Lean Six Sigma

An Introduction to Process Improvement

Course Content

What is Lean Six Sigma (LSS)?

Lean

- Process speed
- How ***quickly*** things move through a process
- Primarily focused on improving cycle times and on-time delivery, by reducing waste and delays in a process

Six Sigma

- Process success
- How ***consistently*** (correctly) things move through a process
- Primarily focused on improving quality, yield and customer acceptance, by reducing defects and variation

Why Lean Six Sigma?

- Cut costs and expenses
- Increase revenues and profit
- Improve delivery times
- Reduce inventory
- Increase customer satisfaction
- Increase employee job satisfaction and retention
- Payback on investment of resources typically 10-20 times

What is Lean?

Key Concepts of Lean

- **Continuous Flow:** Producing and moving one item at a time
- **Cycle Time:** How often a part or product is completed by a process, including wait time
- **Jidoka:** Immediately stop work when an abnormal condition has occurred
- **Just-in-Time (JIT) Production:** makes and delivers just what is needed, just when it is needed, and just in the amount needed
- **Kaizen:** Continuous improvement to create more value with less waste
- **Kanban:** signaling device (sign) for items in a pull system

Taken from Lean Enterprise website

Strengths of Lean

- Tools are easy to learn
- Global view of processes
- Visual changes more apparent
- Broader definition of waste to improve process flow
- Small, immediate changes to improve processes (fail fast)

What is waste?

Seven Types of Waste

1. Overproduction (Producing Too Much or Too Soon)
2. Waiting (Idle Time)
3. Transportation
4. Unnecessary Motion
5. Over-Processing (Too Many Steps to Complete a Job)
6. Inventory (Too Much Stock On Hand)
7. Producing Defects

Flow

- Handoffs, waiting, bottlenecks, inefficiencies, complexity are all forms of "waste"
- Identify and remove these "non-value added" activities and steps from the process
- Redesign or relayout process
- Eliminate defects

What is Six Sigma?

Key Concepts of Six Sigma

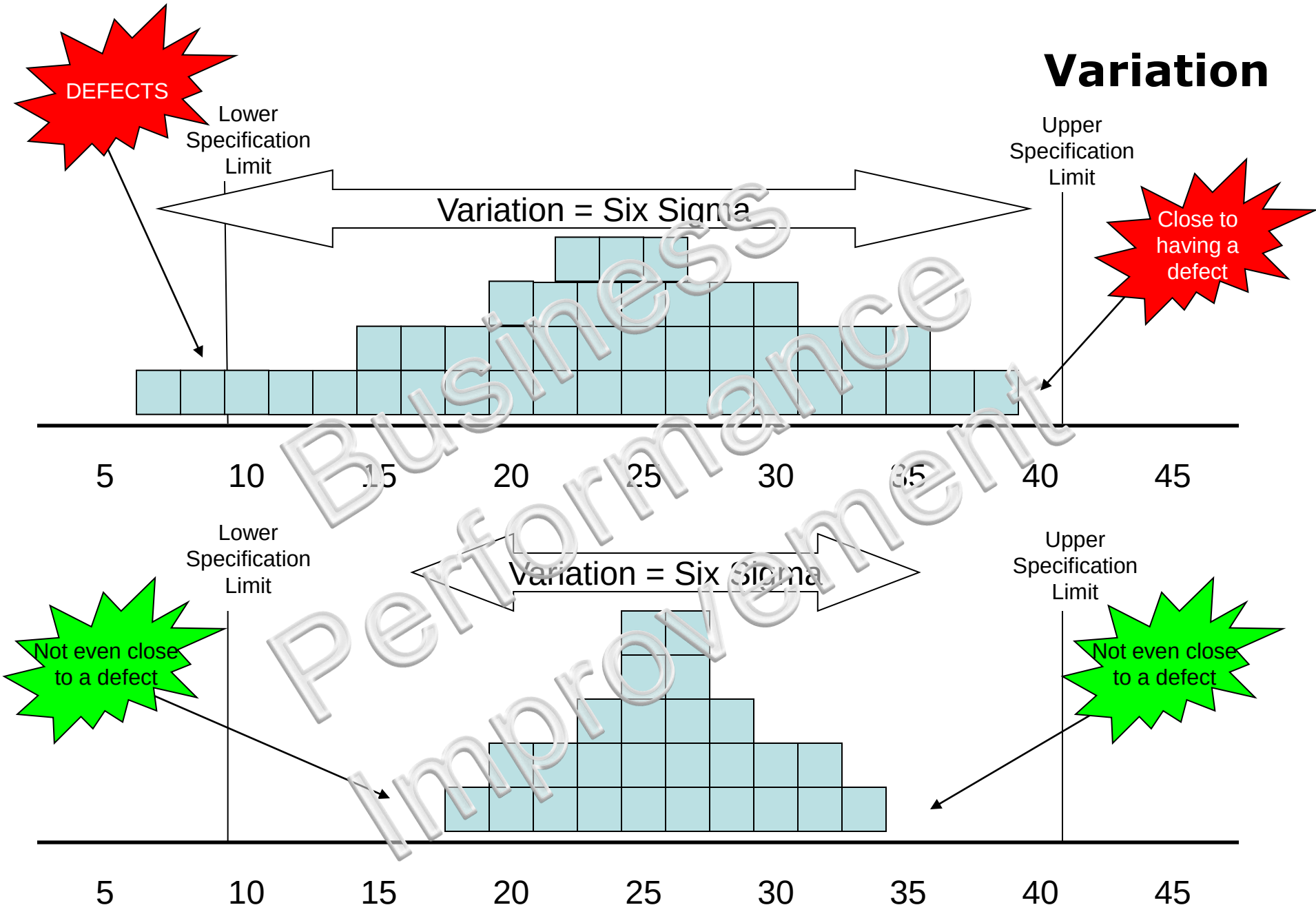
- **Critical to Quality:** Attributes most important to the customer
- **Defect:** Failing to deliver what the customer wants
- **Process Capability:** What your process can deliver
- **Variation:** What the customer sees and feels
- **Stable Operations:** Ensuring consistent, predictable processes to improve what the customer sees and feels
- **Design for Six Sigma:** Designing to meet customer needs and process capability

Taken from General Electric website

Strengths of Six Sigma

- Projects tied to company financials
- Requires highest level support (CEO)
- Structured training hierarchy (Belts)
- Decisions based on statistical methods
- Structured project methodology (DMAIC)
- Prevention emphasized over reaction

Variation



Variation

- Variation leads to higher defects
  - more frequent late deliveries or quality errors
- Less predictable for next process / customers
- Average may be the same, but customers don't see average, only extremes
- Six Sigma refers to a "sigma" level, which corresponds to yield or defect rate
- Example

Sigma Level to Yield

Sigma Level	Defects per Million	Yield
6	3.4	99.99966%
5	230	99.977%
4	6,210	99.38%
3	66,800	93.32%
2	308,000	69.15%
1	690,000	30.85%

Why 99% is not good enough

99.9% is good enough, isn't it?

Equates to 1000 defects per million opportunities (~4.6 sigma level)

Depends on the process...

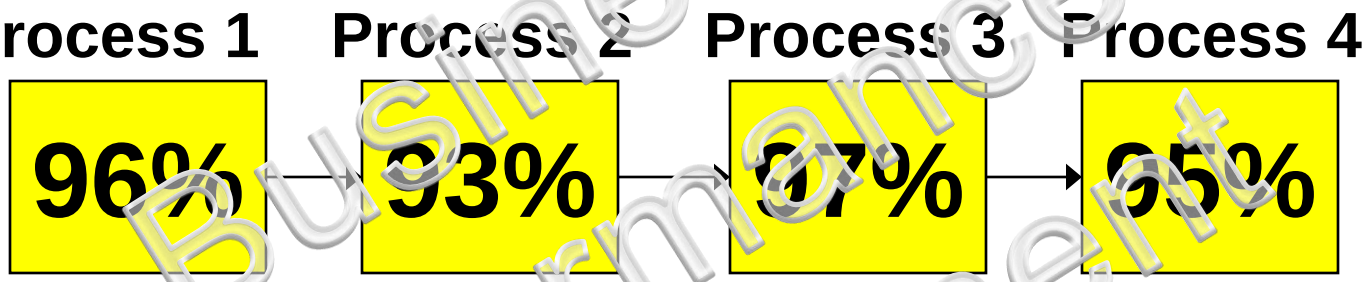
- **4000 wrong medical prescriptions each year**
- **More than 3000 newborns accidentally dropped each year**
- **Two long or short landings at American airports each day**
- **400 letters per hour which never arrive at their destination**

Real Life Sigma Levels

4σ Process	6σ Process
without hot water more than 54 hours each year	without hot water for less than two minutes a year
Lights would be out an hour a week	Lights would be out about two seconds a week
Phone without service for more than four hours a month	Phone without service for about nine seconds a month
about six out of every 1,000 invoices will contain incorrect information	mistakes will occur only about three times in every 1,000,000 invoices
you would spend 37 minutes in the repair shop for every 100 hours you operate the vehicle	you would have only 1.2 seconds of repair for every 100 hours of operation

Why 99% is not good enough

Rolled Yield



Each process operates pretty well, but…

0.96 x 0.93 x 0.97 x 0.95 = 0.823

= **82.3%**

82.3% chance of completing all 4 steps without a failure

What is Lean Six Sigma?

Improvement initiative using both Lean and Six Sigma tools and methodology to deliver quality products and services to the customer, right when they need it, at the lowest cost possible

Lean vs. Six Sigma

Lean		Six Sigma	
5S	One Piece Flow	Statistical Process Control	Process Flows
Cellular Layout	Poka Yoke (Error Proofing)	Designed Experiments	SIPOC
Kanban	Value Stream Mapping	Gage R&R	5 Why's
SMED	Pull System	Cost of Poor Quality	8D Problem Solving
Preventative Maintenance	Standard Work	Control Plans	Pareto
Visual Controls	Just In Time (JIT)	Key Characteristics	Fishbone Diagrams
Takt Time			FMEA

* Not all-inclusive, just showing major tools

Why are they combined together?

- Many companies started with Six Sigma, but missed deliveries trying to inefficiently move from process to process
- Other companies started with Lean, but shipped defective products and services more quickly
- Cannot look at just one half of the answer
- Must evaluate processes from both perspectives equally, otherwise biggest opportunities may be overlooked

Customer Focused

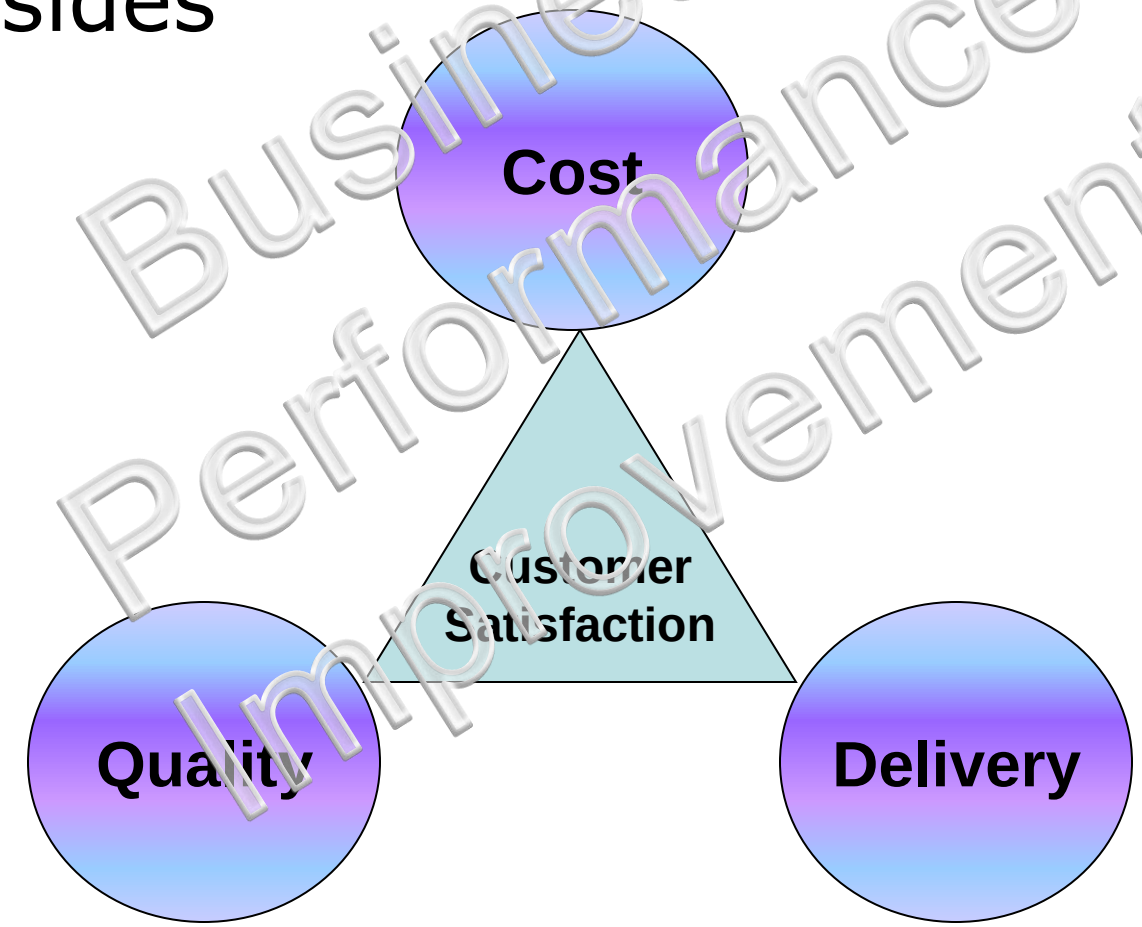
Customers define what "quality" is

Must address both internal and external

Goal is eliminate "defects"

- Six Sigma defect = wrong document sent to customer
- Lean defect = document sent one day late

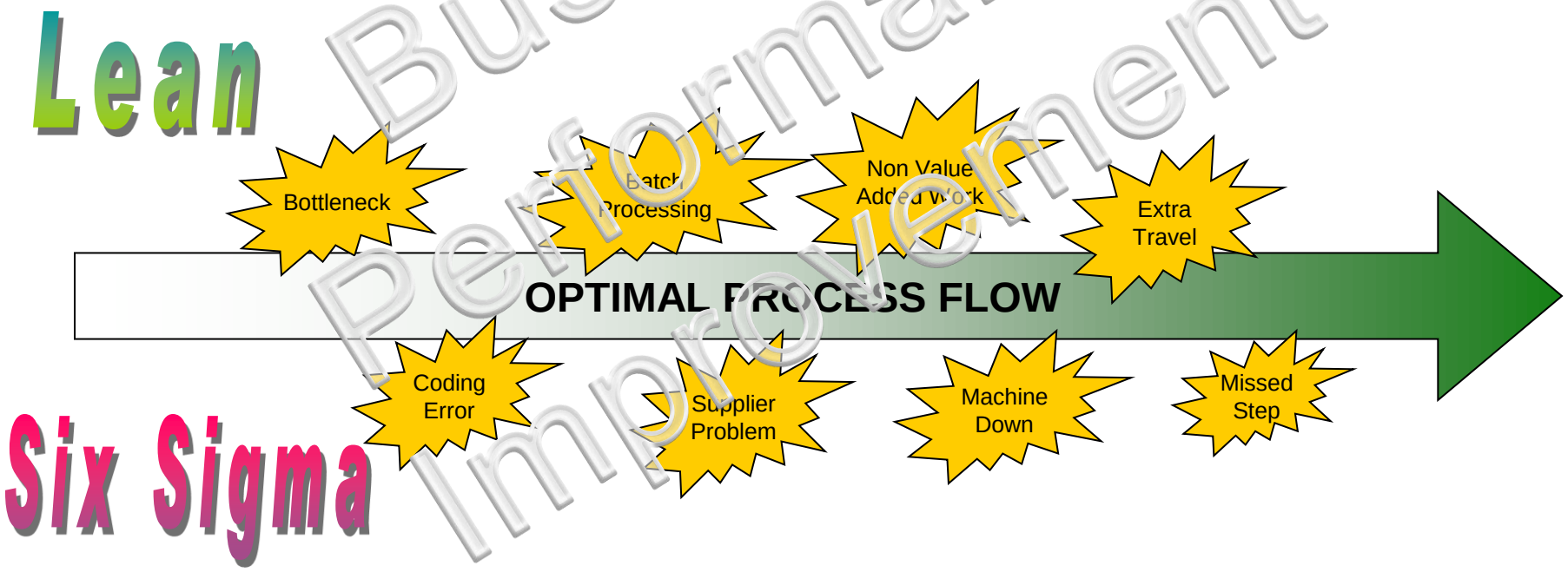
Weakness in one area affects the other two sides



Optimize Process Flow

Eliminate or reduce variation (Six Sigma)

Improve process flow (Lean)



Process Thinking

- Must evaluate problems as process problem, not blame people
  - 85-95% due to process deficiency
- How did the process fail to allow the individual to succeed?
  - Lack of documentation
  - Lack of training
  - Too much complexity
  - Working too quickly
- Once process evaluated, then address people issues

Teamwork

- Necessity to address process issues
- All working on common goal, from different perspectives
- Requires additional skills and training
  - Listening
  - Brainstorming/Organizing ideas
  - Decision making as a team

Data

- Must support opinions with facts (data)
- Problems with obtaining/using data
  - Lack of available data
  - Too much data being collected
  - Poor collection/recording of data (don't trust validity)
  - Poor/incorrect analysis of data
  - Data driving poor behavior

- Collecting data takes a long time
  - Slows down projects, requires extra resources,
- If project continues, could work on insignificant issues, or make overall problem worse
- Typically, good sound judgment used in place of available data
  - Works sometimes, but usually adds more complexity into process, may not address root cause

5 Key Points of LSS

- Customers are most important
- Delivery, quality, and low cost are linked
- Need to eliminate variation and defects, and reduce process flow time
- Data is critical to making sound business decisions
- Have to work together to make the kinds of improvements that customers will notice

How to get started?

- Get highest level of support
- Dedicated Resources
- Champions
- Training
- Business Priority & Project Selection
- Cadence of Projects

Dedicated Resources

- **Master Black Belts**: Experienced Black Belt that oversees projects
- **Black Belts**: Experts on all skills, provide training, run major projects
- **Green Belts**: Skilled on majority of tools, but not experts – high potential candidates, future Black Belts
- **Money Belts**: Finance rep who determines what hits bottom line
- **Yellow Belts**: Skilled on basic tools, data collection tasks
- **White Belts**: Overview and basic training, not part of core team
- **Champions**: Breakdown barriers of resources, funding and priority of project, owns the process

Cannot be part-time activity that is done in their "spare time"!!

Receive training on different topics

- **Teamwork**
  - Facilitation, Decision Making, Team Building
- **Statistics and Data Analysis**
  - Variation, Designed experiments (DOE), Statistical Process Control (SPC), Regression, Correlation, t-tests
- **Lean**
  - Setup reduction, visual controls, mistake proofing, Successive checks, One piece flow, JIT, pull
- **Process Analysis**
  - Flow Diagrams, Value Stream Maps, FMEA, Cause and Effect (Fishbone) Diagrams, 5 Why's, SIPOC
- **Finance**
  - Income Statement, Cost of Defects

Use DMAIC model as foundation

- Successful methodology that uses data to confirm extent of problem, get to root cause, link solutions to causes, and maintain improvements
- **D**efine
- **M**easure
- **A**nalyze
- **I**mprove
- **C**ontrol

- Draft project charter
  - Project scope
  - Team members and assignments
  - Potential benefits
  - Timeline for completion
  - Initial customer and process data review

Tools used: SIPOC, Value Stream Mapping

- Verify measurement system is valid
- Data driven priority
- Visual observations w/ fresh eyes
- Map processes
- More detailed data breakdown

Tools: Pareto chart, Spaghetti chart, Run charts, Cycle Time Map, FMEA, Gage R&R, Flow Diagram

- Experiments to determine key factors affecting data
- Analysis to determine significance of differences

Tools: Statistics, Fishbone Diagrams, 5 Why's, Designed experiments

- Determine best solution as a team
- Based on cost benefit analysis
- Factor in implementation ease
  - Some great solutions may be too difficult to implement, others easier with almost same benefits

Tools: Nominal Group Techniques, Setup Reduction, Mistake Proofing

- Need to make sure problem does not reoccur later
  - Document new process
  - Training on new process
  - Monitor new process w/data
  - Communicate results to other areas
    - Solutions may be systemic, implemented everywhere
- Tools: Control plan, Key Characteristics, Statistical Process Control

Keys to Success of LSS

- Top Level Support
- Pick the right projects
- Pick the right people
- Follow the methodology
- Defined roles and responsibilities
- Communicate
- Training at all levels

Additional Resources

Business Performance Improvement

http://www.biz-pi.com