Leadership through QUALITY
ASQ Columbus Section 801
SPRING CONFERENCE 2011

Bun Height Variation

Project ID: 20124

Lean Six Sigma Project

Bill Soller

Principal, Supplier Six Sigma, LLC

Updated: 3/24/11

Supplier 6σ

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"Rapid performance improvement
and immediate cost savings"

The history of the Hamburger

- A Texas historian attributes the Hamburger to Fletcher Davis of Athens, Texas. Davis is believed to have sold hamburgers at his café in Athens, Texas in the late 1880s, then brought them to the 1904 St. Louis World's Fair.
- Residents of Hamburg, New York, which was named after Hamburg, Germany, attribute the hamburger to Ohioans Frank and Charles Menches. According to legend, the Menches brothers were vendors at the 1892 Summit County Fair in Akron, Ohio when they ran out of sausage for sandwiches and used beef instead.
- The hamburger bun was invented in 1916 by a fry cook named Walter Anderson, who co-founded White Castle in 1921.
- Following the war, hamburgers became unpopular until the White Castle restaurant chain marketed and sold large numbers of small 2.5-inch square hamburgers, known as slyders. They started to punch five holes in each patty, which help them cook evenly and eliminated the need to flip the burger. White Castle was the first to sell their hamburgers in grocery stores and vending machines.
- McDonald's popularized the hamburger in 1940. The first McDonald's restaurant opened in San Bernardino, California by Dick and Mac McDonald. Their introduction of the "Speedee Service System" in 1948 established the principles of the modern fast-food restaurant. In 1961, Ray Kroc (the supplier of their multi-mixer milkshake machines) purchased the company from the brothers for $2.7 million and a 1.9% royalty.
- The rest is history…

Project Summary: (20124) Bun Height Variation

Team Members: Bill Soller, Mustafa Shraim, Cathy Edly, Dale Chapman, Bill Hawkins

Define → Measure → Analyze → Improve → Control

Summary

Mission: Reduce the amount of variation of the height of the hamburger bun. Increase the Cpk from .6 to 1.33.
Project Type: Lean 6 Sigma Project
Est. Project Savings: $100,000
% Complete:88%
Previous Completion: 62%
Start Date: 11/3/10
Original Completion Date: 12/10/10
Current Completion Date: 4/4/11

Progress over last period:

1. Completed the Measure and Analyze Phases.
2. Completed the Improve phase and confirmation runs.
3. Updated control chart

Concerns and Other Issues:

1. Equipment down time, Fermentation thermostat failure.
2. Controlling the input variables.

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Next Steps:

1. Run the line at the optimum settings as identified from the design of experiment and hand over to process owner. Action: John N., Due by 1/17/11
2. Analyze the data for the inputs to the process to determine the amount of variation and create control charts. Action: Dan/Bill, Due by 1/17/11

Team:

Project Leader:	**Bill Soller**
Team Members:	Mustafa Shraim, Cathy Edly, Dale Chapman, Bill Hawkins
Process Owner:	Berry Larkin
Business Champion:	Charlie O'Neil

Who are the customers?

- Consumers
- Associate toasting the bun in the fast food store
- Shareholders and employees

Problem Statement:

Excessive variation of the bun height can cause the stores to vary the toaster settings which result in inconsistent browning of the bun and long cycle times in the stores.

Business Case:

- Dissatisfied customers and loss of future sales on a new product.
- Waste- cost of ingredients, scrap of finished product and scrap of in process ingredients.
- $100,000 in savings on one product line (multiply savings by several plants and lines)

Mission:

Reduce the amount of variation of the height of the hamburger bun.

Increase the Cpk from .6 to 1.33. Allow only one setting for toasting at the stores.

Project Schedule

Phase	Original Target Completion	Current Target Completion	Completion Date	11/5/10	11/12/10	11/19/10	11/26/10	12/3/10	12/10/10	12/17/10	12/24/10	12/31/10	1/7/11	1/14/11	1/21/11	1/28/11	2/4/11	2/11/11
Define	11/10/2010		11/26/2010															
Measure	12/2/2010		12/7/2010															
Analyze	12/3/2010	12/17/2010	12/10/2011															
Improve	12/3/2010	1/17/2011	1/15/2011															
Control	12/10/2010	2/8/2011																

Detailed Schedule

DMAIC DOE	Details	Count	Target Completion	Completion Date
Define	Create Project Charter/Business Case/Mission/Scope	1	11/10/2010	11/26/2010
	Determine team	1	11/10/2010	11/26/2010
	Define operational definitions	1	11/10/2010	11/26/2010
	Determine Y output or response	1	11/10/2010	11/26/2010
	Chart variability over time/ create baseline metrics	1	11/10/2010	12/3/2010
Measure	Determine Measuring System/Data Collection process	1	11/29/2010	11/26/2010
	Determine factors and levels	1	12/6/2010	12/6/2010
	Determine feasibility of combinations	1	12/6/2010	12/6/2010
	Determine randomization of experimental runs	1	12/6/2010	12/6/2010
	Determine number of observations over time for the response	1	12/6/2010	12/6/2010
	Perform data collection process/ensure data accuracy under consistent conditions	1	12/7/2010	12/8/2010

Detailed Schedule

DMAIC DOE	Details		Target Completion	Completion Date
Analyze	Perform statistical analysis/graphical illustrations utilizing Minitab	1	12/10/2010	12/14/2010
	Model relationships and verify results between input (x) and output (Y)	1	12/10/2010	12/14/2010
	Determine significant inputs	1	12/10/2010	12/14/2010
	Determine interactions of X's	1	12/10/2010	12/14/2010
	Define optimal target values of X's	1	12/10/2010	12/14/2010
Improve	Perform a confirmation run (Validation of Desired Settings vs. Prediction Using the Mathematical Model)	1	12/17/2010	1/12/2011
	Perform FMEA or risk analysis	1	12/17/2010	1/12/2011
	Change process setup	1	12/17/2010	1/12/2011
	Measure capability	1	12/17/2010	1/15/2011
Control	Develop a control plan	1	2/8/2011	2/5/2011
	Hand off to Process owner	1	2/8/2011	2/6/2011
	Determine capability of key metrics	1	2/8/2011	2/6/2011
	Update cost savings		2/8/2011	
	Sustain improvement through SPC		2/8/2011	
	Close project and celebrate!		2/8/2011	
	% Complete (out of 26 steps):	**88%**		

What is the Operational Definition?

Height of the baked hamburger bun at it's highest point.

Bun height is measured with a laser

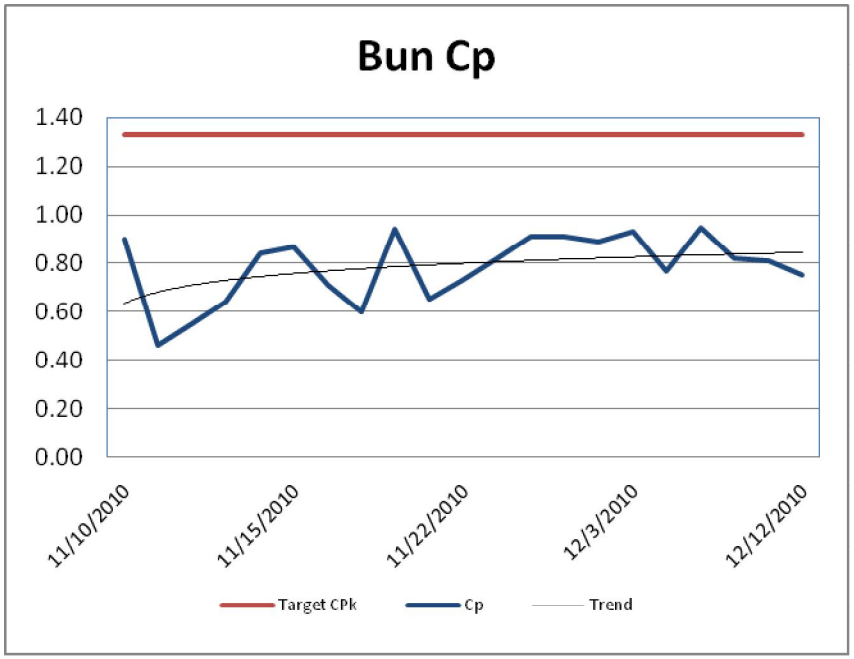
Project Scope:

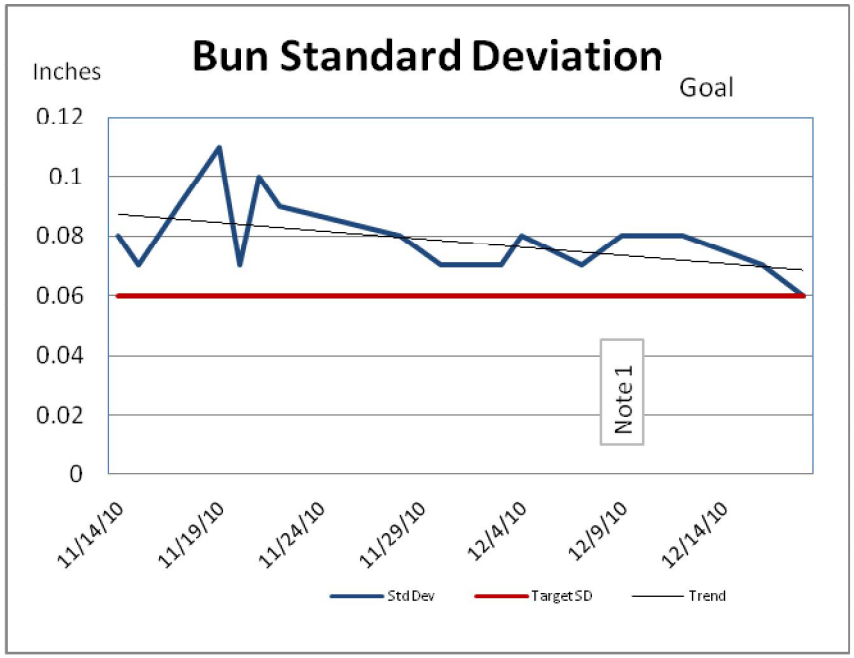
Focused on Bun Height from the Frost Bakeries, Nashville, TN product line.

Critical to Quality Characteristics:

- Bun Height after baking- Target is 2.10”
- Color- Target is 70
- Blotchiness
- Dough Weight- Target is 1.85 oz
- Diameter of Bun

Baseline Data:





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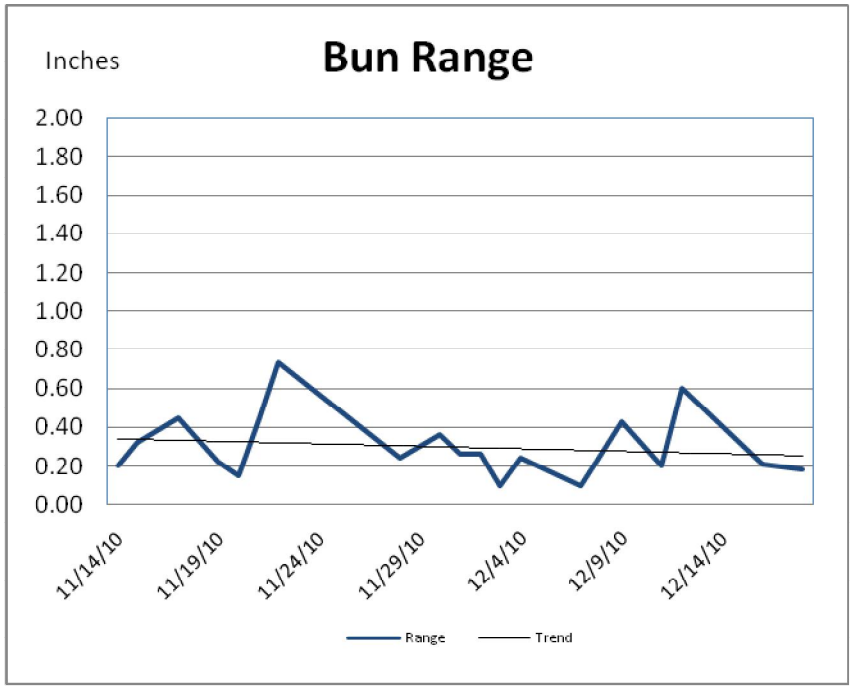

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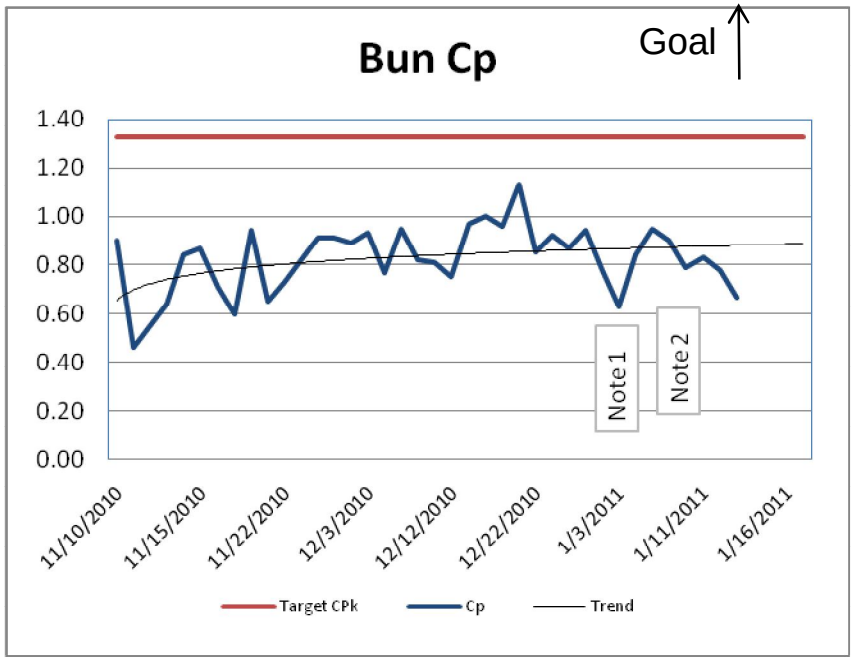
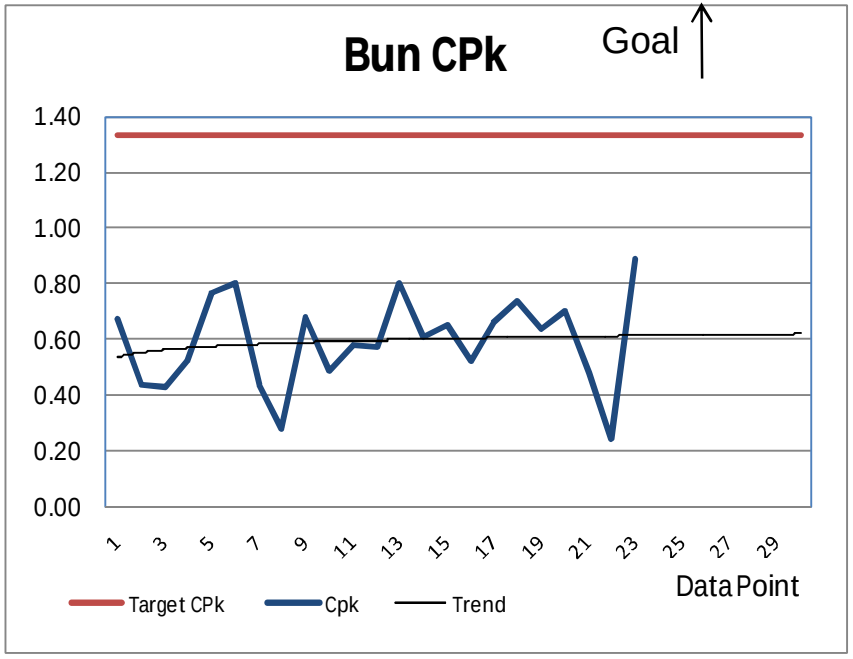




Bun Product Line

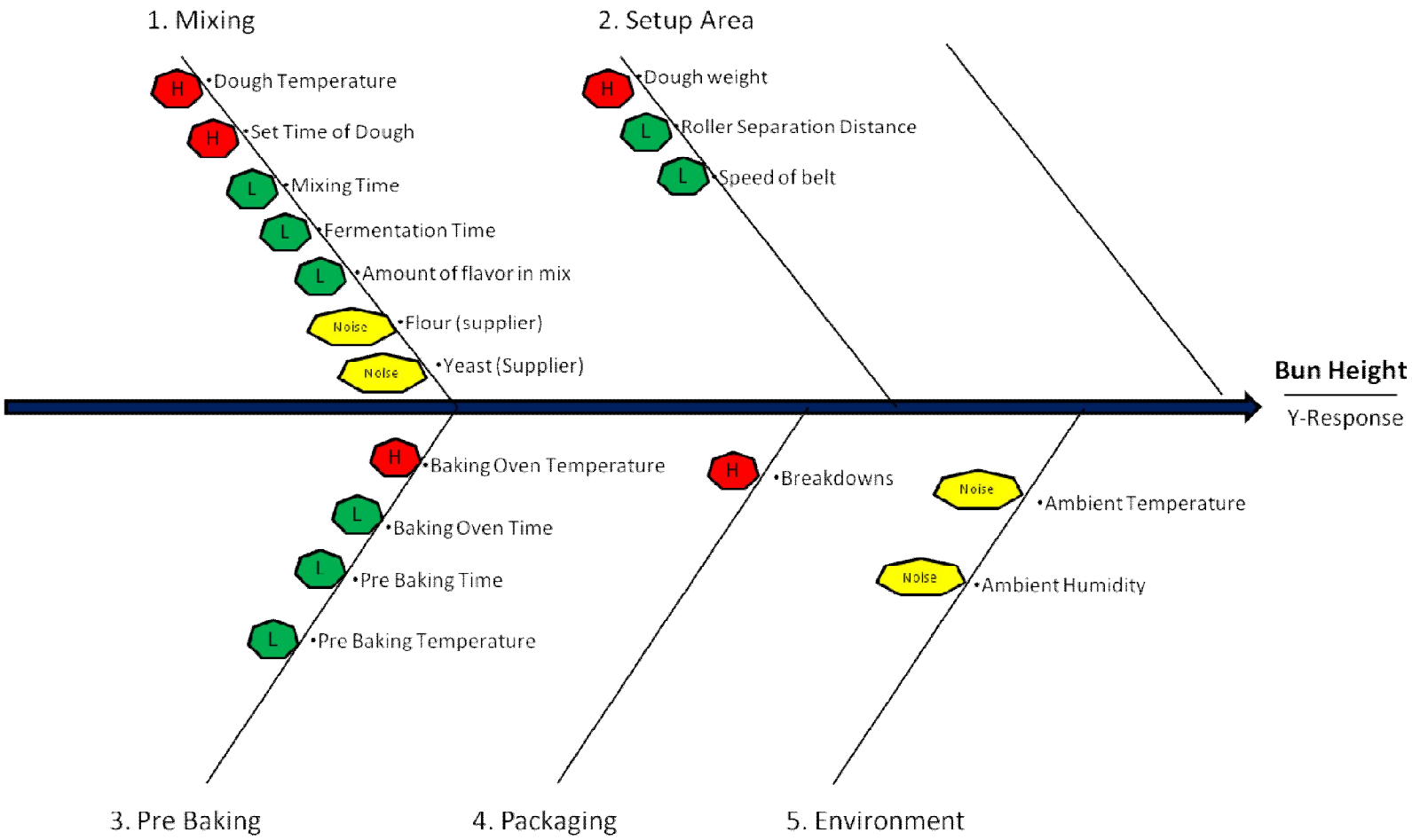
Bun Product Line SIPOC

Bun Line

Supplier	Input	Process	Output	Customer
Raw ingredient Suppliers	Dough Ingredients	Mixing	Mixed Ingredients	Setup Area
Mixing Equipment Suppliers	Mixed Ingredients	Setup	Balls of Dough	Pre-Baking
Setup Area Oven Manufacturer	Balls of dough	Pre-Baking	Raised Dough	Baking Oven Area
Pre-Baking Oven Manufacturer	Raised Dough	Baking	Baked and cooled Buns	Inspection, Packaging area
Baking area	Cooled Buns	Packaging	Packaged Buns	Delivery Drivers to the stores

Factors and Levels:

Identify the most significant factors and settings that control/affect the bun height variation.



Design of Experiment Layout:

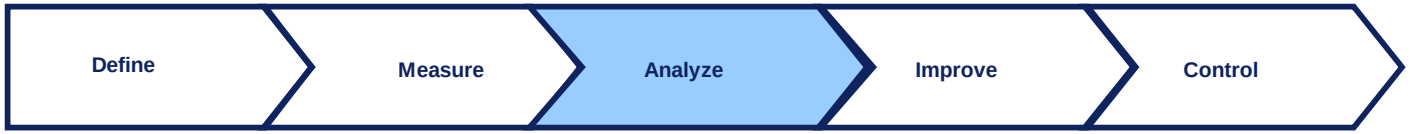
Bun Height Factors and Levels- 1 dough batch at a time				
#	Factor	Level 1	Level 2	Units
1	Oven Temp Zone 1 and 2	- 25 degrees from current	+ 25 degrees from current	Degrees
2	Dough Temperature	72	82	Degrees
3	Dwell Time of Dough	25	35	Minutes
4	Dough Weight	2.1	2.6	Ounces

Design of Experiment Layout:

Setup	Dough Weight	Dwell Time of Dough	Dough Temp	Oven Temp
1	2.1	25	72	-25
2	2.6	25	72	-25
3	2.1	35	72	-25
4	2.6	35	72	-25
5	2.1	25	82	-25
6	2.6	25	82	-25
7	2.1	35	82	-25
8	2.6	35	82	-25
9	2.1	25	72	+ 25
10	2.6	25	72	+ 25
11	2.1	35	72	+ 25
12	2.6	35	72	+ 25
13	2.1	25	82	+ 25
14	2.6	25	82	+ 25
15	2.1	35	82	+ 25
16	2.6	35	82	+ 25

Design of Experiment Sample Data:

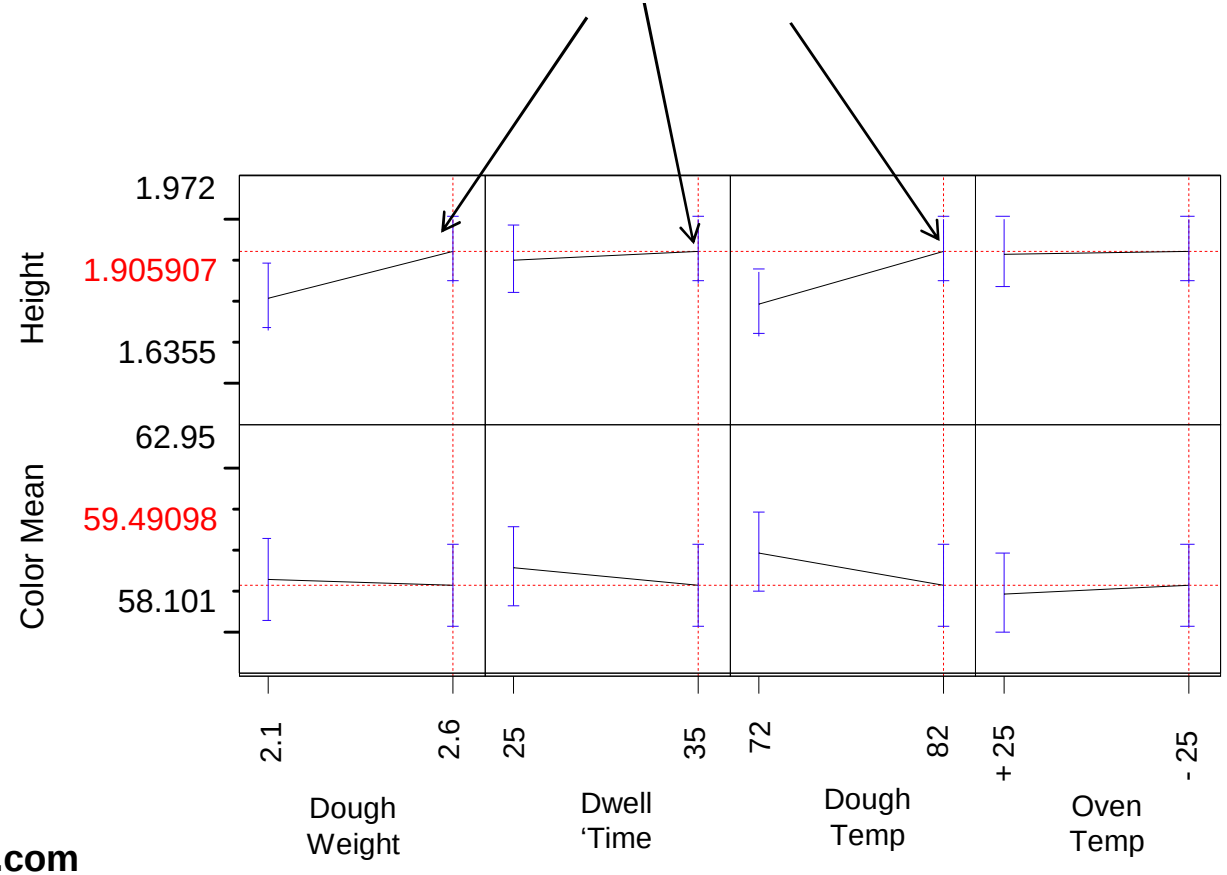
Experiment #	Run Index	# of Buns measured	Mean	Standard Deviation	Sample Time
1	314	234	1.85306	0.0685278	12/7/10 10:35 AM
1	315	885	1.835611	0.08682884	12/7/10 10:35 AM
1	315	1283	1.843478	0.07193302	12/7/10 10:37 AM
1	315	1138	1.83211	0.0584906	12/7/10 10:39 AM
1	315	1221	1.795692	0.07573701	12/7/10 10:41 AM
1	315	1303	1.780444	0.06155552	12/7/10 10:43 AM
1	315	1173	1.765599	0.05574686	12/7/10 10:45 AM
1	315	1144	1.779792	0.07737819	12/7/10 10:47 AM
1	315	1309	1.79921	0.05842915	12/7/10 10:49 AM
1	315	1138	1.805764	0.07326217	12/7/10 10:51 AM
1	315	124	1.862739	0.04404204	12/7/10 10:53 AM
2	316	1046	1.838926	0.05949818	12/7/10 10:54 AM
2	316	907	1.83365	0.05343535	12/7/10 10:56 AM
2	317	855	1.856991	0.06462231	12/7/10 10:57 AM
2	317	1169	1.824035	0.05033763	12/7/10 10:59 AM
2	317	958	1.826018	0.0544378	12/7/10 11:01 AM
3	319	687	1.799394	0.06485479	12/7/10 11:07 AM
3	319	1278	1.757117	0.06369598	12/7/10 11:08 AM

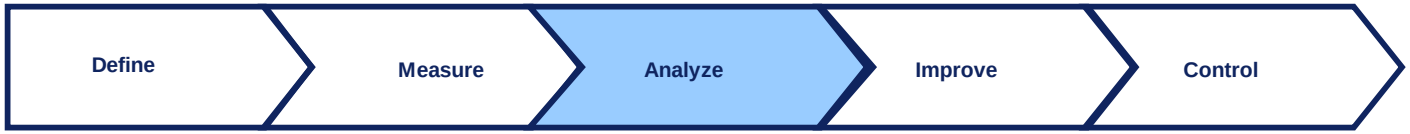


Analyze:

The following settings should produce a Cpk of around 1.0:

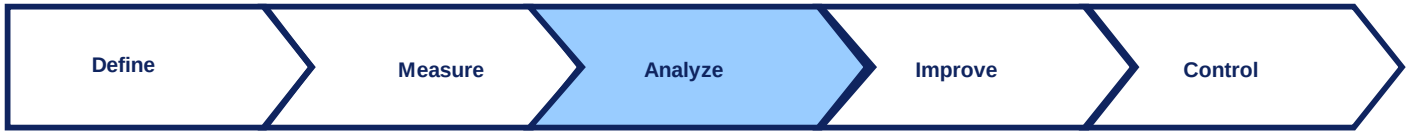
Dough Weight- 2.6oz
Dwell Time of Dough- 35 Minutes
Dough Temperature- 82 degrees
Oven temperature- not a factor- can be set at normal





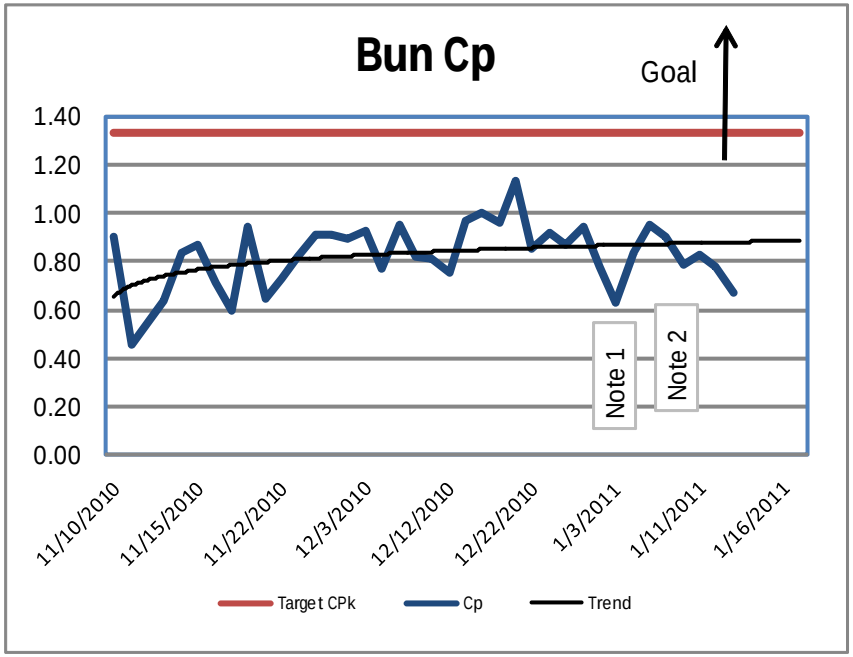
Observations:

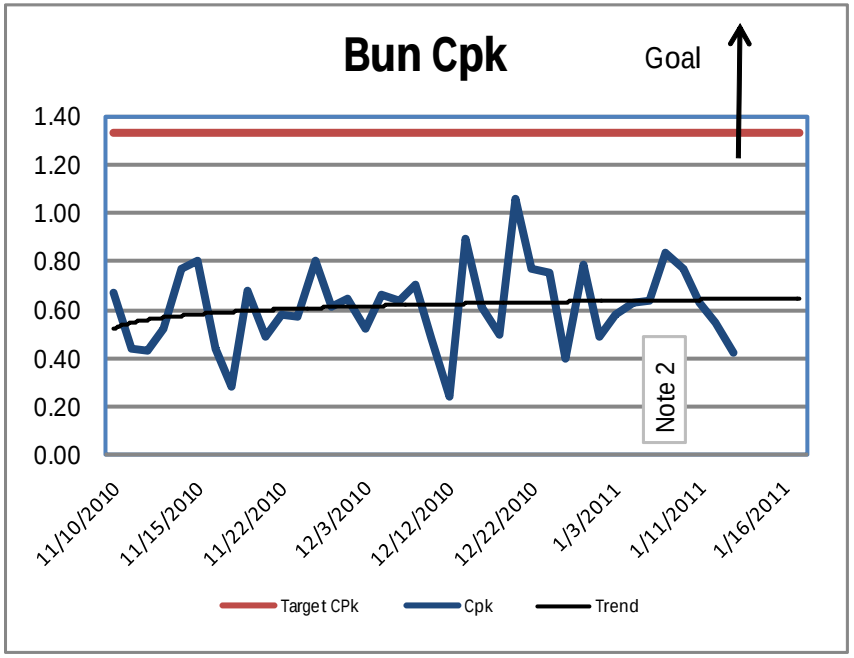
- Dough weight is easily controlled
- Increasing floor time would cause us to lose 25% of production time.
- Dough temperature is attainable, but has other adverse affects on the product such as blotchiness and excessive stickups in the make up area
- The inputs (dough weight and dough temperature) are out of control and need to be better controlled.



Analyze observations:

- The height Cpk has not seen improvement yet after initial changes- need to better control the inputs.

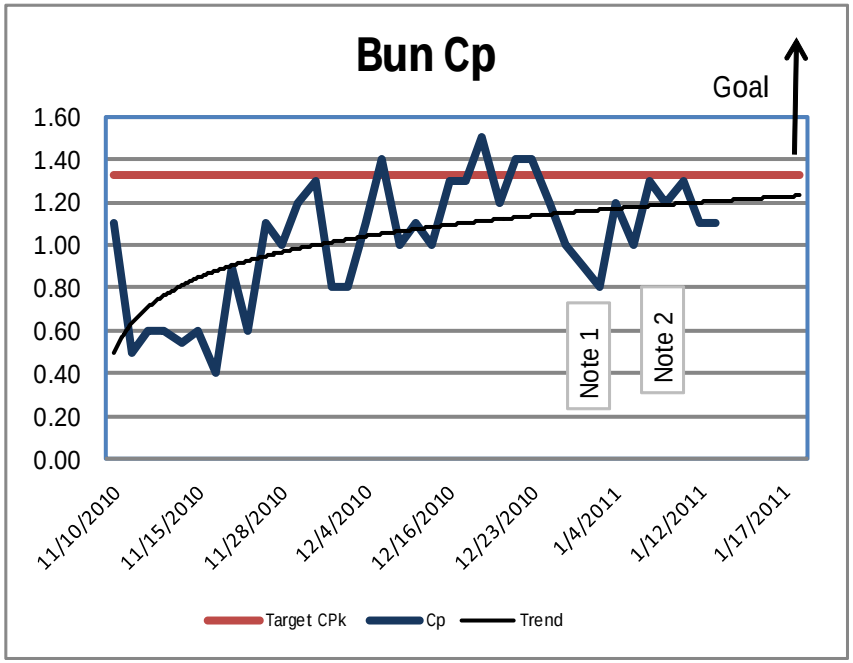


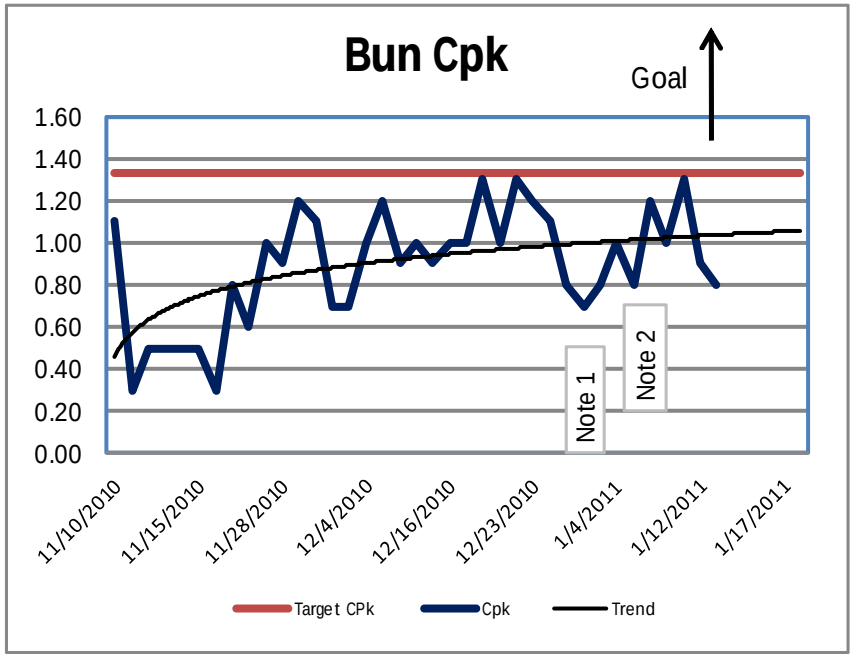


Note 1: Fermentation Thermostat Failure
Note 2: Raised Scaling Weight and Dough Temperature

Analyze observations:

- The Color Cpk has realized a 30% improvement.





Note 1: Fermentation Thermostat Failure
Note 2: Raised Scaling Weight and Dough Temperature

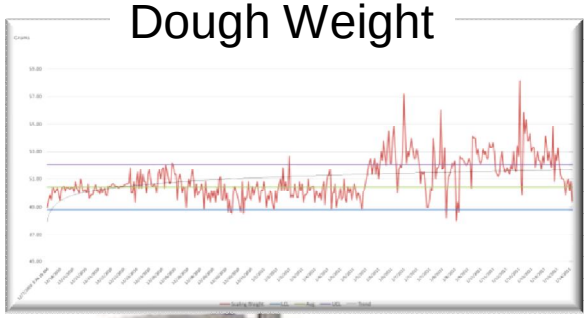
Improvement Actions:

1. Control the inputs to the process
2. Institute control charts on the inputs and identify measures to stabilize the variation
3. Set the dough weight and temperature at the higher end of the specifications

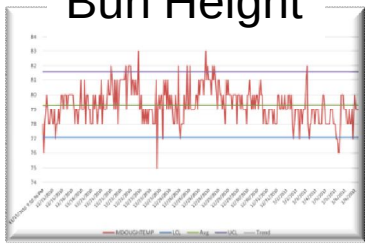
Define | Measure | Analyze | Improve | Control

Control the inputs to control the output

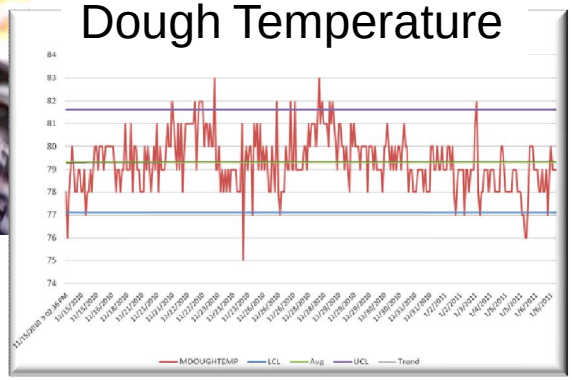
Dough Weight



Bun Height



Dough Temperature



Control Plan:

Control Plan

Revision: A
Revision Date: 2/15/2011

Location: Nashville, TN plan

Key Contact: Dan Smith

Updated by: Bill Soller

Project: 20124 Bun Variation

Mission: Reduce the amount of variation of the height of the hamburger bun. Increase the Cpk from .6 to 1.33.

#	Process	Process Step	Input	Output	Process Specification (LSL, USL,	Measurement Technique	%R&R P/T	Sample Size	Sample Frequency	Documentation Method	Reaction Plan
1	Dough Temperature	Mixing	Dough	Chilled Dough	82 +/- 2 Degrees	Thermostat	n/a	10%	Each Batch	Control Chart	Reset the temperature controls
2	Dwell Time of Dough	Mixing	Dough	Aged Dough	35 +/- 5 Minutes	Clock	n/a	100%	Each Batch	Control Chart	Re-Train
3	Dough Weight	Setup	Dough	Balls of Dough	2.6 +/- .2 oz	Scales	Yes	10%	Each Batch	Control Chart	Recalibrate machine

Challenges:

- The process is an “ART” and they “tweak” things every day.
- How to turn the “ART” into a “SCIENCE”.
- How to run the experiments while running production.
- Tradeoff between quality and production

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Questions?

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