IMPROVEMENT OF MSA AND CPK ON IN-HOUSE MANUFACTURING SUB-PROCESSES FOR AN ELECTRONIC SUBMERSIBLE PUMP SYSTEM

ISE Department | System Design Project
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Abstract

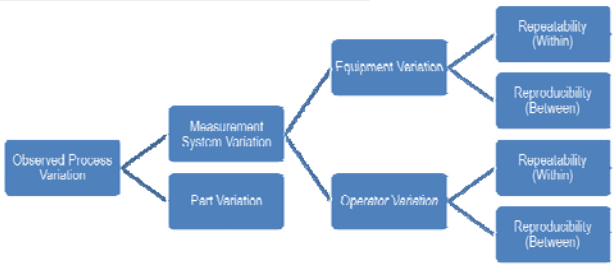
The stator straightening process is an essential step in maximizing the utility of the stator in the Electronic Submersible Pump (ESP) System produced by Schlumberger. The management decided that there is a need to conduct a Measuring System Analysis (MSA) to ascertain the capability of the gage being used in the process, as a part of the company's quality improvement efforts. However, in a recent MSA study conducted by Schlumberger, the gage failed to meet the requirements of a robust measuring system. After studying the gage, the measurement process and the straightening process, our team has proposed recommendations to improve the measuring system.

Objective Statement

- To improve the current measurement system (Characteristics: Perpendicularity and Concentricity)
- To reduce number of defectives transferring out from the stator straightening process

Methodology

Evaluation of Measurement System



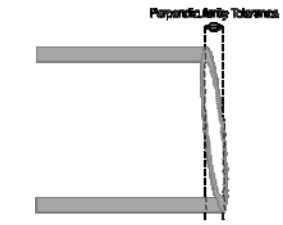
$$(\sigma_{observed})^2 = (\sigma_{part})^2 + (\sigma_{MS})^2$$

$$(\sigma_{MS})^2 = (\sigma_{repeatability})^2 + (\sigma_{reproducibility})^2$$

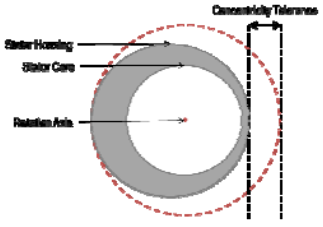
$$GRR(\%\ of\ total\ variation) = {}^{\sigma_{MS}}/_{\sigma_{observed}} \times 100\%$$

GRR	Decision
Under 10%	Generally considered to be an acceptable measurement system
10% to 30%	May be acceptable for some applications
Over 30%	Considered to be unacceptable

Characteristics Measured



Type of Measurement	GRR
Top end perpendicularity	87.21%
Top end concentricity	41.08%
Bottom end perpendicularity	100%
Bottom end concentricity	43.44%

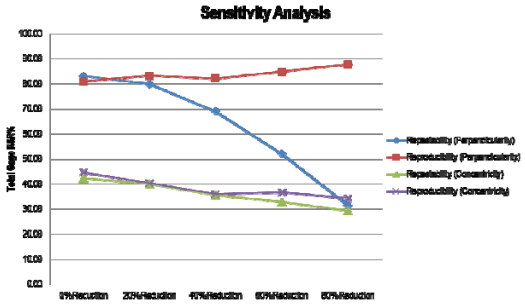


Sensitivity Analysis

Simulation model of the measuring system to understand the factors affecting the measurement and to predict the outcome of varying these factors.

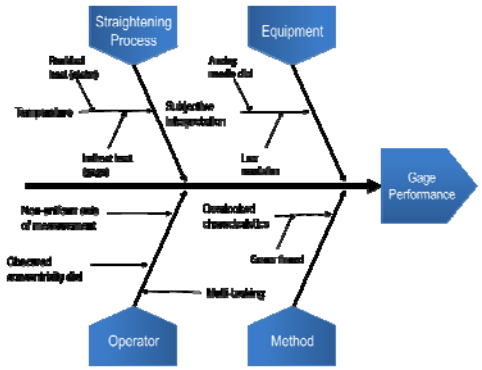
Linear Mixed Effect Model:

$$Measured = True + \sim N(0, \sigma^2_{rpt}) + \sim N(0, \sigma^2_{rpd})$$



Perpendicularity	Concentricity
Improving the repeatability of the MS is crucial to obtaining a satisfactory GRR	Improving both repeatability and reproducibility can result in overall improvement to GRR

Root Cause Analysis



Recommendations

In response to our analysis of the underlying problems plaguing the measuring system, we have formulated a 3-part solution:

1. Tighten the process specification limits as compared to the actual requirements of the ESP.
   - Reduces β error (a false positive occurring when the measurement passes the stator while in fact the stator fails)
   - Compensates for measuring system variation
2. Use a dial with higher resolution and a min-max function.
   - Fulfills the rule of tens given the specification limits of the straightening process
   - Reduces operator error by relieving them of the need to constantly monitor the dial
3. Improve the gage by reinstating the previous phased-out measuring tool which is able to measure the screw thread.
   - Ensures that the screw thread of the stator meets the system requirements