Quantitative Process Improvement

A White Paper by

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What is Quantitative Process Improvement (QPI)? Is it useful for your career … your business … your consulting practice? What do the buzzwords mean?

This white paper is designed to give you a brief overview of QPI. If you like what you read here, please consider taking one of our courses to learn more. All of our public classes are also available as in-house classes.   Till then, here is an overview.

What is Quantitative Process Improvement?

Simply put, it's any effort designed to make a business process better by using quantitative means. What are quantitative means? They are methods which use measurements for proof. In other words, your feelings, hunches, opinions, etc. are not really relevant in a QPI environment, other than as a starting point for testing.   Results which can be proven by measurements are what matters.   Without measurements, quantitative decisions can't be made.

In a military world, those with the best weapons rule. In an economic world, those with the most money rule. In a QPI world, those with the best data and the ability to know how to interpret and use it rule!

Three QPI methodologies are in wide use today. They are Six Sigma, LEAN and Theory of Constraints. If you look hard enough you can find others, but these are the biggies and the best known.   What is a 'methodology'? It's just a set of rules, or way or doing something. In this case, it's an approach to solving problems. Each of the QPI systems mentioned uses a different methodology.

Each QPI system also uses different tools. What do I mean by a 'tool'?   A tool is just a particular technique or instrument for doing something. A flow

chart is a tool. So is a calculator. So is a shovel. They are each designed to do something very particular if you know how to use them. Tools are intended for certain jobs. You wouldn't use a shovel to tighten a screw, but sometimes tools can be used for a wide variety of thing, even things they weren't intended for.

I've used a shovel to kill a snake. It wasn't built for that but it worked just fine. It was the snake or me, the tool was handy and I knew how to use it so I improvised. So it goes with all the QPI tools you'll learn to use over time. Don't get caught up in the rigorous definition of how the tool is supposed to be used. Use it for what works for you.

Descriptions of the three major QPI methodologies:

Six Sigma

Six Sigma was designed to solve problems in processes that repeat many times, and was intended to be used in situations where consistency in the process outputs is needed. Six Sigma was designed to help companies reduce variability in important process characteristics. Six Sigma is very popular today. In contrast to many quality system fads of the past, it shows no signs of weakening and is currently over 20 years old. Like any system, it has its adherents and its detractors. I'll address these later in a comparison table.

Six Sigma started in high volume manufacturing where processes are obvious (just look at all those machines!), and identical outputs are often desired. Six Sigma was 'invented' by two guys at Motorola, but was made popular when General Electric adopted it as a quasi-religion. It's now used world wide in dozens of different industries.

A few examples of repeating processes that Six Sigma techniques have been used on include

> Bearing diameter consistency (manufacturing)
> Defect reduction (all industries)
> Employee turnover reduction (HR)
> Shortening time to close the books (financial)
> Package weight consistency (manufacturing)

Error rate in software (IT)
Reduce # of visits by a technician (service)
Delivery time consistency (service)

Hallmarks of a good Six Sigma project are:

The problem must be clearly defined
Data must be available
The customer must have clear requirements

Six Sigma projects often focus on and count 'defects'. What is a 'defect'? It's simply the result of a process output which fails to meet customer specifications. Think about this. In order to tell that you have defects, you have to be able to measure the characteristic and must have clear guidelines from the customer. If either of those is absent, Six Sigma won't help.

Six Sigma requires that someone on the project team know a lot about data analysis and statistics. Many of the team members need to have an appreciation of the principles that are in use, but at least one of them has to know the nitty-gritty of data analysis and statistics pretty well. Sorry, but math is required. If you slept through math in school, let someone else lead this kind of project and this time stay awake and pay attention!

I teach Six Sigma and I'm afraid to say that many of the people who take classes from us and from everyone else who teach it understand just enough to pass the test while it's fresh. Three months later I'm not sure I'd trust my business to their data analysis skills. Just remember how fast you forgot trigonometry after your high school class. And it seemed so clear at the time! Same thing goes with Six Sigma analytical skills. They require constant practice to keep them sharp. Overall Six Sigma problem solving skills are longer lasting. Once you learn the methodology and the principles you aren't as likely to forget those.

Six Sigma practitioners are given titles which represent how much they know.

- Yellow Belts know just enough to be dangerous

- Green Belts know enough to participate on a team

- Black Belts know enough to lead a team

- Master Black Belts have led several teams and can be considered to know it well, not just have book learning or one or two project experiences.

- Six Sigma trainers can teach others and may or may not be able to effectively lead teams. Depends on their belt status. Training is a different skill than problem solving. In theory you can be an ineffective problem solver but still teach people the principles, although I don't recommend it.

Who 'owns' Six Sigma? Six Sigma is not owned by any organization. You can sort of consider it shareware. It's odd but there is no certifying body, no central group, nada. A few people have created official sounding organizations that imply they have some special standing, but none of them do. I could form the 'Grand Imperial International Institute of Six Sigma' but I don't like to fool people. Some companies have a premier standing in the market because they have established a reputation for high quality in their training and in helping companies create and manage Six Sigma programs. They are really just consulting companies however, not industry standards groups. The ASQ (American Society of Quality) probably should have been the Six Sigma standards body but they blew it early in the life of Six Sigma and decided to make money off it instead. They have recently tried to establish themselves as a standards body with a testing program, but based on what I see in industry, the effort was too little, too late, and not yet widely accepted.

The Six Sigma methodology can be summed up in 5 letters. D M A I C
    DEFINE your problem
    MEASURE the key variables
    ANALYZE the measurements
    Develop an IMPROVEment plan
    Create a CONTROL plan so improvements 'stick'

LEAN

LEAN was designed to reduce waste in a business process. It also started in manufacturing. Toyota started it. They called it the Toyota Production System. It has evolved over the years to take a few different forms but all with the same idea … to get the fat out of your operations. Nobody likes to admit that Toyota knew all the answers so they renamed it LEAN. Besides, it is descriptive. When you remove fat from yourself you get leaner.

There is a methodology in LEAN also but it isn't as clearly explained as the Six Sigma one. Maybe this is because there is no pronounceable acronym for it? In a nutshell, it is as follows:

- First, clean up your act – literally. If you cringe when you remember your mother yelling at you to clean up your room, get ready for some flashbacks. A LEAN program typically starts with a 5S program which is essentially your mother on steroids.
- Determine which of your process steps add value. What things that you do would the customer gladly pay for if they knew you were doing it? This can be a painful exercise, especially when you realize that not much of what you do is worth anything. I think this is the main reason that LEAN people are more humble than Six Sigma people.
- Make the value-added parts of your process move without interruption. All waiting is waste in a LEAN environment.
- Only make what is ordered by the customer. Making stuff in advance is waste in a LEAN world.
- Strive for perfection by eliminating defects. Hmm. Doesn't Six Sigma deal with defects? I'll discuss the overlap later.

LEAN practitioners aren't as title conscious as the Six Sigma folks although recently there have been a bunch of LEAN belts on the market. A few groups are trying to establish levels of LEAN understanding and granting titles to them. Oddly, or understandably, they are using the same titles as Six Sigma - Green Belts, Black Belts and Master Black Belts. These titles aren't as widely used but they seem to be gaining traction.

LEAN isn't as mathematically oriented as Six Sigma. As far as math skills go, to be a Six Sigma Master Black Belt you need the equivalent of a graduate level understanding of applied statistics. To be a LEAN Master Black Belt you need to know how to add, subtract, multiply and divide! This isn't to make fun of the LEAN folks, just to point out that they use different techniques which are more people, observation, flow chart, and visual oriented. On the contrary, too many Six Sigma people get caught up in the math and forget the basics. A phrase which describes this is that they are 'living in n-tuple space'. A LEAN leader has to be good at training and leading lots of people to do fairly simple tasks. Most Six Sigma people don't train. Most LEAN people do. It's an organization thing.

Now that I've poked fun at the LEAN folks a little (I'm one of them so I can do that), let me talk about the complexity of it. Getting 3-4 people to cooperate with you on a fairly focused Six Sigma project takes small group leadership and technical skills. Getting 400 people to cooperate with you on a LEAN project takes the even rarer talent of true large group leadership. LEAN masters are in high demand, as are Six Sigma masters, but for different reasons. If you can do both well, put in your order for a new yacht today!

LEAN is often thought of as a transformation process. The activity changes the way the entire organization works, from the top to the bottom. Six Sigma by contrast is more often a point solution technique. While it is often rolled out as an enterprise wide program, the enterprise focus is to 'find specific problems and use Six Sigma methods to fix them'. In a LEAN transformation, entire organization structures and ways of running operations are changed.

Theory of Constraints (TOC)

TOC is a methodology for solving constraint problems. That can't be a surprise. Another word for constraints is 'bottlenecks'.   While Six Sigma is focused on the elimination of *defects* and LEAN is focused on the elimination of *waste*, TOC is focused on the elimination of *bottlenecks*.

What is a bottleneck? It's simply a part of your process which throttles the flow of goods or services that you are trying to produce. In other words, it's the slowest part of the process, the weakest link in the chain, the most rotten apple in the barrel. You get the idea. In contrast to Six Sigma and LEAN, TOC was invented by one guy, Eli Goldratt. Search for him and you'll find his books and tapes on the subject. In contrast to LEAN and Six Sigma where there are thousands of books, there is only one book to read if you are new to TOC and want to get a flavor of it, The Goal. It's written like a novel, easy to read, non technical and gives you a great informal idea of the process. After reading it you won't be able to actually do anything, but you'll feel a lot more insightful!

TOC is a methodology to use when your primary problem is that you need things to flow FASTER and you have a bottleneck that is preventing it.

To people new at this I often hear that this is stupid. If a machine is going too slow, speed it up! If you can't do that, buy a faster machine! If there are no faster ones, buy a second one and run them together, etc. The same thing is true with people. If one person in your link is slowing you down, train them, yell at them, replace them, or do whatever your particular philosophy for that situation may be.

Sure, if it's that simple do it. You don't need a 'Methodology' to solve obvious problem. You need one to solve hard problems. The constraints that we use TOC for are those for which obvious solutions won't work. That might be because no faster machine exists. There is no space for a second one; we can't afford to rebuild the slow computer system, etc. What do you do then? Simply suffer the repeated beatings from your management? TOC techniques show you how to find solutions which are NOT OBVIOUS.

Actually, LEAN, Six Sigma and TOC all have that in common. Solutions they reveal are often things that we would never have done if we used our intuition. Intuition is great for some things, but for problem solving it can be

a trap. Methodologies help us to avoid going down blind alleys that are traps and find solutions which work, even if they are the opposite of what we thought might be best. It's like opening a box of magic tricks. It's intoxicating and makes you want to do more.

One of the interesting ideas of TOC is that no matter how complicated your business process is there is only ONE constraint (OK, sometimes two.). The point is that the first step in the method is to find it. You aren't looking to create a big laundry list of problem, just find that ONE CONSTRAINT!

This brings me to the TOC methodology. It's just a few steps, like LEAN and Six Sigma:

IDENTIFY the system constraint (what and where it is)

EXPLOIT that constraint (maximize its use)

SUBORDINATE everything else in the process to the constraint (make the constraint the master)

ELEVATE the constraint (crush it with money, etc.)

Return to step one where you will surely be able to find a new constraint. Do this over and over until you get sick of it.

An interesting idea in TOC is that there is no such thing as a conflict in nature. We have problems because we have conflicts. But if there really are no conflicts in nature, what does this mean? A conflict exists because there is at least one erroneous assumption in our thinking. If we can identify that wrong assumption and correct it, a win-win is always possible.

LEAN, Six Sigma and TOC Theories

Six Sigma	Repetitive processes, Reduce VARIATION
Lean	Any process, Remove WASTE
TOC	Any process, Manage BOTTLENECKS

LEAN, Six Sigma and TOC Focus

Six Sigma	Process Problems
Lean	Process flows
TOC	System constraints

LEAN, Six Sigma and TOC Assumptions

Six Sigma	Problems exist, Data is valued System output is improved if variation is reduced
Lean	Waste removal will improve business performance Many small improvements are better than system analysis
TOC	Speed and volume are important Use existing systems Processes are interdependent

LEAN, Six Sigma and TOC Primary Effects

Six Sigma	Uniform process outputs
Lean	Reduced processing time
TOC	Faster throughput

LEAN, Six Sigma and TOC Complaints

Six Sigma	Interactions not considered. Processes looked at independently
Lean	System analysis is not valued
TOC	Minimal worker input, Data analysis is not valued

Note 1: from Dave Nave's article

Here are some typical topics common to each methodology

Selected Topics in Six Sigma

Variation	Histograms	Control Charts
FMEA	DMAIC	DFSS
Design of Experiments	Capability calculations	Goodness of Fit testing
Inferential Statistics	Descriptive Statistics	Software applications
Simulation	Cost of Quality	Team Leadership
Measurement Systems Analysis	Reliability	Regression & Correlation

Selected Topics in LEAN

Value Stream Maps	Team Leadership	Just-In-Time
Pull Systems	One piece flow	Takt Time
Cellular Operations	Process grouping	Workflow balancing
Setup time reduction	SMED	Lean Scheduling
Little's Law	Kanban Systems	Heijunka Scheduling
5S	Visual factory	Poke Yoke

Selected Topics in TOC

| Critical Chains	The Thinking Process	Current Reality Tree
Evaporating Clouds	FMEA	Future Reality Tree
Prerequisite Tree	Transition Tree	Drum Buffer Rope
Throughput Accounting	Necessary and sufficient conditions	Constraint Identification

Some Related Industry Terminology & Meanings

Toyota Production System (TPS) – The precursor of LEAN.

Baldridge Award – A national award for quality excellence in the USA

Oglethorpe Award – The state of Georgia's award for quality excellence. Many US states have similar programs.

Certified Quality Engineer (CQE) – The American Society of Quality top Quality certification. This has almost been made obsolete by the Six Sigma Black Belt which is unfair to the CQEs since they overlap a lot.
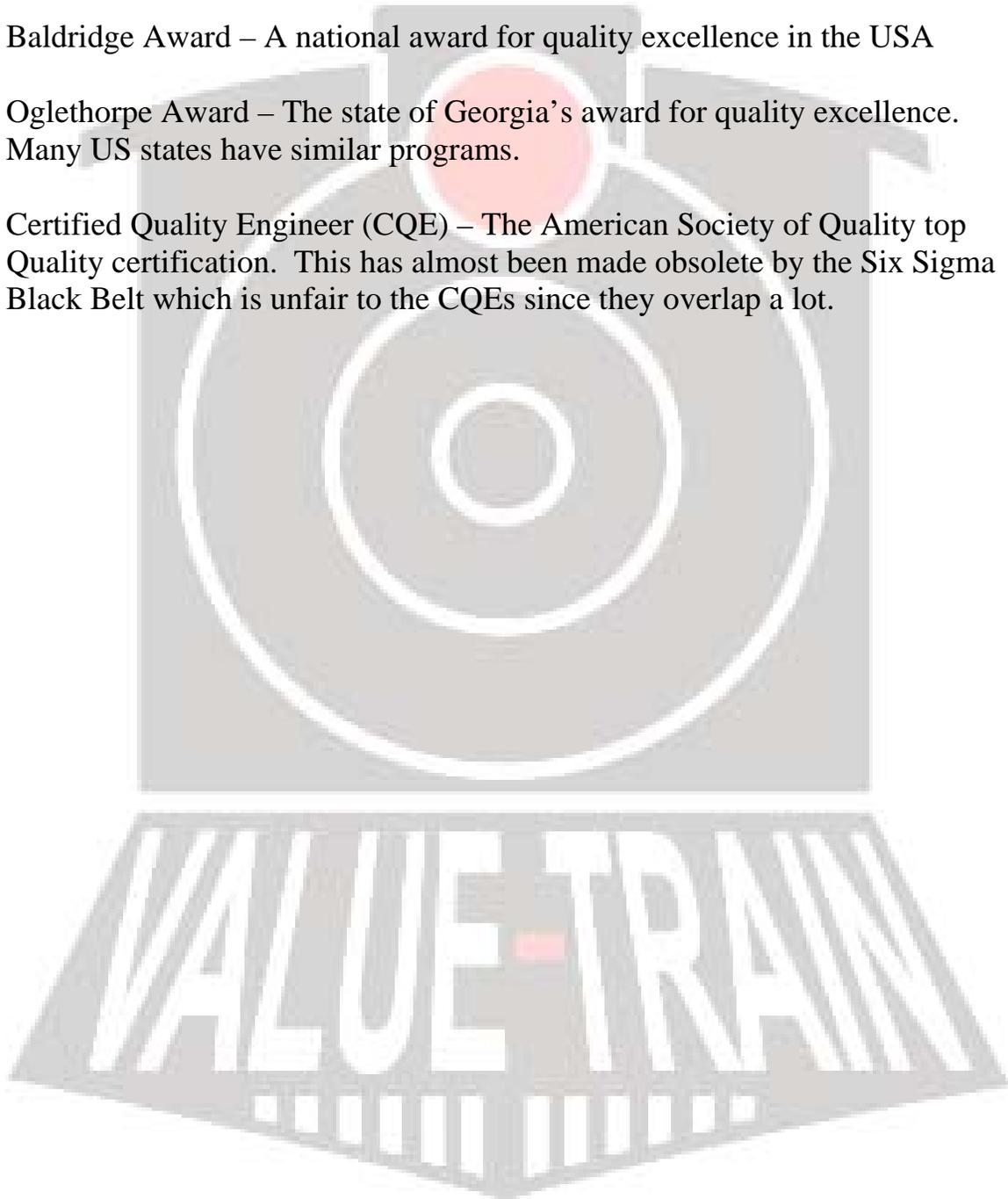
My philosophy on Professional Certifications

- I don't value them
- But I provide them
- Because employers value them
- Because employers use them for screening
- The right certification will help you get the interview
- But only a good UNDERSTANDING will get you the job

Who is Bill Bentley?

- Electrical Engineer, reinvented many times
- CEO and General Manager of two technology companies
- Husband, father, sailor and motorcyclist
- Educator
- Entrepreneur – Owner of Value-Train

What is Value-Train?

- Value-priced…
- Training…
- For people who buy their own education…
- On process improvement subjects…
- That employers care about

What training do we provide?

- Six Sigma Green Belt
- Six Sigma Black Belt
- Lean Enterprise
- PMP Prep
- Minitab (advanced statistics)
- Quantitative Methods Using Excel

We do open enrollment public classes, in-house courses, and process improvement consulting. You can see our public classes and policies at http://www.value-train.com. Call for everything else.

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