Process Improvement Project – Graphing Time Reduction

Mike – MBC 638

Key Dates --->	Team Launch 5/11/08	Define 5/19/08	Measure 5/26/08	Analyze 6/6/08	Improve 7/4/08	Control On-Going

DEFINE

- Extensive graphing is required for good data analysis of lab qualification testing
- 350 Engineer hours in the department are spent on repetitive graphing procedures within Excel. This equates to $52,471/year
- A 30% reduction in graphing time could result in a $15,741 annual savings.

= $

Control

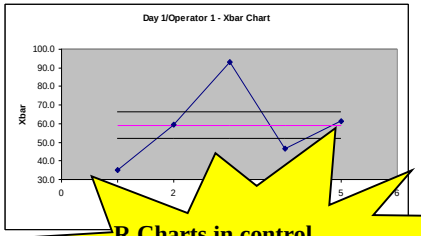
- Maintain Revision Control on original spreadsheet macros
- Provide to Engineering Department
- Survey engineers for usage in 3 months

MEASURE

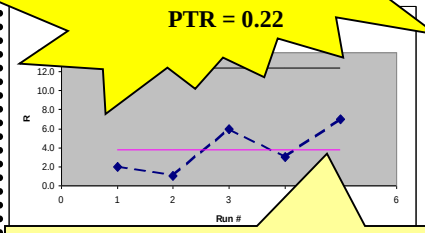
Identified Critical Inputs and Outputs to Measure

Data Stratificatio

Questions about Process	Output	Strati	Measurements
Is y affected by the number of data points recorded in a test?	Y = Graphing Time = f (X)	X1 =	Number of data points collected
Is y affected by the total number of columns graphed?		X2 = Va	Number of different variables measured
Is y affected by the person creating the graphs?		X3 = perator	Name of engineer
Is y affected by the quality of the graph required?		X4 = Graph quality	Title, labels, presentation ready
Is y affected by additional graphs required for comparison?		X5 = Number of graphs	Number of graphs
Is y affected by the total number of columns of data available?		X6 = Total number of available variables	Total number of available variables
		Y = f(X1,X2,X3,X4,X5,X6)	



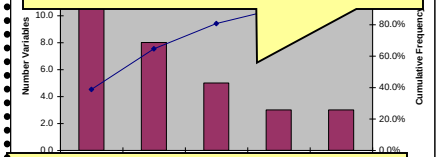
R Charts in control.
Xbar Charts show ability to measure differences
PTR = 0.22



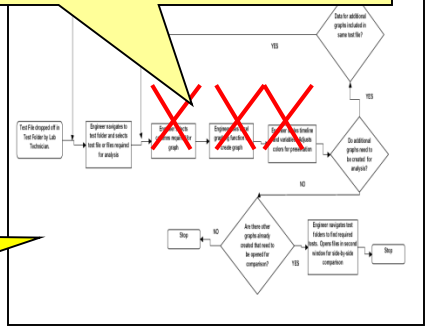
Measurement Systems Analysis using X-bar, R Charts and Precision-To-Total Ratio

ANALYZE

Pareto showed that 80% of graphs consisted of 8 variables or less



Eliminated wasteful, repetitive steps that can be automated with Excel Macros



n=	31
x bar (sec) =	56.7
s =	14.7
1- alpha =	0.95
alpha =	0.05
alpha/2 =	0.025
U=	61.89
L=	51.56

95% Con
51.56 <=
57 +/- 5.1

95% confidence interval that true graphing time is 57 +/- 5.16 seconds

IMPROVE

Before / After

SQL Baseline		SQL Improved Process	
Population Mean =	56.7	Population Mean =	36.2
Std Deviation =	14.7	Std Deviation =	13.5
X2 (Upper Spec Limit)	60	X2 (Upper Spec Limit)	60
Z2 =	0.223	Z2 =	1.762
P(X>60) =	0.412	P(X>60) =	0.039
P(X is out of spec) =	0.412	P(X is out of spec) =	0.039
DPM =	411655	DPM =	39052
SQL =	1.72	SQL =	3.26

Sigma Quality Level Increased from 1.72 to 3.26

Cost Reduction		
	Current	Improved
Time per graph (sec)	57	36
Time spent graphing/year (hr)	350	224
Annual Cost Reduction	$ 52,471	$ 33,529
% Percent Annual Cost Reduction	36%	

$18,943 annual cost reduction! $

H0: mu >=	40
H1: mu <	40
Acceptable Level of Risk=	10%
New Pro	
New Pro	
P = 2* Z()	0.12
Confidence =	87.9%

Hypothesis test indicates 88% confidence that new process meets the goal of at least a 30% improvement in graphing time

BUSINESS CASE: $18,943 Annual Cost Reduction if Implemented in Engineering Department

Process Improvement Project – Cooking Optimization

Process owner: Neil

Key Dates ---> Define Feb | Measure March | Analyze March | Improve April | Control May

DEFINE

- Optimize the governing factors of cooking, with considerations being the taste and cost.
- 2 types of dishes- A & B
- A & B have a fixed amount of chicken, carrots, tomatoes, capsicum, onion.
- Chilies and Garlic also, but varying quantity.

S- Money (Myself) & Wegmans (Ingredients)

I- Ingredients, Utensils, Electric Stove

P- Cooking Process

O- Dish A & B

C- Volunteers

BUSINESS IMPACT

To save money while still maintaining taste of the dishes

MEASURE

Taste of Dish A

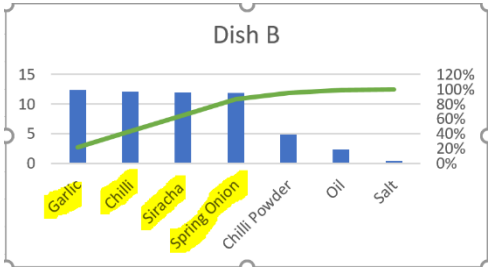
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.975343
R Square	0.951293
Adjusted R Square	0.817349
Standard Error	0.572722
Observations	16

Taste of Dish B

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.961183
R Square	0.923874
Adjusted R Square	0.771621
Standard Error	0.577931
Observations	16



ANALYZE

	Dish A	*Dish B*
Mean	12.49375	13.4075
Variance	0.035252	0.072767
Observatio	16	16
Pooled Var	0.054009	
Hypothesiz	0	
df	30	
t Stat	-11.1209	
P(T<=t) one	1.82E-12	
t Critical or	1.310415	
P(T<=t) two	3.64E-12	
t Critical tw	1.697261	

Dish B>Dish A, avg. means (even with less ingredients)

DISH A

	Coefficients	*tandard Erro*	*t Stat*	*P-value*
Intercept	8.475946	3.326206	2.548232	0.063424
Oil	6.925075	14.30528	0.484092	0.653631
Salt	-97.6778	30.61652	-3.19036	0.033205
Garlic	-0.25219	2.210084	-0.11411	0.914649
Chilli	1.982741	1.655498	1.197671	0.297162
Oyster Sauce	-1.33654	8.535989	-0.15658	0.883163
Soy Sauce	-13.1329	5.225875	-2.51306	0.065842
Vinegar	-133.494	52.54363	-2.54063	0.063938
Sugar	56.30255	22.41828	2.511456	0.065955
TIME (0: <20min, 1	-0.87867	0.416752	-2.10838	0.102678
0: Frying Pan, 1: Po	-0.70553	0.444811	-1.58613	0.187895
0: Lunch, 1: Dinner	-1.64182	0.753891	-2.17779	0.094979

DISH B

	Coefficients	*tandard Erro*	*t Stat*	*P-value*	l
Intercept	4.284399	2.546402	1.682531	0.153291	
Oil	14.61448	8.934605	1.635716	0.162826	
Salt	-119.228	25.44542	-4.68565	0.005406	
Garlic	6.650005	2.115406	3.143606	0.025562	
Chilli	-0.1598	1.46335	-0.1092	0.917288	
Siracha	-16.2184	5.156419	-3.14528	0.025514	
Chilli Powder	-7.05818	6.386648	-1.10515	0.319417	
Spring Onion	12.03818	3.795757	3.171482	0.024774	
TIME (0: <20min, 1	0.725191	0.404223	1.794039	0.132773	
0: Frying Pan, 1: Pc	-1.27077	0.490818	-2.58909	0.048891	
0: Lunch, 1: Dinner	0.952884	0.493137	1.932289	0.111164	

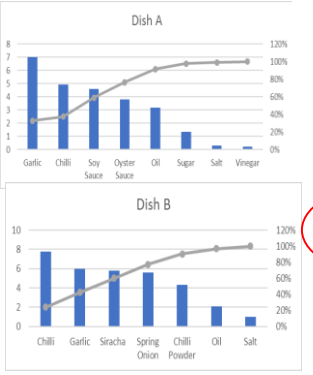
When Y = cost, all ingredients are significant; but when Y = Taste above inputs are significant

IMPROVE

Keeping the ingredients which have significance to cost and taste in mind, with preferences to taste; I run the test again with less quantity of salt, garlic, siracha, soy sauce, sugar and vinegar.

	Variable 1	*Variable 2*
Mean	12.08563	12.86
Variance	0.01078	0.030907
Observatio	16	16
Pooled Var	0.020843	
Hypothesiz	0	
df	30	
t Stat	-15.171	
P(T<=t) one	6.48E-16	
t Critical or	1.310415	
P(T<=t) two	1.3E-15	
t Critical tw	1.697261	

CONTROL



DISH A & B average savings

$15.2

$

We can see from the new t-test that the mean cost of the dish A & B now have lower avg. means and only chili & garlic are in excess (acceptable).

Purchase Coordination Sheet – Cycle Time

Process owner: Landon

Key Dates →	Team Launch: September 6	Define: September 10	Measure: September 17	Analyze: September 24	Improve: October 29	Control: November 19

DEFINE

S L O W

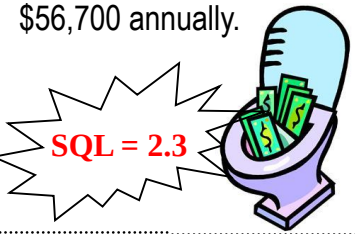
Problem Statement

Cycle time for a signature sheet averaged 11.25 days with each project manger spending about 11.25 hours for each purchase over $100,000.

Business Impact

The average wage a project manager earns is $35/hr, therefore it costs $393.75 per project in just gathering signatures! At 144 projects a year this process costs $56,700 annually.

W a s t e



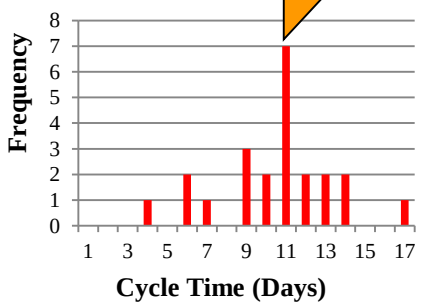
MEASURE

Signature Sheet Cycle Time (man-hours)	Past man-hours	
	4	11
	6	11
	6	11
	7	11
	9	12
	9	12
	9	13
	10	13
	10	14
	11	14
	11	17
	11	28

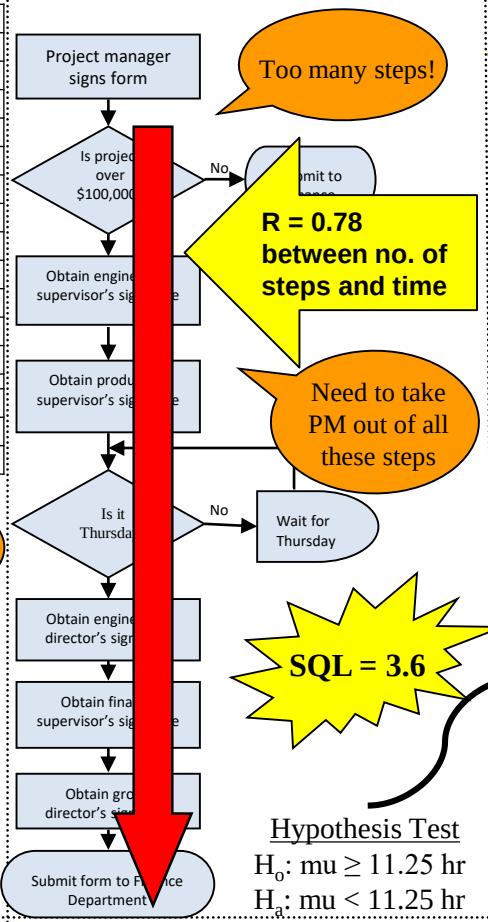
Mean=	11.25
Std dev=	4.57
Median=	11.0

High man-hours

High cycle time



ANALYZE



R = 0.78 between no. of steps and time

SQL = 3.6

Hypothesis Test

H_o: mu ≥ 11.25 hr

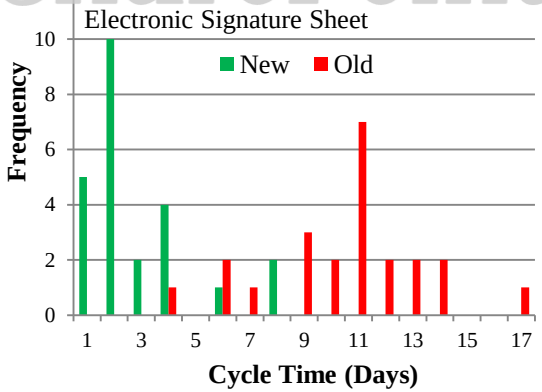
H_a: mu < 11.25 hr

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}} = \frac{0.2 - 11.5}{0.23/\sqrt{24}} = -240.7 \qquad P\text{-value} \approx 0$$

Success

IMPROVE

SharePoint



- Cycle time reduced to 2.88 days!
- Man-hours reduced to 0.20 hours!
- Cost savings $55,692 annually!
- SQL raised from 2.3 to 3.6 and rising!

CONTROL

- Finance Office will not accept old version of signature sheet.
- Purchases tracked in SharePoint
- Appraisal rated on compliance

TEAM MEMBERS

Landon, Engineering Project Managers, Finance Office, Stakeholders

Process Improvement Project - for Widget Assembly

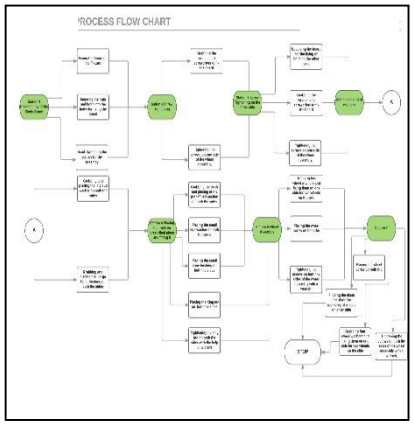
Nelson

Key Dates --->	Team Launch	Define 2/02/2017	Measure 2/16/2017	Analyze 03/23/2017	Improve 04/13/2017	Control 04/20/2017

DEFINE

Problem statement: Due to high cycle times we cannot get the desired amount of throughput for the Widget assembly. The average cycle time for each part is less than 44 seconds. Defects are inherent because of improper line balancing and bottleneck in the system.

SQL = 2.752



Why is SQL less?
What can be done better?
What factors shall we measure, analyze and improve?

MEASURE

Percent of Total Variance Ratios	
EV	7.21
AV	3.65
R&R	10.86
PV	89.14

R&R =10.86% < 30 %, Measurement plan is okay

Ho :Mean cycle time for part >= 44 seconds

Ha :Mean cycle time for part < 44 seconds

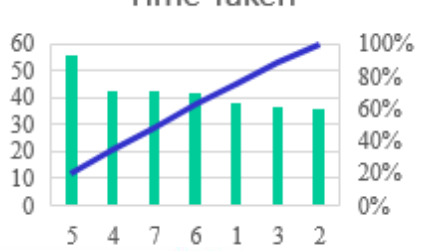
Sample size	36
Sample mean	45.036
Standard Deviation	2.681
Hypothesized mean	44
Test Statistic (Z)	2.318537859
P-value	0.989789946

REJECTED

> 44 seconds

From the above result P-value is greater than 0.05 thus we do not reject the Null hypothesis and thus the Mean cycle time is greater than 44 seconds. Hence we need to analyze what's wrong

ANALYZE



Because the Station 5 has the highest number of activities being done and thus it takes the highest time. So we need to equally divide the number of activities hence to reduce cycle time

	1	2	2	1.5	1		
	Easy to implement	Resources	Cost	Process impact	Complexity	Total	R
Solution 1	5	3	3	1	5	23.5	3
Solution 2	1	1	1	5	1	13.5	4
Solution 3	3	3	5	3	3	26.5	2
Solution 4	3	3	5	5	3	29.5	1

Solution 1	To reduce number of activites at station 5 and distribute them equally
Solution 2	Increase one more station and equally dstirubte the activites at station 5
Solution 3	Reduce one station form the process line and combine two stations
Solution 4	To implemet Solution 1 and Solution 3 together

We have finalized fourth proposed solution from the matrix and thus we need to improve the process based upon the selected solution.

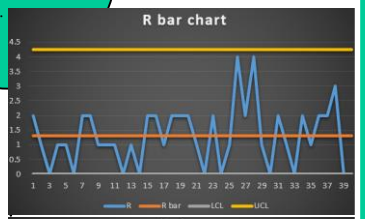
IMPROVE

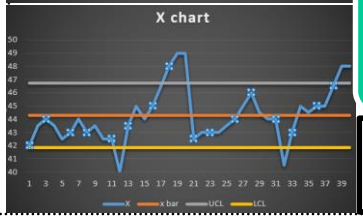
Mean	47.94	45.30
Known Variance	10.37	3.57
Observations	36.00	44.00
Hypothesized Mean Differenc	0.00	
z	4.36	
P(Z<=z) one-tail	0.00	
z Critical one-tail	1.64	
P(Z<=z) two-tail	0.00	
z Critical two-tail	1.96	

Here the p-value = 0.00 < 0.05. Hence we reject the null hypothesis and we can say the Cycle time before is greater then the cycle time after improvement. Hence we have improved our process considerably.

SQL = 3.545

CONTROL





Here we have selected the R chart and Xbar chart for the control of the process because the sub group size is only two for my process. Now as we can see the R chart seems to be under control. Only some of the points on Xbar chart are out of control for the process. Thus we need to double check what wrong at those points and figure out a way to get the process under control.

Also from the Cp and Cpk values we can see that our process is capable to be undertaken but there is still scope of improvement to make it more capable.

Cp = 1.16
Cpk = 1.08

PROJECT TEAM : Nelson, Karen

Process Improvement Project – Cycle Time Reduction

Process owner: Dan

Key Dates --->	Team Launch 8/23	Define 9/08	Measure 10/16	Analyze 10/24	Improve 10/31	Control On-Going

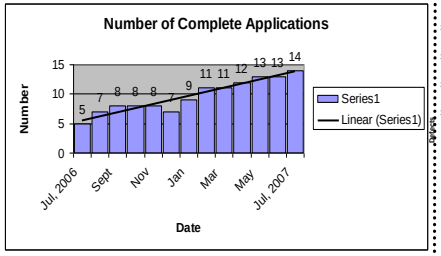
DEFINE

It takes 43 days to process a grant application. Only 8% of applications are being processed within 30 days of receipt. The time to process the application has lead to unhappy applicants and staff who are finding more and more of their daily work time being devoted to "grant administration." The funding levels available to applicants and the number of applications are expected to increase in the near future, which has the potential to compound the problem.

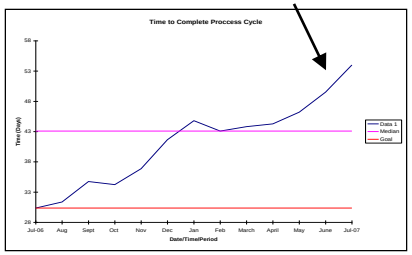
SQL=1.9

MEASURE

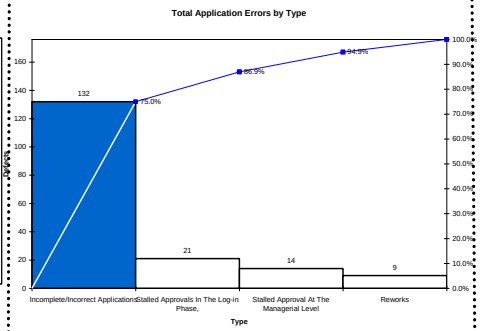
The Number of applications received is increasing.



The time to complete a process cycle is also increasing.



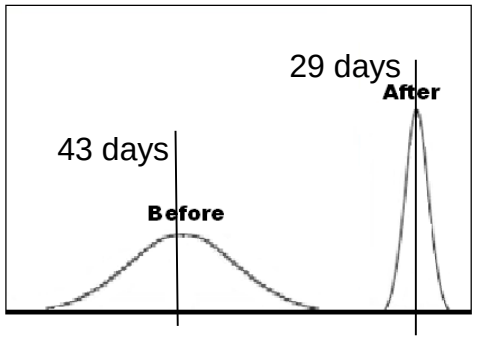
ANALYZE



Problem:
Incomplete and inaccurate applications were identified as the primary factor leading to defects in the process cycle.

Solution:
New Application process incorporating drop down menus

IMPROVE



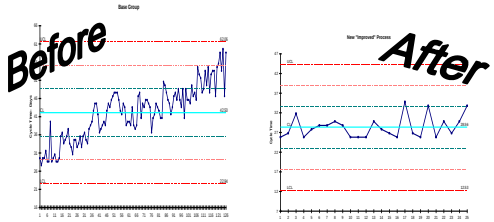
New Application Procedure =

Less Mistakes & Quicker Cycle Time

SQL=3

CONTROL

The defect rate reduced from 93% to 32%



Monthly monitor and review procedure is in place. Out of control signal = action plan.

PROJECT TEAM: *Dan • Mary • Karen • Linda • Peter*

BUSINESS CASE: **$54,000 in annual processing costs**

Increase Monthly Income of Check Cashing Business

Process owner: Yanni

Key Dates --->	Project Launch 2/2	Define 2/3	Measure 2/11	Analyze 3/16	Improve 4/6	Control 4/15

DEFINE

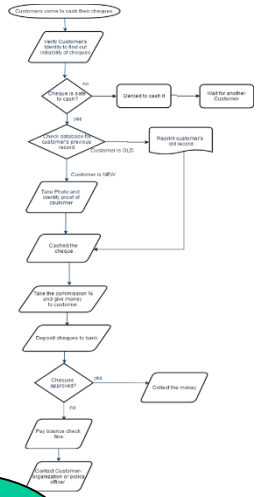
Problem Statement

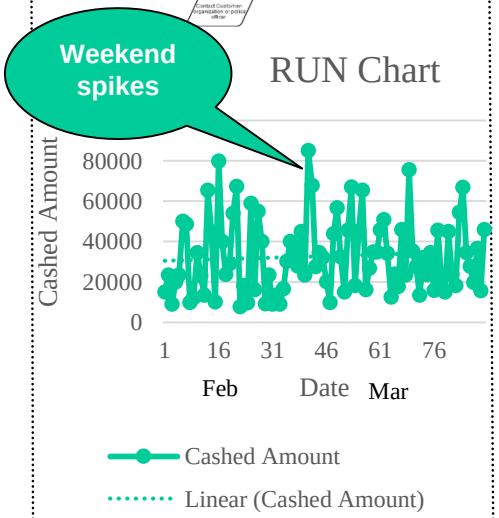
Revenue varies by month.
Weekly average of check Cashed amount= $80k
Variability:
Cashed amount= $45-50k

Business Impact

Increase yearly cashed amount by $60K-70K by reducing the variability per month by.
That will improve monthly average income.

MEASURE



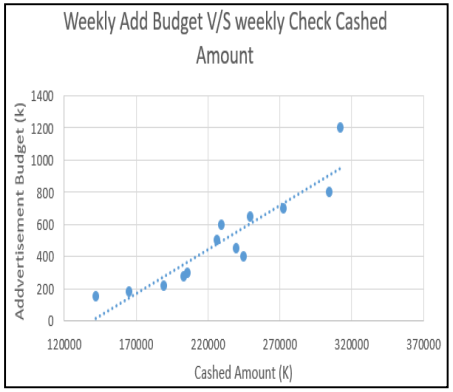


ANALYZE

Questions About Process	Output	Stratification Factors X Variables	Measurements
Is Y affected by the day of the week?	Y= Weekly Check Cashed Amount =f(X)	X1= Day of the week	Avg cashed check on Friday-Sat and on remaining days
Is y affected by the holidays?		X2= Holidays	Avg cashed check amount on holidays.
Is y affected by the no of the people waiting in queue?		X3= no of people waiting in queue	Number of people waiting in queue
Is y affected by the Promotional Run?		X4=Promotional Offers	How many
Is y affected by the Advertisements?		X5=Advertisements	How many
Is y affected by the no of employers?		X6=No of employers	How many
Is y affected by the type of customer?		X7=Old or New Customer	%of new and old customer of total
Is y affected by the Money block in bounce checks?		X8=Bounce Checks Amount	money lost due to check bounce
Is y affected by the weather condition?		X9=Weather Condition	Avg daily temp or other things rain, snow
		Y=F(X1,X2,X3,X4,X5,X6,X7,X8,X9)	

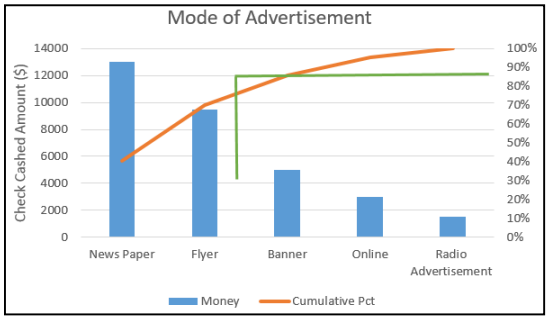
Multiple Linear Regression Analysis

- Advertisements
- Money Lost due to Fraud Checks



IMPROVE

	Selection Criteria and Weight					
	4	1.5	2.5	5		
Proposed Solution	Time to implement	Difficulty to implement	Cost	Accuracy	Total	Rank
Train your empoyees	2	4	4	3	39	2
Hire Check Specilist	3	4	1	3	35.5	3
Buy Advanced Check checking Equipment	5	2	1	5	50.5	1



CONTROL

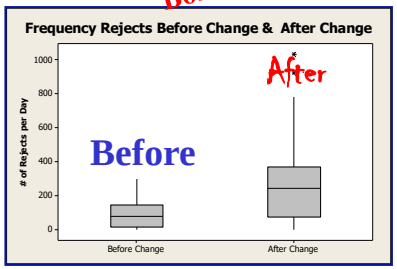
- Monitor the Run chart weekly.
- Implement advanced check cashing equipment and keep track of Bounced checks.
- Increase newspaper and flyer advertising.

Finding the Skinny on Thin Film Sensor Reject Rates

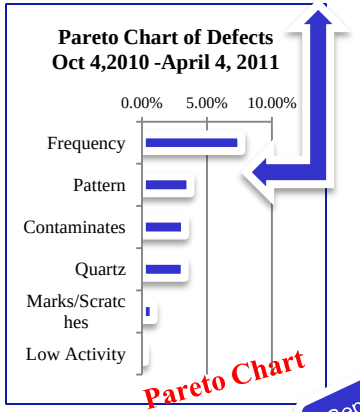
DEFINE – 5/15/11

1) Problem Statement:
Production reject rate of thin film sensors increases after process change.

Box Plot



2) Work on largest category of defect for MAXIUM IMPACT



Pareto Chart

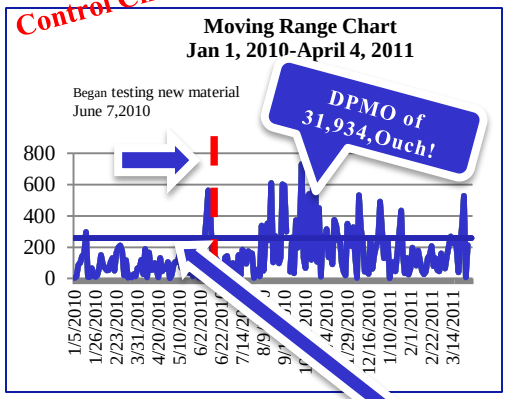
3) Business Impact:
Reducing/eliminating frequency rejects will prevent reworking of part, extra inventory and labor from 100% testing which could potentially save

$300K!

MEASURE - 6/1/11

4) Out-of-Control:
Process is highly variable to begin w/ but much worse after change.

Control Chart



5) Change of Focus
The change did cause an increase in variability, but the process is not very good to start w/ a **DPMO of** 19,263! Finding the root cause of the inherent process variability should solve the new issue.

6) Identify Primary Inputs (Y)

Separated wheat from chaff

Cause & Effect Matrix

Scoring:1=low, 3 = med, 5=high,
…ce to Customer (sensors w/ correct frequency) = 1

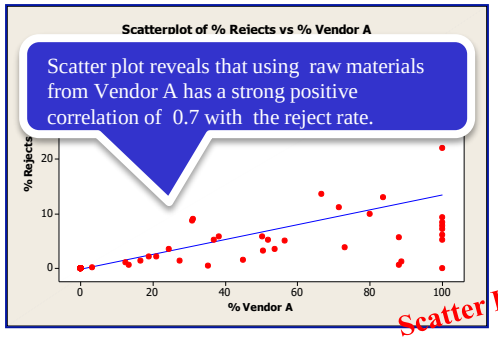
…ess …puts	Effect	Rating	Probability	Score
Vendor frequency sorting quality	Allow accurate calculation of thickness	5	High, makes adjustments when providing thickness data to techs	25
Fixture Geometry	Even coating thickness	5	High, location determines the thickness of the coating.	25

C&E Matrix

Thanks to the team:
Rick, Steve & Production Staff

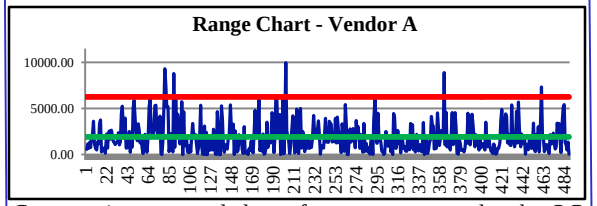
ANALYZE - 7/1/11

7) Probable Cause 1 - Raw Material Supply



Scatter Plot

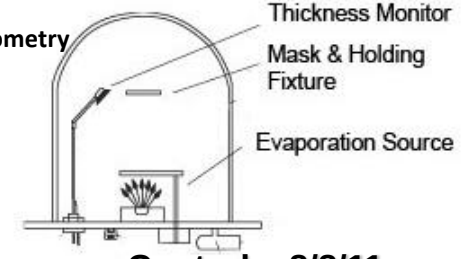
The r^2 shows that the amount of raw material used from Vendor A explains 46.6 % of the change in reject rate.



Constructing a control chart of measurements taken by QC of frequency illustrates that the vendors process is out of control.

8) Probable Cause 2 – Evaporation Fixture Geometry

The sensors are held in a fixture positioned over a evaporation source that coats them with metal. I performed a test run to measure baseline performance. The data revealed that the metallic coating has too much variation in thickness w/ a mean of 2235 Å, but the range should be 500 Å. This could be caused by the position of the source, size of mask or angle of the holding fixture.



H_o: Test 1 thickness variability ≤ Test 2

$$Z = \frac{\bar{x}1 - \bar{x}2}{\sqrt{\frac{s1^2}{n} + \frac{s2^2}{n}}} = \frac{2235 - 2264}{\sqrt{\frac{333^2}{252} + \frac{242^2}{252}}}$$

Hypothesis Test

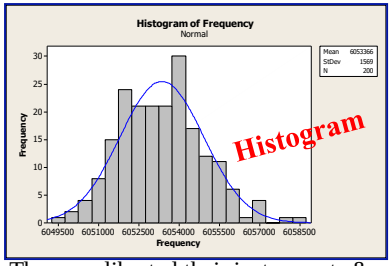
Z = -1.19 P = 1-Z = 1-1.19 =0.86 =86%

A second run was done to test if a centered evaporation source would decrease thickness variability (Ha). A one-tail test was performed & the P value was high, thus it did not significantly improve the process. This points to the mask size & fixture as the root cause of the variation.

IMPROVE - 8/1/11

9) Solution to Probable Cause 1

-Receipt of material from Vendor A was halted. A comparison of their measurements vs. ours found a 7.6 KHz difference!



Histogram

They recalibrated their instruments & next shipment was markedly improved with a mean very close to the center of our specification range of 6.055 as shown on this histogram.

10) Solution to Probable Cause 2

I'm working with engineering to develop a new fixture that will improve the geometry.

Control – 8/8/11

10) Changes to be Made:

✓QC technician does acceptance testing of raw materials w/ zero tolerance.
✓Vendor supplies Certificate of Analysis w/ test statistics.
✓Control chart created for raw materials.
✓New fixture for more uniform thickness to prevent any frequency rejects.