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Six Sigma

DMAIC - Improve Phase

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Generate, Select, Design And Implement Improvements

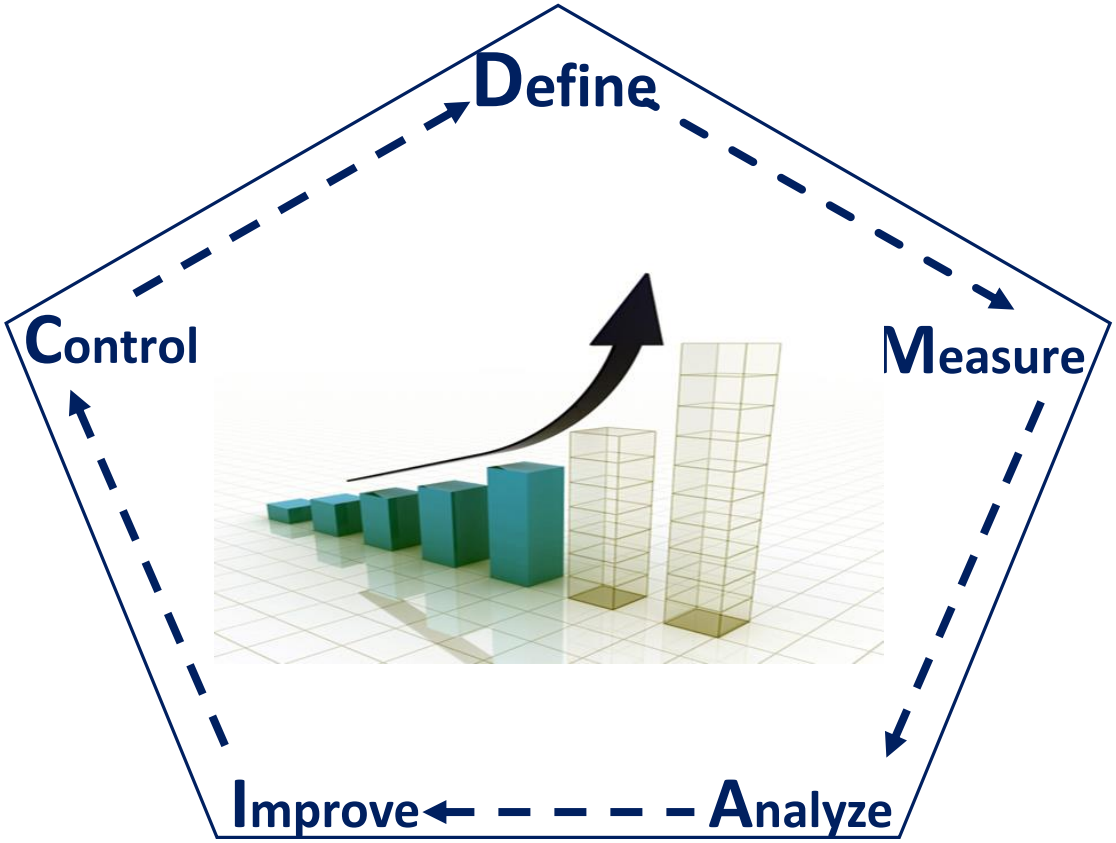
- Solution Design Developed & Documented
- Solution Validated & Cost / Benefit Proposal Presented to Champion
- Solutions Tested On A Small Scale Or Pilot Program
- Implementation Plan Developed And Executed

Six Sigma Improve Phase Questions

- Once it is known which inputs affect the outputs most, how can they be controlled?
- How many trials do we need to ensure optimal settings have been achieved?
- Should the old process be improved, or should a new process be designed?
- By how much has the defects per million opportunities decreased?

- The most applicable tool at this phase is process mapping to show new & improved processes.

Six Sigma: Improve



Improve

the process & remove defect causes.
Generate, Select, Design and Implement Improvements.

Six Sigma: Improve

- The improve phase focuses on developing ideas to remove root causes of variation, testing & standardizing these solutions.
- This phase includes:
  - Identifying ways of removing causes of variation.
  - Verify critical inputs.
  - Discover relationships between variables.
  - Establish operating tolerances which are upper and lower specifications. of the process, and if followed precisely will ensure “defect free” products.
  - Optimize critical inputs or reconfigure the current process.

Six Sigma: Improve

The goal of the improve phase is to test sources of variation to determine which of these actually cause process variation in the customer CTQ.

7. Screen / Identify Causes of Variation.

8. Discover Variable Relationships.

9. Estimate Operating Tolerances & Pilot Solutions.

7. Screen / Identify Causes of Variation.

At this stage we determine which factors will be changed to improve the CTQs.
In step 6 (MEASURE) we selected the "vital few x's" for each CTQ (little y).

In step 7 we select an appropriate improvement strategy based upon characterizing x's as either
operating parameters or critical elements.

Operating Parameters are x's that change in amount, rather than being replaced with another type / kind. Operating Parameters can be set to several levels to see how they affect the process Y.
Critical Elements are x's that are typically changed in type or kind, rather than in amount. These x's are not necessarily measurable on a specific scale.

7. Screen / Identify Causes of Variation

Having identified the pertinent operating parameters and / or critical elements, we would then review whether Design of Experiments (DOE) would be appropriate and, if so, develop the appropriate design, called a screening design.

The screening design is used to validate or eliminate factors (i.e. x's), but is not ordinarily able to determine the optimal settings of the x's.

Important considerations include the number of factors, number of levels of each, the 'range' of settings for each factor, replication, randomization & whether to use blocking variables.

8. Discover Variable Relationships.

GOAL: to determine the precise changes needed

It is common to apply Optimizing DOE at this point, to determine the 'best' settings of the x's. It is common to use fractional factorial designs or central composite designs to accomplish this goal.

It is common to include "baseline conditions" among the factor settings. We desire to determine the "transfer function" (the regression equation). In combination these are intended to yield a proposed solution to achieve project objectives.

Important considerations include the testing budget, available personnel, and time allotted for the study.

9. Estimate Operating Tolerances & Pilot Solutions.

PURPOSE:

to estimate the range of values for each vital x that will satisfy customer requirements.

CONCEPT:

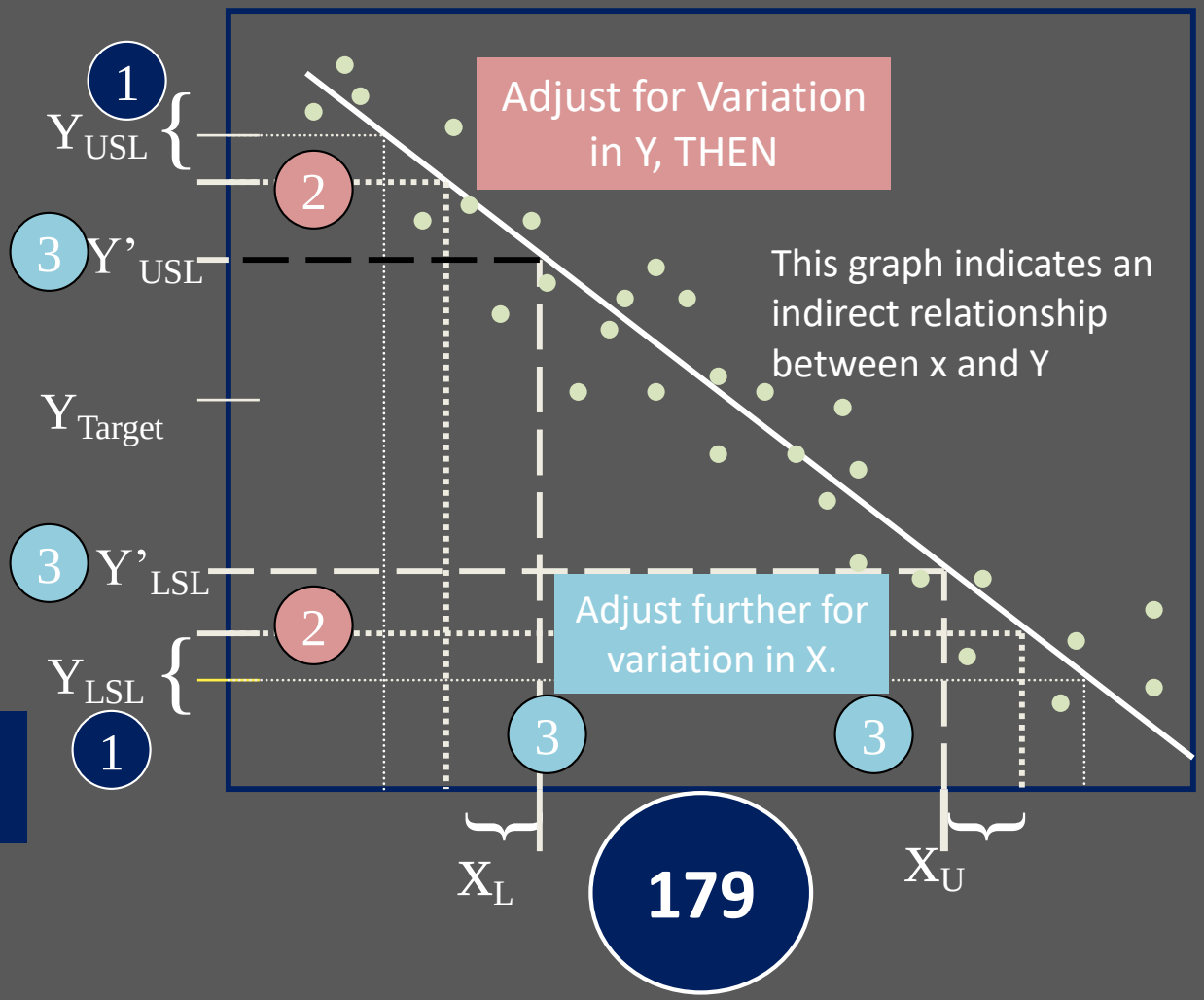
IF we can characterize the x-Y relationship AND we know the required specifications of Y, THEN the tolerances can be set for each x factor.

Specifications flow down from customer requirements and we adjust tolerances accounting for variation, unless variation is small enough to be ignored.

STATISTICAL TOLERANCING

Six Sigma: Improve

9. Estimate Operating Tolerances & Pilot Solutions.



Original Y Specifications

Statistical Tolerancing

Six Sigma

End of Improve Phase