited or focus efforts in the wrong areas. Advanced analytics is one way that manufacturers can use the vast data available to more efficiently test hypotheses using fact-based analysis.

Advanced analytics is currently used by manufacturing companies to address a whole host of different questions using historical performance, such as: span compression; demand aggregation; predictive material availability; and network impact modeling.

Example

A highly engineered product manufacturing OEM was suffering from long product span time that directly drove higher product cost (i.e., efficiency, inventory holding, overhead absorption, low value-add time, etc.); hence, it was performing below target margins. Traditionally the company had looked to reduce the span time of individual parts with the largest span in an effort to reduce the overall span of the aircraft. Without looking at the total picture of how span is correlated they tended to "chase ghosts" during span compression activities, meaning they were often misled about the true drivers of product span. By utilizing advanced analytics, the company was able to use a new approach to identifying the true critical path for the product by looking at the product span time holistically and the interaction between part span times. Through this new approach, the manufacturer was able to identify opportunities to reduce total product span time by over 30% (~12 months).

[8] George V. Higgins, The Guardian, June 17, 1988.

[10] "When There's No Such Thing as Too Much Information," Steve Lohr, The New York Times, April 23, 2011, http://www.nytimes.com/2011/04/24/business/24unboxed.html?_r=0.

Tenet #4:
Buy runs, not players

In the movie Moneyball,[11] a statistician suggests the following: "People who run ball clubs, they think in terms of buying players. Your goal shouldn't be to buy players; your goal should be to buy wins. And in order to buy wins, you need to buy runs.z Baseball thinking is medieval. They are asking all the wrong questions."

The same is true in process improvement. Many companies ask questions and use tools that fail to address root causes of problems. They employ temporary fixes that end up being costly and unsustainable. Fixes often focus on one aspect of the issue and commonly are in the form of process tweaks such as an additional quality check, creating new roles that are potentially redundant, or implementing a new system, but these actions are equivalent to buying individual "players" to fix a process rather than understanding the process itself. Such process improvement efforts effectively put a bandage on visible symptoms of problems, thus laying the foundation for disappointment—addressing symptoms alone can lead to problems reappearing.

Example

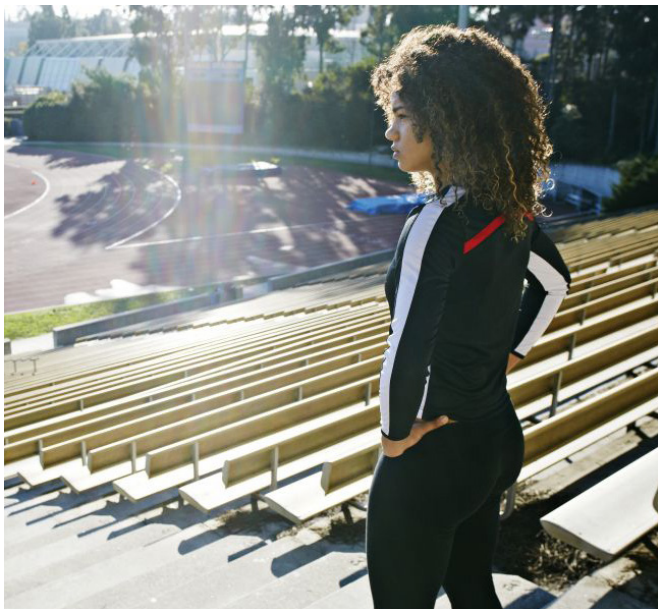
Like many companies, a heavy equipment manufacturer for years had in place a daily meeting with various managers from the business to address the ever growing list of "random" issues that were impacting the production line. Symptoms usually involved various work cells being shut down for not having parts or parts being reworked due to quality defects. The heavy equipment manufacturer decided to turn the daily meeting into a Root Cause Corrective Action meeting where each issue was analyzed to identify the true cause of the symptom they were facing and develop an action plan to address the root cause. For example, when they began to analyze the list of issues they noticed that a number of door panels were being reworked due to paint scrapes and dents in the panels. Further analysis showed that the defects were occurring during the delivery of the parts to the line and were a result of poor packaging and handling. To address this, the company created new packaging to hold the doors during transportation, eliminating the repeated quality defects during the handling process that had required costly repairs and production down time.

Instead, companies can better understand how to generate "runs" when they look holistically at the process to identify root causes and systemic issues. Rather than focus on short term fixes, when problems are identified and addressed at their core, the benefits tend to be greater and longer lasting.

Every day, manufacturers are forced to handle "random" events that are impacting their business. From threats of shutting down production lines due to parts not showing up on time to reworking parts due to poor quality, manufacturers are constantly firefighting to keep production lines up and running.

Many times, companies waste valuable time and money only addressing the symptoms that are impacting them (expedite, part rework, etc.). Unfortunately, by only addressing the symptom the issues will continue to reappear, kicking off the firefighting process all over again.

To address this, companies should look to tackle the true root cause of the problem. One method is Root Cause Corrective Action (RCCA), a process that tackles the root cause of the problem and prevents issues from reappearing.



[11] *Moneyball.* Dir. Bennett Miller. Perf. Brad Pitt and Jonah Hill. Columbia Pictures, 2011.

Tenet #5:
Carry it across the goal line

In Super Bowl XXVII, the Dallas Cowboys' #78, Leon Lett, recovered a fumble on the Dallas 35-yard line and ran it toward the end zone. At the 10-yard line, approaching the end zone, Lett slowed down and held the football out in celebration, unaware that an opponent was chasing him down from behind. The opponent knocked the ball out of Lett's outstretched hand just before he crossed the goal line, sending the ball through the end zone and costing the Cowboys a touchdown.

In the absence of proactive leadership alignment and change management, process improvement teams can fumble before they cross the goal line, too. Two-thirds of executives indicated in a recent survey that competing priorities for time and resources often take precedence over process improvement efforts, resulting in an unstructured or undefined process excellence program.[12] Because of this, process excellence efforts can either have a tough time getting off the ground or go after too much and stretch their resources too thinly. Instead, leadership can take on fewer improvement efforts and execute well against those things rather than taking on too much at once and fumbling. Process improvement efforts can have the flashiest data-driven analyses and the most insightful recommendations that get at the root causes of the problem, yet those recommendations may be worthless if others in the company don't accept and act on them in a committed and coordinated manner.

Like many other industries, manufacturing companies may have a hard time seeing process improvement initiatives through to completion and on through the sustainment phase. There are many reasons why companies don't see these initiatives through, such as: competing priorities; organizational leadership changes; and lack of accountable leaders. in these initiatives because of this lack of ownership, focus, clear business impact, and rewards. Many times companies lose interest in these initiatives because of this lack of ownership, focus, clear business impact, and rewards.

Another reason manufacturing companies may have a hard time pushing through to sustainment is the number of stakeholders required to make a change. Many times, to implement an improvement multiple processes must be changed, each with a different stakeholder in charge. If any single stakeholder does not buy in to the change and fulfill their commitment, the whole initiative can be at risk.

One thing, however, remains the same, no matter how much time and effort is put in to the improvement initiatives, without completion and a focus on sustainment, anticipated benefits will likely not come to fruition.

However, by developing a solution that focuses on implementation and sustainment, process improvement initiatives can be successful and benefits can be realized.

Example

A global aerospace and defense contractor was facing increased pressure from customers to hit projected production rates and costs requiring a 90% reduction in cycle time and a 50% reduction in cost per unit. Like many manufacturing companies the focus immediately turned to identifying improvement opportunities within production to help achieve the projections: developing standard work, work cell layouts, part presentation, etc. After identifying and prioritizing the improvement initiatives, teams utilized small scale pilots to demonstrate proof of concept. Following successful proof of concept it was time to implement the changes across the business.

When looking at the projects lifecycle, just as much time and effort, if not more, was focused on implementation and sustainment of initiatives as was spent on assessment and reconfiguration. During the implementation and sustainment phases, much of the focus was put on engraining the changes in the business. Layouts were designed and implemented in a way that prevented employees from reverting back to the old layout, and work instructions were changed in the technology system while metrics were realigned with a focus on working jobs in order and on time to ensure the changes were followed. Through this focus on implementation and sustainment, the anticipated benefits were realized and sustained over time.

[12] "3rd Biennial PEX Network Report: State of the Industry, Trends and Success Factors in Business Process Excellence"

Tenet #6:
Two heads are better than one

While training is essential for obtaining skills and knowledge, coaching and mentorship help people apply learning in the real world. Research of coaching effectiveness shows that a structured, proactive coaching approach where a schedule is followed leads to more successful project completion in comparison to an ad-hoc coaching approach (see figure 2).[13]

Such a mentorship model is necessary for effective implementation of Lean Six Sigma; it can keep teams motivated, foster continuous learning, and, most importantly, maintain improvement gains. One such model, the "belt" method, has been successful in helping teams draw from the wisdom of those who have walked the path before.

Figure 2: Coaching Improves Outcomes

Lean Six Sigma became widely adopted in the manufacturing industry in the 1990s and 2000s. Many companies developed entire organizations around the topic to educate employees, provide certification, and drive Lean Six Sigma projects.

Lean Six Sigma is an approach that can be used for maximizing benefit while minimizing effort. It can be further enhanced by educating others through an apprenticeship model where employees new to the concept can learn from the experience of those whom have been through it before.

Example

Through acquisitions in Europe and China, a global manufacturer saw their business grow nine-fold in a short period of time. With such quick growth, they were unable to effectively scale up production to meet the increased demand as was seen in the growing order backlog. The global manufacturer looked to deploy and implement Lean manufacturing across their various production facilities to achieve demand and cost targets. After an assessment of Lean manufacturing across ten production sites worldwide, three major sites were chosen to pilot a "Perfect Factory" concept and supplier development effort to improve capacity and reduce inventory. A proactive coaching model was used where those with extensive experience in Lean Six Sigma mentored other members of the team throughout the process. This proactive coaching model helped enable the successful transformation of the pilot sites where improvements were realized through implementation of Lean operations planning, synchronization of production operations, developing a plan for every part, pull replenishment strategy, enhanced inventory management process, and waster reductions. Through the Lean manufacturing pilots, the business saw a 50% increase in throughput, 60% reduction in lead time, and 30% reduction in inventory.,

[13] http://www.isixsigma.com/implementation/teams/how-effectively-coach-green-belts-and-black-belts/

Intelligent process improvement: Back to the future

Today's manufacturers face a dynamic competitive environment characterized by disruptive technologies and increasingly complex supply chains, which bring significant challenges as well as opportunities. Process improvement efforts can be deployed quickly and return results in the near term. However, companies that do this can also take a long term view and recognize the need for continual process improvement efforts to address evolving market conditions.

If ever there was an ultramarathon in business, process improvement is likely it. It requires discipline, patience, consistency, and lots of hard work, and the mindset is foundational to any level of change an organization needs to make. When process improvement methodologies first came into vogue in the 1980s and '90s, they challenged 50 or more years of conventional manufacturing wisdom, enabling companies to improve manufacturing quality, reduce production waste, eliminate bottlenecks, streamline processes, and cut costs. Twenty or more years down the path, many variations of standard process improvement techniques and tools have been introduced. Along with them have come many opinions about which techniques and tools are most effective. However, one incontrovertible fact remains: Lean Six Sigma continues to be one of the most prevalent and consistently productive approaches to process improvement. The six tenets described in this paper can help companies continue to leverage Lean Six Sigma for solid results in the modern ultramarathon that process improvement represents.

Case study
Increasing competitive advantage through data-driven analysis

Almost every manufacturing company is challenged with the task of balancing the demand and supply of the business while mitigating any risk as best as possible. A global aerospace and defense contractor was having a hard time hitting production rates and cost targets established by the customer primarily due to the inability to predict such demand and supply risk. To combat these issues, the company turned to advanced analytics to better model demand and supply risks while standing up a new organization to utilize these tools in risk mitigation.

One of the first main challenges was the lack of an aggregate demand profile that also included any potential risk. In the past, the company had done little to estimate the demand risk driven by quality, and that which was estimated was driven by opinions. To address this, an analytics solution was put in place to aggregate demand across the various business areas and risk was added based on historical performance by the business. This allowed the business to follow the facts when preparing for risk instead of basing decisions purely on assumptions.

Knowing a business has risk is only half the battle as to act on it many times involves buying down such risk. Eliminating the risk as much as possible is beneficial as it can reduce the cash outlay to mitigate the risk. To effectively mitigate the risk, a Root Cause Corrective Action process was implemented to identify the sources of demand and supply variation. Using the RCCA process, key sources of variation could be eliminated at the source, preventing downstream impacts.

To ensure that the analytics tools and RCCA process became engrained in the business and anticipated benefits realized, a new organization was established and key business metrics were designed. The organization was designed to optimize demand and supply utilizing the analytics tools and RCCA process. In addition, the organization utilized new metrics across the business to hold people across the organization accountable for the new business goals of minimizing variability within demand and supply.

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