

Managing Quality Costs

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Before We Begin!

- Top management understands the language of \$
- Tracking quality costs does not solve quality problems
- Other costs such as inefficient processes and other forms of waste should also be accounted for.



Quality Professionals vs. Top Management

<i>Quality Professionals Are Busy Calculating</i>	<i>Top Management Understands</i>
σ DPMO RPN PPM Cpk Cp GRR Quality Level Ppk Pp % On-Time Defective Rate Error Rate	



Breakdown of Quality Costs

- Costs of Conformance:
 - Prevention Costs
 - Appraisal Costs

- Costs of Non-Conformance (Failure)
 - Internal Failure Costs
 - External Failure Costs



Prevention Costs

- Costs associated with activities to prevent poor quality in products and services
- Examples include (but not limited to):
 - Quality Planning
 - Process Control (including SPC)
 - Design Verification / Validation
 - QMS Development / Maintenance
 - Training / Workforce Development
 - Preventive Maintenance
 - QMS / Process Audits
 - Supplier Capability Monitoring
 - Defining Acceptance Criteria for Software Release



Appraisal Costs

- Costs associated with measuring, evaluating, or auditing products / services to ensure conformance to established standards
- Examples include (but not limited to):
 - Incoming Product Inspection
 - Lab-Acceptance Testing
 - In Process Inspection
 - Insurance Policy Review
 - Setup for Inspection
 - Calibration Costs
 - Product Final Audits
 - Field Testing (prior to release)
 - Software QA Testing
 - Software Code Regular Reviews



Internal Failure Costs

- Costs associated with product or service not conforming to requirements prior to its delivery
- Examples include (but not limited to):
 - Scrap
 - Rework
 - Unplanned Downtime
 - Supplier-Caused Losses
 - Extra Production Operations
 - Troubleshooting / Corrective Action
 - Re-inspection
 - Preparing Wrong Order
 - Software Re-testing after code correction



External Failure Costs

- Costs associated with product or service not conforming to requirements after its delivery
- Examples include (but not limited to):
 - Returns
 - Complaint Processing
 - Complaint Investigation
 - Replacement
 - Customer Downtime
 - Troubleshooting
 - Product Recall
 - Liability Costs
 - Warranty Charges
 - Customer Support on Quality Issue
 - Defect Notification
 - Remedial Upgrade of Software

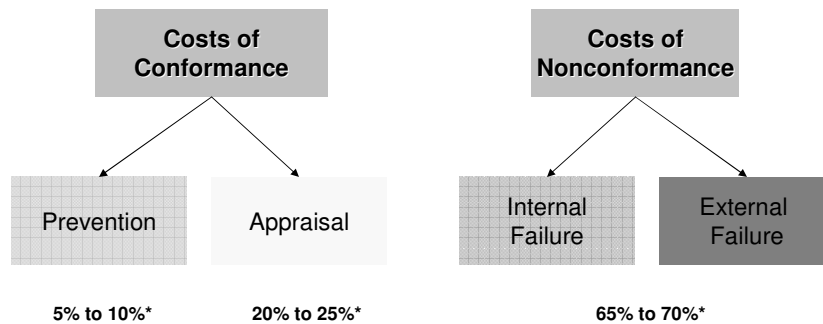


Types of Errors & Quality Costs

		Your product/service is actually	
		Good	No Good
The decision of your internal quality assurance is to	Accept	Correct Decision **No Waste**	Incorrect Decision (Type II Error) **Results in External Failure Costs**
	Reject	Incorrect Decision (Type I error) ** Results Internal Failure Costs**	Correct Decision **Results in Internal Failure Costs**



Conformance vs. Nonconformance Costs



*Breakdown of Quality Costs according to Feigenbaum

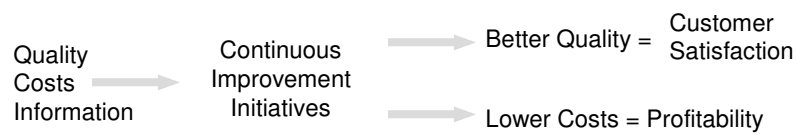


Another Definition for Quality Costs

$$\text{Quality Costs} = \text{Actual Cost of Providing Product or Service} - \text{Cost of Only Value-Added Activities}$$



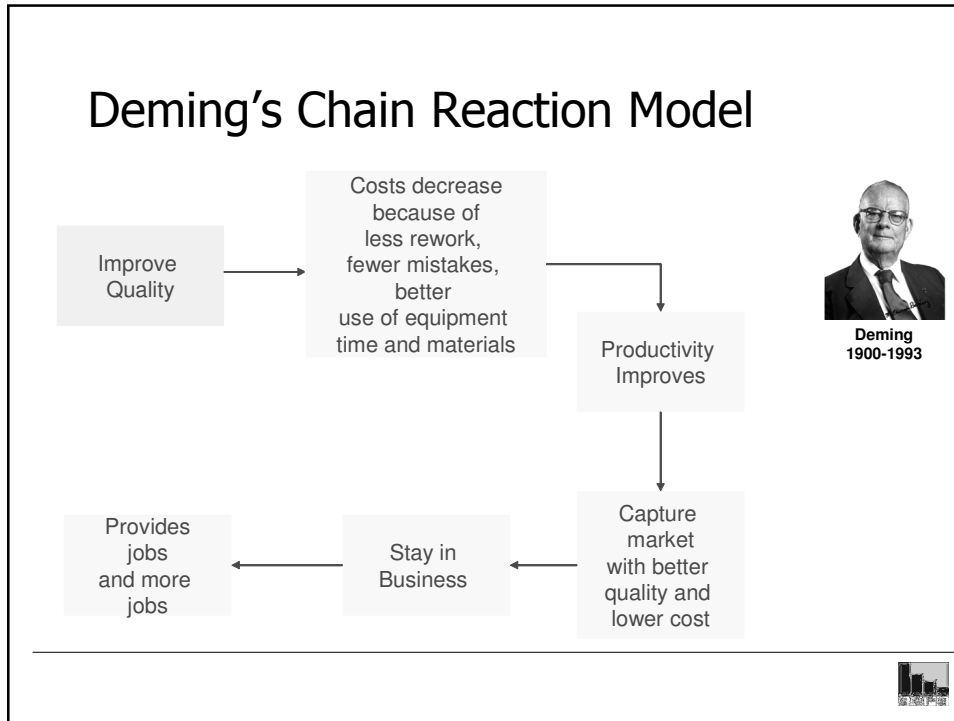
Quality Costs as Input



Input

Output





- ## Juran on Quality Costs
- "In the US, about one-third (33%) of what we do consists of redoing work previously done!"
 - Examples
 - Manufacturing: scrap, rework, additional inspection
 - Service: Rewriting insurance policy, Losing luggage, wrong prescription, wrong order returned, re-installing software
- A small bar chart logo is located in the bottom right corner of the slide's frame.

Juran on Quality Costs - Cont'd

- Quality-related costs are estimated to be between 20% and 40% of sales
- Quality costs extend beyond manufacturing to support and logistics
- The bulk of quality costs are related to poor quality (Failure Costs)

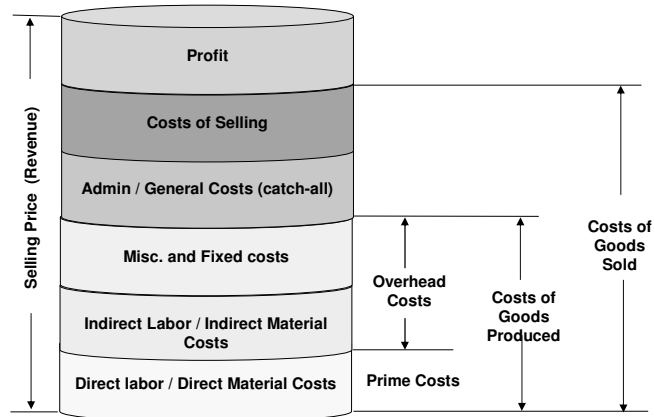


Traditional Cost Structures

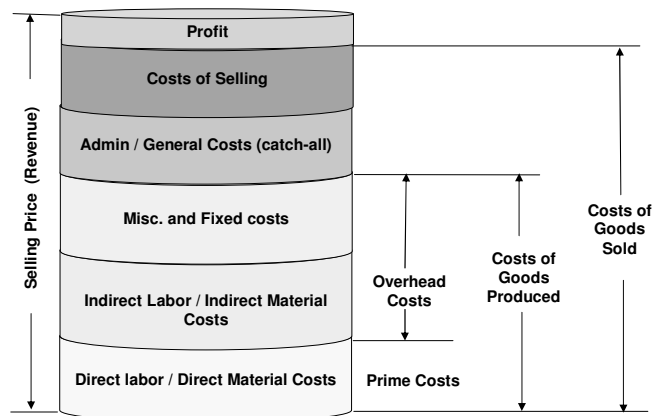
Category	Examples
Direct Material	Plastic product: resin; Hamburger: bun
Direct Labor	Production Operator, Packaging Associate; Cook
Indirect Materials	Costs consumed in the operation but not a part of the end product or service. Examples: perishable tools, shipping materials.
Indirect Labor	Supervisors, Maintenance personnel, Material handler
Fixed & Misc. Expenses	Depreciation, Taxes, Rent, Utilities, Design Engineering (for Mfg), Scheduling, Customer Service
Cost of Selling	Marketing, Sales, Advertising, Invoicing, Warehousing, Shipping
Admin / General Costs	This is a catch-all category. Examples include Public Relations, Legal, Financial, etc.



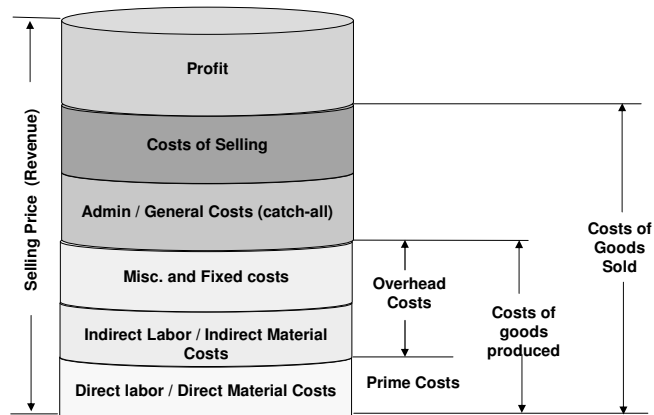
Traditional Cost / Revenue Structure



Increasing Costs of Quality



Decreasing Costs of Quality

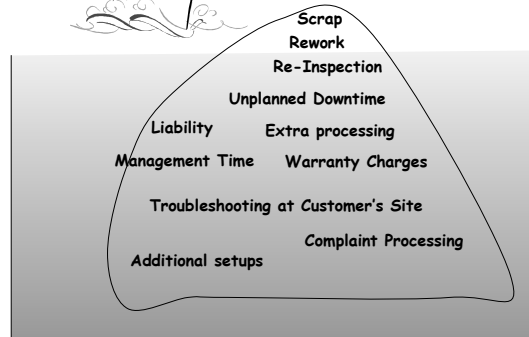


Capturing Quality Costs

- Hidden quality costs are like variation within a process.
- If you do not understand their sources, then you accept them and live with them
- If you design the system to catch them, you'll be able to isolate them and remove their root causes

Hidden Costs of Quality

- Only a few quality costs are obvious (tip of the iceberg)
- Westinghouse Electric reported a multiplier effect of 3 to 4 due to hidden costs of failure costs



More Examples of Hidden Costs of Quality

- Extra Inventory
- Premium freight
- Unexpected overtime
- Lost machine capacity
- Re-scheduling production
- Emergency material purchases (small lots)
- Extra wear / tear on equipment
- Overtime for troubleshooting



Hidden Costs of Quality

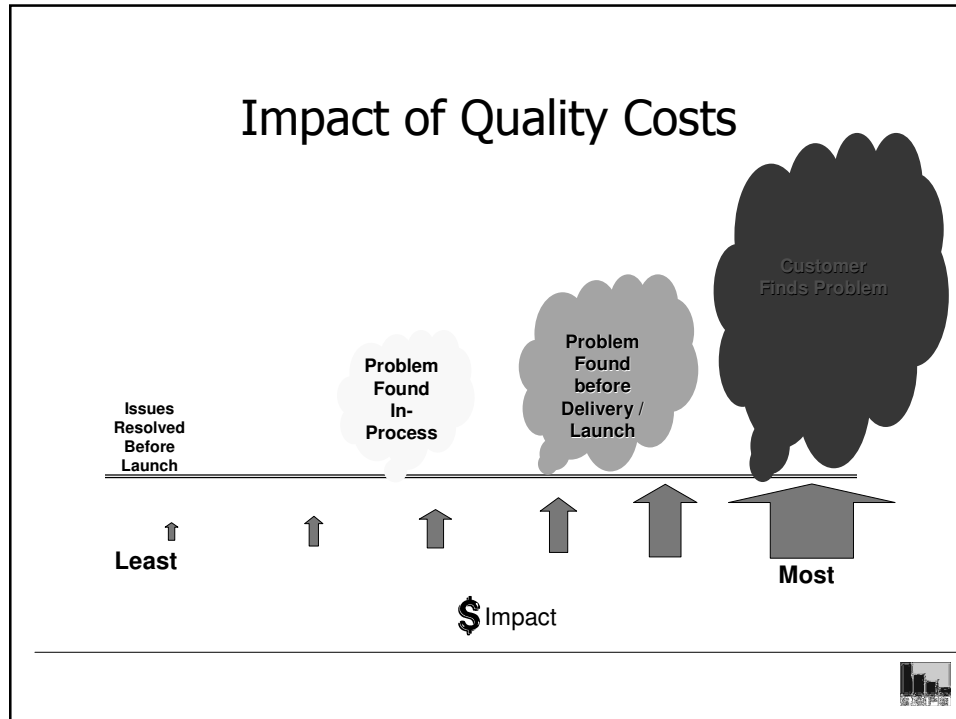
- Most quality costs that are related to failure are hidden because the typical accounting system classifies them by the type of cost, not by their cause
- Historical records of quality costs suggest that for every \$1 of scrap / rework, there is \$6 to \$7 in hidden costs




High Quality Costs Impact

- Increased quality costs inflate production cost which may result in:
 - Utilizing inferior material / service to compensate
 - Increasing the selling price of the product or service
- Increased quality costs result in image problems due to:
 - Defective product
 - Dissatisfaction of customers





- ### Typical Cost of Quality
- Estimates for Quality Costs come mainly from the manufacturing sector but can be extended to other sectors as well
 - Quality Related Costs are 20% to 40% of sales
 - CoQ for good performing companies are between 2% and 5%, most of which should be preventive
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CoQ Data Collection

- Best Case
 - Departmental Accounting
 - Schedules
 - Time Reports
 - Defect Reports
 - Outsourcing / Purchasing Records
- Worst case
 - Interviews to determine estimates



Reporting Cost of Quality Information

- To compare over time, between divisions or between projects, it is best to report CoQ information in terms of ratios:
 - Total CoQ/Sales
 - Total CoQ/CoGP
 - Total NC-CoQ/CoGP
 - Internal Failure Cost/ CoGP
 - External Failure Cost/ CoGP
 - Appraisal Cost / CoGP
 - Prevention Cost / CoGP

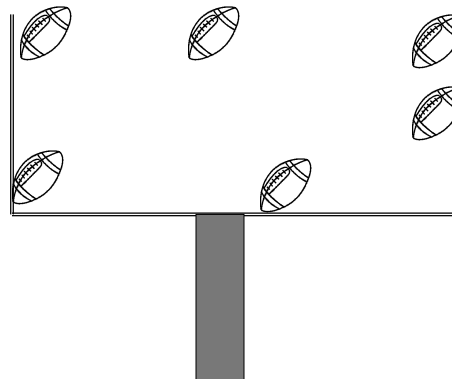


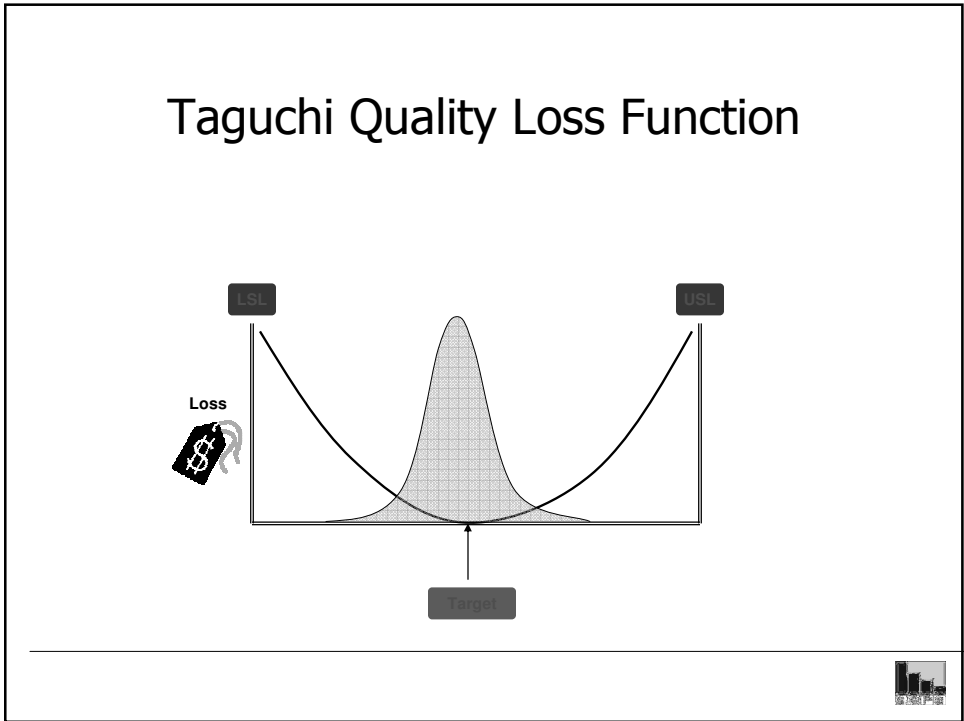
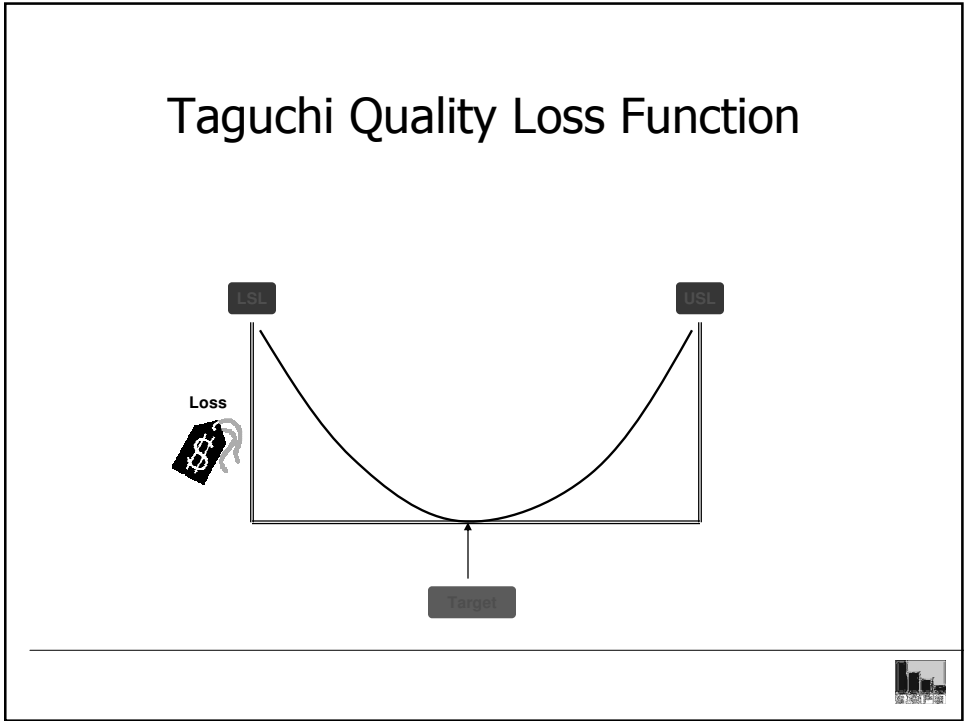
Taguchi Quality Loss Function

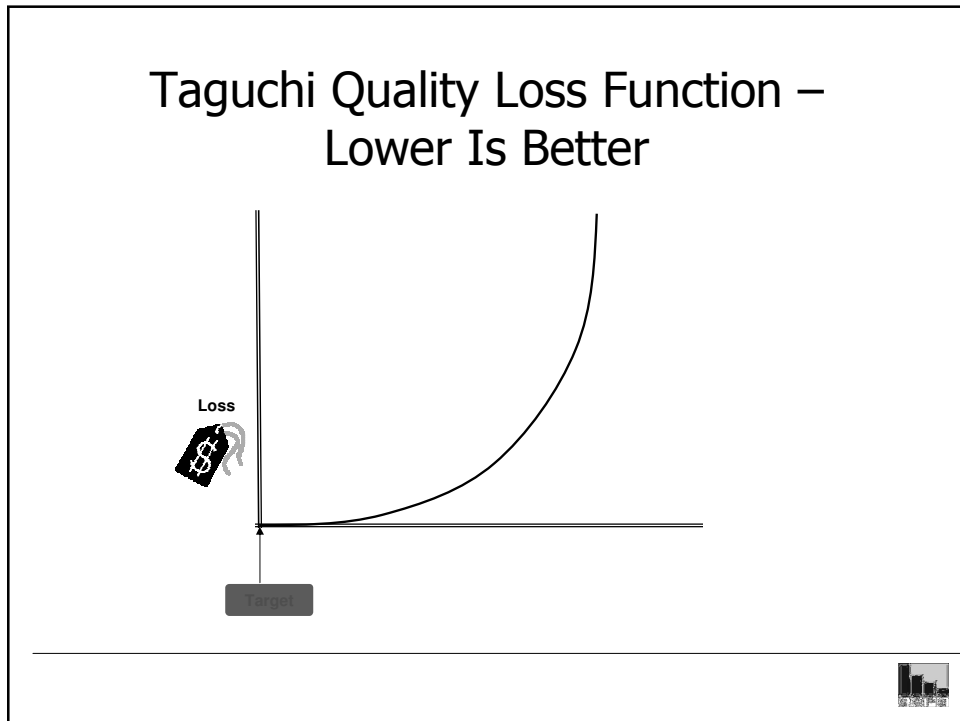
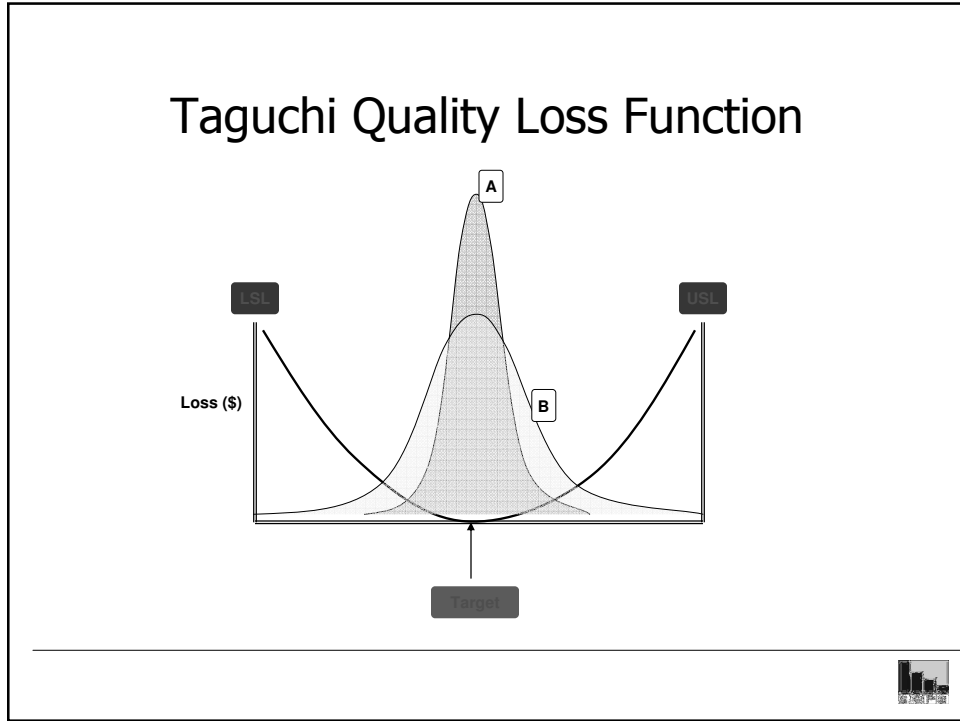
- The Taguchi philosophy:
 - Cost cannot be reduced without affecting quality
 - Quality can be improved without increasing cost (also Crosby's "Quality is Free")
 - Cost can be reduced by improving quality
 - Improving quality can be achieved by reducing variation



Taguchi Quality Loss Function







Case Study: Results & Analysis - Cont'd

Quality Cost Item	January				February				March			
	% of Salary	Hours	\$	Total \$	% of Salary	Hours	\$	Total \$	% of Salary	Hours	\$	Total \$
Outside Calibration Service			\$500	\$500			\$500	\$500			\$500	\$500
Ongoing Incoming Inspection		25		\$500		20		\$400		20		\$400
Third Party Audits -by a Registrar-				\$0				\$0			\$1,500	\$1,500
Process Audits	10%			\$500	10%			\$500	10%			\$500
Regular In-process Inspection		20		\$400		20		\$400		20		\$400
Processing Customer Complaints	8%			\$400	10%			\$500	10%			\$500
Sorting and Replacing Due to Customer Returns		50		\$1,000		40		\$800		35		\$700
Downgrading Differential (Found by customer)			\$2,000	\$2,000			\$1,500	\$1,500			\$1,500	\$1,500
Travel Expenses to Customer Site for Sorting			\$1,500	\$1,500			\$1,000	\$1,000			\$1,500	\$1,500
Premium Freight Due to Customer Complaint			\$2,500	\$2,500			\$2,000	\$2,000			\$1,500	\$1,500
Re-inspecting after Machine Alarm		40		\$800		40		\$800		50		\$1,000
Troubleshooting process failure		15		\$300	10%			\$500	8%			\$400
incoming inspection for a Problem	5%			\$250	10%			\$500	5%			\$250
Scrap Differential (found in-house)			\$7,500	\$7,500			\$2,500	\$2,500			\$3,000	\$3,000
Unplanned Machine Downtime			\$2,000	\$2,000			\$2,500	\$2,500			\$2,000	\$2,000
Overtime Resulting from Process Failure		60		\$1,200		30		\$600			\$40	\$40
Lost capacity due to internal process failure			\$3,000	\$3,000			\$2,000	\$2,000				\$0
Quality Planning	10%			\$500	10%			\$500	10%			\$500
Poka Yoke Device			\$1,500	\$1,500				\$0				\$0
Scheduled Preventive Maintenance			\$1,500	\$1,500			\$1,500	\$1,500			\$1,500	\$1,500
Supplier Development Expense			\$1,200	\$1,200			\$200	\$200			\$200	\$200
Quality Education				\$0				\$0				\$0
Marketing research	10%			\$500	10%			\$500	10%			\$500
Statistical Analysis and Preventive Action	10%			\$500	15%			\$750	15%			\$750
Total				\$30,050				\$20,450				\$19,140

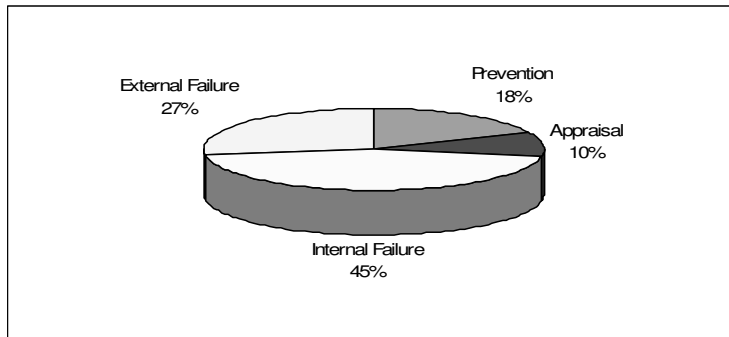


Case Study: Results & Analysis - Cont'd

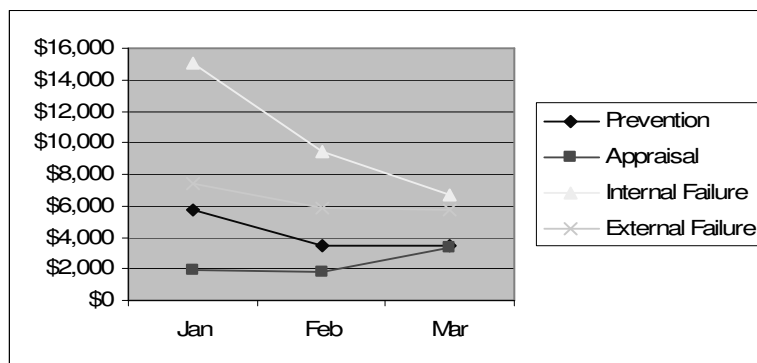
	Jan	Feb	Mar	Total
Prevention	\$5,700	\$3,450	\$3,450	\$12,600
Appraisal	\$1,900	\$1,800	\$3,300	\$7,000
Internal Failure	\$15,050	\$9,400	\$6,690	\$31,140
External Failure	\$7,400	\$5,800	\$5,700	\$18,900
Total Costs of Quality	\$30,050	\$20,450	\$19,140	\$69,640
Cost of Goods Produced	\$110,000	\$110,000	\$110,000	\$330,000
Sales	\$200,000	\$200,000	\$200,000	\$600,000



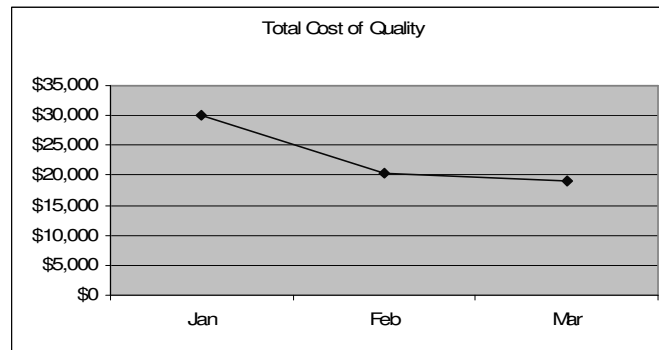
Case Study: Results & Analysis - Cont'd



Case Study: Results & Analysis - Cont'd



Case Study: Results & Analysis - Cont'd



Case Study: Results & Analysis - Cont'd

Summary of Quality Costs

	Jan	Feb	Mar	Total	Annual Projection
Prevention	\$5,700	\$3,450	\$3,450	\$12,600	\$50,400
Appraisal	\$1,900	\$1,800	\$3,300	\$7,000	\$28,000
Internal Failure	\$15,050	\$9,400	\$6,690	\$31,140	\$124,560
External Failure	\$7,400	\$5,800	\$5,700	\$18,900	\$75,600
Total Costs of Quality	\$30,050	\$20,450	\$19,140	\$69,640	\$278,560
Cost of Goods Produced	\$110,000	\$110,000	\$110,000	\$330,000	\$1,320,000
Sales	\$200,000	\$200,000	\$200,000	\$600,000	\$2,400,000
Total Costs of Quality / Sales	0.15	0.10	0.10	0.12	0.12
Costs of NC / Costs of Goods Produced	0.20	0.14	0.11	0.15	0.15
Internal Failure Costs / COGP.	0.14	0.09	0.06	0.09	0.09
External Failure Costs / COGP.	0.07	0.05	0.05	0.06	0.06
Prevention Costs / COGP.	0.05	0.03	0.03	0.04	0.04
Appraisal Costs / COGP.	0.02	0.02	0.03	0.02	0.02

If well-performing companies keep their **total cost of quality** – to – **sales** ratio within 5% (mostly in prevention costs), how do you rate this company?



Thank You!

Questions and Inquiries:

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