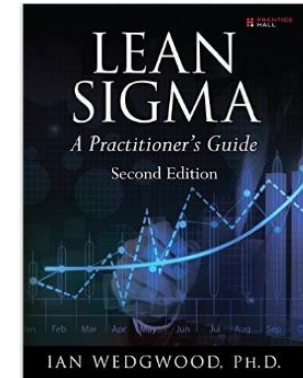


# Six Sigma

John Fico, Adjunct Professor  
Fall 2020

# Materials for Class

- **Minitab 19 (software)**
  - <https://pulse.floridapoly.edu/software-downloads/>
- **LS Text:** *Lean Sigma (second edition)*; Ian Wedgwood, 2016.
- **LSSM Text:** *Lean Six Sigma & Minitab®*; Quentin Brook, 2020.
  - This is a tool reference book
    - Tool application with examples, how to interpret results
- Optional reference: *Lean Six Sigma “Quick Study”*; Bar Charts, Inc., 2016



# Agenda: Week 1

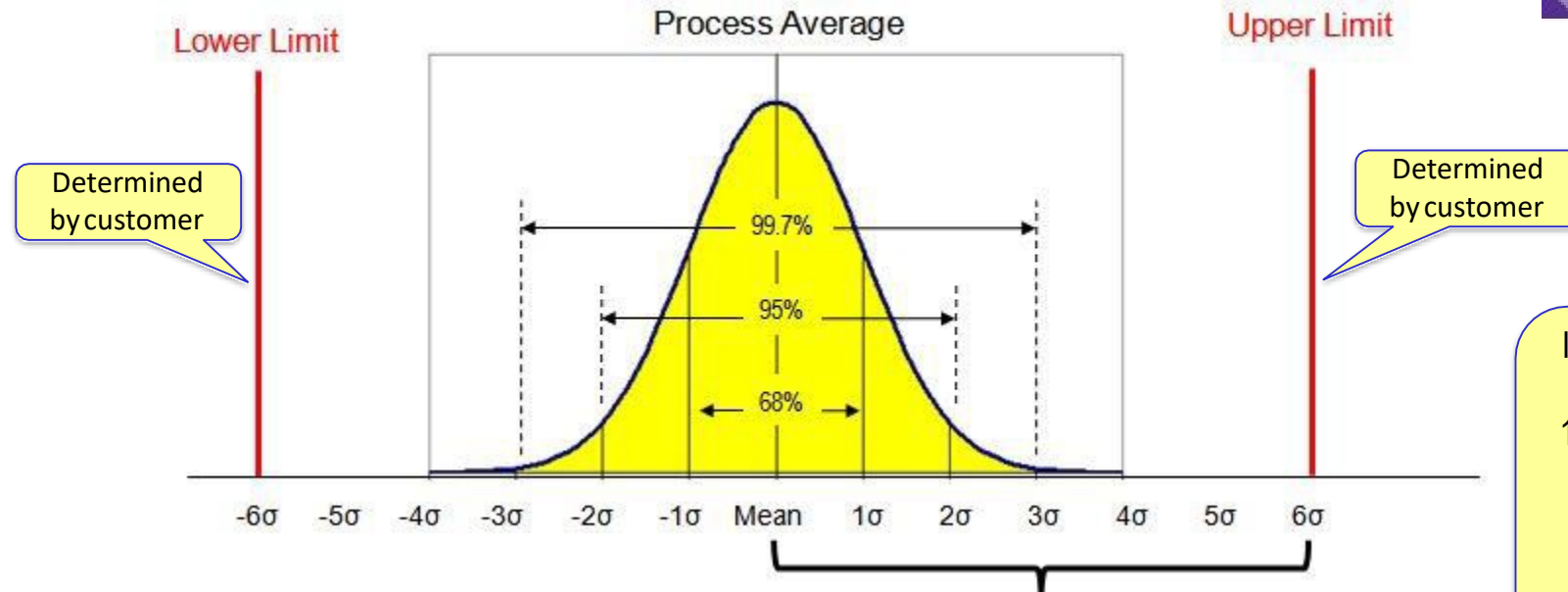
- Syllabus review (reference separate pdf file)
  - Professor's expectations of students
    - Vision statement: *Upon course completion, students will have knowledge of fundamental skills to successfully manage a Six Sigma project to achieve targeted business benefits.*
  - How to contact the professor
- Materials for Class: Texts 1 and 2 (and how to use them); Minitab software
- Six Sigma Course Introduction
  - <https://www.gembaacademy.com/school-of-six-sigma/introduction/six-sigma-overview>
- Six Sigma Principles using a LEGO Technic model

# Six Sigma Course Introduction

- What this course *is*
  - Emphasis on Six Sigma tool selection and **application** (including Minitab®) to help an organization solve problems and realize business benefits
    - Some Lean tools will also be introduced, but course emphasis is Six Sigma
  - Learn how to:
    - Initiate, charter, and manage a Six Sigma project with sustainable results
      - Establish clear definition of a problem & apply the correct tools to achieve targeted outcome
        - What if I don't know what questions to ask in defining a problem? (It's about prioritization.)
      - Develop a rigor in following DMAIC process in problem solving
        - What if we don't have data? (We need to get it.)
      - Understanding stakeholder needs & expectations
        - The value of collaboration
- What this course *is not*
  - A statistics course



# What is Six Sigma?



Example: In a 2 Sigma process, 95% of the measured values taken in a process will be within two standard deviations from the process average.

Sigma Performance Levels – One to Six Sigma	
Sigma Level	Defects Per Million Opportunities (DPMO)
1	690,000
2	308,537
3	66,807
4	6,210
5	233
6	3.4

Initially deployed at Motorola in 1986. Adopted at GE at a global scale in 1990s; inspiring many other companies to follow.

**$\sigma$  = Standard Deviation**

Amount of variation of a set of data values  
Expressed in same unit of measure as data

Six Sigma seeks to improve the quality of the output of a process by identifying and removing the causes of defects and minimizing variability in manufacturing and business processes.

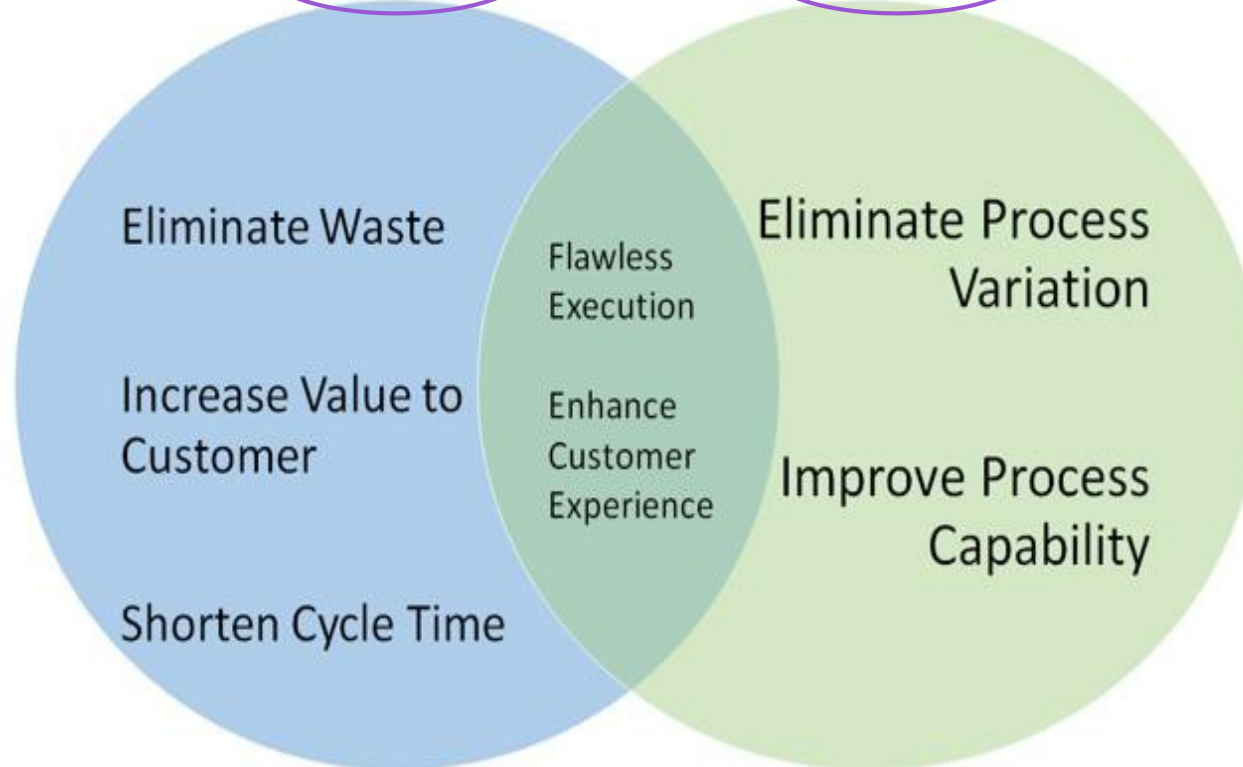
# Lean and Six Sigma

MAN 4558  
Course Focus

Lean

Six Sigma

MAN 3520  
Course Focus



## What is Six Sigma ( $6\sigma$ )?

**Sigma:** statistical concept representing amount of variation present in a process relative to customer requirements

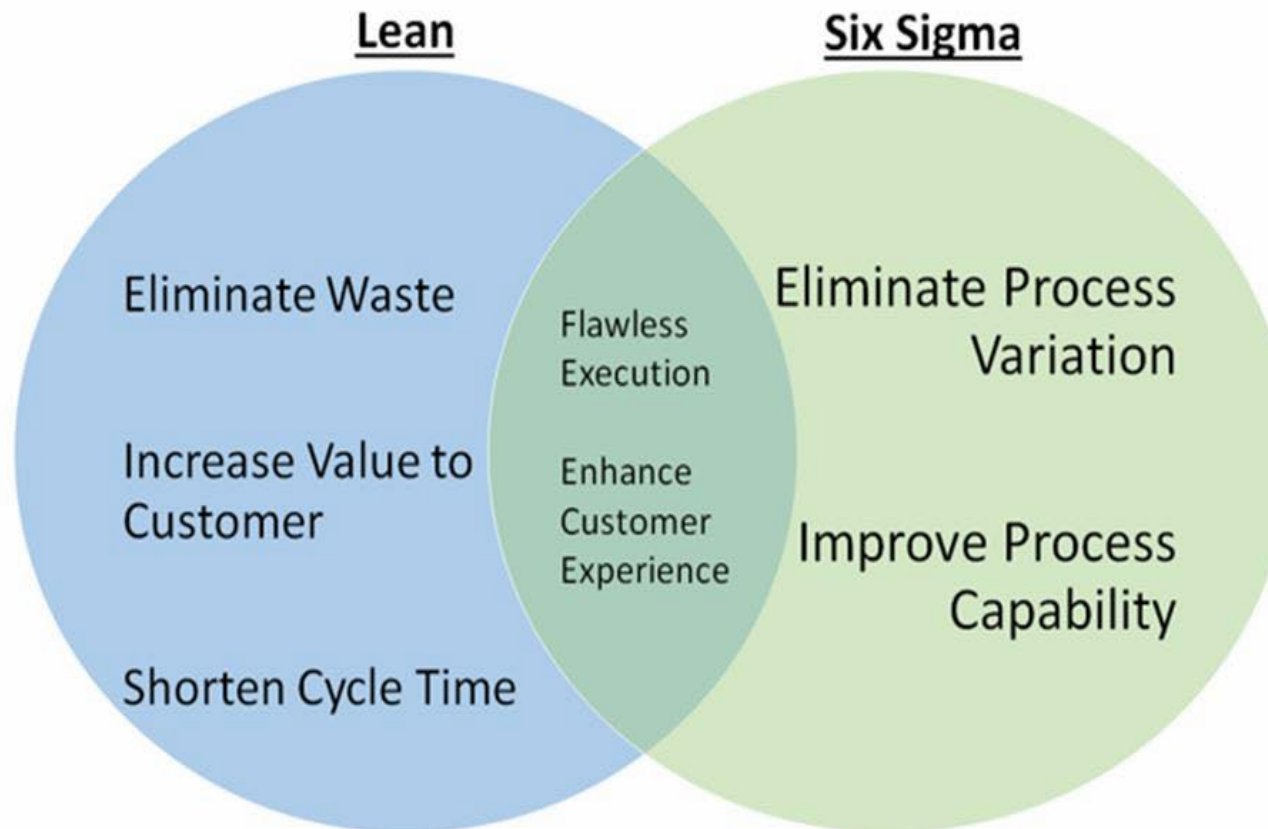
**Six Sigma:** variation in process is so small that resulting products or services are 99.9997% defect free

Six Sigma also refers to a business philosophy of focusing on continuous improvement by understanding customer needs, analyzing business processes, and integrating proper measurement methods

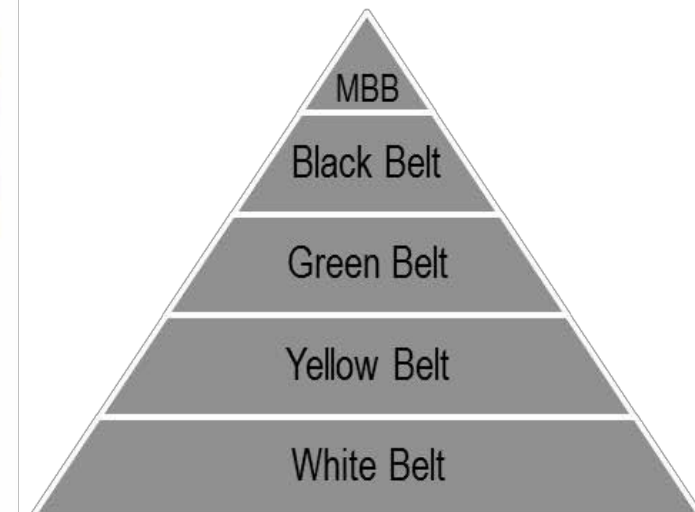
Source: The Six Sigma Memory Jogger II

Each Lean or Six Sigma project executed within an organization follows a defined sequence of steps & has quantified value targets.  
Examples: reduce process cycle time, reduce pollution, reduce costs, increase customer satisfaction, increase profits.

# Lean and Six Sigma



Skill levels modeled after  
Martial Arts hierarchy





# “Belt” Hierarchy

**Master Black Belt:** The highest level of Six Sigma expertise; all responsibilities involves implementation of Six Sigma including statistical analysis, strategic and policy planning, implementation and mentoring of Black Belts

**Black Belt:** A professional who has usually completed an examination and has been certified in its methods; all job responsibilities include implementation of Six Sigma methodology throughout all levels of the business, leading teams and projects and providing Six Sigma training and mentoring to Green and Yellow Belts.

**Green Belt:** In many Organizations this is the entry level; a Six Sigma trained (often certified) professional who does network on Six Sigma projects exclusively. This include responsibilities of leading projects/teams and implementing Six Sigma methodology at the project level.

**Yellow Belt:**

This level is generally the lowest in the hierarchy, but holders often are closest to the project details and occupy a key role on the project team. They usually observe and ascertain that project details are completed in a timely manner.

**White Belt:**

Lean Six Sigma awareness – usually for production associates so they can feel ownership



# What Can Six Sigma Do?

*Six Sigma engages employees in organizations to drive process improvements using collaborative tools and methodologies resulting in:*

- *reduced operating costs*
- *improved velocity*
- *increased user experience*

Six Sigma  
Tools

Project  
Management  
Tools



Program designed to  
apply the correct tools to  
the specific problem

# DMAIC vs. DMADV

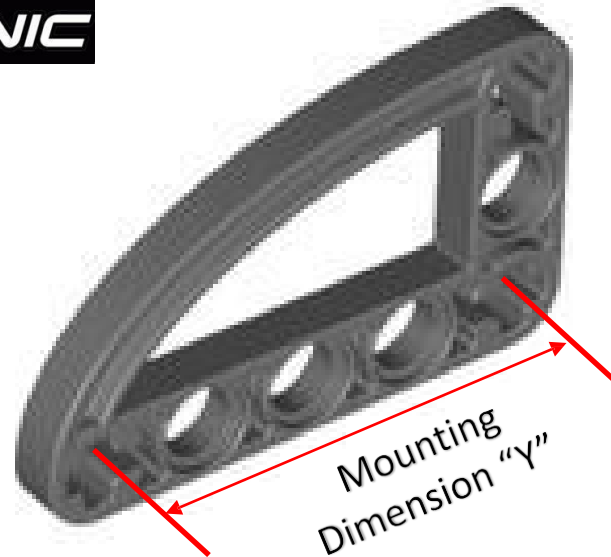
- Review of DMAIC
  - Define, Measure, Analyze, Improve, Control
    - Improve existing process (i.e. producing fewer defective parts)
- Review of DMADV
  - Define, Measure, Analyze, Design, Verify)
    - Part of Design for Six Sigma
    - Develop new process (i.e. new product to achieve time to market objective)

Six Sigma projects are characterized by predefined phases –  
depending on the type of product or process.

# Basic Six Sigma Principles



# Basic Six Sigma Principles



Driver Cage Beam  
on LEGO car



$$Y = f(x)$$

**Example: Driver Cage Beam**

**Y = Mounting Dimension** (millimeters)

Impacted by:

**X1** = Material (resin)

**X2** = People (training)

**X3** = Machines (mold temperature)

(could be additional Xs)

## Quality & Availability:

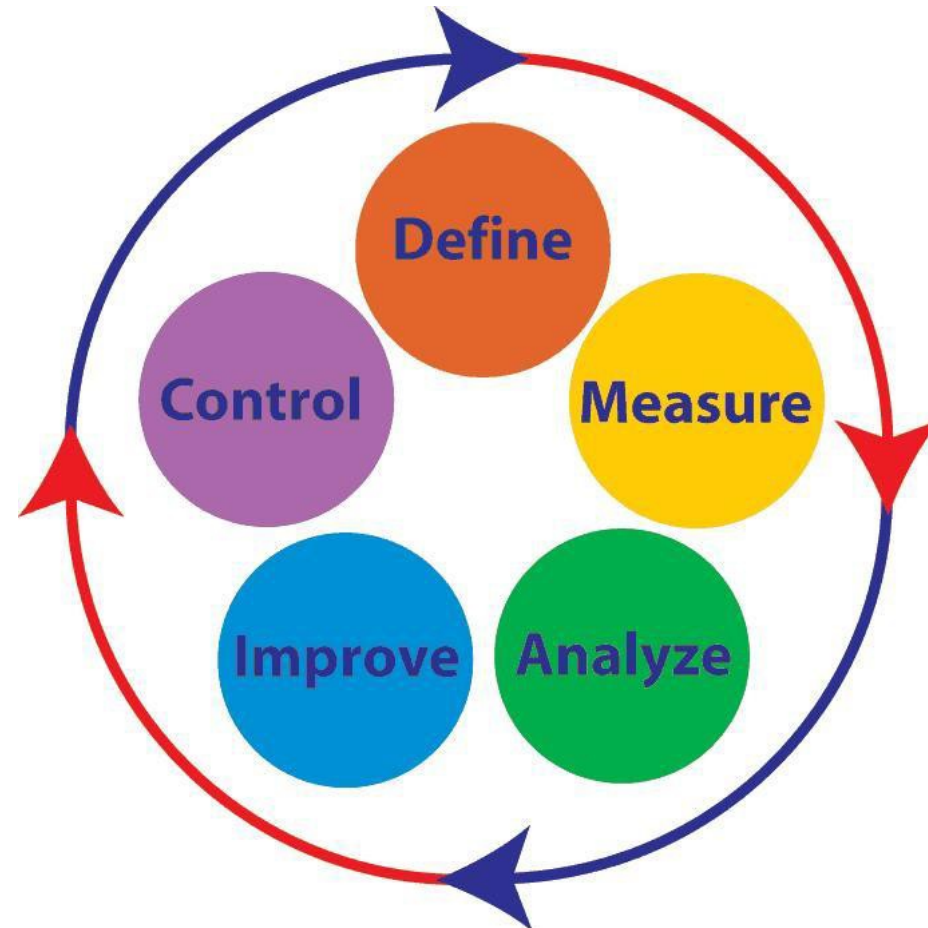
- Must fit mating LEGO parts every time
- Meet customer demand
  - when needed
  - in the right quantities
  - in the right locations
- Have consistent color & surface textures

## **Alignment to Florida Poly**

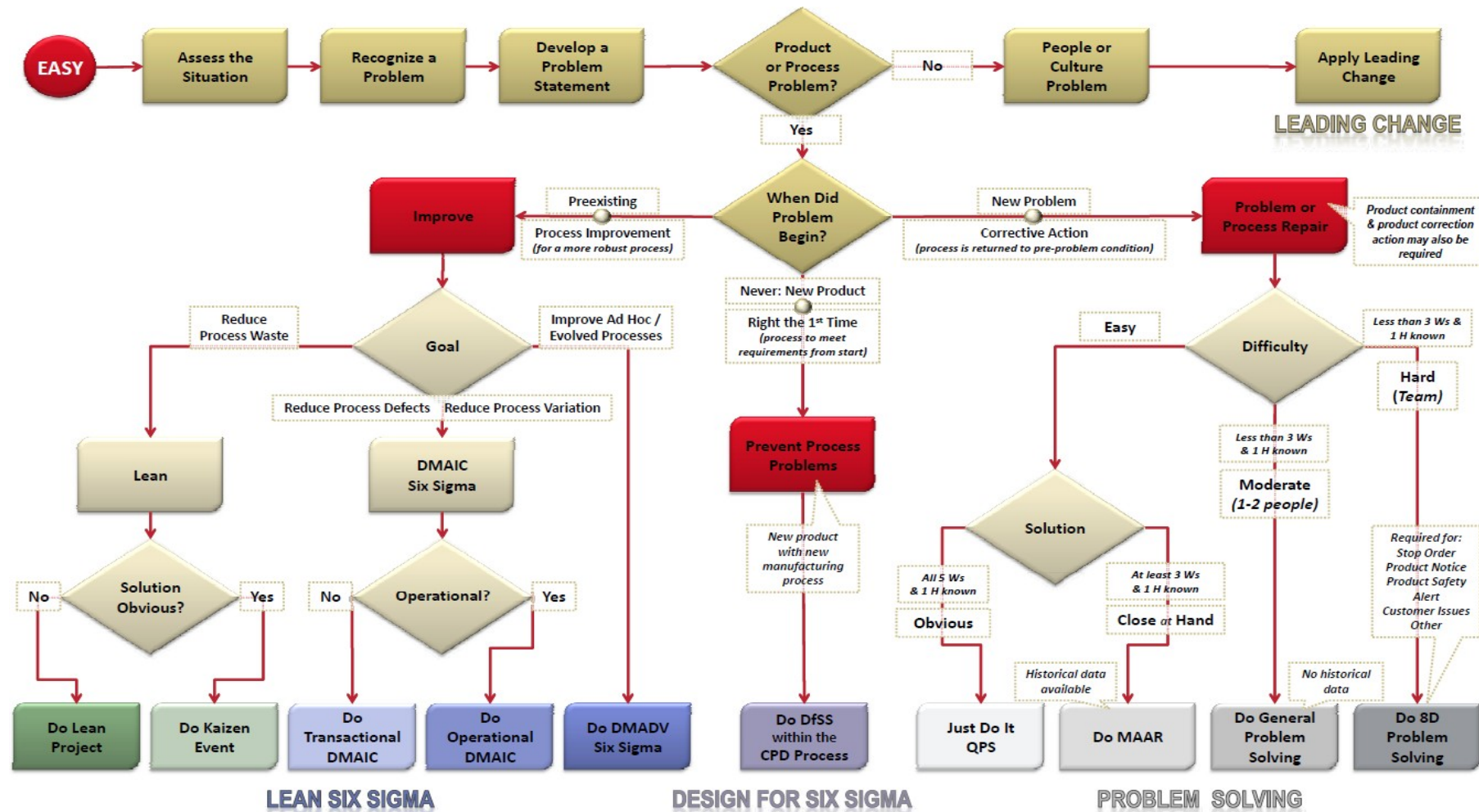
**Example: Time to Complete Purchase Orders**  
Quantify the variability in elements that *significantly* affect the time required to execute process.

**Six Sigma helps us understand variation**  
occurring in the Xs and how it impacts the mounting dimension (Y).

# Six Sigma Problem-solving Methodology



# Problem Solvers Guide





# Six Sigma Statistically Visualized

