Six Sigma

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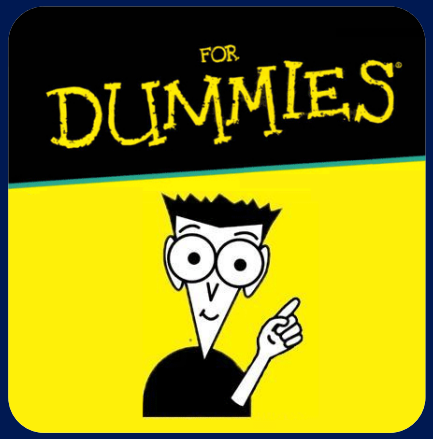
Disclosures

- Founding partner of TreatSafely, LLC
  - www.treatsafely.org
  - i.treatsafely.org
- Founding partner of Oncology Owl, LLC
  - SPC-based QA software
- Royalties from textbook
  - *Quality and Safety in Radiotherapy*

Six Sigma Demystified

- The scientific process applied to quality improvement



Not quite...also includes many new tools, issues of change management and sustaining change.

What is Six Sigma?

- An accessible structured approach to data-based quality improvement using a wide variety of tools and techniques that is tied to the goals of management including overall time and/or cost savings for the institution.

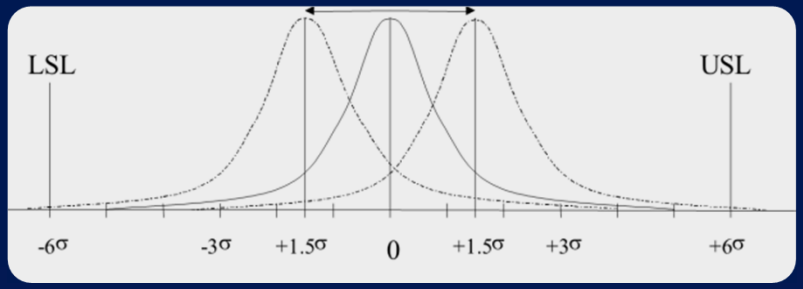
Bill Smith

- Creator of Six Sigma
  - TQM spinoff; a better mousetrap
- 1952 Naval Academy graduate
  - 35 years engineering and QA
- Joined Motorola in 1987
  - Using 6σ, Motorola was the 1988 Baldrige winner
- Died at work of a heart attack in 1994

Six Sigma Excellence

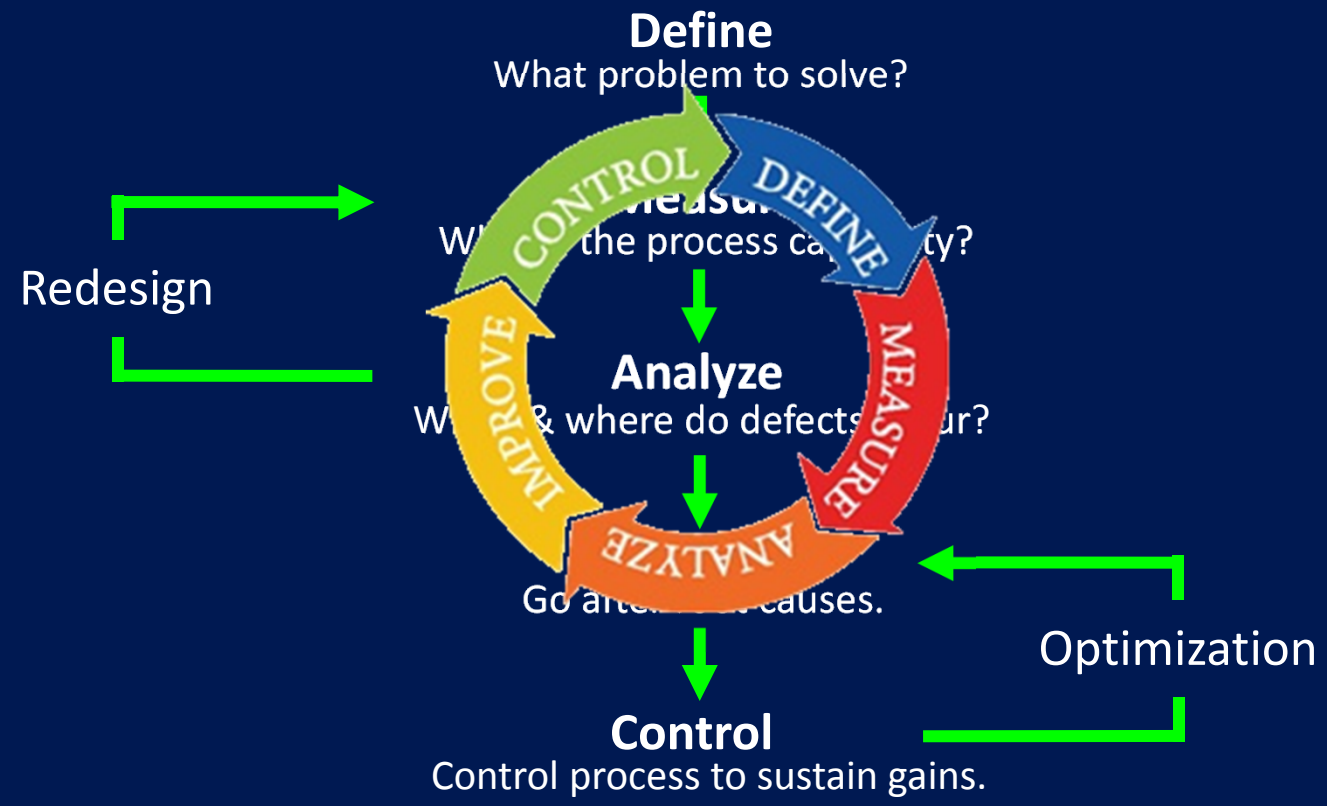
- Defective parts per million (ppm) opportunities

Limits in sigma around the mean	Probability of having a product outside the limits (Centered distribution)	Probability of having a product outside the limits (distribution shifted by 1.5σ)
3 sigma	**2700 ppm**	66,810 ppm
4 sigma	63.4 ppm	6,210 ppm
5 sigma	0.34 ppm	233 ppm
6 sigma	2 ppb	**3.4 ppm**



DMAIC

- Define – Measure – Analyze – Improve – Control



Six Sigma Training

- Support obtained (~$20k)
  - May 2010
- June – December 2010
- 5 members / 5 projects
  - Clin Ops Manager, Physics, IT, Dosimetry, Therapy
  - Example
    - Reduce the time for patients to start SRS treatment

Six Sigma – Project Scorecard

Define		*Measure*		*Analyze*		*Improve*		*Control*	
Develop a Project Charter with the Project Focus, Key Metrics, and Project Scope		Create a Process Map of the key process involving key personnel involved in the process.		Analyze process flow and identify waste		Prioritize potential solutions including cost benefits.		Create a Control Plan for solution	
Form an improvement team including key stakeholders		Create a plan for collecting data		Determine sources of variation across process		Identify, evaluate, and select, best solution		Continue to monitor and stabilze process using control charts	
Validate problem statement and goals with stakeholders		Determine process performance / capability		Analyze data collected for trends, patterns, and relationships.		Develop, optimize and Implement pilot solution		Develop SOP's and process maps for implemented solution	
Create a communication plan with action items		Validate the measurement systems		Perform root cause analysis and prioritize causes.		Develop "To Be" value stream map		Transition project to process owner	
Create a Value Stream Map of the selected process involving key personnel involved in the process.		Collect data for "As-Is" process		Analyze two samples using Hypothesis Tests		Validate pilot solution for portential improvements with feedback from key stakeholders		Communicate project success & challenges to create opportunities for system wide adoption.	
Develop a high level process map (SIPOC)				Analyze three or more samples using ANOVA		FMEA of potential failures		Facilitate change management	
Collect baseline data if exists				Understand relationships in two variables Correlation		Design of Experiments			
Determine "Voice of Customer" as it relates to the project				Determine relationships in variables using Regression					
Review with Sponsor		**Review with Sponsor**		**Review with Sponsor**		**Review with Sponsor**		**Review with Sponsor**	

Project Charter

Project Charter - Six Sigma Performance Improvement Projects

Project Name: Reducing the time for identifying and starting cranial SRS patients on treatment
Start Date: 6/29/2010
End Date: 9/30/2010

Project Team Members

Responsibility	Name	Department	Title
Team Leader	**Todd Pawlicki & Greg White**		**Physicist & Dosimetrist**
Project Sponsor	**Josh Lawson, MD**		**Physician (Rad Onc)**
Executive Champion	**AJ Mundt, MD**		**Department Chair (Rad Onc)**
Process Owner	**Mary Collins**		**Clinical Operations Manager**
Stakeholder	**John Alksne, MD**		**Physician (Neurosurgen)**
Team Member	**Grace Kim & Jia-Zhu Wang**		**Physicists**
Team Member	**Matt Taylor**		**Chief Therapist**
Team Member	**Rich Fletcher**		**Chief IT**
Team Member	**Polly Nobiensky**		**Chief Nurse**

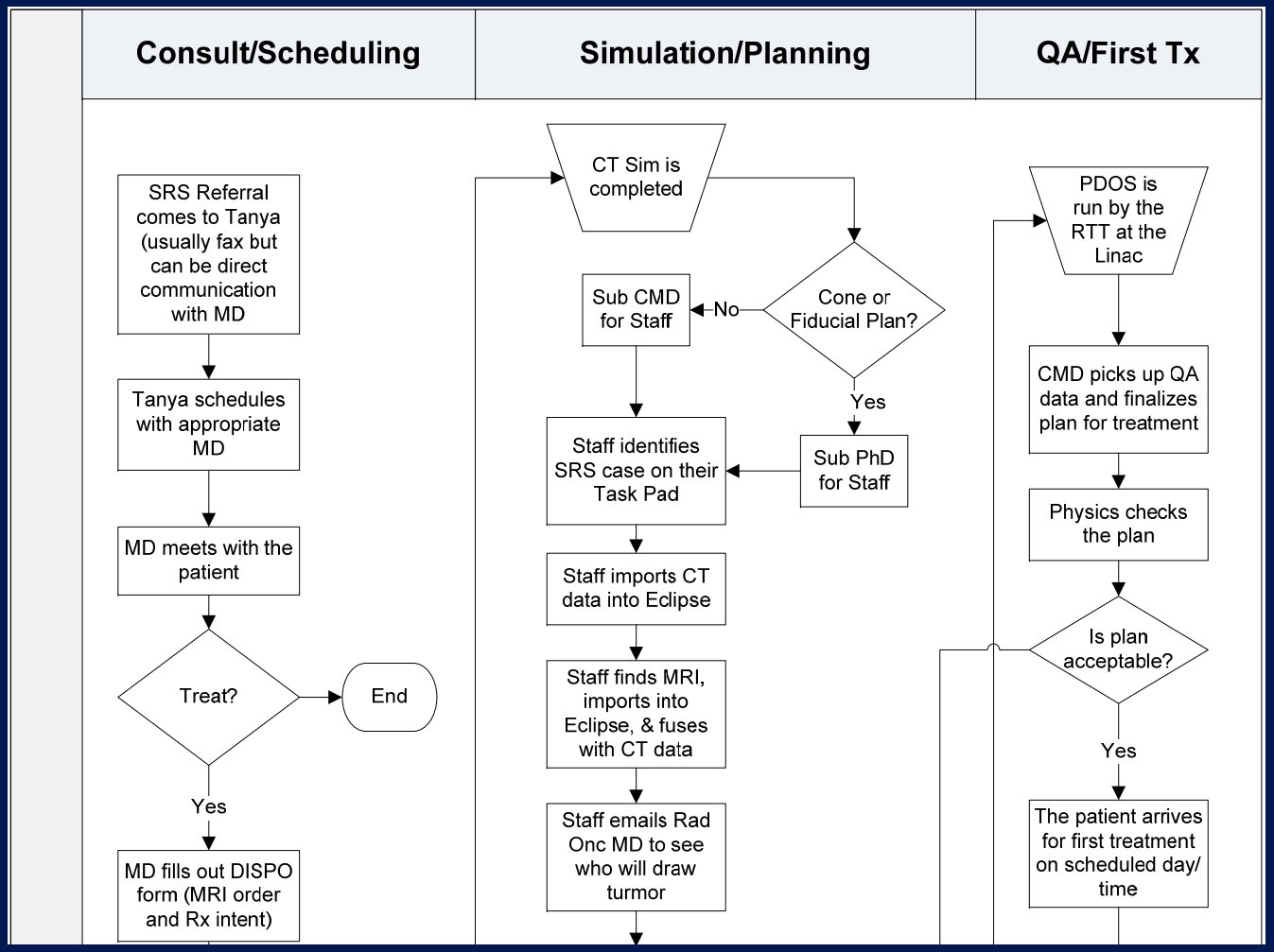
Problem Statement and Scope

Problem Statement
Currently, it takes 16.3 work days to get a cranial SRS patient on treatment. This results in stress for the patients in waiting for their treatment as well as deviations from high-quality care, in some cases due to medical conflicts with chemotherapy, for example.
Scope
Starts after consult is completed and ends when the patient's first fraction begins.

Objective and Metrics

	Objective
	Decrease the time from consult to first fraction treated by 70%. The goal is to have all SRS patients treated within 5 work days of their consult.
Primary Metric(s)	Work day hours (7am - 5pm): Consult to first fraction treated.
Secondary Metric(s)	Work day hours: Consult to Sim
	Work day hours: Sim to PDOS started
	Work day hours: PDOS to first fraction treated

Process Map


Consult/Scheduling
Simulation/Planning
QA/First Tx
SRS Referral comes to Tanya (usually fax but can be direct communication with MD
Tanya schedules with appropriate MD
MD meets with the patient
Treat?
End
Yes
MD fills out DISPO form (MRI order and Rx intent)
CT Sim is completed
Sub CMD for Staff
No
Cone or Fiducial Plan?
Yes
Sub PhD for Staff
Staff identifies SRS case on their Task Pad
Staff imports CT data into Eclipse
Staff finds MRI, imports into Eclipse, & fuses with CT data
Staff emails Rad Onc MD to see who will draw turmor
PDOS is run by the RTT at the Linac
CMD picks up QA data and finalizes plan for treatment
Physics checks the plan
Is plan acceptable?
Yes
The patient arrives for first treatment on scheduled day/ time

Data Collection Plan

Process Owner: Todd Pawlicki	**Data Collection Plan**	UC San Diego Radiation Oncology
Process: Reducing the time for identifying and starting cranial SRS patients on treatment		

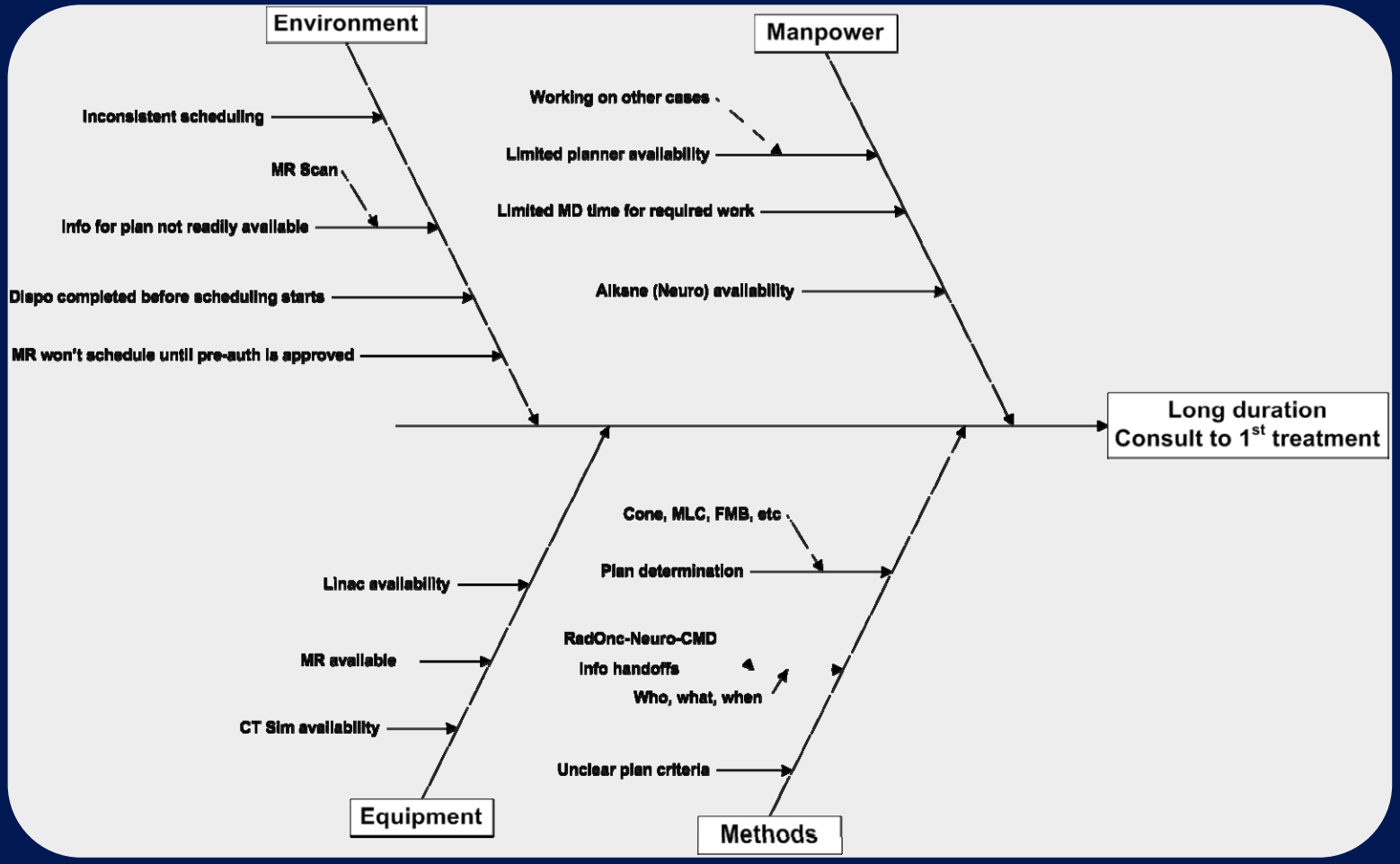
Data				Operational Definition and Procedures			
What?	Measure Units & Data Type	Sample Size	Stratification Factors	Who will collect data	How Measured?	How will data be collected	Where will data be collected
Consult	date & time		By case type (cranial SRS)	Schedulers	Entered in Aria	Entered by staff (part of routine procedures)	Aria database
CT Sim	date & time		Taken from consult case	Schedulers	Entered in Aria	Entered by staff (part of routine procedures)	Aria database
PDOS	date & time		Taken from CT Sim case	Dosimetrist	Entered in Aria	Entered by staff (part of routine procedures)	Aria database
First treatment	date & time		Taken from PDOS case	Therapist	Entered in Aria	Entered by staff (part of routine procedures)	Aria database
Consult to first treatment	duration (7am-5pm workdays)	41	By case type (cranial SRS)	n/a	calculated from above data	n/a	Aria database

Descriptive Statistics of Baseline Data

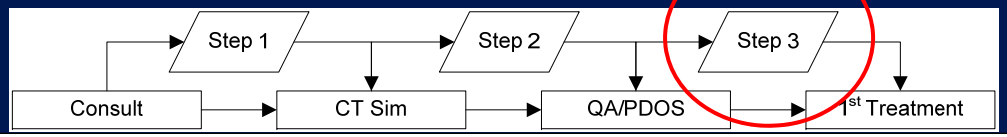
Consult to First Treatment **(workdays, 7am - 5pm)**

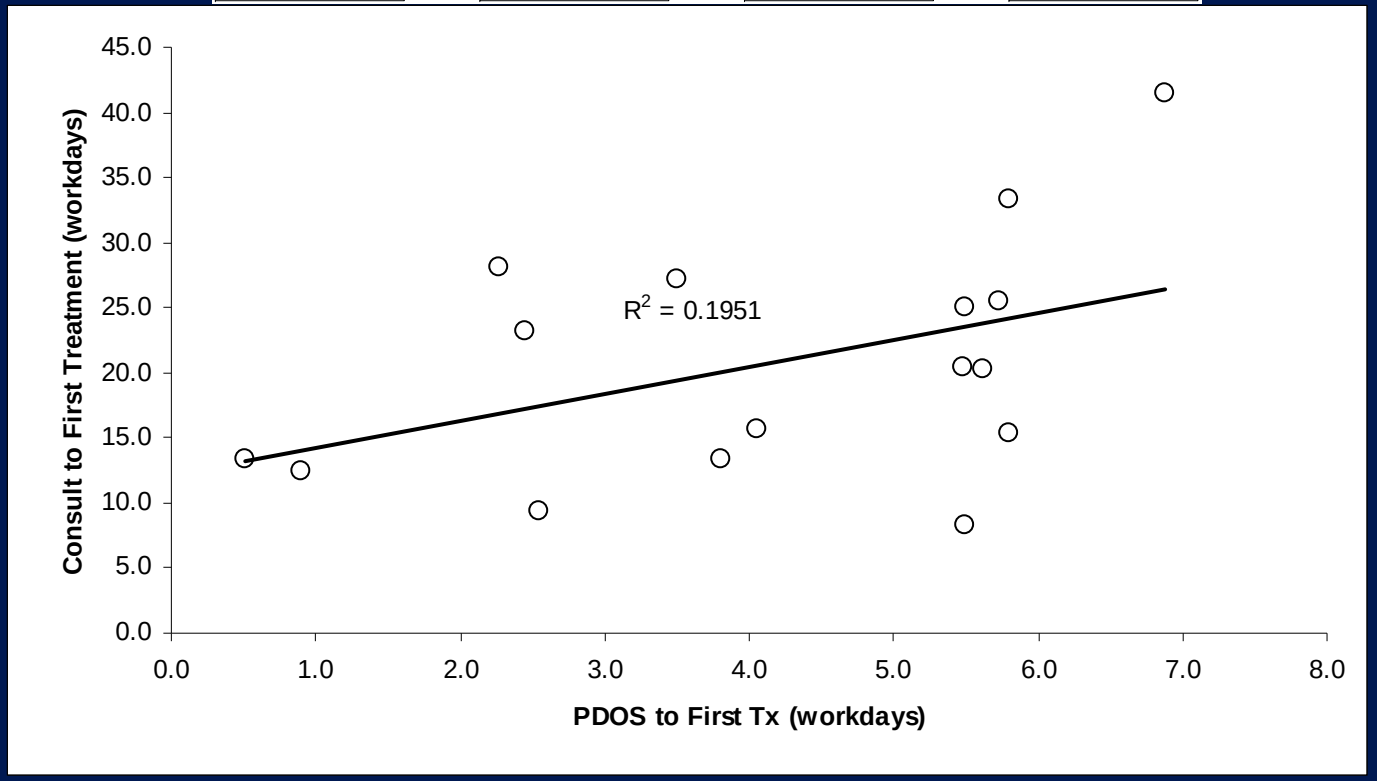
	Raw Data	Outlier Removed
Mean	19.6	16.3
Standard deviation	11.9	6.5
Minimum	8.3	8.3
Maximum	48.7	28.1

Fishbone Diagram

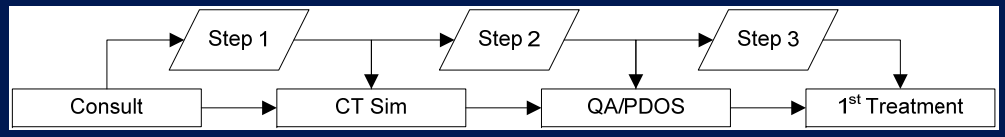


Correlation Analysis





Correlation Analysis – Conclusions



- Strongest correlation for primary metric
  - Consult to CT Sim (Step 1)
- The steps are only weakly correlated with each other
  - Improving one step won't have an effect on the other steps

Before Change

	Consult to Sim (workdays)	*Sim to PDOS (workdays)*	*PDOS to First Tx (workdays)*	*Consult to First Tx (workdays)*
	17.9	5.8	3.5	27.2
	29.3	5.3	6.9	41.5
	3.4	6.2	5.8	15.4
	20.5	5.2	2.3	28.0
	17.3	2.3	5.5	25.1
	13.0	7.7	2.4	23.2
	1.6	1.2	5.5	8.3
	2.6	4.2	2.6	9.4
	5.6	7.2	0.5	13.3
	5.8	5.9	4.1	15.7
	3.6	11.1	5.6	20.3
	9.3	2.3	0.9	12.5
	13.2	14.4	5.8	33.4
	7.4	12.4	5.7	25.5
	1.0	8.6	3.8	13.4
	2.7	12.2	5.5	20.4
Mean (workdays)	12.37	5.01	3.88	21.26
Stdev (workdays)	9.66	2.14	2.12	10.70
Minimum (workdays)	1.60	1.20	0.51	8.30
Maximum (workdays)	29.30	7.70	6.88	41.47

Process Map: "To-Be" Process

Classifi-cation	INPUTS (x's)	Input Spec / Settings	PROCESS STEP	OUTPUTS (y's)	Output Specs / Measurment Levels
Start / Decision Block (YES / NO)		(For all "C" & "K" Classifications)	Process Block; Off Page Connector; Rework; Preparation or Data; Delay	Inventory; Data Entry	(If applicable)
C	- Pre-Heat temp - Cycle time - Travel tank speed - Cure Temp - Dip time	600-700 65-80 20-35 400-500 12-17	Warm up the oven before starts shift for 1 hour		
			Tune all process parameters at the oven		
			Align Wire form		
			Wires in Good shape → Replace wires		
C C N C	- Silicone concentration - Silicone recirculation - Silicone Temperature - Silicone remove	2.5-3.5 ratio xx psi	Oven starts with wire form dipping into silicone tank		
C C N C	- Pre-Heat Temperature - Thermocouples - Top Zone heaters - Vents	600-700 Calibrated 400-500 Open/Close	Pre-heat wire form		
C K C K N N	- Dip time - Plastisol Temperat - Travelup tank speed - Traveldown tank speed - Buil up surface - Insulation from oven	12-17 < 80 F 8-15 sec 25-35 sec	Wire form dipping into plastisol tank		

Implementation Plan

Project: Implementation Plan

Process: _____

Project Team: _____ **Company Name Here**

Team Leader: _____

Status	Ref	Action/Task/Activity	Person Assigned	Key Stakeholders	Expected Completion Date	Comment

After Change

	Consult to Sim (workdays)	*Sim to PDOS (workdays)*	*PDOS to First Tx (workdays)*	*Consult to First Tx (workdays)*
	3.0	7.7	1.9	12.6
	0.0	1.9	0.5	2.5
	0.2	4.5	1.0	5.7
	1.1	4.6	0.9	6.5
	1.9	2.8	0.5	5.2
	6.4	1.0	0.9	8.3
	0.1	6.6	1.6	8.3
	0.2	5.9	0.9	7.0
Mean (workdays)	1.62	4.36	1.03	7.01
Stdev (workdays)	2.21	2.34	0.50	2.94
Minimum (workdays)	0.05	1.00	0.53	2.47
Maximum (workdays)	6.40	7.65	1.95	12.60

Cost Benefit Analysis

Cost Benefit Analysis

Process: _____

Project Team: _____

Team Leader: _____

Expected Costs

Description	Unit	Cost
	Expected Costs	**$ -**

Benefits

Description	Unit	Savings
	Estimated Procurement Savings	**$ -**
	Projected Project Savings	**$ -**

FMEA

Failure Modes and Effects Analysis (FMEA)

Process: FMEA Number:

FMEA Team: FMEA Date: (Original)

Team Leader: (Revised)

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FMEA Process											Action Results				
Process Function	Potential Failure Mode	Potential Effect(s) of Failure	Severity	Potential Cause(s) of Failure	Occurrence	Current Controls	Detection	Risk Priority Number (RPN)	Recommended Action	Responsibility & Target Completion Date	Action Taken	Severity	Occurrence	Detection	RPN

Six Sigma – Project Scorecard

Define	Measure	Analyze	Improve	Control
Charter	**Process map**	Analyze process flow and identify waste	**Prioritize**	Create a Control Plan for solution
Form an improvement team including key stakeholders	**Data plan**	**Find variation**	Identify, evaluate, and select, best solution	**Control charts**
Validate prob.	Determine process performance / capability	Analyze data collected for trends, patterns, and relationships.	Develop, optimize and Implement pilot solution	**SOPs**
Communicate	Validate the measurement systems	**RCA**	**"to be" VSM**	Transition project to process owner
Create a Value Stream Map of **"as is" VSM** process.	**Collect data**	Analyze two samples using Hypothesis Tests	Validate pilot solution for portential improvements with feedback from key stakeholders	Communicate project success & **Communicate** adoption.
Develop a high level process map (SIPOC)		**ANOVA**	**FMEA**	Facilitate change management
Collect baseline data if exists		Understand relationships in two variables Correlation	**DOE**	
Verify VOC		**Regression**		
Review with Sponsor	**Review with Sponsor**	**Review with Sponsor**	**Review with Sponsor**	**Review with Sponsor**

Six Sigma Lessons Learned

- Requirements
  - Direct line of accountability to senior management
- Key to success
  - Need protected time for participants
  - Make use the guided problem solving
- Most difficult part
  - Data collection and analysis