

**Relevance of Topic:** 36%

**Suitable for:** Six Sigma

**Own contribution:** 80%



Voice of Customer &amp; Business

Requirements and Deviations

Severity of Problems of Outputs

## Project-Charter

Business Relevance	Problem
Scope/ Objectives	Experts Belt-Team Management

Input

Requirements and deviations

negative Influences on Problems

Process-Steps &gt; Activities

Input, Output, Methods &amp; Resources

negative Influences on Problems

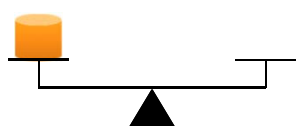
		Problems (Y)			
		Y1	Y2	Y3	Yn
Input (Xi)	Xi1		3		
	Xi2				1
Process-Steps (Xp)	Xp1	2		4	
	Xp2				5
	Xpn		7		

		Operationalisation		Graphical Display	
		Y1	Y2	Y3	Yn
Problems (Y)	Y1				
	Y2				
Input (Xi)	Xi1				
	Xi2				
Process-Steps (Xp)	Xp1				
	Xp2				
	Xpn				

**Risk: 14%**

There is a/ no Difference in: the degree of: (Y) ... between: Levels of: (x)

Test: ANOVA



12

9 3

6

011011102200801  
110114051978101  
101501195801001  
010100101010101  
001110100110011

**Application & Support:**

- Management (Sponsor, Accountable)
- Belt (Black-Belt/ Green-Belt)
- Experts

## Identify Project

- collect project topics
- evaluate topics
- prioritize topics
- select project

## Define Project

- process and output
- problem
- effect
- solution ideas (if present)

## SIPOC (Supplier-Input-Process-Output-Customer)

- structure process into the main process steps
- assign inputs and (intermediate) outputs
- assign supplier and customer

## VoC/ VoB &gt; CCR/ CBR &gt; CtQ

- interview customer/ manager
- derive requirements for outputs and evaluate their deviations
- derive problems Y of the output and their severity

## Project-Charter

- focus on critical problems Y
- specify their business relevance
- define scope and objectives
- build a team

## Input-Analysis

- identify necessary inputs
- specify the requirements
- specify negative influences xi of inputs on the output/ problems Y

## Process-Mapping &amp; -Analysis

- map process steps into activities
- assign inputs and outputs
- specify methods & resources
- specify neg. influences xm/ xr

## Cause &amp; Effect-Matrix (C&amp;E)

- evaluate impact strength of the negative influences of inputs xi, methods xr and resources xm on the outputs/ problems Y

## Data-Collection-Plan

- operationalize influences xi, xm, xr and problems Y as measurands
- determine scale level
- determine conditions and procedure of measurement

## Hypotheses

- automatically generated with:
  - type of hypothesis (Difference/ Relationship)
  - relevance of hypothesis (Risk)
  - appropriate statistical tests

## Measurement-System-Analysis

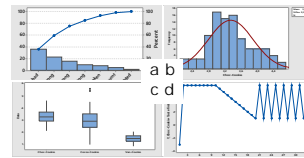
- check repeatability, reproducibility, stability and linearity of the measurement system
- Gage R&R

## Collect Data

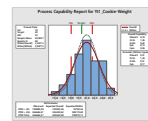
- collect existing data
- measure actual data
- according to Data-Collection-Plan

**Focus:**

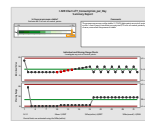
- Y Problem
- X Influence/ Cause
- Z Effect
- S Solution
- P Project Management



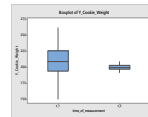
## Process-Capability



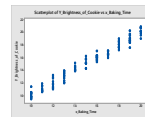
## Process-Control



## Difference



## Relationship



## Graphical Data Evaluation

- a) Pareto-Chart
- b) Histogram
- c) Boxplot
- d) Time Series Plot

## Process-Capability/ -Control

- Yield%/ DPU/ DPMO
- Z.Bench (Sigma Level)/ cp/ cpk ...
- I-MR/ xbar-R/ xbar-S/ P-/ U-Chart as baseline of the process

## Test Hypothesis

- Difference-Hypothesis:  $Y_a \neq Y_b$
- Relationship-Hypothesis:  $Y \neq f(x)$

## Root-Cause-Analysis

- identify root-causes x' of the negative influences x on the problems Y

## Solution-Ideas

- develop solutions to eliminate, circumvent or adjust parameter of the root-causes x'
- prioritize solutions

## Design of Experiments (DoE)

- adjust significant/ relevant parameters x to optimize Y

## Action-List

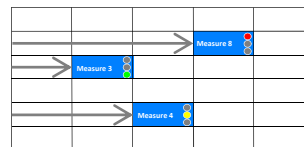
- specify solutions as measures (Who?/ What?/ until When?)

## FMEA (Failure Mode and Effects Analysis)

- minimize risks of measures

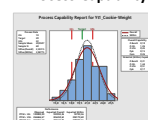
## Implementation

- decide on measures
- inform and motivate
- qualify (if necessary)
- implement measures

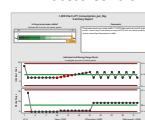


Measure	Yield	DPU	DPMO	Z.Bench	cp	cpk	I-MR	xbar-R	xbar-S	P-/U
Measure 1										
Measure 2										
Measure 3										
Measure 4										

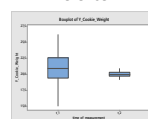
## Process-Capability



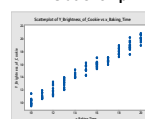
## Process-Control



## Difference



## Relationship



## Process-Capability/ -Control

- Yield%/ DPU/ DPMO
- Z.Bench (Sigma Level)/ cp/ cpk ...
- I-MR/ xbar-R/ xbar-S/ P-/ U-Chart for the improved process

## Test Hypothesis

- Difference-Hypothesis:  $Y_a \neq Y_b$
- Relationship-Hypothesis:  $Y \neq f(x)$

## Sustainability, Documentation

- Process-Management-Plan
- Project-Story-Book

**Tools:**

- sigmaGuide®
- Minitab®

Copyright: reiner.hutwelker@sigmaLogic.de

**Relevanz des Themas:** 36%

**Tauglichkeit für:** Six Sigma

**eigener Beitrag:** 80%



**Voice of Customer & Business**

**Anforderungen und Abweichungen**

**Schwere der Probleme des Outputs**

Project-Charter	
Business-Relevanz	Problem
Scope/ Ziele	Experten Belt-Team Management

**Input**

**Anforderungen und Abweichungen**

**negative Einflüsse auf Probleme**

**Prozess-Schritte > Aktivitäten**

**Input, Output, Methoden & Ressourcen**

**negative Einflüsse auf Probleme**

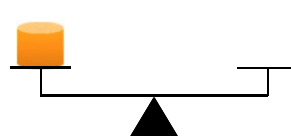
		Problems (Y)			
		Y1	Y2	Y3	Yn
Input (Xi)	Xi1		3		
	Xi2				1
	Xi3			4	
Process-Steps (Xp)	Xp1	2			
	Xp2			5	
	Xpn		7		

		Operationalisation				Graphical Display			
		Y1	Y2	Y3	Yn				
Problems (Y)	Y1								
	Y2								
	Y3								
Input (Xi)	Xi1								
	Xi2								
	Xi3								
Process-Steps (Xp)	Xp1								
	Xp2								
	Xpn								

**Risiko: 14%**

Es gibt (k)einen Unterschied in: Ausmaß von (Y) ... zwischen: Stufen von (x)

**Test: ANOVA**



12

9 3

6

011011102200801  
110114051978101  
101501195801001  
010100101010101  
001110100110011

**Ausführung & Support:**

Management (Sponsor, Accountable)

Belt (Black-Belt/ Green-Belt)

Experten

## Projekt identifizieren

- Themen einsammeln
- Themen bewerten
- Themen priorisieren
- Projekte auswählen

## Projekt definieren

- Prozess und Output
- Problem
- Wirkung
- Lösungs-Ideen (falls vorhanden)

## SIPOC (Supplier-Input-Process-Output-Customer)

- Prozess in die wichtigen Prozess-Schritte gliedern
- Inputs und (Zwischen-) Outputs zuordnen, ebenso wie Lieferanten und Kunden

## VoC/ VoB > CCR/ CBR > CtQ

- Kunden/ Manager befragen
- Anforderungen an Outputs und deren Abweichungen ableiten
- Abweichungen bewerten und Schwere der Probleme Y ableiten

## Project-Charter

- kritische Probleme Y fokussieren
- Business-Relevanz ableiten
- Scope und Ziele definieren
- Team zusammenstellen

## Input-Analyse

- notwendige Inputs identifizieren
- Anforderungen an Inputs konkretisieren
- negative Einflüsse xi auf Probleme der Outputs Y ableiten

## Prozess-Mapping & -Analyse

- Prozess-Schritte in Aktivitäten gliedern
- Inputs & Outputs, Methoden & Ressourcen zuordnen
- Neg. Einflüsse xm/ xr ableiten

## Cause & Effect-Matrix (C&E)

- Stärke der negativen Einflüsse der Inputs xi, Methoden xm und Ressourcen xr auf die Probleme des Outputs Y bewerten

## Daten-Erhebungs-Plan

- Einflüsse x und Probleme Y als Messgrößen operationalisieren
- Bedingungen und Prozedur der Messung konkretisieren

## Hypothesen

- automatisch erzeugt mit:
  - Typ der Hypothese (Unterschied/ Zusammenhang)
  - Relevanz der Hypothese (Risiko)
  - angemessener statistischer Test

## Mess-System-Analyse

- Wiederholbarkeit und Reproduzierbarkeit, Stabilität & Linearität des Mess-Systems prüfen
- Gage R&R

## Daten erheben

- vorhandene Daten abrufen
- aktuelle Daten messen
- Gemäß Daten-Erhebungs-Plan

**Fokus:**

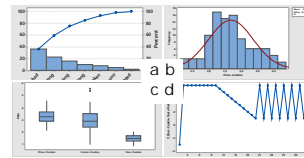
Y Problem

X Einfluss/ Ursache

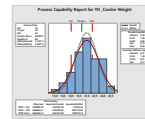
Z Effekt

S Lösung

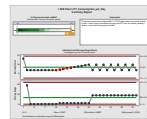
P Projekt Management



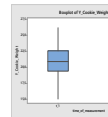
## Prozess-Fähigkeit



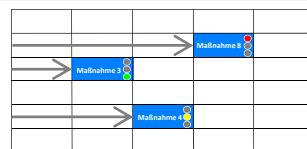
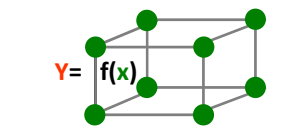
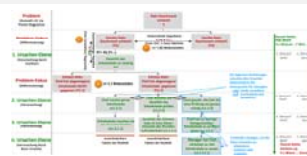
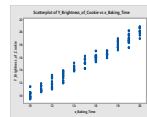
## Prozess-Monitoring



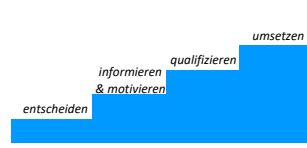
## Unterschied



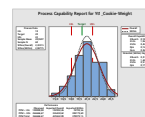
## Zusammenhang



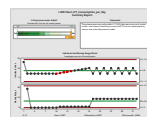
		Operationalisation				Graphical Display			
		Y1	Y2	Y3	Yn				
Input (Xi)	Xi1		3						
	Xi2				1				
	Xi3			4					
Process-Steps (Xp)	Xp1	2							
	Xp2			5					
	Xpn		7						



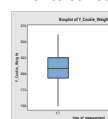
## Prozess-Fähigkeit



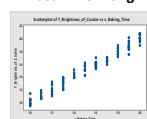
## Prozess-Monitoring



## Unterschied



## Zusammenhang



**Tools:**

sigmaGuide®

Minitab®

## Daten graphisch analysieren

- a) Pareto-Diagramm
- b) Histogramm
- c) Boxplot
- d) Zeitreihen-Diagramm

## Prozess-Fähigkeit/-Monitoring

- Yield%/ DPU/ DPMO
- Z.Bench (Sigma Level)/ cp/ cpk ...
- I-MR/ xbar-R/ xbar-S/ P-/ U-Chart als Baseline des Prozesses

## Hypothesen-Tests

- Unterschieds-Hypothese:  $Y_a \neq Y_b$
- Zusammenhangs-Hypothese:  $Y \neq f(x)$

## Ursache-Wirkungs-Analyse

- Basis-Ursachen x' der negativen Einflüsse x auf die Probleme Y identifizieren

## Lösungs-Ideen

- Lösungs-Ideen entwickeln, mit denen die Basis-Ursachen x' eliminiert, umgangen oder optimal justiert werden können
- Lösungs-Ideen priorisieren

## Design of Experiments (DoE)

- justiere signifikante/ relevante Parameter x zur Optimierung von Y

## Maßnahmen-Liste

- Lösungen in konkrete Maßnahmen überführen (Wer?/ Was?/ bis Wann?)

## FMEA (Failure Mode and Effects Analysis)

- Risiken der Maßnahmen minimieren

## Umsetzung

- entscheide über Maßnahmen
- informiere & motiviere
- qualifiziere (wenn notwendig)
- setze Maßnahmen um

## Prozess-Fähigkeit/-Monitoring

- Yield%/ DPU/ DPMO
- Z.Bench (Sigma Level)/ cp/ cpk ...
- I-MR/ xbar-R/ xbar-S/ P-/ U-Chart zur verbesserten Prozess-Leistung

## Hypothesen-Tests

- Unterschieds-Hypothese:  $Y_a \neq Y_b$
- Zusammenhangs-Hypothese:  $Y \neq f(x)$

## Nachhaltigkeit & Dokumentation

- Process-Management-Plan
- Project-Story-Book

**Copyright:** reiner.hutwelker@sigmaLogic.de