

Traditional COPQ Is Only the Tip of the Iceberg

One of the key business metric concepts of Six Sigma is the concept of the Cost of Poor Quality (COPQ). COPQ represents the visible and less visible costs of all the defects that exist in our processes. Essentially, the highest quality producer is the lowest cost producer where cost is represented by the COPQ._

Inspection
Warranty
Scrap
Rework
Rejects

Traditional Quality Costs

(tangible)

More Setups
Expediting Costs
Lost sales
Late Delivery
Lost Customer Loyalty
Excess Inventory
Long Cycle-Times
Engineering Change Orders

Additional Costs of Poor Quality

(intangible)

Lost Opportunity

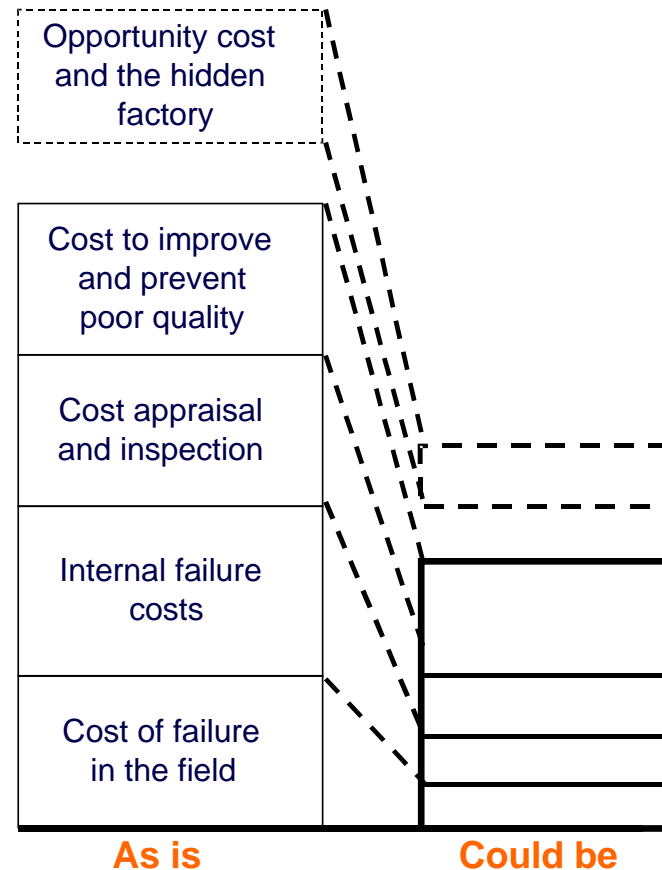
Hidden Factory

(Difficult or impossible to measure)



The Cost of Poor Quality (COPQ)

- Avoided capital cost
- Opportunity cost of additional volume if sales > capacity
- Lost customer loyalty
- Time spent expediting
- Cost to the customer
- Improvement program costs
- Process control
- Quality engineering and admin
- Inspection/test (materials, equipment, labor)
- Vendor control
- Quality audits
- Scrap/rejects
- Rework
- Longer cycle times and excess inventory
- Warranty claims
- Maintenance and service



Cost of Poor Quality(COPQ)

Cost of Poor Quality(COPQ)

1. Cost of Failure-Internal and External

A. Defective stock	\$3,276	0.37%
B. Repairs to product	73,229	8.31
C. Scrap-collected	2,288	0.26
D. Scrap-waste	187,428	21.26
E. Customer adjustments	408,200	46.31
F. Downgrading products	22,838	2.59
G. Customer ill will		Not counted
H. Customer policy adjustments		Not counted
Subtotal	\$697,259	79.10%

2. Cost of Appraisal and Inspection

A. Incoming inspection	32,655	2.68%
B. Inspection 1	32,582	3.70
C. Inspection 2	25,200	2.86
D. Spot-check inspection	65,910	7.37
Subtotal	\$147,347	16.61%

3. Cost of Prevention

A. Local plant quality	7,848	0.89
B. Group quality	30,000	3.40
Subtotal	\$37,848	4.29%

4. Other Opportunity Costs

Not counted

GRAND TOTAL	\$882,454	100.%
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Adapted from Juran's Quality Control Handbook (1988), 4th Edition

Cost of Quality

Internal Failure Costs <ul style="list-style-type: none">● Scrap● Rework● Supplier Scrap & Rework	External Failure Costs <ul style="list-style-type: none">● Cost to Customer● Warranty Cost● Returned Material
Appraisal Costs <ul style="list-style-type: none">● Inspection● Testing● Quality Audits● Initial & Maintenance Costs of Test & Inspection Equipment	Prevention Costs <ul style="list-style-type: none">● Quality Planning● Process Planning● Process Control● Training
Opportunity Costs	

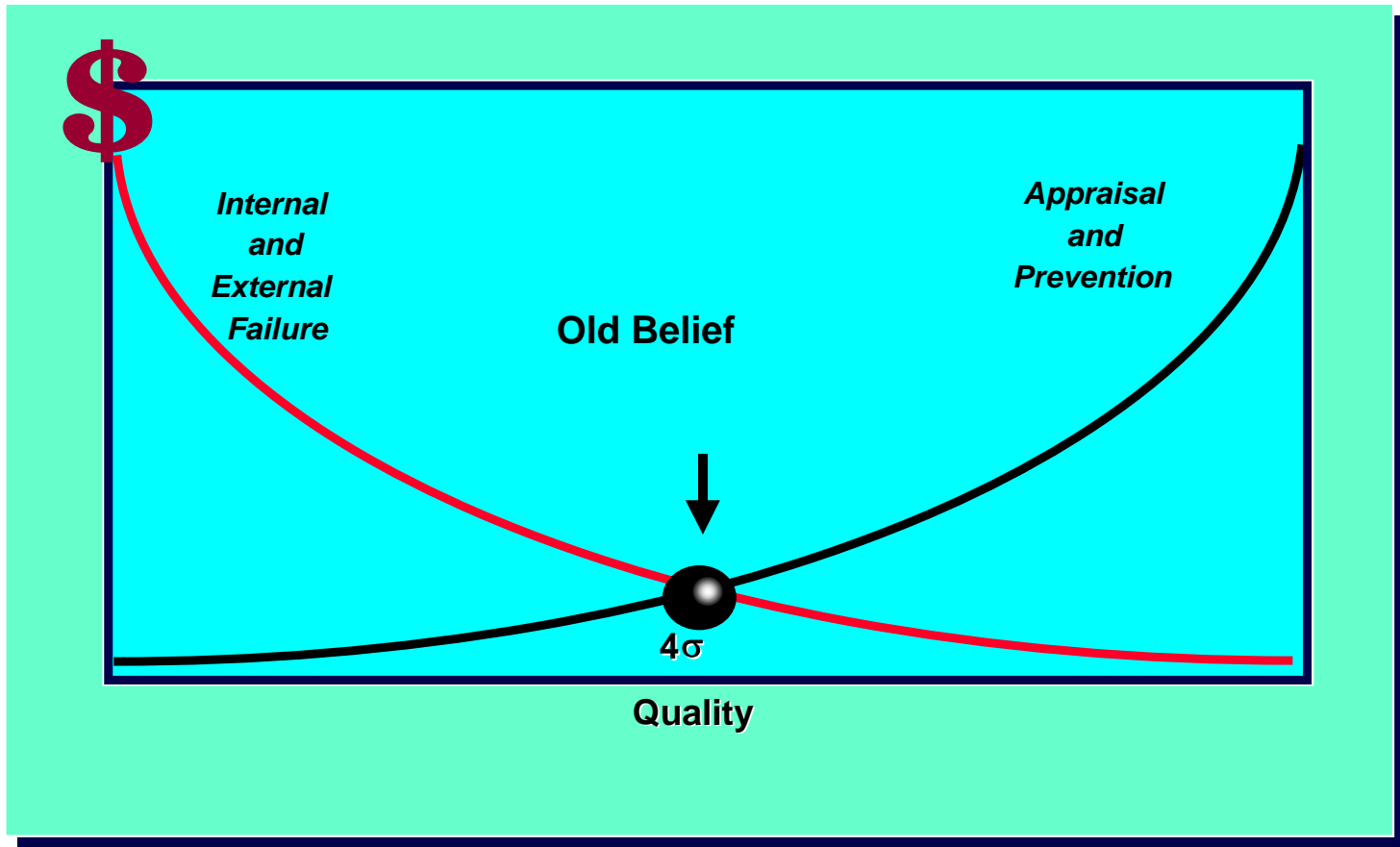


Hard Savings

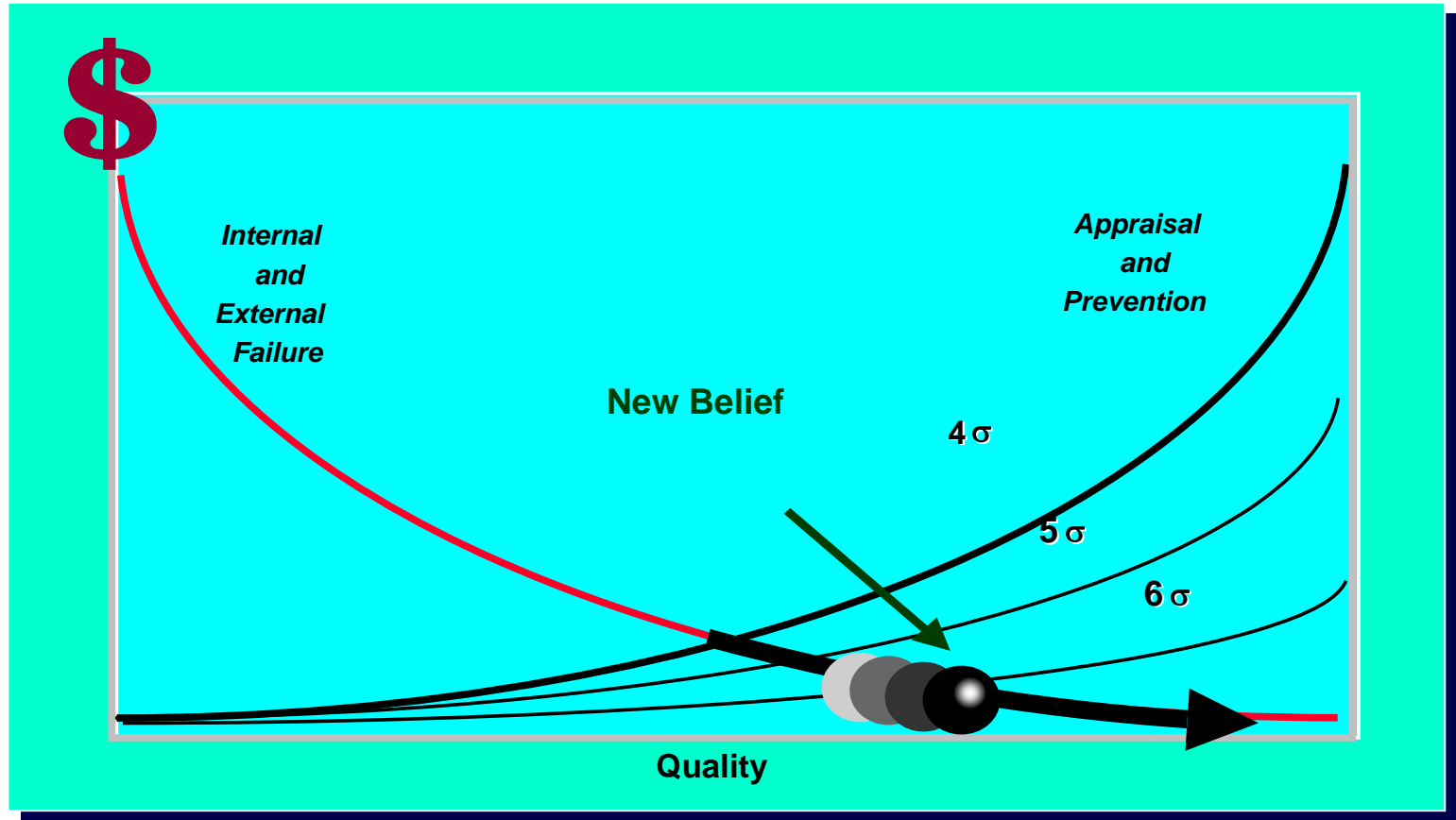
Potential Savings

Soft Savings

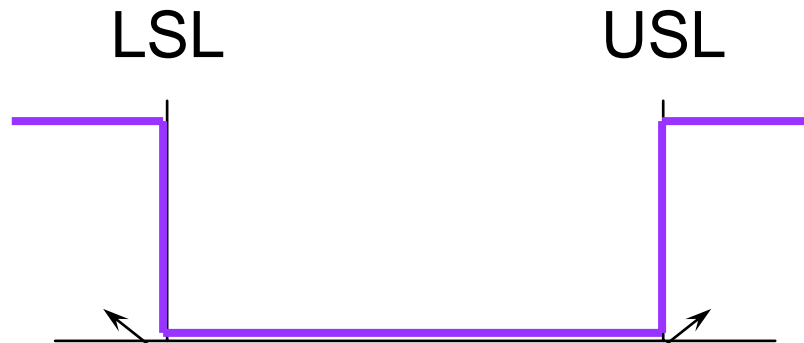
Won't It Cost Too Much to Improve Quality?



The Enlightened Perspective



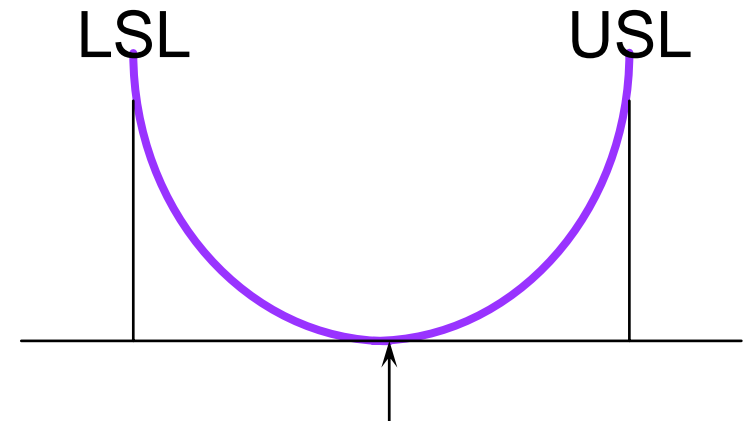
Impact of Variation on Cost



Area outside the specification limits represent quality losses.
Conformance to Specifications

“Goal Post Mentality”

Old Philosophy of Quality



No Losses @ the Target
Deviation from the target represents quality losses.
Taguchi's Loss Function
Average Loss = $k[\sigma^2 + (\bar{y} - T)^2]$

“Variation is Evil”
-Some Production Guy

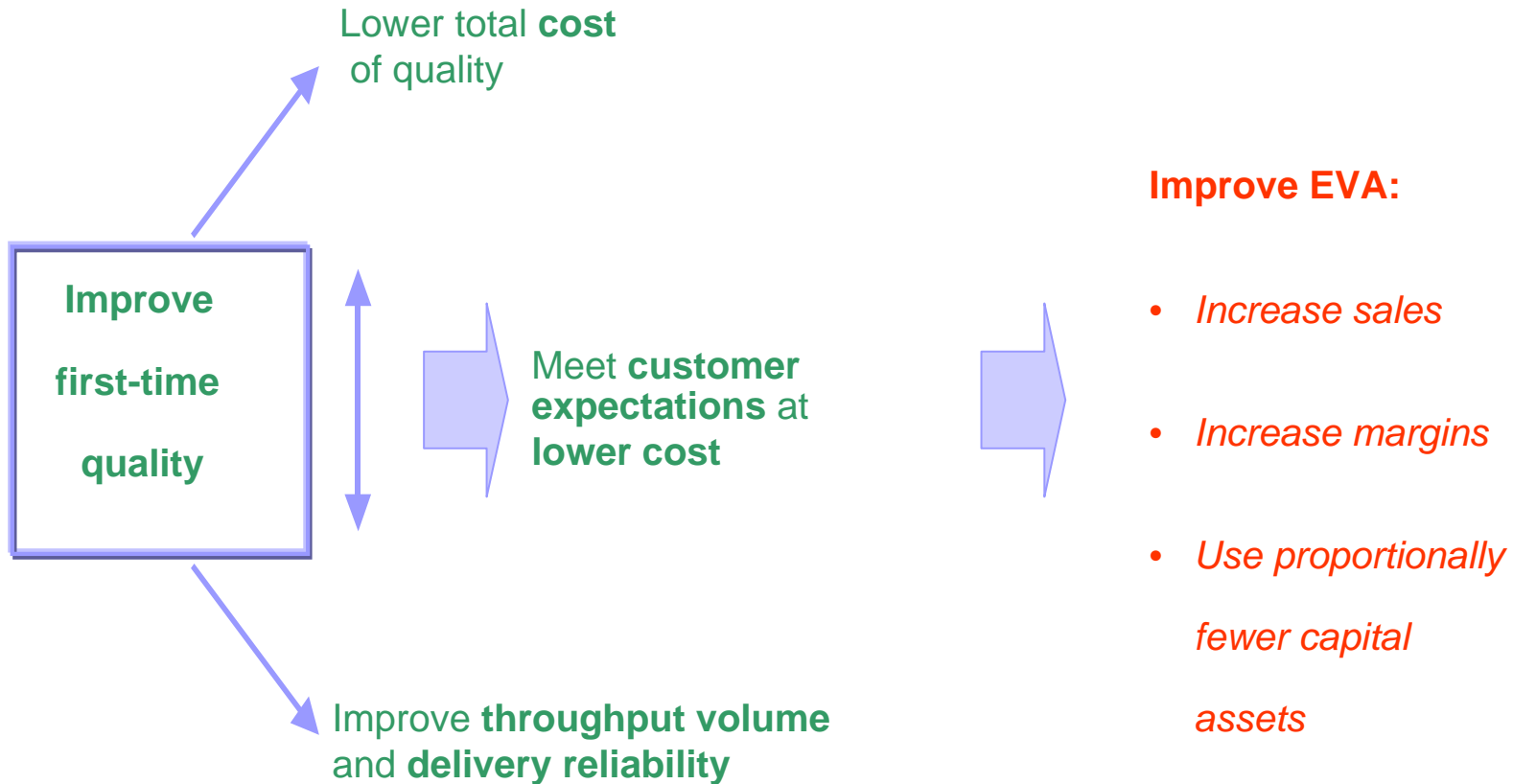
New Philosophy of Quality

The Cost of Quality

SIGMA LEVEL	DEFECTS PER MILLION OPPORTUNITIES	COST OF QUALITY
2	308,537 (Noncompetitive companies)	Not applicable
3	66,807	25-40% of sales
4	6,210 (Industry average)	15-25% of sales
5	233	5-15% of sales
6	3.4 (World class)	< 1 % of sales

Each sigma shift provides a 10 percent net income improvement.

Quality Is a Driver of EVA



Ideas for Measures

Strategic	Customer expectations	1. Establishment of CTQ standards	<i>Businesses need to define relevant customer segments and specific metrics; may vary by function e.g. manufacturing, engineering, order fulfillment etc.</i>
		2. Performance against CTQ standards	
	Cost of poor quality	3. \$ estimate baseline	
		4. Rate of improvement per month	
	Overall quality level	5. Estimate based on top-down analysis and aggregation of individual process/product Sigma levels	
Process quality *	Sigma/DPMO/DPU	6. Build-up from process/part level DPU/DPMO to business/product level sigma	
	Annual compound improvement per year	7. Monthly improvement rates (%) in DPMO compared to goal	
	Cycle time	8. Cycle/response time compared to goal (where applicable)	
Six Sigma activities	Projects	1. # (current vs target)	
		2. Status of projects (e.g. completion of final report, sign-off)	
	Agents and Master Agents	3. # Agents (current vs target)	
		4. # Master Agents (current vs target)	
		5. Status by individual (e.g. tenure, drop-out rate and reasons)	
	Training and communication	6. Communication coverage by employee segment	
		7. Measurement of communication effectiveness	
		8. Training participant feedback/assessment score; knowledge assessment	

* For critical processes