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Providing Life-Changing Opportunites

Lean 6 Sigma Yellow Belt

Teacher Workbook

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Lesson 1: Introduction to Six Sigma

Instructions: While watching the videos, fill in the missing words according to the information presented by the instructor.

Purpose and Goals of Six Sigma

Learning Objective: *After completing this topic, you should be able to recognize the purpose of Six Sigma and its potential value to an organization*

1. DPMO stands for **Defects** Per Million **Opportunities**.
2. DPMO is a scientific measure and a way to calculate the number of potential **mistakes** or **defects** we get when we provide a product or service.
3. The next part of this system is called the **improvement** methodology. And the phrase for that is called DMAIC.
4. DMAIC stands for d**efine**, m**easure**, a**nalyze**, i**mprove** and c**ontrol**.
5. Six Sigma has been widely adopted by **industry** leaders of all kinds in all industries. The Six Sigma basic techniques have been in practice for nearly **100** years.
6. Six Sigma is not limited just to **manufacturing**, which is the industry where it was born. This methodology has been successfully deployed in every kind of business.
7. All industries, whether they are for profit or not, are concerned with **operating** costs.
8. Six Sigma has been a very effective method to accomplish this by using proven methods to reduce the cost of **quality** over time.
9. Another key component is driving customer **satisfaction**.
10. Six Sigma initiatives that are being implemented the right way are focused on the voice of the customer and also focused on making changes that reduce **variation**, reduce **inefficiencies** and improve **quality** in our processes.

Key Characteristics of Six Sigma

Learning Objective: *After completing this topic, you should be able to identify key characteristics of Six Sigma*

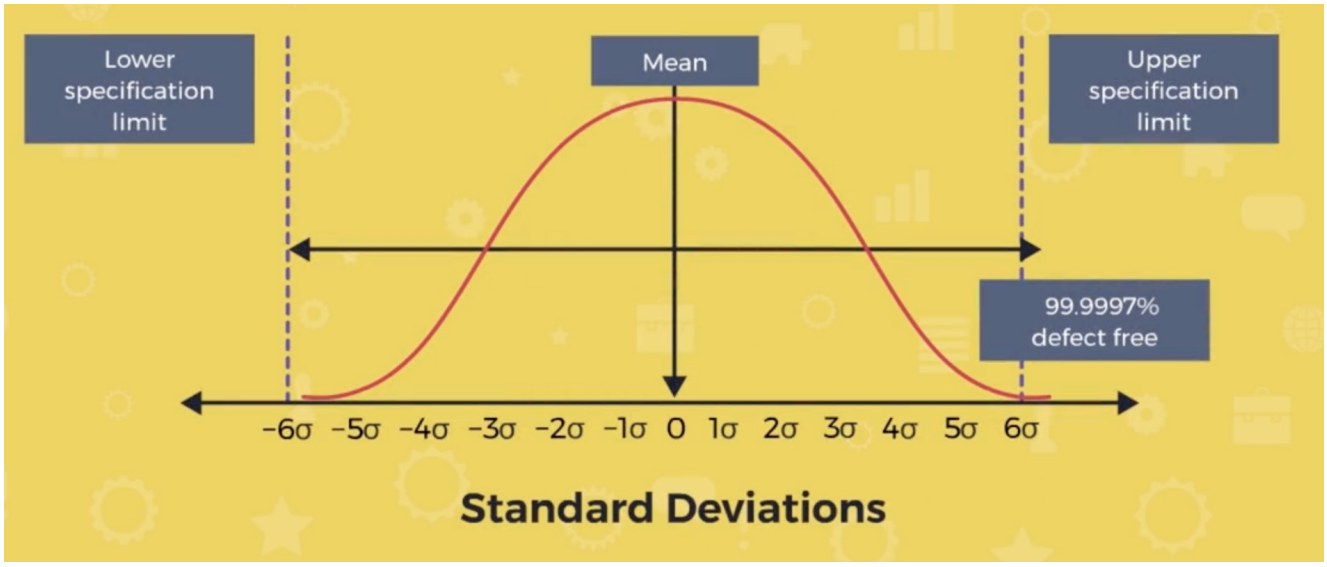
1. This topic addresses the concept of Defects Per Million Opportunities, or **DPMO**.
2. As we're able to measure and capture data about something, we can begin to chart it and evaluate its relative **performance** against a goal, or mean measurement.
3. Using the methods for Six Sigma, we begin to understand with the use of **standard deviations**, how our performance compares to that goal with respect to an upper or lower specification **limit**.
4. Fill in the blanks on the image below:

Mean: The mean is the average of the given numbers and is calculated by dividing the sum of given numbers by the total number of numbers.

$$\text{Mean} = \frac{\text{Sum of all the observations}}{\text{Total number of observations}}$$

Standard Deviation: The standard deviation is a measure of the amount of variation of a set of values. A low standard deviation indicates that the values are close to the mean of the set, while a high standard deviation indicates that the values are spread over a wider range.

Sigma: Sigma is the greek symbol (σ) used to represent a standard deviation



5. Many operations may set a level of tolerance at **three** standard deviations, plus or minus from the mean. An operation performing at a level of Six Sigma quality is 99.9997% **defect** free, meaning only about **three** defects per million opportunities are expected.

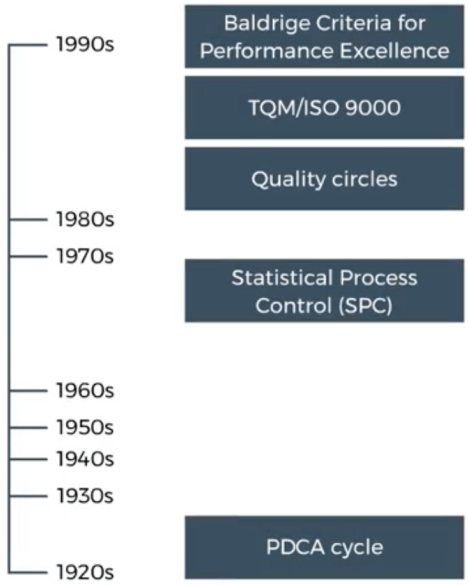
6. Here is the difference that Six Sigma makes when an operation is able to limit defects to only 3.4 per million opportunities in its processes. (Fill in the blanks below):

Three Sigma (3σ)	Six Sigma (6σ)
20,000 items of mail lost per hour	7 items of lost mail per hour
5,000 incorrect surgeries performed per week	1.7 incorrect surgeries per week
No electricity for almost 7 hours per month	No electricity for 1 hour every 34 years
54,000 wrong drug prescriptions per year	1 wrong drug prescriptions every 25 years
5 short or long landings at a major airport in the US	1 short or long landings at ALL US airports in 10 years

7. Six Sigma quality can affect every single industry that we work in, from manufacturing to **consulting**, profit to **nonprofit**, government to the **private** sector.

Evolution of Six Sigma

Learning Objective: *After completing this topic, you should be able to sequence key developments in the evolution of Six Sigma*



1. Back in the early **1920**s there was the Plan, Do, Check, Act cycle.
2. Then as we moved into the 1960s and 70s this led to **statistical** process control and the formation of the Japan Union of Scientists and Engineers.
3. Then the United States began adopting and embracing total quality management, or TQM in the 1980s. In that same time frame is when **quality** circles developed by the Japanese began to be well understood.
4. Moving into the late 80s and early 90s, we had the integration of ISO9000 with total quality management and the development of the Baldrige criteria for **performance** excellence.
5. The evolution of Six Sigma as we know it today is largely credited to the work done at **Motorola** and at **General Electric**.

Lesson 2: Six Sigma Principles

Instructions: While watching the videos, fill in the missing words according to the information presented by the instructor.

Six Sigma Methodology

Learning Objective: *After completing this topic, you should be able to recognize core concepts of the Six Sigma methodology*

1. Match the steps of the DMAIC Process below with the correct description:

Define: _____

Measure: _____

Analyze: _____

Improve: _____

Control: _____

A. Analyze and determine the best actions to implement the next step

B. This involves really understanding the issue we're trying to address and determining the outcome we want to accomplish.

C. During this step, we make sure we achieve the results. We use that information as an input to the next iteration of the DMAIC process, and we start all over again.

D. Make improvements on the process.

E. Measure and determine the inputs and the things we can measure and potentially improve.

2. PDCA stands for Plan, Do, Check, Act. It's similar to the DMAIC process but simpler. The **Plan** and **Do** steps correlate very much with Define, Measure, and Analyze. And then the **Check** and the **Act** correspond with Improve and Control to make sure that we actually get the result that we're seeking.

3. The similarity between the DMAIC process and the PDCA cycle is that both of these are intended to be cycles of continuous **improvement**.

4. Now we will discuss the Transfer function and how it plays into Six Sigma. The Y represents the **output** (the result, the actual process that we want to improve, or the outcome).

5. In the function used here, X is the **input**, f is the **transformation** applied and Y is the **output**. These are the variables that actually contribute to the success of the process.

$$Y = f(X)$$

Six Sigma Projects

Learning Objective: *After completing this topic, you should be able to identify considerations when assessing an organization's readiness to use Six Sigma for a project*

1. The typical duration of a Six Sigma project can be very short, just hours, or a few days in the case of a small quality team effort to make an incremental improvement, or it could take a year or longer to get to the end result. That said, it's pretty typical for Six Sigma projects to run **four** to **eight** weeks.
2. The purpose of various projects varies dramatically, but generally they're going to focus on the following things including:
    - Reducing the **variation** of a customer's experience.
    - Getting things to market **quicker**.
    - Eliminating **errors** and mistakes.
    - Finding ways to **reduce** cost in operating processes.
3. There are some important considerations as you move into implementing Six Sigma including:
    - The first and foremost is **management** buy-in. If you don't have support, sponsorship, and adequate funding, it's kind of a no-go for any significant project.
    - Start small and then go bigger as we develop **confidence** and abilities in the organization.
    - Don't miss the opportunities to **innovate** and reinvent ways to improve our performance.
    - Make sure we understand what's already going on **before** we try to introduce Six Sigma.
    - Another thing to watch out for is when the **cost** to implement actually outweighs the **benefits**.
    - We also need to define clear **success** factors for the organization and the people involved.
4. There are three steps that need to be followed to assess organizational readiness.
    - Step 1 is assessing the outlook and the future path. Ask the question, is change a critical business **need** now?
    - Step 2 is evaluating current performance. Ask the question, is there a strong strategic **rationale** for applying Six Sigma to our business?
    - Step 3 is reviewing systems and capacity for the change. Ask the question, can existing improvement systems achieve the degree of **change** needed to keep us successful and competitive without using Six Sigma?

The Value of Six Sigma to the Organization

Learning Objective: *After completing this topic, you should be able to identify ways in which Six Sigma can benefit an organization*

1. Focusing on the voice of the **customer** to drive change and improvement in the organization is absolutely critical.
2. And this is where Six Sigma tools to analyze **data** can be very helpful to understand what customers care about.
3. A fantastic tool kit in the Six Sigma bag is called **Kano**. Kano is a way of gathering data from customers and beginning to understand what's important to them that really differentiates us.
4. We want to rigorously examine **features** and **functions** that we plan for future products. And then we determine which of those are particularly important to the customer. Then we determine how we're going to incorporate those at the correct level of quality and speed to earn the market share that we really deserve.
5. We continue to work towards **shorter** product development cycles, being tightly aligned to the **customer**'s needs, and doing everything better and faster than our **competitors**.

Lesson 3: Introduction to Lean

Instructions: While watching the videos, fill in the missing words according to the information presented by the instructor.

Purpose and Value of Lean

Learning Objective: *After completing this topic, you should be able to recognize foundational Lean concepts*

1. Taichi Ohno is considered by many to be the **father** of what we call Lean today.
2. According to Mr. Ohno, the essence of Lean is that we first calculate from the time that we receive an order for a product or service to the time we get paid for that fulfillment. The objective is to make that **timeframe** progressively shorter and shorter.
3. Lean is about reducing **waste** across the entire value stream in terms of time and effort on the part of human beings. This results in maximized value, better efficiency, quality, and customer satisfaction.
4. Lean is a very team-based approach to continuous improvement. It leverages the technique of **kaizen** very much. Kaizen involves all employees in the process of continuous improvement.
5. Lean identifies the value added activities and separates out non-value added activities in order to eliminate them as we go. This brings increased value to all of our **stakeholders**.
6. We prioritize based on the voice of our **customer**.
7. We also can begin to use a simple technique called **Pareto**, or Pareto diagramming, where we identify which 20% of the activities are associated with 80% of our opportunities or problems so that we can work to improve those.
8. In summary, the cornerstones of Lean are eliminating **waste**, prioritizing the **customer**, and understanding that 80% of problems are caused by **20**% of the activities.

Kaizen: A Japanese term meaning "change for the better" or continuous improvement. It involves making the work environment more efficient and effective by creating a team atmosphere, improving everyday procedures, ensuring employee engagement, and making a job more fulfilling, less tiring, and safer.

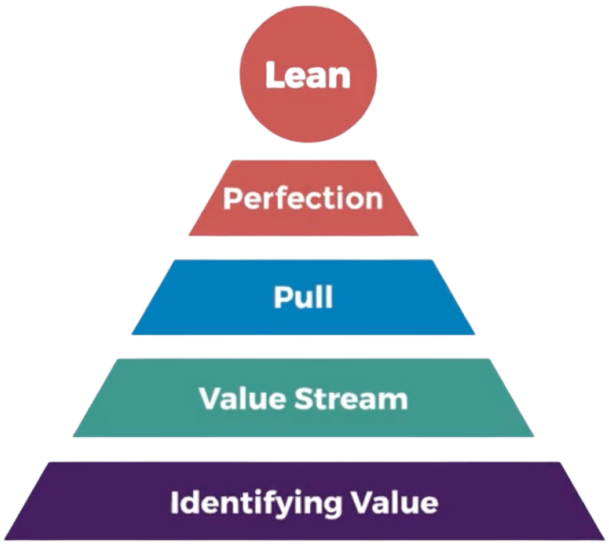
Stakeholder: A stakeholder is any individual that has an interest in a company and can either affect or be affected by the business. The primary stakeholders in a typical corporation are its investors, employees, customers, and suppliers.

Pareto: The Pareto principle states that for many outcomes, roughly 80% of consequences come from 20% of causes. Other names for this principle are the 80/20 rule, the law of the vital few, or the principle of factor sparsity.

Lean Concepts and Process Steps

Learning Objective: *After completing this topic, you should be able to match Lean concepts to their descriptions*

1. We have a four-step pyramid to represent the concepts of Lean. Label the 4 steps from the pyramid below:



1) <u>Identifying Value:</u>
- Identifying Value should always start with the customer.
- Determine what creates value in the process of our product.

2) <u>Value Stream:</u>
- Any series of activities and processes that create value in an organization by breaking down the steps
- We typically capture cost and quality data and the amount of time that elapses as we move along the value stream.

3) <u>Pull:</u>
- The idea is that instead of pushing inventory through the system by planning and anticipating how much might be needed, we actually allow the customer to trigger a pull of inventory based on consumption.
- We can minimize inventory by only having the minimal inventory necessary to create a time buffer between steps in the process, but no more than that.

4) <u>Perfection:</u>
- Dedication to continuous improvement
- From a safety perspective, the only acceptable goal for safety would be zero, zero injuries, deaths, lost time, accidents, or even near misses.
- While we may never actually get there, we have to be committed to continuous improvement to drive perfection.

Lean and the Concept of Value-added

Learning Objective: *After completing this topic, you should be able to classify examples of value- and nonvalue-added activities and waste*

1. Value is defined by how well a product or service actually meets our customer's **requirements**.
2. Value added includes activities that actually add value to the end product, and that our customer is **willing** to pay for. Non-value added would be any activities the customer is **unwilling** to pay for.
3. There will always be some non-value add activities that we just can't change easily. The concept of Lean includes the classic seven wastes.

   Match the types of waste from the diagram to the descriptions below:

1) **Overproduction**: This is any effort beyond what's required to meet the customer's requirements. Building inventory or having a bunch of people sitting around waiting for a phone call is a form of that.
2) **Extra processing:** Includes reworking a product or service.
3) **Motion**: The physical movement of people, material, and information that's taking up time or space, but not really adding value.
4) **Waiting**: Delays, both planned and unplanned, that consume time and money, but don't really add value in the opinion of our customer.
5) **Transportation**: Trucking, logistics, and shipping in excess of the minimal requirement needed to deliver to the customer.
6) **Inventory**: excessive inventory beyond just what's needed to support a smooth pull of production of information through the value stream.
7) **Defects**: This includes any need to fix, repair, scrap, or otherwise correct and inspect that could be avoided by doing it right the first time.

Lesson 4: Lean Tools Commonly used in Six Sigma

Instructions: While watching the videos, fill in the missing words according to the information presented by the instructor.

Lean Tools: Just-in-time

Learning Objective: *After completing this topic, you should be able to recognize examples of the just-in-time method*

1. Just-in-Time is important to us because it's a very clear and easy to execute control of **inventory** processes.
2. It controls the flow of materials and products to meet the drumbeat of customer **demand**, also known as "Takt" time.
3. There are many benefits and limitations associated with "Just-in-Time." There are four examples of benefits and four examples of limitations below. Label each as a benefit or limitation with a "B" or "L":

- Allows downsizing to a lower cost: _____
- Can experience supply shortages: _____
- Generates less waste: _____
- Transportation issues: _____
- Spike in demand from customers: _____
- Lowers inventory costs: _____
- Saves storage space: _____
- Delays in delivery of materials: _____

Lean Tools: Poka-yoke

Learning Objective: *After completing this topic, you should be able to recognize examples of poka-yoke*

1. Poka-yoke translates roughly in Japanese as "**mistake proofing.**" We also might hear it as error proofing.
2. What we're doing with error proofing methods and Poka-yoke is determining where **human** errors can occur in a process.
3. There are many types of Poka-yoke devices. There's really no limit to these, but let's cover some of the important ones. Label 4 examples below:
    a. **Checklists**: so that we don't forget the important things that need to happen and the particular order they may need to follow in order to ensure a quality result.

b. **Screening**: a very powerful technique, giving us the ability to force the accepting of legitimate values or options within a given process. Simple screening devices might prevent problems with accepting agreements that we don't want when we're accepting software licensing.

c. **Signaling** methods: very powerful with different colors of lights denoting different actions by the support team.

d. **Control:** methods such as color coding or providing safety mechanisms so that we have smooth movement of material without injuries or safety problems or damage to the product.

4. Additional examples may include enclosing the moving parts of a machine so no oil or chips could fly up and loose clothing cannot get caught in the gears. Some machines are designed so that safety doors must be engaged before the tools will move. All of these Poka-yoke devices help to prevent or minimize human **error**.

Lean Tools: Kanban

Learning Objective: *After completing this topic, you should be able to recognize examples of Kanban-pull*

1. Kanban is Japanese term associated with the notion of a white card, or a card that you can see and touch. But in reality, it's any form of a **signal** that can be used to pull materials into the value stream.

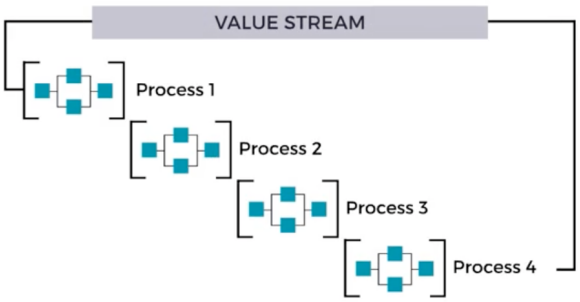
2. A great advantage of using Kanban and pull is avoiding **overproduction**, by only making what's needed when it's needed.

Lean Tools: Value Stream Mapping

Learning Objective: *After completing this topic, you should be able to identify the types of information revealed by value stream mapping*

1. A value stream map depicts the flow of resources and information as it goes across the entire value stream. It defines and shows us how value is derived and delivered from **start** to **finish**.

2. There are four steps in the process of analyzing the value stream. Step 1 is defining the product family. Step 2 is creating a **current** state map. Step 3 is creating a **future** state map. And step 4 is planning the implementation of **improvements**.



Lesson 5: Relationship between Lean and Six Sigma

Instructions: While watching the videos, fill in the missing words according to the information presented by the instructor.

Six Sigma and Lean: Differences and Similarities

Learning Objective: *After completing this topic, you should be able to recognize differences and similarities between Six Sigma and Lean*

1. The focus of Six Sigma is around eliminating sources of **variation**, the number of mistakes and **defects** we're making. As opposed to Lean, where we're trying to take **unnecessary** time out of the process and eliminate **waste** wherever it happens.
2. The methodology associated with Six Sigma suggests a very rigorous five step process. Define, measure, analyze, improve, and control, where we're gathering the **data** and going through a number of different steps that are highly rigorous and very oriented around data.
3. With Lean, we're less focused on the data, at least the precision of it. Lean uses a four step process of identifying the **end-to-end** value stream. Identifying the opportunities to improve the overall end-to-end performance, designing a solution, implementing the solution, and taking steps to make sure that the **improvement** is continuous and lasting.
4. In Six Sigma, we tend to be very focused on a **point** in the value stream. The performance, say, of a single step and our ability to produce quality at that step.
5. Lean, on the other hand, considers the **entire** process and what we can do to improve the process to deliver things faster with better quality and more efficiency at the same time.
6. The key tools associated with Six Sigma are narrowly focused on specific problems and very **statistical** in nature. We use metrics and statistical process control tools to bring things under control and keep them controlled.
7. Lean focuses on removing **waste**, improving the overall operation of the business, and being committed to continuous, small incremental improvements over time.
8. In total, between both of these tool kits, there are more than **100** different defined tools that can potentially be learned and mastered in your learning journey. Zero defects and zero waste is the goal. We may never get there, but we want to be continually dedicated to improving **quality**.
9. Both methodologies, and particularly when they are leveraged **together**, are proven to deliver significant benefits and customer satisfaction, employee satisfaction, overall cost reductions, and making the company a better place to be.

The following chart can be referenced for a comparison of Lean and Six Sigma attributes.

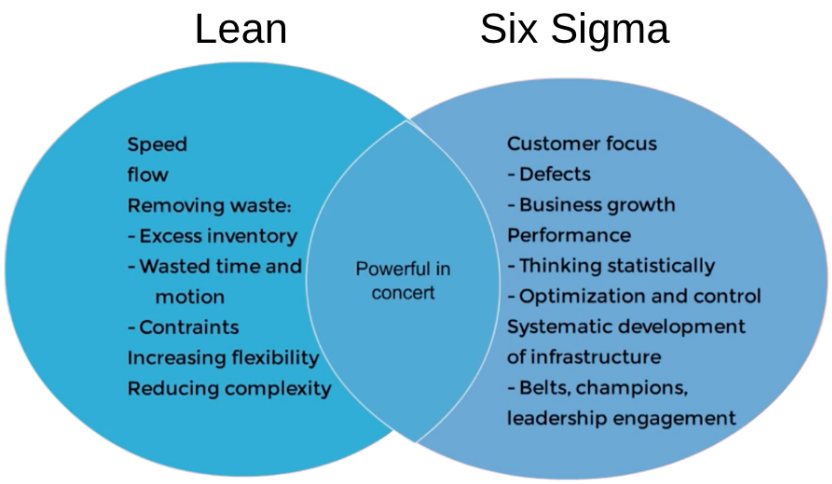
Six Sigma and Lean: Differences

Attribute	Six Sigma	Lean
Focus	Reduce variation	Remove/reduce waste
Methodology	1. Define 2. Measure 3. Analyze 4. Improve 5. Control	1. Identify opportunity 2. Design solution 3. Implement solution 4. Ensure continuous improvement
Key tools and techniques	Statistical tools Exploratory data analysis Management and planning tools Six Sigma metrics SPC tools	TOC, muda, value stream mapping, Kanban, 5S, standard work, poka-yoke, continuous flow, setup reduction, kaizen and kaizen blitz, TPM, visual factory
Primary effects	Less variation, fewer defects, and uniform process output	Reduced waste Reduced flow time
Key concepts and assumptions	Reduced variation = Reduced defects Data and analysis support improvement	Removing waste, improving business, continuous small improvements preferred

Integrating Lean with Six Sigma

Learning Objective: *After completing this topic, you should be able to recognize criteria you must take into consideration before integrating Lean and Six Sigma*

1. Integrating Lean and Six Sigma is the focus of this topic. Think of them as pieces of the puzzle that interlock and create tremendous **value** for any kind of organization.
2. Lean and Six Sigma overlap, and are very powerful when working together to eliminate **waste** and **variation**, to drive value for any organization.



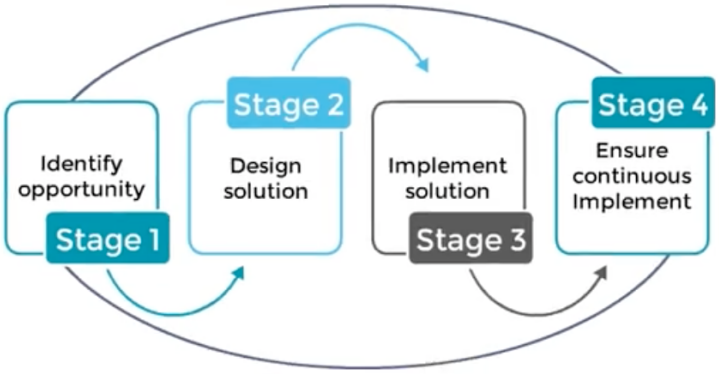
3. Fill in the blanks on the chart below:

Criteria	Lean Tools	Six Sigma Tools
Time frame/ financial commitment	Quick Relatively **inexpensive** **Fast** results	Require rigorous statistical analysis **Expensive** **Longer** time frame
Nature of primary problem	**Waste** Velocity of Process Inventory Bloat	**Variation** and defects
Capacity for culture **change**	Eased into the organization: **immediate** success builds long term behavior and system changes	Culture change occurs over a **longer** time
Pervasiveness of **problem**	Isolated and relatively **simple** to fix Low-hanging fruit	Defects and variation permeate processes: requires more intensive **efforts**

Lean Six Sigma Deployment

Learning Objective: *After completing this topic, you should be able to recognize activities involved in Lean deployment*

There are four stages in a Lean Six Sigma deployment.



1. The steps for stage 1 are employee training, recognizing customer defined value, and **identify** existing opportunities.
2. In stage 2 of Lean Six Sigma deployment, we design the **solution**.
3. In the third stage of Lean Six Sigma deployment, we decide which improvements to address first. We then **prioritize** low hanging fruit, which are improvements that involve workers and processes that have highly visible waste.
4. In the fourth stage of Lean Six Sigma deployment, we ensure continuous **improvement** requires employee buy-in and ownership. They need to continue to find new ways to eliminate waste, ensure that improvements are sustained, generate new ideas, and act on ideas.