Slide 1

Quality

GREEN BELT TRAINING
CONTROL PLAN, POKA YOKE, SPC

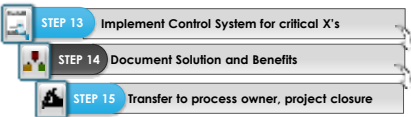**Dr.Gopal Sivakumar**

Venue: GCT, COIMBATORE

Ministry of Micro, Small and Medium Enterprises, Government of India

Quality means doing it right, when no one is looking. Henry Ford

Slide 2

CONTROL PHASE OVERVIEW

STEP 13 — Implement Control System for critical X's

STEP 14 — Document Solution and Benefits

STEP 15 — Transfer to process owner, project closure

Slide 3

1 Control plan to monitor & sustain improvement

2 Control charts detect the presence of special cause

CONTROL PHASE DELIVERABLES

4 Replication & Standardization

3 Documented Solutions and Benefits

Slide 4

CONTROL PLAN

A Control Plan includes the following
- Process documentation
- Data Collection Plan
- Mistake Proofing System
- Response / Reaction Plan
- Communication Plan
- Audit / Inspection Plan
- Risk Mitigation System
- Statistical Process Control

Slide 5

Mistake Proofing Techniques

Technique	Prediction / Prevention	Detection
Shutdown	When a mistake is about to be made	When a mistake or defect has been made
Control	Errors are impossible	Items cannot move on to the next step
Warning	That something is about to go wrong	Immediately when something goes wrong

Slide 6

TYPES OF POKE YOKE

WARNING POKE YOKE
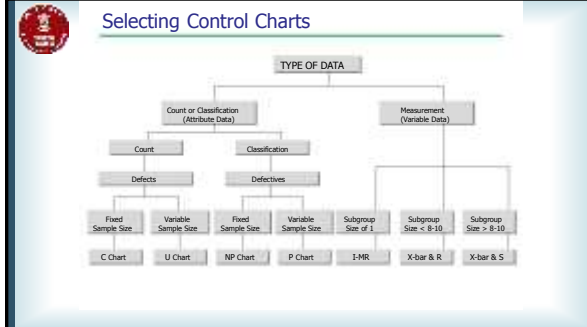- Signals that a mistake can occur
- Blinking light, alarm

CONTROL POKE YOKE
- Controls the possibility of a mistake to occur
- Gate closes before train crosses

Selecting Control Charts

How do I calculate the control limits?

$\overline{X}$ – R Chart

For the averages chart:

$$CL = \overline{\overline{X}}$$
$$UCL = \overline{\overline{X}} + A_2 \overline{R}$$
$$LCL = \overline{\overline{X}} - A_2 \overline{R}$$

For the range chart:

$$CL = \overline{R}$$
$$UCL = D_4 \overline{R}$$
$$LCL = D_3 \overline{R}$$

n	D4	D3	A2
2	3.27	0	1.88
3	2.57	0	1.02
4	2.28	0	0.73
5	2.11	0	0.58
6	2.00	0	0.48
7	1.92	0.08	0.42
8	1.86	0.14	0.37
9	1.82	0.18	0.34

$\overline{X}$ = average of the subgroup averages
$\overline{R}$ = average of the subgroup range values
A_2 = a constant function of subgroup size (n)

UCL = upper control limit
LCL = lower control limit

How do I calculate the control limits?
p and np Charts

For varied sample size:

$$UCL_p = \overline{P} + 3\frac{\sqrt{\overline{P}(1-\overline{P})}}{\sqrt{n}}$$
$$LCL_p = \overline{P} - 3\frac{\sqrt{\overline{P}(1-\overline{P})}}{\sqrt{n}}$$

For constant sample size:

$$UCL_{np} = n\overline{P} + 3\sqrt{n\overline{P}(1-\overline{P})}$$
$$LCL_{np} = n\overline{P} - 3\sqrt{n\overline{P}(1-\overline{P})}$$

Note: P charts have an individually calculated control limit for each point plotted

P = number of rejects in the subgroup/number inspected in subgroup
$\overline{P}$ = total number of rejects/total number inspected
n = number inspected in subgroup

How do I calculate the control limits?
c and u Charts

For varied opportunity (u):

$$UCL_u = \overline{U} + 3\frac{\sqrt{\overline{U}}}{\sqrt{n}}$$
$$LCL_u = \overline{U} - 3\frac{\sqrt{\overline{U}}}{\sqrt{n}}$$

For constant opportunity (c):

$$UCL_C = \overline{C} + 3\sqrt{\overline{C}}$$
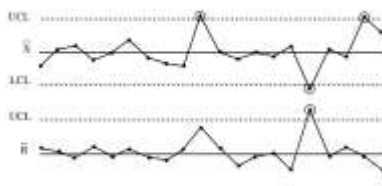$$LCL_C = \overline{C} - 3\sqrt{\overline{C}}$$

Note: U charts have an individually calculated control limit for each point plotted

$\overline{C}$ = total number of nonconformities/total number of subgroups
$\overline{U}$ = total number of nonconformities/total units evaluated
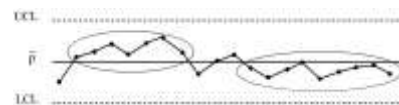n = number evaluated in subgroup

Chart interpretation for abnormalities – Rule 1
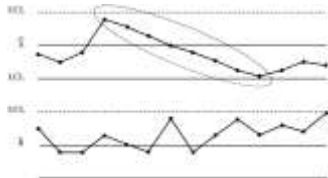Point outside the limits

11

Chart interpretation for abnormalities – Rule 2
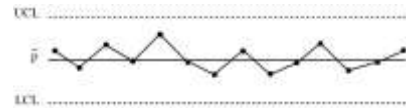7 Points in a row above or below the mean line.

12

Chart interpretation for abnormalities – Rule 3
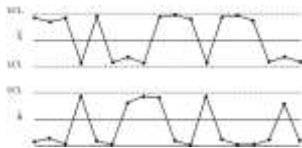7 points in a row descending or ascending

13

Chart interpretation for abnormalities – Rule 4
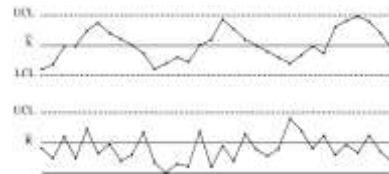Too Close to the average

14

Chart interpretation for abnormalities – Rule 5
Too far away from the average

15

Chart interpretation for abnormalities – Rule 6
 Cyclic pattern

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DOCUMENT SOLUTION & BENEFITS

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Document Solution and Benefits

Why should I document the solution?

1. Solutions should be documented for review and application in other processes in the organization.
2. It also acts as lessons learnt document for other greenbelts.

Document Solution and Benefits

Standardization and Solution Replication

1. **Replication** is taking the solution from the team and applying it to the same type or a similar type of process
2. **Standardization** is taking the lessons / solutions from the team and applying those good ideas to processes that may be dissimilar to the original process improved

Implementation approach

- **Sequenced approach**
  - Solution is fully implemented in one location; implementation begins at a second location
- **Parallel approach**
  - Solution is implemented at 2 or more location or processes simultaneously
- **Phased approach**
  - When a pre-determined milestone is achieved at one location; the implementation at a second location begins
- **Flat approach**
  - Implementation is done at all target locations, companywide

Project benefits

- **The result of the improvement and financial benefit need to be monitored for one year.**
- **Project Closure document, consists of**
  - Results of the project
  - Control activities
  - Status of incomplete tasks
  - Approval of key stakeholders

Quality

GREEN BELT TRAINING

TRANSFER TO PROCESS OWNER

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Transfer to Process Owner, Project Closure

Six sigma team needs to ensure that the improvement is sustained. Transferring the responsibility to process owner will require

- Process Control Plan
- Review meetings to communicate the state of the process
- Updated flowcharts, procedures and statement of work
- SPC measures including control plan
- Out of control action plans, Response plans to define how irregularities in the process are handled

Additional activities during wrap up

- The team might consider evaluating how the team worked together
- Management may devise rewards to recognize the work and success of the team

Recognition and celebration of a successful six sigma drive process excellence philosophy within the organization and managing change becomes simpler.

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