

# Six Sigma



# Templates

Step	MAIC	Focus	Action	Question
1	Measure	CTQ	Select CTQ Characteristic	Does the selected CTQ offer high impact quality, cost or time ?
2	Measure	CTQ	Define Performance Standards	Can stated performance standards satisfy customer and business needs?
3	Measure	CTQ	Validate Measurement System	Is the current measurement system acceptable by conventional standards?
4	Analyze	CTQ	Establish Product Capability	Does the existing capability of this CTQ need to be improved to meet performance requirements?
5	Analyze	CTQ	Define Performance Objectives	Do we know the extent to which the variation must be reduced to meet objectives?
6	Analyze	CTQ	Identify Variation Sources	Do we know the major family of variation?
7	Improve	CTQ and CTP (Critical to Process)	Screen Potential Causes	Are the leverage CTP's known?
8	Improve	CTQ and CTP (Critical to Process)	Study Key Relationships	Do we know what relationships among the CTP's must be controlled ?
9	Improve	СТР	Establish Operating Tolerances	Do we know the functional limits for the CTP's?
10	Control	CTP	Validate Measurement System (for X's)	Is the current measurement systems acceptable by conventional standards for the CTP's?
11	Control	CTP	Determine Process Capability (Y and X's)	Can process operate within chosen limits to a $6\sigma$ capability?
12	Control	CTP	Implement Process Control System	Can objectives be consistently met?

Know	See	ΤοοΙ
Selection critieria and timeframe	Decision Matrix	Brainstorming, pareto, C&E analysis, process/design FMEA, COPQ, RTY, dpu, Y.norm
Mean, target, Spec Limits, functional limits, required capability	Graphical presentation of requirements	Communication with customers, Strat Plan, Design specifications
P/T and R&R values	GRR Table	Gage R&R spreadsheet
Baseline μ, σ, Cp, Cpk, Pp, Ppk	Minitab Capability Six Pack and Six Sigma Macro Reports	Minitab
Baseline and target $\mu$ , $\sigma$ , Cp, Cpk, Pp, Ppk	Picture of "is" and "ought"	Minitab
Inputs, noise variables	Process Map and capabilities of each input variables	Process Map, FMEA, Cause and Effect Matrix, Multivari chart
Direction of effect and sensitivity of selected CTP's with respect to $\mu$ , $\sigma$	Graphical and tabular form	Main Effects Plot, ANOVA, $\epsilon$ (SSe/SSt), Autocorrelation, Regression
Main effects, Interactions, clear of confounding	Graphical and tabular form	Main Effects Plot,Interaction Plots, ANOVA, $\epsilon$ (SSe/SSt), Autocorrelation, Regression
Regression coefficients and coding information	Equation and graphical	Main effects plots, regression, interactions plot
P/T and R&R values	GRR Table	Gage R&R spreadsheet
Baseline μ, σ, Cp, Cpk, Pp, Ppk	Minitab Capability Six Pack and Six Sigma Macro Reports	Minitab
Control charts, CTQ yield information	Six Sigma Reports	Six Sigma Macro, control chart option

Data	Location
Continuous and discrete data, Spec Limits for short term,	Simulator, QA/QC, Manufacturing
Reliability and warranty data, engineering data, Mean, Standard Deviation, Spec Limits for short term	Simulator
Sample Data over process range	Lab/Floor
n= 500 subgroups = 100 subgroup size = 5, record Y and X's for future use	Simulator
From capability analysis and performance standards	Previous outputs
Process understanding	Grey Matter
Data from product capability study	
Sample Data over process range	Shop floor
Rational subgroups of continuous data	Shop floor

### Six Sigma Project Template

Project Name				
Group Name		1	Black Belt Name	
Department Name		,	Team Members	
Project Champion Name				
Process Owner Name				
Total FTE's Performing Process				
Total Cost of Process (000's)				
Total Cost of Process (000's)				
Problem Statement	<b>Defect FTE's</b> (if app.)		Cost of Defec	ot land
Provide complete and detailed description	State the Problem/Defect			
State the Defect or Undesired Event	State the Problem/Derect			
Exclude solutions				
Do not include causes				
Review with Finance				
Define measurement source				
Include Baseline data (if available)				
IncludeTimeframe				
Include conditions surrounding problem				
Project Objective/Desired State	State the Project Objective/Desired State of	and make sure it links l	back to the Problem Statement	
Clearly define and quantify	State the Project Objective			
70% Defect Reduction Sought				
Include Entitlements - Best Performance				
Include available benchmark data				
Benefits (\$000's)	Cost Benefits		Client/	Employee Benefits
Include Shareholder/Cost Penefits	FTF Cost Savings		Internal/F	vternal Client Benefits
	Other Cost Savings			
Include Client Service Benefits - Intrnl/Ext	Other Cost Savings		EM Cost Bonefits outside of	
Employee Benefits	Revenue		Cost Delients outside of	Group
	Total Cost Benefits	\$0		
Dependencies	Can project be performed in 4 mor	athc?		
Dependencies		1015:		
Significant Systems Development	Description:			
Major Capital Investment				
External Considerations				
Potential to Leverage	Yes No			
<u> </u>	 Description:			
	Description.			
Other Information	Include any other information related to the	he Project as necessary	v	
			, ,	

Project Action Plan												
Project		Black B	elt									
Process Owner			Date									
What	How	Who	W	nen	Deliverables							
(Action to Take)	(Action Steps)	(Accountable)	Start	Finish								

# **Critical to Quality Characteristics** Project Name: Project Description:

Project Managers: Date:

How to Satisfy Wants		/										
What the customer wants		/		/	/	/	/	/	/	/	<u> </u>	/
	Total											

## SIPOC

Who are the What do the suppliers provide to my process? What are the start and end

What product or service does the process

Who are the customers

Suppliers	Input	<b>Process</b> (High Level)	Output	Customers
1	1	Start Point:	1	
	2			2
	3		2	1
2	1			2
	2	Operation or Activity	3	1
	3	1		2
3	1	2	4	1
	2	3		2
	3	4	5	1
4	1	5		2
	2	6	6	1
	3	7		2
		8		
		9		
		10		
		11		
		End Point:		

Suppliers	Inputs	Process		Outputs	Customers	
(Providers of the required	(Resources required by the	(Top level description of the		(Deliverables from the	(Anyone wh	o receives a
resources)	process)	acti	vity)	process)	deliverable fro	m the process)
		Requirements			Requirements	

# Process Analysis Worksheet

Process Name (& boundaries): Process Owner(s):

Step No. (1)	Activity (2)	Responsible position (3)	Volume per week (4)	No. individuals (5)	Total hrs per week (6)	NVA (Y/N?) (7)	NVA hrs/ week (8)
Sum=							





# Brainstorm Potential Root Causes

Problem

Statement:

Rank	Potential Root Cause	Supporting Data & Analysis?*	Source?	Who?	When?

*Common types of data and analysis	Analysis description:
Detailed Process Review	Careful walkthrough of the process step by step to determine the source, nature and frequency of the problem
Process Mapping	Detailed process flow analysis to understand all the steps of the process, how the problem occurs and to document the process flow
Visual Analysis	Visual examination of the problem and visual documentation such as digital photos and videos
Cause and Effect (Event) Analysis	Examination of the potential relationship of factors and or event conditions on the problem
Data Collection and Analysis	Measurement of performance from the product or process and an analysis of current data and associated factor effects
Additional Tests and Experiments	Additional tests or experiments designed to understand the current situation and determine the root cause

Function	Deplo	yment Ma	trix								
					Outputs	s/ Outcome	es				
		Output 1	Output 2	Output 3	Output 4	Output 5	Output 6	Output 7	Output 8	Output 9	Score
Inputs											
Wght	Wght	1		2							
Input 1		10	) 2	2							14
Input 2											
Input 3											
Input 4											
Input 5											
Input 6											
Input 7											
Input 8											
Input 9											
Input 10											
Input 11											
Input 12											
Score		10	) 4	4 (	0 (	) (	0 0	) (	) (	) (	)

Risk Assessment	Form						
List the Solution or Major Elements of	Failure Mode	Severity	Probability	Score	Action	Owner	Due Date
Your Solution	List each failure mode	10 is Worst	very probable)	need attention)	r idii		Date
1.Solution							
1	a)						
	b)						
	C)						
2. Solution	a)						
	b)						
	c)						
3. Solution	a)						
	b)						

Solution Eval	Solution Evaluation Form														
List Root Cause(s)	List Solutions	% Effect	Estimated Cost	Complexity	Estimated Benefit	Risk*	Priority	Validation?							
Root Cause 1	Solutions 1	% of cost effect of solution solution will have implementat on the root cause		time or effort to implement short term? long term?	savings due to solution or improvement in customer satisfaction	High Medium or Low	Order of potential solution implmentation 1st, 2nd, 3rd	Need to verify effectiveness of solution							
Root Cause 2															

\* Use Risk Assessment Form

Data Collectio	Data Collection Plan													
Define W	hat to Mea	isure	Dei	fine How to Meas	sure	Who will Do it?		Sample	e Plan					
Measure	Type of Measure	Operational Definition	Measurement or Test Method	Data Tags Needed to Stratify the Data	Data Collection Method	Person(s) Assigned	What?	Where?	When?	How Many?				
Name of parameter or condition to be measured	X or Y attribute or discrete data, product or process data	Clear definition of the measurement defined in such a way as to achieve repeatable results from multiple observers	Visual inspection or automated test? Test instruments are defined. Procedures for data collection are defined.	Data tags are defined for the measure. Such as: time, date, location, tester, line, customer, buyer, operator, etc.	Manual? Spreadsheet? Computer based? etc.	State who has the responsibility?	What measure is being collected	Location for data collection	How often the data is collected	The number of data points collected per sample				

Measure Relationships													
Responses or Outputs (Ys)				Factors (Xs)									
Dependent Variable	USL	LSL	Target	Independent Variable(s)	USL	LSL	Target						

Project Name:					Start Date:		6/10/2002					
					Use lines an	d or color bar	s to indicate s	tart and stop	dates for each	n activity		
Phase:	Activity	Start Date	End Date	Assigned to:	6/10/2002	6/11/2002	6/12/2002	6/13/2002	6/14/2002	6/15/2002	6/16/2002	6/17/2002
1. Define and												
Contain the												
Problem												
2. Measure the												
Problem												
3. Perform												
Root Cause												
Analysis												
- ,												
4. Plan and												
Implement												
Improvement												
5. Assess												
Effectiveness of												
Improvement												
6. Standardize												
and Control												
7. Realize and												
Reflect												
				1								

#### 

3. Perform						
Root Cause						
Analysis						
4. Plan and						
Implement						
Improvement						
5. Assess						
Effectiveness of						
Improvement						
6. Standardize						
and Control						
7. Realize and						
Reflect						

6/24/2002 6/25/2002

#### Root Cause Analysis Timeline Project Name: Start Date End Date Assigned to: 6/26/2002 6/27/2002 6/28/2002 6/29/2002 6/30/2002 7/1/2002 7/2/2002 7/3/2002 7/4/2002 Phase: Activity 1. Define and Contain the Problem 2. Measure the Problem 3. Perform Root Cause Analysis 4. Plan and Implement Improvement 5. Assess Effectiveness of Improvement 6. Standardize and Control 7. Realize and Reflect

# Root Cause Analysis Timeline Project Name:

Phase:	Activity	Start Date	End Date	Assigned to:	7/5/2002	7/6/2002	7/7/2002	7/8/2002	7/9/2002	7/10/2002
1. Define and										
Contain the										
Problem										
2. Measure the										
Problem										
3. Perform										
Root Cause										
Analysis										
4. Plan and										
Implement										
Improvement										
5. Assess										
Effectiveness of										
Improvement										
6. Standardize										
and Control										
7. Realize and										
Reflect										

2 <sup>2</sup> Facto	orial D	)esigr	າ (with up	to 5 rep	olicates)									
				Replic	ations									
	Α	В	AB	1	2	3	4	5	Sum	Average				
	-1	-1	-	28	25	27	1		80	26.67				
	1	-1		36	32	32			100	33.33				
	-1	1		18	19	23			60	20.00				
	1	1	-	31	30	29			90	30.00				
ave -	23.3	30.0	26.7	7										
ave +	31.7	25.0	28.3	3										
effect	8.3	-5.0	) 1.7	,										
			·		D = ((									
	A Effec	ct			BETT	ect				AB Intera	action			
			3	2.0					40.0					
30.0			_ 2	8.0					30.0					
20.0			2	6.0					20.0					
				4.0					10.0					
ave	- ave +		-	ave -	ave	+			A -		A+	- В -		
												⊢B+		
ANOVA														
Sources	SS	df	MS	F	F table	Stat si	α							
A	208.3	1	208.33	53.2	11.2586	*	0.01							
В	75.00	1	75.00	) 19.1	11.2586	*								
AB	8.33	1	8.33	3 2.13	11.2586	ns								
Error	31.33	8	3.92	2										
Total	323.0	11												
REGRESS	SION MC	DEL												
Intercept		27.50	)											
A coefficie	nt	4.167	7											

B coefficie	ent	-2.5																
AB coeffic	ient	0																
PREDICT	ION EQU	JATION																
A	1																	
В	1																	
Y-hat	29.17																	
RESIDUA	LS	1																
			Actual	Pred F	Residual	rank	Perc	Z										
1	-1	-1	28	25.8	2.167	1	2.5	-1.96		3.000							1	
2	-1	-1	25	25.8	-0.833	16	77.5	0.755										
3	-1	-1	27	25.8	1.167	5	22.5	-0.755		2.000	•	•		•	•			
4	-1	-1	0	0	0.000	7	32.5	-0.454						Ĭ				
5	-1	-1	0	0	0.000	7	32.5	-0.454		1.000	•	•			•			
1	1	-1	36	34.2	1.833	3	12.5	-1.15							•			
2	1	-1	32	34.2	-2.167	18	87.5	1.15	(	0.000		••	••	<b></b>	<b>+</b> +		-	
3	1	-1	32	34.2	-2.167	18	87.5	1.15			ф	5	10	15	20	0 2	25	
4	1	-1	0	0	0.000	7	32.5	-0.454		1.000	•							
5	1	-1	0	0	0.000	7	32.5	-0.454										
1	-1	1	18	20.8	-2.833	20	97.5	1.96		2 000			•	•				
2	-1	1	19	20.8	-1.833	17	82.5	0.935				•						
3	-1	1	23	20.8	2.167	1	2.5	-1.96		3 000			•					
4	-1	1	0	0	0.000	7	32.5	-0.454		5.000								
5	-1	1	0	0	0.000	7	32.5	-0.454		1 000								
1	1	1	31	29.2	1.833	3	12.5	-1.15		+.000							_	
2	1	1	30	29.2	0.833	6	27.5	-0.598										
3	1	1	29	29.2	-0.167	15	72.5	0.598										
4	1	1	0	0	0.000	7	32.5	-0.454										
5	1	1	0	0	0.000	7	32.5	-0.454										



٨	В-	26 7	B +	
A - A +		26.7		20 30
		00.0		00
	1			

#### DOE 2^3 template

$2^3$ Fac	torial De	sign (v	vith up to	5 replica	ites)											
								Repli	cations							
	Α	В	С	AB	AC	BC	ABC	1	2	3	4	5	Sum	Average		
(1)	-1	-1	-1	1	1	1	-1	1	2	3			6	2.00		
a	1	-1	-1	-1	-1	1	1	1	2	3			6	2.00		
b	-1	1	-1	-1	1	-1	1	1	2	3			6	2.00		
ab	1	1	-1	1	-1	-1	-1	1	2	3			6	2.00		
С	-1	-1	1	1	-1	-1	1	1	2	3			6	2.00		
ac	1	-1	1	-1	1	-1	-1	1	2	3			6	2.00		
bc	-1	1	1	-1	-1	1	-1	1	2	3			6	2.00		
abc	1	1	1	1	1	1	1	1	2	3			6	2.00		
ave -	2.00	2.00	2.00	2.00	2.00	2.00	2.00									
ave +	2.00	2.00	2.00	2.00	2.00	2.00	2.00									
effect	0.00	0.00	0.00	0.00	0.00	0.00	0.00									
						1						1				
	A Effect B E				B Effect	t			С	Effe	ct					
	2.50															
	2.00	•		2.50				2.50								
	1.50			2.00				2.00	•	-						
	0.50			1.00				1.50								
	0.00			0.50				0.50								
	ave a	ive		0.00				0.00								
	-	+		ave -	ave +				ave	ave						
		1							-	т		_				
		D Intoro	ation					) Into	action							- 41
	A	D Interat					A	, milei	action						BC Intera	ction
	50					2 50										
2.0						2.00			_					2.50		
1.	50					1.50								1.50		-
1.0	50					1.00								1.00		
0.0				→ В -		0.00					-	C-		0.50		
	A -		A +	— R +		Α	-		A +			C1		B -		B +
				<b>D</b> +							-	0⁺				-

L											
Sources	SS	df	MS	F	F table	Stat sig	α				
А	0.00	1	0.00	0.00	8.53	ns	0.01				
В	0.00	1	0.00	0.00	8.53	ns					
С	0.00	1	0.00	0.00	8.53	ns					
AB	0.00	1	0.00	0.00	8.53	ns					
AC	0.00	1	0.00	0.00	8.53	ns					
BC	0.00	1	0.00	0.00	8.53	ns					
ABC	0.00	1	0.00	0.00	8.53	ns					
Error	16.00	16	1.00								
Total	16.00	23									
REGRESS	ION MOD	EL									
Intercept		2.00									
A coefficier	nt	0									
B coefficier	nt	0									
C coefficier	nt	0									
AB coeffici	ent	0									
AC coeffici	ent	0									
BC coeffici	ent	0									
ABC coeffi	cient	0									
PREDICTI	ON EQUA	TION									
А	1										
В	1										
С	1										
Y-hat	2.00										

#### DOE 2^3 template


		ANOVA				
					В-	B +
				A -	2.00	2.00
			 	A +	2.00	2.00
					C-	C+
				A -	2.00	2.00
				A +	2.00	2.00
						_
				_	C-	C+
				В-	2.00	2.00
				B +	2.00	2.00
C_						

#### DOE 2^3 template


# Parts per Million Calculator

This is a simple sigma level calculator

Enter process sigma level, compute PPM				
Process Sigma Level ->	6			
PPM	3.4			
Percent	0.00034%			

#### Enter percent, compute PPM and process sigma level

If the percent is less than 1, you must use the percent sign after the number (e.g., 0.01%)

Percent ->	0.00034%
PPM	3.4
Process Sigma Level	6.0

Enter DPMO, compute process sigma level

DPMO ->	3.4	
Process Sigma Level	6.0	

# Sigma Level (no shift) Calculator

NO 1.5 SIGMA SHIFT IN THESE CALCULATIONS

Enter process sigma level, compute PPM
Process Sigma Level ->

Process Sigma Level ->	6
PPM	0.0
Percent	0.00000%

Enter percent, compute PPM and process sigma level

Percent ->	1.00%
PPM	10000
Process Sigma Level ->	2.326

Enter DPMO, compute process sigma level

Process Sigma Level ->	4.5	
DPMO	3.4	

Rolled Throughput Yield Calculator					
Step	DPMO	DPMO/1,000,000	1-(DPMO/1,000,000)		
1	5,000	0.005	0.995		
2	15,000	0.015	0.985		
3	1,000	0.001	0.999		
4	50	0.00005	0.99995		

RTY= 0.99472

## **DPMO** Calculator

This template calculates the DPMO using the number of defects.

Total number of units:	2500
Number of defects:	4
Opportunities for Error in one unit:	20
DPMO =	80

Not sure of what goes into the units?

The Data Processing Dept supervisor wants to calculate the DPMO of data entry errors in her dept. A total of 2,500 forms were processed that day, and the supervisor finds 4 fields with error. There are 20 entry fields on each data entry form. For this scenario: Total number of units = 2,500 Number of defects = 4 Opportunities for error in one unit = 20



Conversion Calculator					
Sigma	Conversion T	able			
	Sigma Level				
Defects Per	(With 1.5	Cale (Sigmo			
Million	Sigma	Cpk (Sigma Level / 3) With			
Opportunities	Shift)*	1.5 Sigma Shift*			
933,200	0.000	0.000			
915,450	0.125	0.042			
894,400	0.250	0.083			
869,700	0.375	0.125			
841,300	0.500	0.167			
809,200	0.625	0.208			
773,400	0.750	0.250			
734,050	0.875	0.292			
691,500	1.000	0.333			
645,650	1.125	0.375			
598,700	1.250	0.417			
549,750	1.375	0.458			
500,000	1.500	0.500			
450,250	1.625	0.542			
401,300	1.750	0.583			
354,350	1.875	0.625			
308.500	2.000	0.667			
265,950	2.125	0.708			
226,600	2.250	0.750			
190,800	2.375	0.792			
158,700	2.500	0.833			
130,300	2.625	0.875			
105,600	2.750	0.917			
84.550	2.875	0.958			
66.800	3.000	1.000			
52,100	3.125	1.042			
40,100	3.250	1.083			
30,400	3.375	1.125			
22,700	3.500	1.167			
16,800	3.625	1.208			
12,200	3.750	1.250			
8,800	3.875	1.292			
6,200	4.000	1.333			
4,350	4.125	1.375			
3,000	4.250	1.417			
2,050	4.375	1.458			
1,300	4.500	1.500			
900	4.625	1.542			
600	4.750	1.583			
400	4.875	1.625			
230	5.000	1.667			
180	5.125	1.708			
130	5.250	1.750			
80	5.375	1.792			
30	5.500	1.833			

23	5.625	1.875
17	5.750	1.917
10	5.875	1.958
3	6.000	2.000

The table assumes a 1.5 sigma shift because processes tend to exhibit instability of that magnitude over time. In other words, although statistical tables indicate that 3.4 defects / million is achieved when 4.5 process standard deviations (Sigma) are between the mean and the closest specification limit, the target is raised to 6.0 standard deviations to accommodate adverse process shifts over time and still produce only 3.4 defects per million opportunities.

# Six Sigma Project Timeline Project Name:

ID	Task	Hours	Start	End	Status
1	Define	1 Wk	25-Sep-01	1-Oct-01	Complete
2	Measure	17 Wks	2-Oct-01	25-Jan-02	Working
4	Project Direction Meeting	1 Hrs	22-Jan-02	22-Jan-02	
5	Assign Roles	5 Min	22-Jan-02	22-Jan-02	
6	Review Status	10 Min	22-Jan-02	22-Jan-02	
7	Review Schedule	5 Min	22-Jan-02	22-Jan-02	
8	Project Direction Decision	33 Min	22-Jan-02	22-Jan-02	
9	Clarify Options	10 Min	22-Jan-02	22-Jan-02	
10	ID Decision Maker	2 Min	22-Jan-02	22-Jan-02	
11	Vote on Options	2 Min	22-Jan-02	22-Jan-02	
12	Dialog A	5 Min	22-Jan-02	22-Jan-02	
13	Vote on Options	2 Min	22-Jan-02	22-Jan-02	
14	Dialog B	5 Min	22-Jan-02	22-Jan-02	
15	Vote on Options	2 Min	22-Jan-02	22-Jan-02	
16	Decision Maker Decides	5 Min	22-Jan-02	22-Jan-02	
17	Assign Tasks	5 Min	22-Jan-02	22-Jan-02	
18	Work Tasks	2 Days	22-Jan-02	24-Jan-02	
19	Process Map & Data Meeting	96 Min	24-Jan-02	24-Jan-02	
38	Work Tasks	1 Day	24-Jan-02	25-Jan-02	
39	Tollgate Review	1 Hrs	25-Jan-02	25-Jan-02	
40	Analyze	2 Wks	25-Jan-02	8-Feb-02	
41	FMEA Meeting 1	92 Min	25-Jan-02	25-Jan-02	
50	Work Tasks	4 Days	25-Jan-02	31-Jan-02	
51	FMEA Meeting 2	92 Min	31-Jan-02	31-Jan-02	
60	Work Tasks	4 Days	31-Jan-02	6-Feb-02	
61	FMEA and Data Analysis Meeting	78 Min	6-Feb-02	6-Feb-02	
77	Work Tasks	1 Day	6-Feb-02	7-Feb-02	
78	Improvement Direction Meeting	1 Hrs	7-Feb-02	8-Feb-02	
91	Tollgate Review	1 Hrs	8-Feb-02	8-Feb-02	
92	Improve	3 Wks	8-Feb-02	28-Feb-02	
117	Control	4 Wks	28-Feb-02	28-Mar-02	

Comments

Gage Control Plan								
Gage Information         Gage Name         Gage ID/Serial Number         Gage Type         Reference Information         Calibration Procedure         Handling and Storage         Maintenance         Spare Parts	Personnel Information         Department         Storage Location         Responsible Storage         Responsible MSA	Page: of Document No: Revision Date: Supercedes: Frequencey:						

	Data	Posoluton	Pige	Linearity	Stability	Calib	ration		GR&R		Notes
	Dale	Resolution	DIdS	Linearity	Stability	Date	Ву	%R&R	P/T	Disc Index	Notes
Baseline											
In-Service											
In-Service											
In-Service											
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			X	X	X	X	X	Х	X	X	pts X	X	X	X sde	X	X		
	Relationship Matrix 9=Strong, 3=Moderate, 1=Weak		uality of Service	taffing Levels	all Volume	all Routing	aining	ystems Problems	formation Sources: peed/Availability	all Blocking	vailability of Other De	xception Processing	tework Reduction	xperience Level of Re	elivery of Info	schnology Limitations		ow Important
	Service Level		a	Ω.	U U	U U	F	Ś		U U	Ą	Ш	Ľ	Ú	Δ	Ť		Í
	IVR Usage																	
ent	Call Work																	
nagem	Productivity and Calls Per Hour																	
Ma	Cost																	
	Risk Exposure																	
	Compliance																	
	POC Resolution Call Duration and Hold Time																	
lient	Call Backs																	
ernal C	Call Transferred																	
Ext	Call Blocked																	
	Time in Queue																	
	How Important	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
																		l
	Metric																	
	Target																	

Baseline	Metric	Target

				С	aus	se 8	k Ef	fec	t M	atri	X					
Rating of Importance to Customer																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Process Inputs																Total
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Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

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#### Page 46

Potential Failure Modes and Effects Analysis (Information Sheet)

PFMEA Number:	
Process Name:	
Process Responsibility:	
Prepared By:	
Affected Product(s):	
PFMEA Key Date:	
PFMEA Origination Date:	
PFMEA Revision Date:	
Core Team Members:	

#### Process / Product Failure Modes and Effects Analysis

(FMEA)

						_								
rocess or roduct Name:							Prepared by:			Page of				
esponsible:							FMEA Date (Orig)	_ (Re	v)					
Process Step	Key Process Input	Potential Failure Mode	Potential Failure Effects	S E V	Potential Causes	0 C C	Current Controls	D E T	R P N	Actions Recommended	Resp.	Actions Taken	S E V	0 C C
What is the process step	What is the Key Process Input?	In what ways does the Key Input go wrong?	What is the impact on the Key Output Variables (Customer Requirements) or internal requirements?	How Severe is the effect to the cusotmer?	What causes the Key Input to go wrong?	How often does cause or FM occur?	What are the existing controls and procedures (inspection and test) that prevent eith the cause or the Failure Mode? Should include an SOP number.	How well can you detect cause or FM?		What are the actions for reducing the occurrance of the Cause, or improving detection? Should have actions only on high RPN's or easy fixes	Whose Responsible for the recommende d action?	What are the completed actions taken with the recalculated RPN? Be sure to include completion month/year		
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D E T R P N

Effect	Criteria: Severity of Effect Defined	Ranking
Hazardous: Without Warning	May endanger operator. Failure mode affects safe vehicle operation and / or involves noncompliance with government regulation. Failure will occur <b>WITHOUT</b> warning.	10
Hazardous: With Warning	May endanger operator. Failure mode affects safe vehicle operation and / or involves noncompliance with government regulation. Failure will occur <b>WITH</b> warning.	9
Very High	Major disruption to production line. 100% of product may have to be scrapped. Vehicle / item inoperable, loss of primary function. Customer very dissatisfied.	8
High	Minor disruption to production line. Product may have to be sorted and a portion (less than 100%) scrapped. Vehicle operable, but at a reduced level of performance. Customer dissatisfied.	7
Moderate	Minor disruption to production line. A portion (less than 100%) may have to be scrapped (no sorting). Vehicle / item operable, but some comfort / convenience item(s) inoperable. Customers experience discomfort.	6
Low	Minor disruption to production line. 100% of product may have to be reworked. Vehicle / item operable, but some comfort / convenience item(s) operable at reduced level of performance. Customer experiences some dissatisfaction.	5
Very Low	Minor disruption to production line. The product may have to be sorted and a portion (less than 100%) reworked. Fit / finish / squeak / rattle item does not conform. Defect noticed by most customers.	4
Minor	Minor disruption to production line. A portion (less than 100%) of the product may have to be reworked on-line but out-of-station. Fit / finish / squeak / rattle item does not conform. Defect noticed by average customers.	3
Very Minor	Minor disruption to production line. A portion (less than 100%) of the product may have to be reworked on-line but in-station. Fit / finish / squeak / rattle item does not conform. Defect noticed by discriminating customers.	2
None	No effect.	1

#### FOccurance

Probability of Failure	Possible Failure Rates	Cpk	Ranking
Very High:	≥ 1 in 2	< 0.33	10
Failure is almost inevitable	1 in 3	≥ 0.33	9
High: Generally associated with processes similar to previous	1 in 8	≥ 0.51	8
processes that have often failed	1 in 20	≥ 0.67	7
Moderate: Generally associated with processes similar to	1 in 80	≥ 0.83	6
previous processes which have	1 in 400	≥ 1.00	5
experienced occasional failures, but not in major proportions	1 in 2,000	≥ 1.17	4
<b>Low:</b> Isolated failures associated with similar processes	1 in 15,000	≥ 1.33	3
Very Low: Only isolated failures associated with almost identical processes	1 in 150,000	≥ 1.5	2
<b>Remote:</b> Failure is unlikely. No failures ever associated with almost identical processes	≤ 1 in 1,500,000	≥ 1.67	1

Detection	Criteria: Liklihood the existence of a defect will be detected by test content before product advances to next or subsequent process	Ranking
Almost Impossible	Test content detects < 80 % of failures	10
Very Remote	Test content must detect 80 % of failures	9
Remote	Test content must detect 82.5 % of failures	8
Very Low	Test content must detect 85 % of failures	7
Low	Test content must detect 87.5 % of failures	6
Moderate	Test content must detect 90 % of failures	5
Moderately High	Test content must detect 92.5 % of failures	4
High	Test content must detect 95 % of failures	3
Very High	Test content must detect 97.5 % of failures	2
Almost Certain	Test content must detect 99.5 % of failures	1

# **Control Plan**

	Core Team:							Date (Orig)	):		
								Date (Rev)			
_											
				Current Control Plan							
Process Step	Input	Output	Process Spec (LSL, USL, Target)	Cpk / Date (Sample Size)	Measure ment System	%R&R or P/T	Current Control Method (from FMEA)	Who	Where	When	Reaction Plan
											1

	Six Sigma Process Control Plan										
Process Name:		Prepared by:	Page: of								
Customer	Int/Ext	Approved by:	Document No:								
Location:		Approved by:	Revision Date:								
Area:		Approved by:	Supercedes:								

Sub Process	Sub Process Step	СТ	ſQ	Specification Characteristic	Specification/ Requirement	Measurement Method	Sample Size	Frequency	Who Measures	Where Recorded	Decision Rule/ Corrective Action	SOP Reference
		KPOV	KPIV		USL LSL							

	Six Sigma Preventative Maintenance Plan										
Process Name:		Prepared by:	Page: of								
Customer	Int/Ext	Approved by:	Document No:								
Location:		Approved by:	Revision Date:								
Area:		Approved by:	Supercedes:								

System	Failure Mode	СТQ		Predictor	Predictor Level	Measurement Method	Sample Size	Frequency	Who Measures	Where Recorded	Decision Rule/ Corrective Action	SOP Reference
		KPOV	KPIV		USL LSL							

# Key Process Output Variable Capability Status Sheet

Customer Requirement (Output Variable)	Measurement Technique	%R&R or P/T Ratio	Upper Spec Limit	Target	Lower Spec Limit	Ср	Cpk	Sample Size	Date



# Failure Mode and Effects Analysis

	(Design FINEA)				FMEA Number:	
					Page	of
Design Responsibility:					Prepared by:	
					FMEA Date (Orig.)	(Rev.)
0		п				Action Results
	Design Responsibility:	(Design Responsibility:	(Design Responsibility:	(Design PMEA)	(Design FMEA)	(Design FWIEA) FMEA Number: Design Responsibility: Prepared by: FMEA Date (Orig.)

					0			n				Action	result	5		1
Item / Process Function	Potential Failure Mode	Potential Effect(s) of Failure	S e >	Potential Cause(s)/ Mechanism(s) of Failure	C C U r	Current Design Controls Prevention	Current Design Controls Detection	e t e c	R. P. N.	Recommended Action(s)	Responsibility & Target Completion Date	ActionsTaken	S e v	O c u r	D e t e c	R. P. N.



Hundredth place for Z-value

Z-Value	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.50000	0.49601	0.49202	0.48803	0.48405	0.48006	0.47608	0.47210	0.46812	0.46414
0.1	0.46017	0.45620	0.45224	0.44828	0.44433	0.44038	0.43644	0.43251	0.42858	0.42465
0.2	0.42074	0.41683	0.41294	0.40905	0.40517	0.40129	0.39743	0.39358	0.38974	0.38591
0.3	0.38209	0.37828	0.37448	0.37070	0.36693	0.36317	0.35942	0.35569	0.35197	0.34827
0.4	0.34458	0.34090	0.33724	0.33360	0.32997	0.32636	0.32276	0.31918	0.31561	0.31207
0.5	0.30854	0.30503	0.30153	0.29806	0.29460	0.29116	0.28774	0.28434	0.28096	0.27760
0.6	0.27425	0.27093	0.26763	0.26435	0.26109	0.25785	0.25463	0.25143	0.24825	0.24510
0.7	0.24196	0.23885	0.23576	0.23270	0.22965	0.22663	0.22363	0.22065	0.21770	0.21476
0.8	0.21186	0.20897	0.20611	0.20327	0.20045	0.19766	0.19489	0.19215	0.18943	0.18673
0.9	0.18406	0.18141	0.17879	0.17619	0.17361	0.17106	0.16853	0.16602	0.16354	0.16109
1.0	0.15866	0.15625	0.15386	0.15151	0.14917	0.14686	0.14457	0.14231	0.14007	0.13786
1.1	0.13567	0.13350	0.13136	0.12924	0.12714	0.12507	0.12302	0.12100	0.11900	0.11702
1.2	0.11507	0.11314	0.11123	0.10935	0.10749	0.10565	0.10383	0.10204	0.10027	0.09853
1.3	0.09680	0.09510	0.09342	0.09176	0.09012	0.08851	0.08691	0.08534	0.08379	0.08226
1.4	0.08076	0.07927	0.07780	0.07636	0.07493	0.07353	0.07215	0.07078	0.06944	0.06811
1.5	0.06681	0.06552	0.06426	0.06301	0.06178	0.06057	0.05938	0.05821	0.05705	0.05592
1.6	0.05480	0.05370	0.05262	0.05155	0.05050	0.04947	0.04846	0.04746	0.04648	0.04551
1.7	0.04457	0.04363	0.04272	0.04182	0.04093	0.04006	0.03920	0.03836	0.03754	0.03673
1.8	0.03593	0.03515	0.03438	0.03362	0.03288	0.03216	0.03144	0.03074	0.03005	0.02938
1.9	0.02872	0.02807	0.02743	0.02680	0.02619	0.02559	0.02500	0.02442	0.02385	0.02330
2.0	0.02275	0.02222	0.02169	0.02118	0.02068	0.02018	0.01970	0.01923	0.01876	0.01831
2.1	0.01786	0.01743	0.01700	0.01659	0.01618	0.01578	0.01539	0.01500	0.01463	0.01426
2.2	0.01390	0.01355	0.01321	0.01287	0.01255	0.01222	0.01191	0.01160	0.01130	0.01101
2.3	0.01072	0.01044	0.01017	0.00990	0.00964	0.00939	0.00914	0.00889	0.00866	0.00842
2.4	0.00820	0.00798	0.00776	0.00755	0.00734	0.00714	0.00695	0.00676	0.00657	0.00639
2.5	0.00621	0.00604	0.00587	0.00570	0.00554	0.00539	0.00523	0.00508	0.00494	0.00480
2.6	0.00466	0.00453	0.00440	0.00427	0.00415	0.00402	0.00391	0.00379	0.00368	0.00357
2.7	0.00347	0.00336	0.00326	0.00317	0.00307	0.00298	0.00289	0.00280	0.00272	0.00264

2.8	0.00256	0.00248	0.00240	0.00233	0.00226	0.00219	0.00212	0.00205	0.00199	0.00193
2.9	0.00187	0.00181	0.00175	0.00169	0.00164	0.00159	0.00154	0.00149	0.00144	0.00139
3.0	0.00135	0.00131	0.00126	0.00122	0.00118	0.00114	0.00111	0.00107	0.00104	0.00100
3.1	0.00097	0.00094	0.00090	0.00087	0.00084	0.00082	0.00079	0.00076	0.00074	0.00071
3.2	0.00069	0.00066	0.00064	0.00062	0.00060	0.00058	0.00056	0.00054	0.00052	0.00050
3.3	0.00048	0.00047	0.00045	0.00043	0.00042	0.00040	0.00039	0.00038	0.00036	0.00035
3.4	0.00034	0.00032	0.00031	0.00030	0.00029	0.00028	0.00027	0.00026	0.00025	0.00024
3.5	0.00023	0.00022	0.00022	0.00021	0.00020	0.00019	0.00019	0.00018	0.00017	0.00017
3.6	0.00016	0.00015	0.00015	0.00014	0.00014	0.00013	0.00013	0.00012	0.00012	0.00011
3.7	0.00011	0.00010	0.00010	0.00010	0.00009	0.00009	0.00008	0.00008	0.00008	0.00008
3.8	0.00007	0.00007	0.00007	0.00006	0.00006	0.00006	0.00006	0.00005	0.00005	0.00005
3.9	0.00005	0.00005	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00003	0.00003
4.0	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003	0.00002	0.00002	0.00002	0.00002