King Fahd University of Petroleum & Minerals

Department of Construction Engineering & Management

CEM 515: Project Quality Management

"SIX SIGMA FOR PROJECT MANAGERS"

GROUP# 1

Monday, December 11, 2006

OUTLINE

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- Six sigma as a metric
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  - Understanding sigma-level metrics
- Six sigma as a goal
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  - Six sigma level of quality
  - Understanding sigma-level metrics
- Six sigma “by the Belts”

What is six sigma?

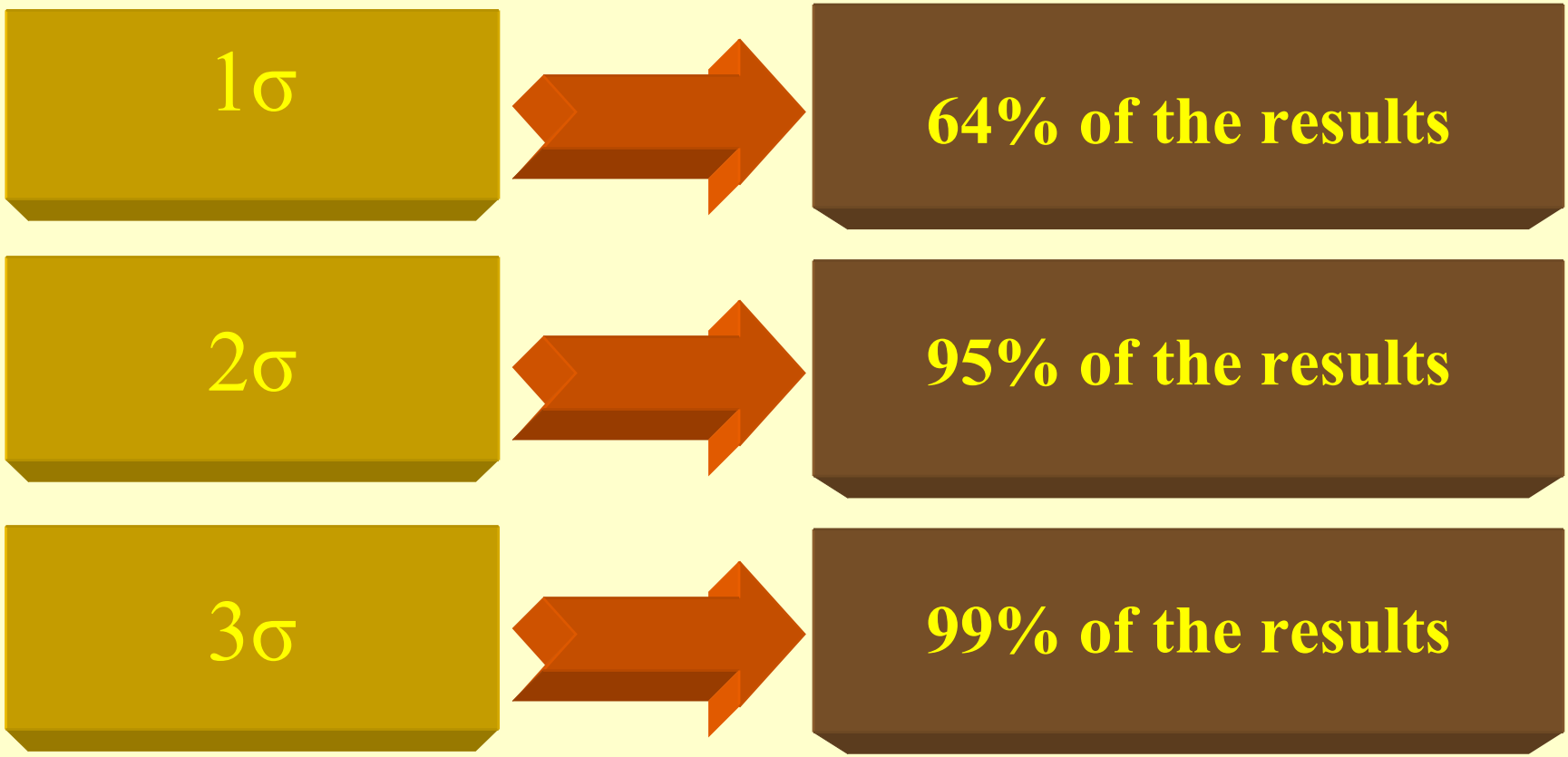
Sigma (σ) is the Greek symbol used in statistics to indicate the statistical property of a set of grouped data called "standard deviation."

"Grouped data" refers to any set of data that are somehow related.

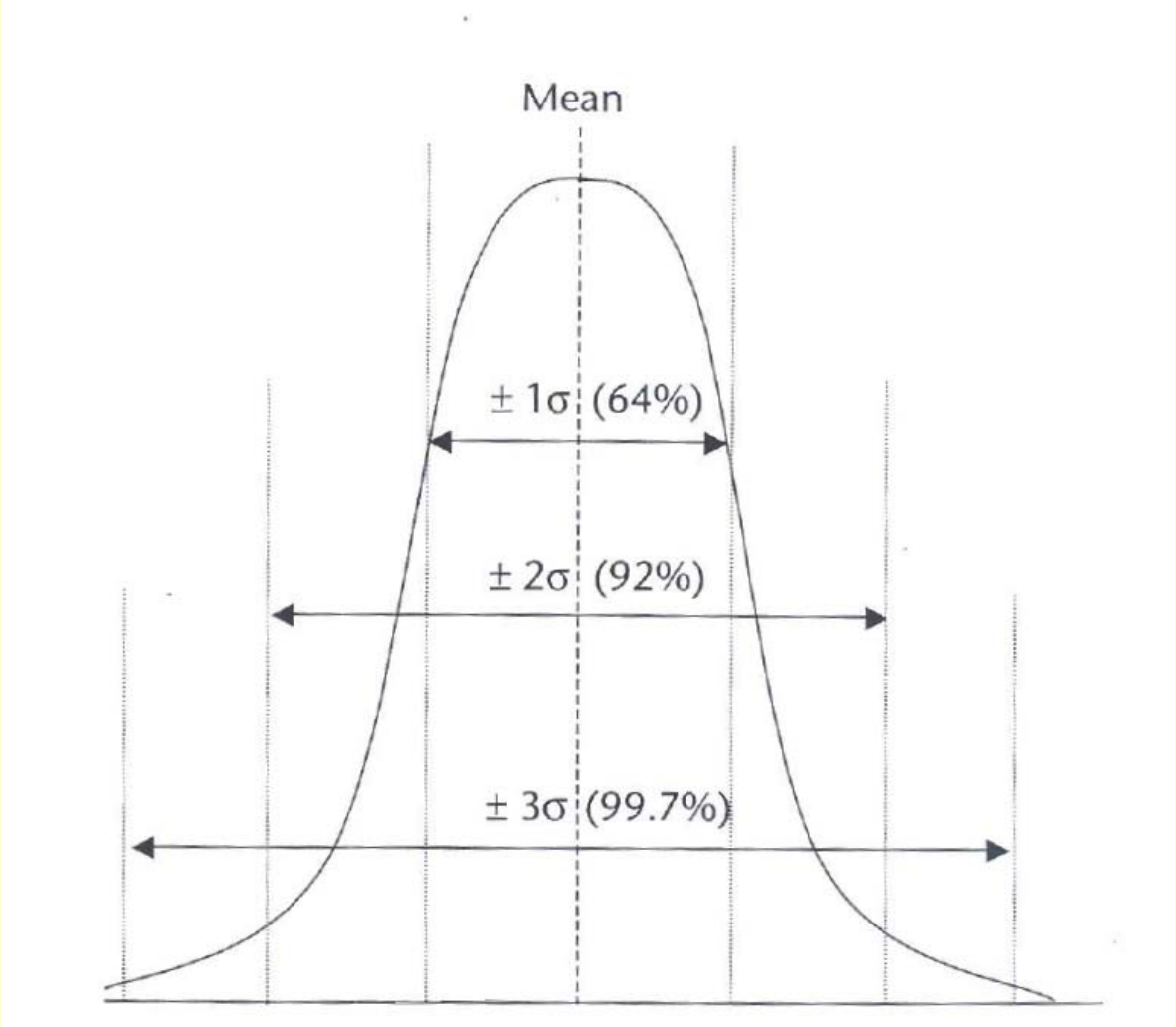
"For any given distribution, the percentage of the results that falls within any number of standard deviations is a constant

What is six sigma?

For a normal distribution



What is six sigma?



- Comparison between 1σ, 2σ, and 3σ

What is six sigma?

- For the mathematical derivation of six sigma, the area under the curve is 99.999999998%; in other words, about 2 parts per billion (ppb) are not under the curve.

- To illustrate, 2 ppb of the world's population (as of early 2003) would be 12 people.

What is six sigma?

- By analogy, temperature is all bout the average speed of molecules, but making the room warmer has more to do with starting a fire, turning up the thermostat, or shutting the window than it does with the molecules and how they are moving.

- In the analogy, the result- a warmer room- is what is important; in six sigma, improved quality is what is important.

What is six sigma?

- Any process will have its “design objectives” as defined by its creators
- This property is the specification limit

Six Sigma As a Metric

- Metrics can be grouped into categories according to what types of activities and decisions they tend to reflect and support.

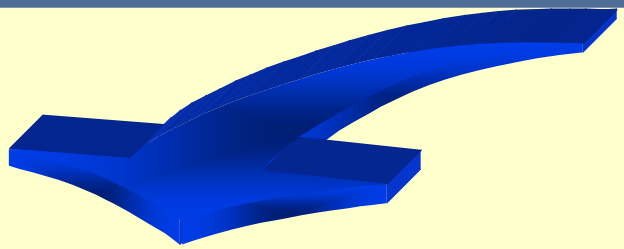
Six Sigma As a Metric

- Six Sigma metric DPMO can be considered in the efficiency measurement category
  - *Especially if the efficiency is the defect removal rate to the defect introduction rate for products*

- Alternatively, It can be considered in the effectiveness measurement category, where eliminating the production of defect is considered the right thing to do

Defining Defects

Two measures are used to derive the sigma value for quality for any given process or product

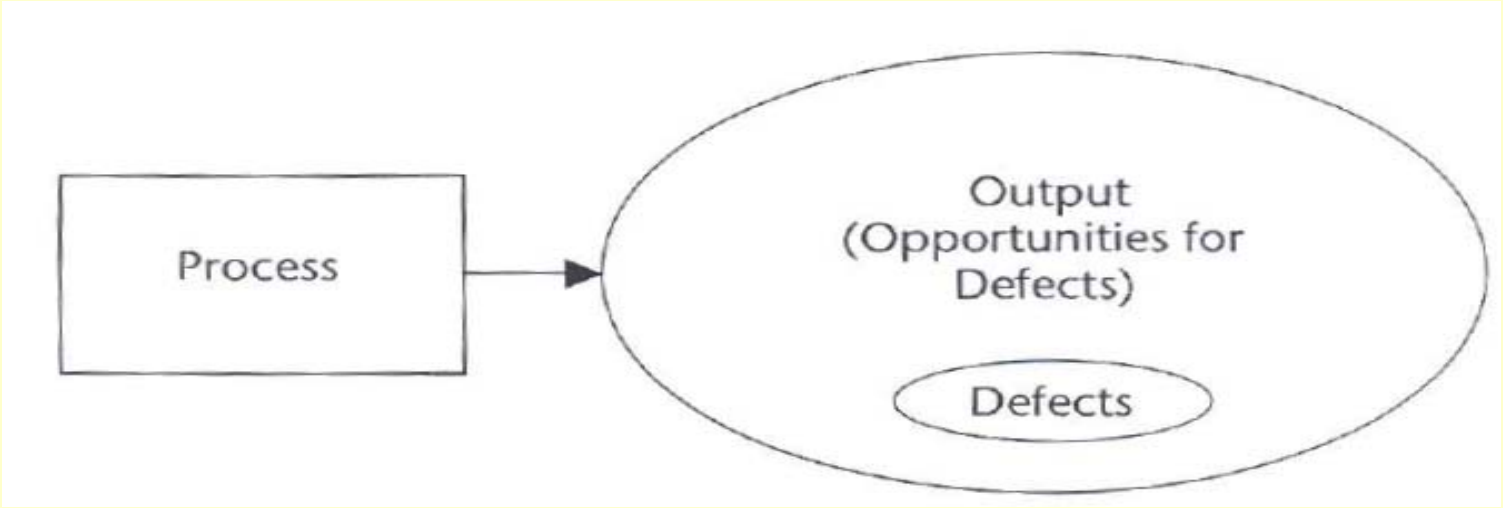


the number of defects
In that product
or within an execution
of that process

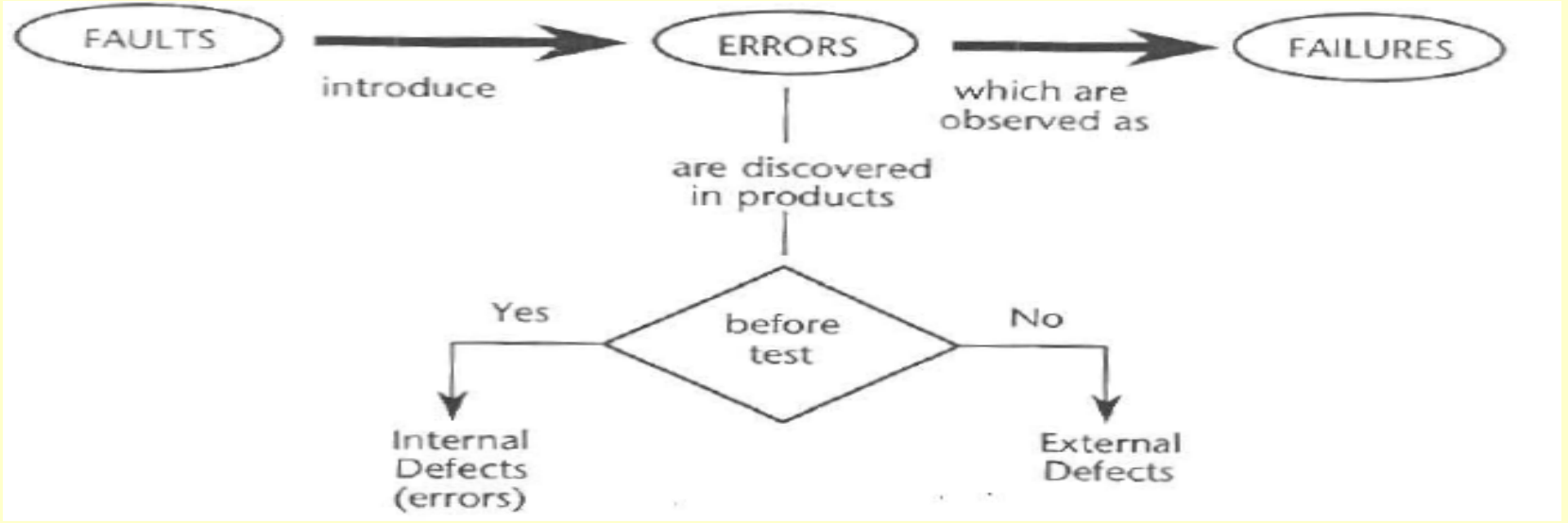
the number of opportunities
for defects within
that product or within an
execution of that process

Defining Defects

- some of the opportunities for defects are realized as defects.



Defining Defects



- Major problems with quality and quality management often arise as a result of the lack of some common operating definitions of terms.
- Figure distinguishes between internal and external and between errors and defects, but we refer to them collectively as defects.

Defining Defects

In practice, it will be necessary to make these defect classification distinctions to evaluate the effectiveness of improving process (i.e. eliminating faults) with the resultant reduction or elimination of errors.

Achieving six sigma is much more about discovering and eliminating faults, which would eliminate all types of defects and failures.

Defining Defects

The quality of a product or a process is expressed as its defect density.

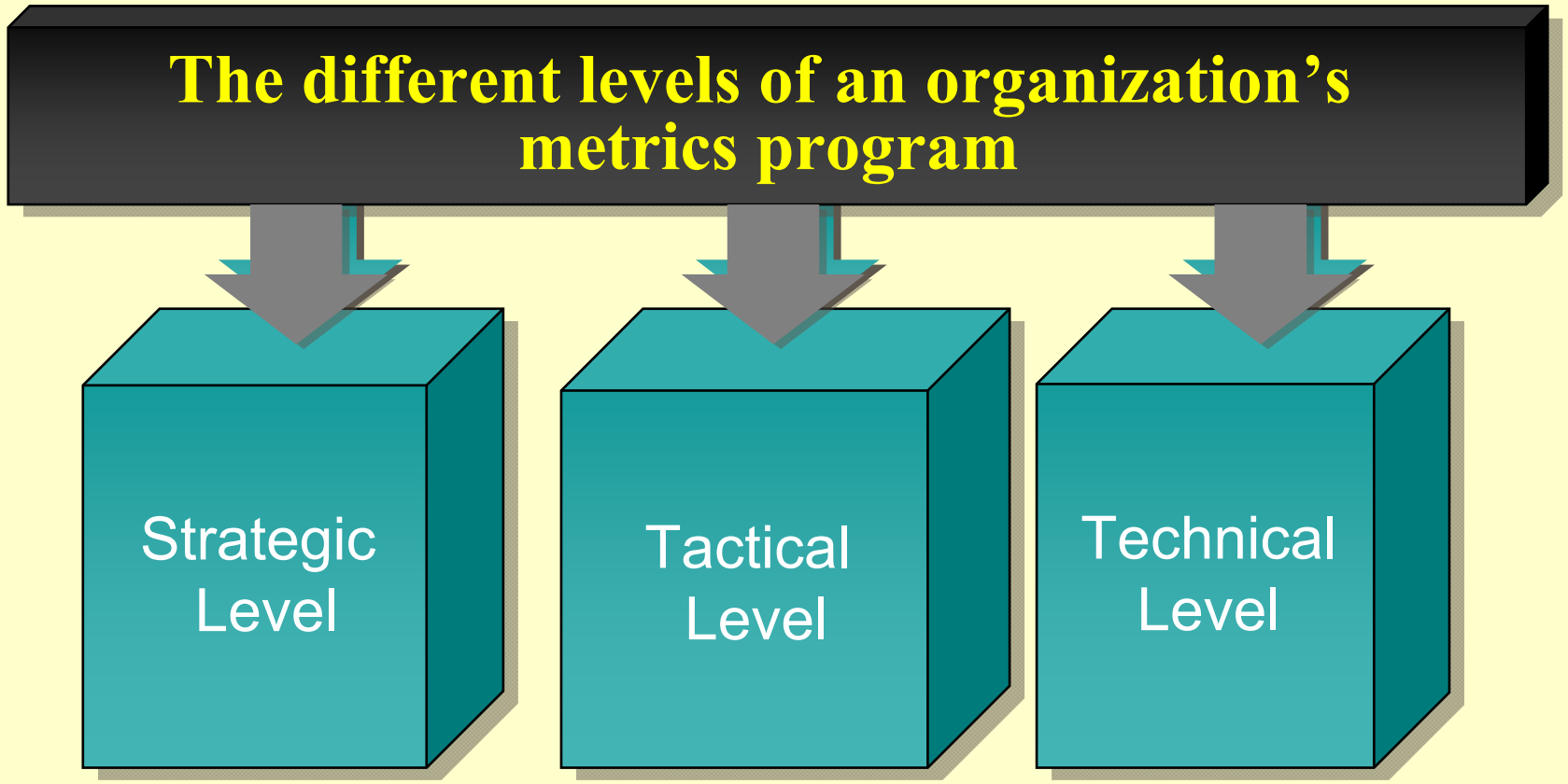
This defect density is then compared with a standard determination of the sigma level associated with that particular value of defect density.

The lower the observed defect density, the higher the sigma level for thee quality of that set of product or process results.

Defining Defects

- Any piece considered not to meet the requirements, would be counted as a defect
- Each piece produced would be counted as an opportunity for this type of defe
- Each part may have many opportunities for defects
- Each part may also have many defects
- It is important to make the distinction between a defect and a failure
- Failure can occur even if there are no defects
- A defect may not result in a failure

Six Sigma as a Strategic-level Metric



Six Sigma is a Strategic Level Metric

Six Sigma as a Strategic-level Metric

- General relationship between parameters for any selected process:

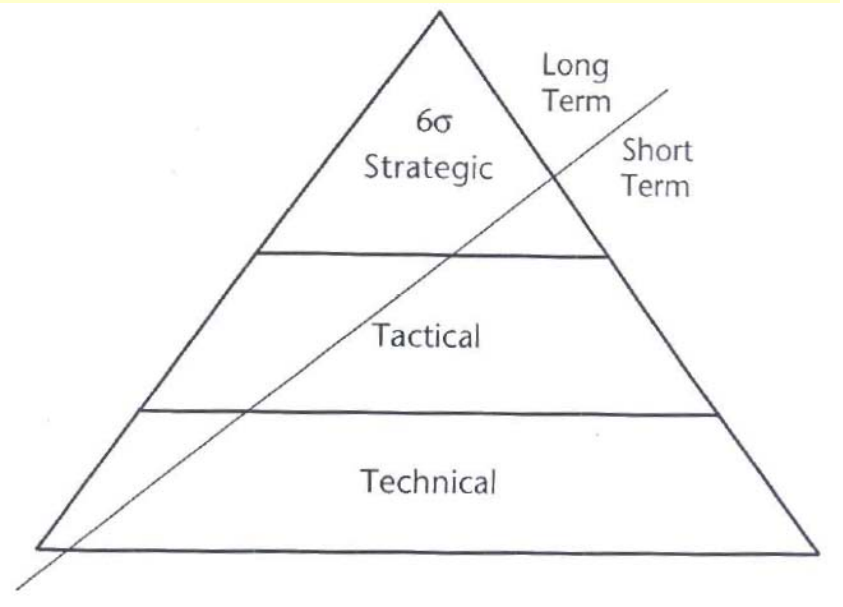
$$f(E,\sigma,T)=K$$

K: constant for the process
E: Efficiency or productivity
T: Cycle-time

- Six Sigma is expressed and reported as the sigma level associated with the observed ratio of defects per opportunity for defects (DPMO)

Six Sigma As a Strategic-Level Metric

- Six sigma describes the characteristic of a process to produce defects or the results of a process to contain defects.



- Certainly in business, success depends on having the processes and executing them at the right level, time, and place.

Understanding Sigma-Level Metrics

- Standard Deviation is a measure of dispersion for a related group of data that represents the result measure for the performance or output of a particular process.
- These results are distributed in non-random distribution (normal distribution)
- Median is the value at which there an equal number of values below and above
- Mode is the most commonly occurring value
- Even though Six Sigma is applied in every type of process, industry and organization, its roots are deep in manufacturing

Understanding Sigma-Level Metrics

σ Level	DPMO
0	> 941,000
1	693,000
2	308,000
3	67,000
4	6,200
5	230
6	3

Six Sigma As a Goal

- The goal of any organization is to fulfill its mission
- For a commercial organization, satisfying its owners by acquiring and satisfying customers and remaining viable

Six Sigma As a Goal

- Any type of organization can express its goals in terms of its relationships with those inside or outside the organization
- These goals are characterized as “vision”, “mission”, “goals”, and “objectives”
- For an organization to exist and continue, it must have some level of quality, responsiveness, and affordability.

Six Sigma As a Goal

- Improving Quality
- Traditional Quality Control
- Six Sigma Level of Quality

Improving Quality

- Six Sigma program is about improving processes to achieve better quality
- Quality Definitions
  - Conformance to specification
  - Fitness for use
  - Whatever the customer says it is
- The sigma quality performance level of any process is a property of that process. That is, the value exists; all we need to do is measure.

Improving Quality

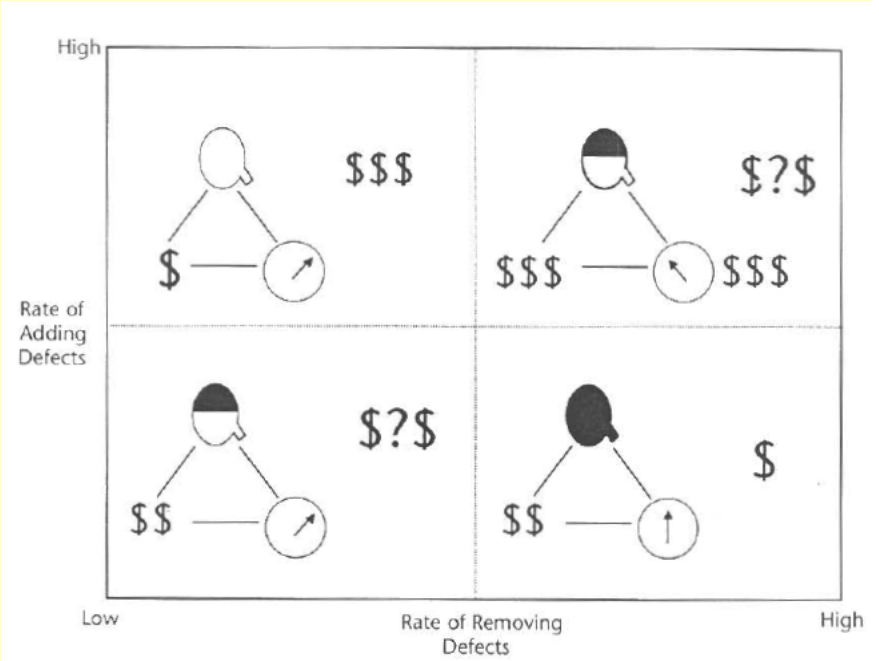
- There are few businesses that are not candidates for some level of improvement in performance, be it quality (better), cycle time (faster), or cost (cheaper)
- We say “better-faster-cheaper, pick two,” but the reality of improvement is that we must achieve some improvement in all three.

Traditional Quality Control

- It looks first at finding defects and then fixing them.
- Actual practice is more like letting the defects “find themselves,” or evaluating the failure rate and then fixing the damage and possibly also fixing that particular instance of the defect.
- The next step is fixing the process to reduce the production of defects.
- In general, traditional quality control seeks a balance where the ability to detect and fix defects equals or exceeds slightly the propensity of the process to produce defects.

Traditional Quality Control

- Cost of quality “COQ” contribution for detection and correction is represented in each quadrant
- COQ contribution for “prevention” consists of the cost of defect prevention, detection, and correction
- The upper right quadrant has a very high cost of quality while the lower left quadrant has a low cost of quality.



- The lower left quadrant clearly represents the state of the process being “in-control”
- At high levels of quality, such as at six sigma, the rate of removal is hardly an issue in the overall cost of quality.

Six Sigma Level of Quality

- A six sigma level of quality is very near perfection
- As a generalization, if we change a process to improve the quality of its output
  - The cost of that process and the time it takes to produce a given amount of acceptable output will also decrease
- So we can demand and achieve perfection or near perfection according to the standards we set to evaluate quality

Six Sigma Level of Quality

- Many processes already function at well above six sigma levels of quality
  - Ex.: Airline safety
  - Even if flights operated at six sigma, there would be an unacceptable safety risk
- On the other hand, there are several areas where we accept performance at very low six sigma levels
  - Ex.: Crash of PC
  - If we applied six sigma, PC will be crashed once every 1,170 years

Six Sigma by the Belts

- Six sigma projects are those chartered to improve the quality of existing processes
- Black belts manage the six sigma projects
- Although the amount and content of six sigma black belt training varies widely, it will include extensive exposure to and practice with the statistical tools associated with six sigma
- The role of “green belt” is somewhat similar to that of the black belt, but it is generally not a full-time position
- For six sigma projects, most of the project team will likely be trained as green belts

Six Sigma by the Belts

- Green belt training is often provided to executives and managers who will no be participating directly in six sigma projects, but who need a good understanding of the processes and implications of six sigma.
- The “master” black belt is also full time position, but primary responsibility is to provide training and guidance to the organization in general, and to the other six sigma participants.
- Black belts are the people in the organization with the training and experience to lead the projects that will change the processes.