

# SIX SIGMA CONCEPT

FROM A... to Z...



**PREPARED BY:**

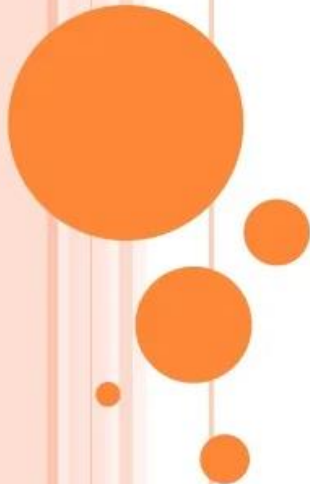
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# SIX SIGMA(□)

**"THERE IS A BETTER WAY TO RUN YOUR ORGANIZATION."**



## WHAT IS SIX SIGMA?

❑ Six Sigma is a disciplined, data-driven approach and methodology for eliminating defects (driving toward six standard deviations between the mean and the nearest specification limit) in any process – from manufacturing to transactional and from product to service.

Six Sigma is a set of techniques, and tools for process improvement.

❑ The word Sigma is a statistical term that measures how far a given process deviates from perfection.



## HISTORY

- Since the **1920's** the word “**sigma**”(s) has been used by mathematicians and engineers as a symbol for achievement of **Measurement in product quality variation.**
- In the **mid-1980's** engineers in Motorola in the USA used “**Six Sigma**”(S) an **informal name for an in-house initiative for reducing defects in production processes**, because it represented a suitably high level of quality.

- In the **late-1980's** **Motorola** extended the **Six Sigma** methods to its critical business processes, became a formalized 'branded' name for a **performance improvement methodology**, i.e, beyond purely 'defect reduction'.
- In **1991** Motorola certified its **first 'Black Belt' Six Sigma experts**, which indicates the beginnings of the **formalization of the accredited training of Six Sigma methods**.
- By the year **2000**, Six Sigma was effectively established as an **industry in its own right, involving the training, consultancy and implementation of Six Sigma methodology**.

## FEATURES OF SIX SIGMA

- A six sigma process is one in which **99.9999966%** of the products manufactured are statistically expected to be free of defects (**3.4 defects per million**).
- Six Sigma's aim is to eliminate waste and inefficiency, thereby increasing customer satisfaction by delivering what the customer is expecting.
- Six Sigma is a data driven methodology, and requires accurate data collection for the processes being analyzed.
- Six Sigma is about putting results on Financial Statements.

- Six Sigma follows a structured methodology, and has defined roles for the participants.
  
- Six Sigma is a business-driven, multi-dimensional structured approach for:
  - Improving Processes
  - Lowering Defects
  - Reducing process variability
  - Reducing costs
  - Increasing customer satisfaction
  - Increased profits



# FATHER OF SIX SIGMA



Sir Bill Smith

*“ the Father of six sigma”*

# KEY CONCEPTS OF SIX SIGMA

## CRITICAL TO QUALITY:

Attributes most important to the customer.

DEFECT: Failing to deliver what the customer wants.

## STABLE OPERATIONS:

Ensuring consistent, predictable processes to improve what the customer sees and feels.

## PROCESS CAPABILITY:

What your process can deliver.

## VARIATION:

What the customer sees and feels.

## DESIGN FOR SIX SIGMA:

Designing to meet customer needs and process capability.

## KEY ELEMENTS OF SIX SIGMA

### CUSTOMERS

Customers define quality. They expect performance, reliability, competitive prices, on-time delivery, service, clear and correct transaction processing and more.

### PROCESSES

By understanding the transaction lifecycle from the customer's needs and processes, we can discover what they are seeing and feeling.

### EMPLOYEES

Company must provide opportunities and incentives for employees to focus their talents and ability to satisfy customers.

# ORGANIZATION OF SIX SIGMA

Leadership

Sponsor

Implementation Leader

Coach

Team Leader

Team member

Process Owner

## EXTENDED DEFINITIONS OF ROLES IN SIX SIGMA(BELT COLORS)

### Black Belt

The individual designated as a Black Belt has completed a thorough internal training program and has the experience of working on several projects.

### Master Black Belt

The Master Black Belt is available to answer procedural questions and to resolve the technical issues that come up.

### Green Belt

A Green Belt is less experienced than a Black Belt but is cast in a key role within the team.

## IS SIX SIGMA RIGHT FOR AN ORGANIZATION?

Is the strategic course clear for the company?

Is there a strong theme or vision for the future of the organization that is well understood and consistently communicated?

How effective are your current improvement and change management systems?

Is the business healthy enough to meet the expectations of analysts and investors?

Is the organization good at responding effectively and efficiently to new circumstances?

What other change efforts or activities might conflict with or support Six Sigma initiative?

# PROJECT GENERATION FOR SIX SIGMA

There are generally two ways to generate projects:

**TOP-DOWN**: This approach is generally tied to business strategy and is aligned with customer needs. The major weakness is they are too broad in scope to be completed in a timely manner

**BOTTOM-UP**: In this approach, Black Belts choose the projects that are well suited for the capabilities of teams. A major drawback of this approach is that, projects may not be tied directly to strategic concerns of the management.

# METHODOLOGY OF SIX SIGMA

Six Sigma has two key methodologies:

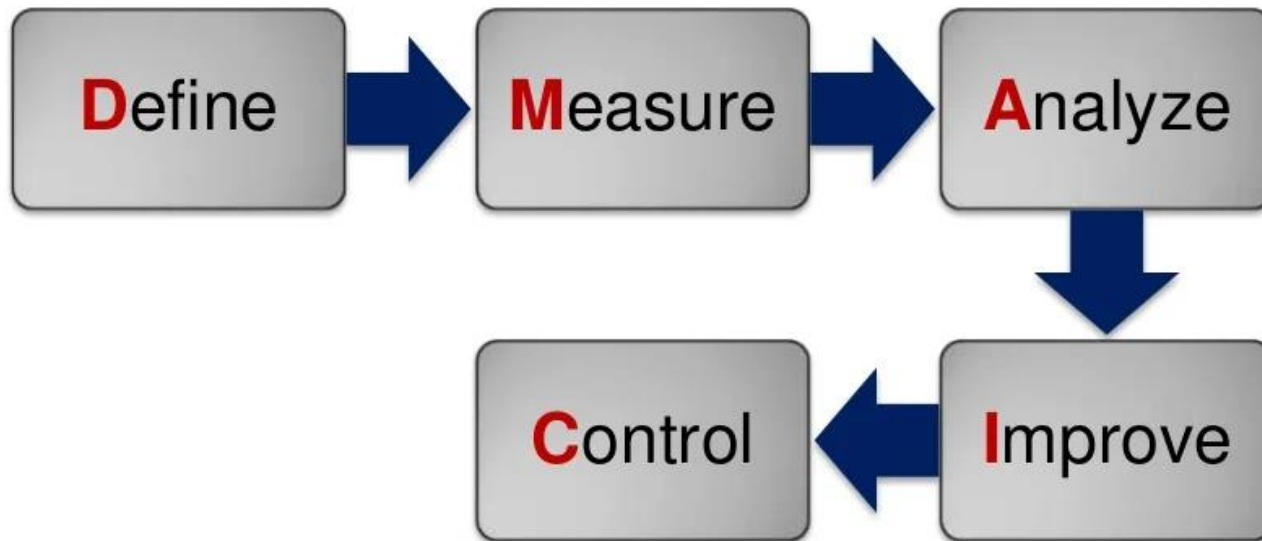
**DMAIC**: It refers to a data-driven quality strategy for improving processes. This methodology is used to improve an existing business process.

**DMADV**: It refers to a data-driven quality strategy for designing products and processes. This methodology is used to create new product designs or process designs in such a way that it results in a more predictable, mature and defect free performance.



# DMAIC METHODOLOGY

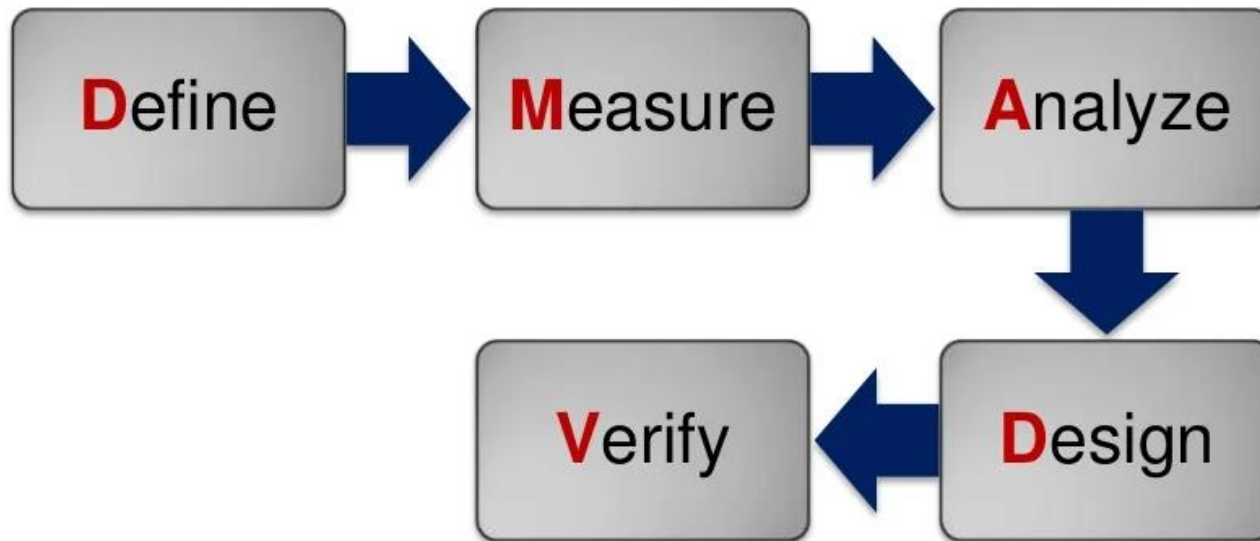
This methodology consists of the following five steps.



- **DEFINE:** Define the problem or project goal that needs to be addressed.
- **MEASURE:** Measure the problem and process from which it was produced.
- **ANALYZE:** Analyze data and process to determine root cause of defects and opportunities.
- **IMPROVE:** Improve the process by finding solutions to fix, diminish, and prevent future problems.
- **CONTROL:** Implement, control, and sustain the improvement solutions to keep the process on the new course.

# DMADV METHODOLOGY

This methodology consists of the following five steps.



- **DEFINE** : Define the Problem or Project Goal that needs to be addressed.
- **MEASURE**: Measure and determine customers' needs and specifications.
- **ANALYZE**: Analyze the process to meet the customer needs.
- **DESIGN**: Design a process that will meet customers' needs.
- **VERIFY**: Verify the design performance and ability to meet customer needs.

# DEFINE PHASE

The first step is **Define**. During the Define phase **four** major tasks are undertaken.

**1- Project Team Formation**

**2- Document Customers Core  
Business Processes**

**3- Develop A Project Charter**

**4- Develop The SIPOC Process Map**

## MEASURE PHASE

During the Measure Phase, the overall performance of the **Core Business Process** is **measured**. There are **three** important parts of Measure Phase:

Data Collection  
Plan And Data  
Collection

Data  
Evaluation

FMEA

## Data Collection Plan And Data Collection

A data collection plan is prepared to collect the required data. This plan includes **what type of data needs** to be collected, what are the sources of data, etc.

You collect data from **three** primary sources:



## Data Evaluation

At this stage, the collected data is evaluated and sigma is calculated. It gives an approximate number of defects.

-A Six Sigma defect is defined as anything outside of customer specifications.

-A Six Sigma opportunity is the total quantity of chances for a defect.

First we calculate Defects Per Million Opportunities (DPMO), and based on that a  $\sigma$  is decided from a predefined table:

***Number of defects***

DPMO = ----- X 1,000,000

***Number of Units X Number of opportunities***





## EXAMPLE

The food ordering delivery project team examines 50 deliveries and finds out the following:

- Delivery is not on time (13)
- Ordered food is not according to the order (3)
- Food is not fresh (0)

So now, **DPMO** will be as follows:

$$\text{DPMO} = \frac{13 + 3}{50 \times 3} \times 1,000,000 = 103,666.7$$

According to the **Yield to Sigma Conversion Table**, 106,666.7 defects per million opportunities is equivalent to a sigma performance of **between 2.7 and 2.8**.

This is the method used for **measuring results** as we proceed through a project. This beginning point enables us to locate the **cause and effect** of those processes.

## Conversion table

Yield %	DPMO	Sigma
6.68	933200	0
8.455	915450	0.125
10.56	894400	0.25
13.03	869700	0.375
15.87	841300	0.5
19.08	809200	0.625
22.66	773400	0.75
26.595	734050	0.875
30.85	691500	1
35.435	645650	1.125
40.13	598700	1.25
45.025	549750	1.375
50	500000	1.5
54.975	450250	1.625
59.87	401300	1.75
64.565	354350	1.875
69.15	308500	2
73.405	265950	2.125
77.34	226600	2.25
80.92	190800	2.375
84.13	158700	2.5
86.97	130300	2.625
89.44	105600	2.75
91.545	84550	2.875
93.32	66800	3

Yield %	DPMO	Sigma
94.79	52100	3.125
95.99	40100	3.25
96.96	30400	3.375
97.73	22700	3.5
98.32	16800	3.625
98.78	12200	3.75
99.12	8800	3.875
99.38	6200	4
99.565	4350	4.125
99.7	3000	4.25
99.795	2050	4.375
99.87	1300	4.5
99.91	900	4.625
99.94	600	4.75
99.96	400	4.875
99.977	230	5
99.982	180	5.125
99.987	130	5.25
99.992	80	5.375
99.997	30	5.5
99.99767	23.35	5.625
99.99833	16.7	5.75
99.999	10.05	5.875
99.99966	3.4	6

## Failure Mode And Effects Analysis (FMEA)

It refers to **preventing defects before they occur**. The **FMEA** process usually includes rating possible defects, or failures, in **three** ways:

- The likelihood that something might go wrong.
- The ability to detect a defect.
- The level of severity of the defect.



### EXAMPLE

Rate each of these **three** areas from **1 to 10**, with **1** being the **lowest FMEA** level and **10** being the **highest**. The higher the level, the more severe the rating. Hence, a high FMEA indicates the need to devise and implement improved measuring steps within the overall process. This would have the effect of preventing defects.

## ANALYZE PHASE

There are **five** specific types of analyses that help to **promote the goals** of the project.

SOURCE ANALYSIS

PROCESS ANALYSIS

DATA ANALYSIS

RESOURCE ANALYSIS

COMMUNICATION ANALYSIS

## SOURCE ANALYSIS

This is also called **root cause analysis**. It attempts to find **defects that are derived** from the sources of information or work generation. After finding the root cause of the problem, attempts are made to resolve the problem before we expect to eliminate defects from the product.

## PROCESS ANALYSIS

-**Analyzing** the **numbers** to find out how **well or poorly** the **processes** are working, compared to what's possible and what the competition is doing.

-Process analysis includes **creating** a more **detailed** process map, and **analyzing** the more detailed **map**, where the **greatest inefficiencies** exist.

-The process refers to the **precise movement** of **materials, information, or requests** from one place to another.

## DATA ANALYSIS

- Many a times **the data itself** may have **defect**.
- There may be a case when products or delivery **do not** provide all the needed information.
- Data is analyzed** to find out defects and attempts are made to resolve the problem before it is expected to eliminate defects from the product.

## RESOURCE ANALYSIS

- It is also needed to ensure that employees are properly trained in all departments that affect the process.
- Resources include raw materials needed to manufacture, process, and deliver the goods.

### **For example,**

If the Accounting Department is not paying vendor bills on time and, consequently, the vendor holds up a shipment of shipping supplies, it becomes a resource problem.



## COMMUNICATION ANALYSIS

-One problem common to most processes high in defects is poor communication.

-The classic interaction between a customer and a retail store is worth studying because many of the common communication problems are apparent.

### **For example,**

A vendor wants payment according to agreed-upon terms, but the Accounting Department wants to make its batch processing uniform and efficient. Between these types of groups, such disconnects demonstrate the importance of communication analysis.

## IMPROVE PHASE

The **objective** of Improve phase is to **identify**:

- Improvement breakthroughs,
- Identify high gain alternatives,
- Select preferred approach,
- Design the future state,
- Determine the new sigma level,
- Perform cost/benefit analysis,
- Design dashboards/scorecards, and
- Create a preliminary implementation plan.

## CONTROL PHASE

-This is the phase where one ensures that the processes continues to work well, produce desired output results, and maintain quality levels.

-This phase is concerned with four specific aspects of control, which are as follows.

**Quality control**

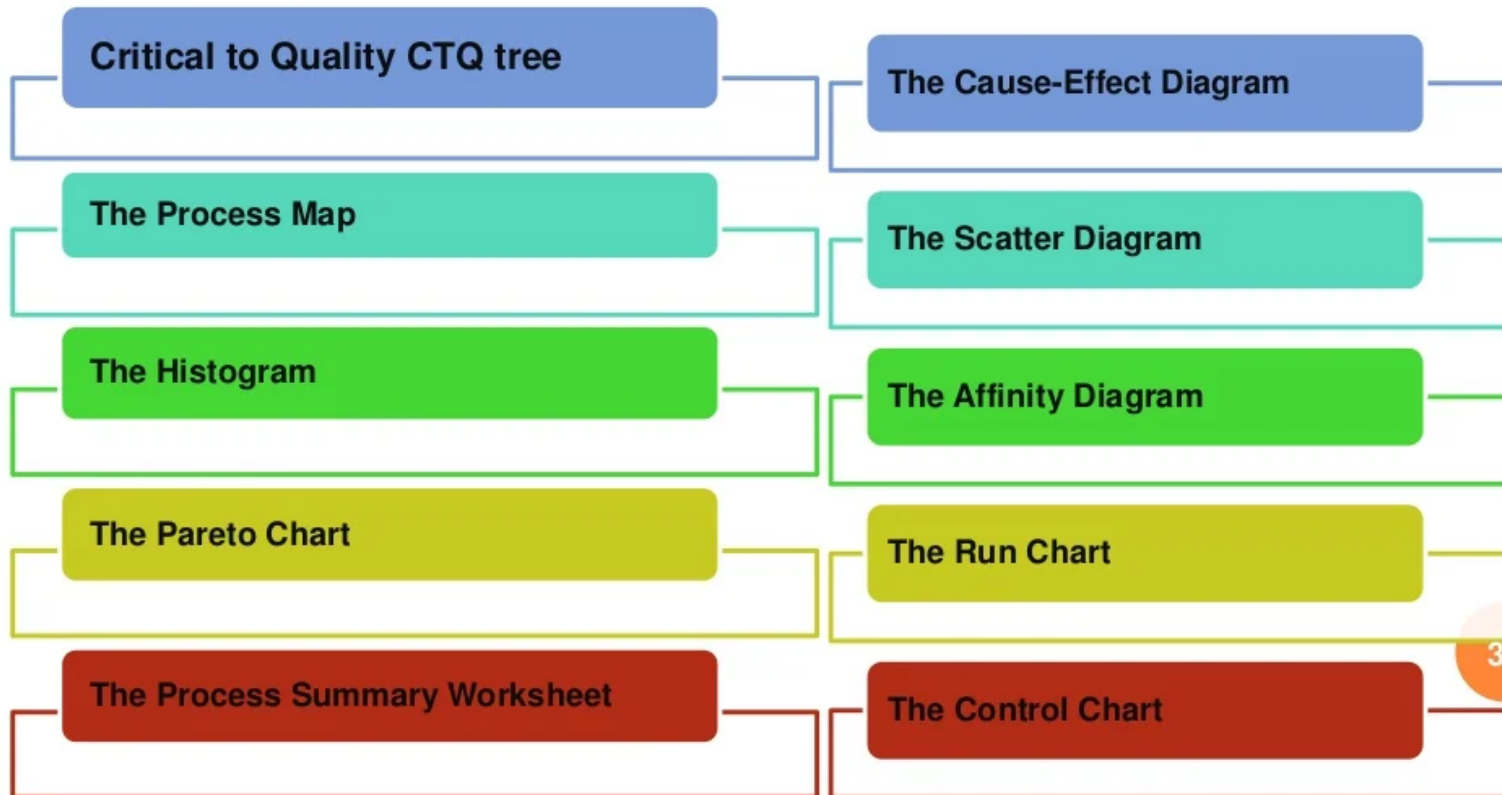
**Standardization**

**Control  
methods and  
alternatives**

**Responding  
when defects  
occur**

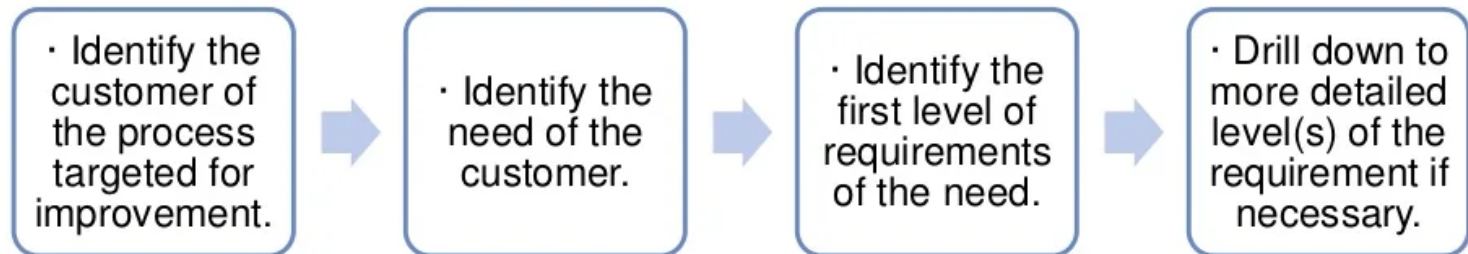
# TECHNICAL TOOLS

The technical tools are those tools which a Six Sigma team member needs to master as they progress through any one of the methodology.

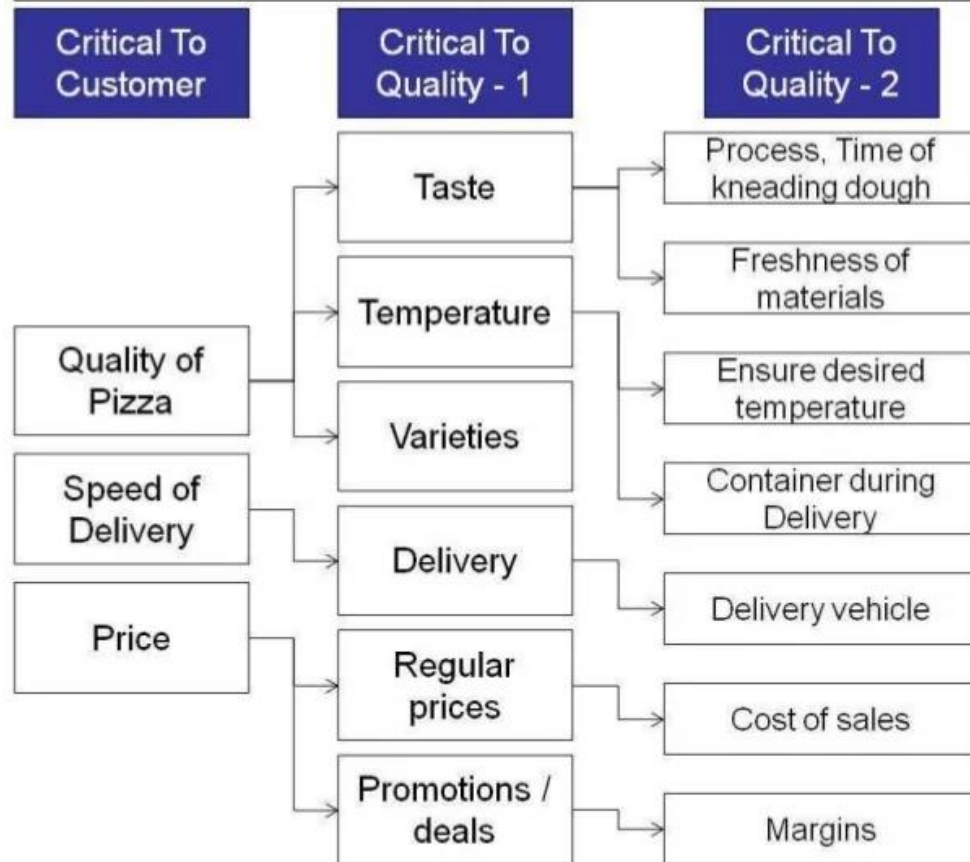


## Tool #1 – The Critical to Quality (CTQ) Tree

The steps in creating a CTQ tree are as follows:



# Pizza Delivery



**CTQ TREE**

## Tool #2 – The Process Map

-A process map is a picture of the current steps in the process targeted for improvement.

A process map has five major categories of work:

The identification of the suppliers of the process,

The inputs the suppliers provide,

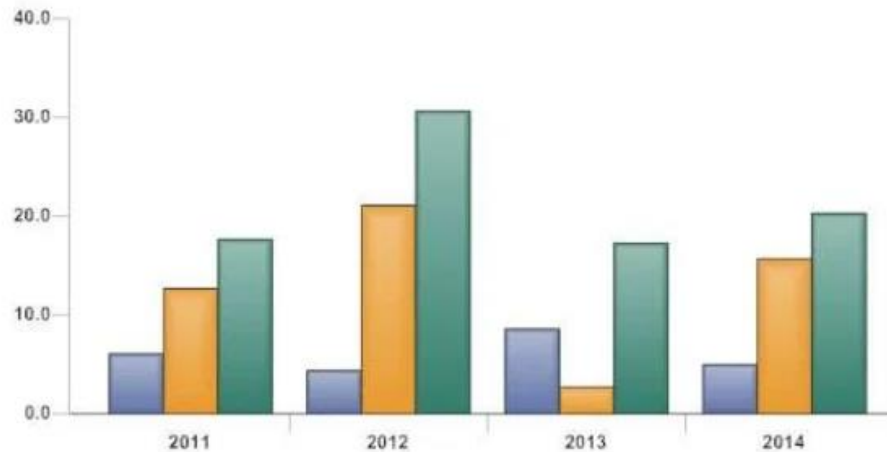
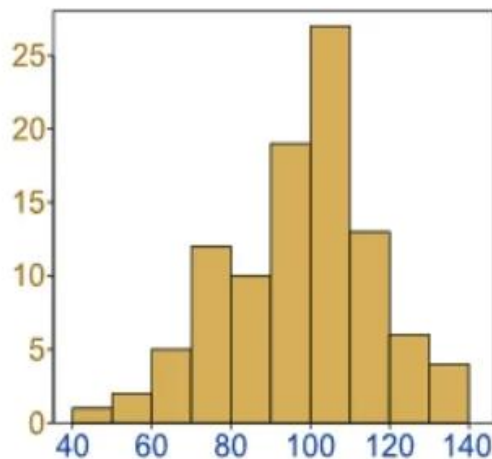
The name of the process,

The output of the process,

The customers of the process.

## Tool #3 – Histogram

- ❑ Data is of two types - Discrete data (go/no go, fail or pass) and Continuous data (time, height etc.).
- ❑ The data should be organized into graphs or charts, which makes it easier to understand, what the data is saying about the process.



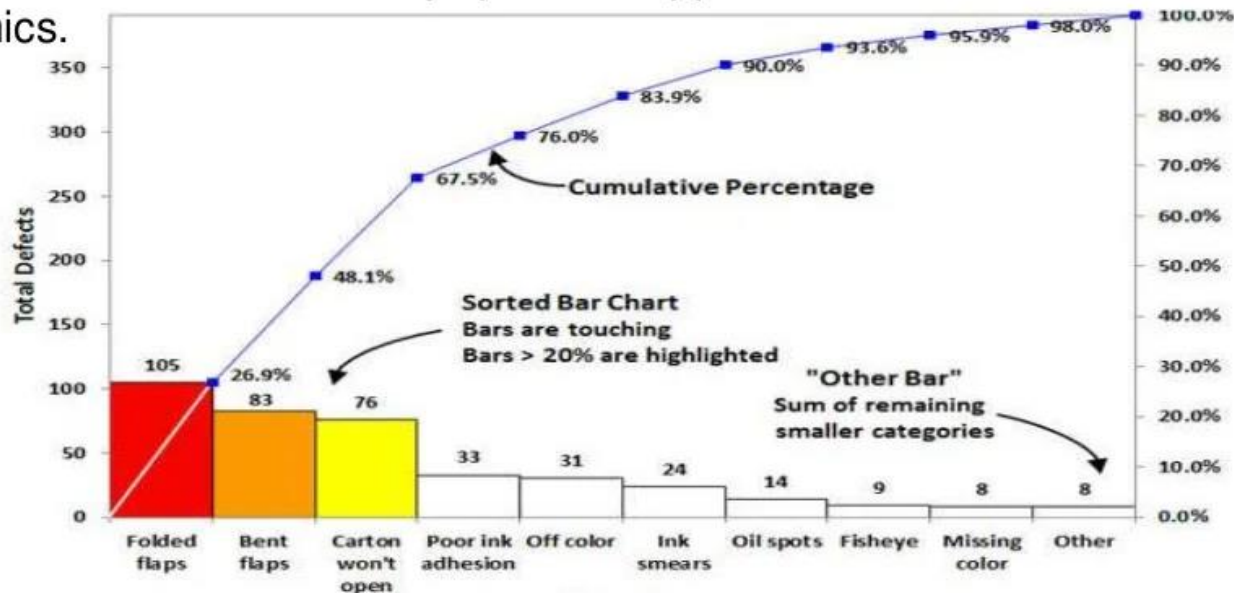


## Tool #4 – The Pareto Chart

➤ When the data is discrete, Pareto chart is used.

PARETO PRINCIPLE: An Italian economist Vilfredo Pareto, in the sixteenth century proved mathematically that 80 percent of the world's wealth was controlled by 20 percent of the population.

➤ This 80-20 rule eventually proved applicable in arenas other than economics.



## Tool #5 – The Process Summary Worksheet

□ The process summary worksheet is a "roll-up" of the sub process map indicating which steps **add value** in the process and which steps **don't add value**.

### Process Summary Worksheet

Process Step	1	2	3	4	5	6	Total Minutes	Percent
Time ( in minutes )	1	20	15	45	10	15	106	100.0
Value added	x					x	16	15.1
Non-value added		x	x	x	x		90	84.9
Moves							0	0
Delays				x			45	42.5
Set-up							0	0
Internal failures			x		x		25	23.5
External failures		x					20	18.9
Control / Inspection							0	0
Value-enabling							0	0

## BENEFITS OF SIX SIGMA(□)

.Generates sustained success

· Sets a performance goal for everyone

· Enhances value to customers

· Accelerates the rate of improvement

· Promotes learning and cross-pollination

· Executes strategic change

## MYTHS ABOUT SIX SIGMA(□)

- Six Sigma is only concerned with reducing defects.
- Six Sigma is a process for production or engineering.
- Six Sigma cannot be applied to engineering activities.
- Six Sigma uses difficult-to-understand statistics.
- Six Sigma is just training.

## “COMPANIES” WHO HAVE IMPLEMENTED SIX SIGMA(□)

- ❖ 3M.
- ❖ Amazon.com.
- ❖ BAE Systems.
- ❖ Bank of America.
- ❖ BD Medical.
- ❖ Bechtel Corporation.
- ❖ Boeing.
- ❖ Caterpillar Inc.
- ❖ Telco
- ❖ Tisco
- ❖ Ford
- ❖ Visteon
- ❖ Wipro

and many more.....!!!



**THANK YOU**