QUALITY ENGINEERING CONCEPTS AND TECHNIQUES

56:231 Computer Integrated Manufacturing

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INTRODUCTION

- Frederick Taylor's "*Principals of Scientific Management" (1915)*
- ASQC (1965)
- Taguchi's online and offline quality control

BODY OF KNOWLEDGE

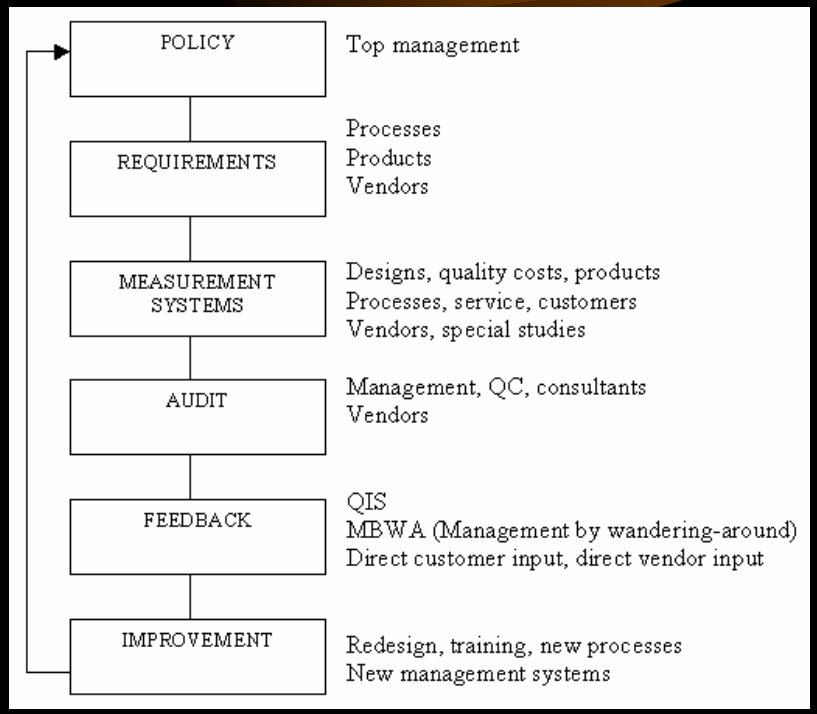
- Probability, Statistical Quality Control and Design of Experiments
- Quality Planning and Management, Product Liability
- Metrology, Inspection and Testing
- Quality Cost Analysis
- Quality Auditing

BODY OF KNOWLEDGE

- Reliability, Maintainability and Product Safety
- Quality Information Systems
- Motivation and Human Factors

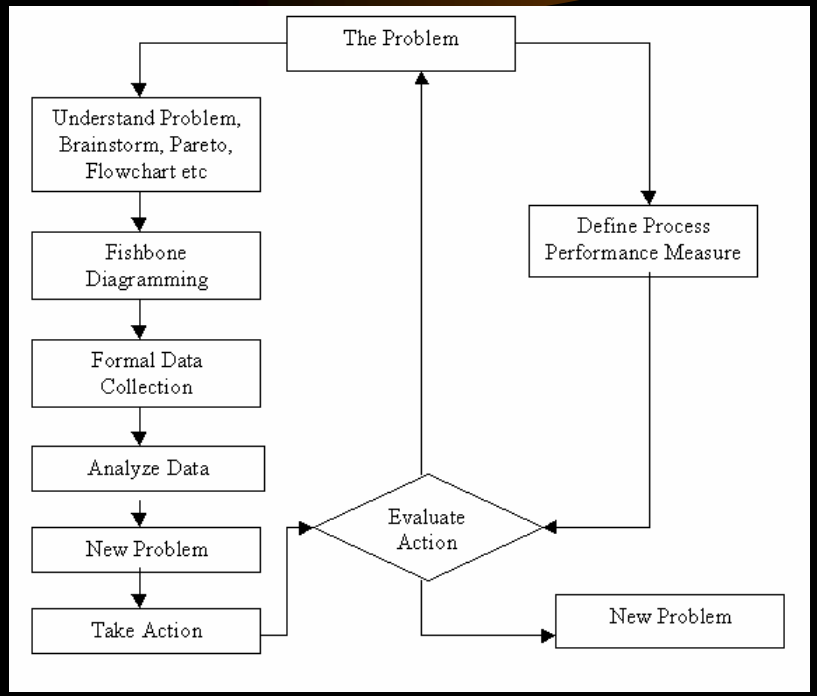
QUALITY ORGANIZATION AND MANAGEMENT

- TQC by Kaoru Ishikawa (1985) in Japan
- Feigenbaum (1983, 1986) in US
- Quality Circles
- JIT



QUALITY INFORMATION SYSTEMS

- Planning the system
- Data collection
- Data storage
- Data retrieval



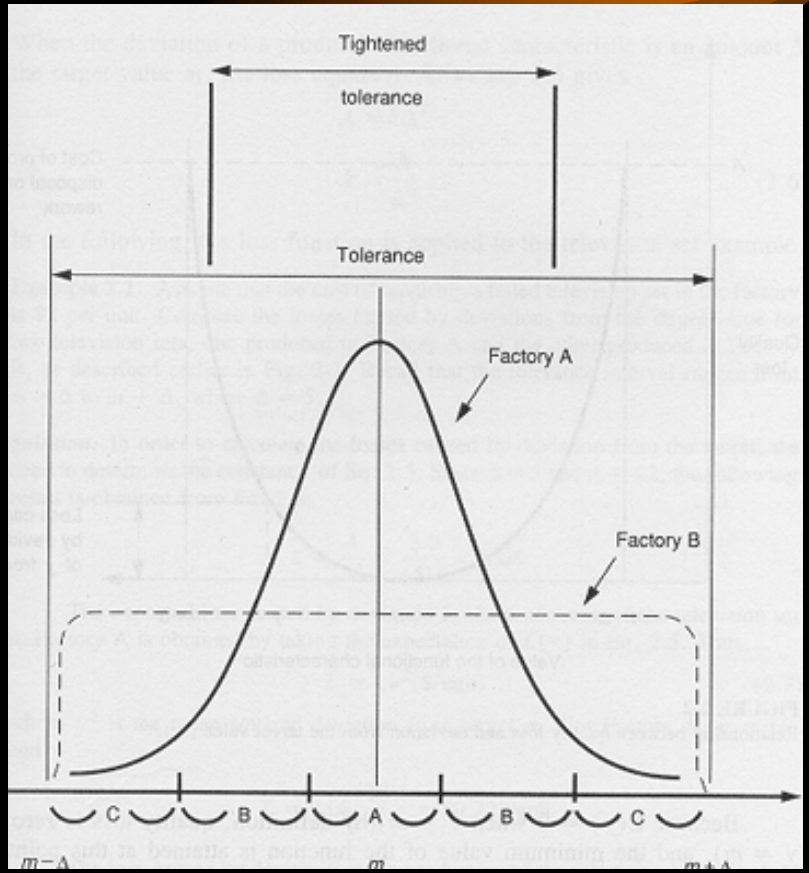
INSPECTION AND MEASUREMENT

- Inspection by variables
- Inspection by attributes
- Machine vision
- Light sensors
- Coordinate measuring machines

TAGUCHI TECHNIQUES

- Definition of quality according to Taguchi
- Quality value

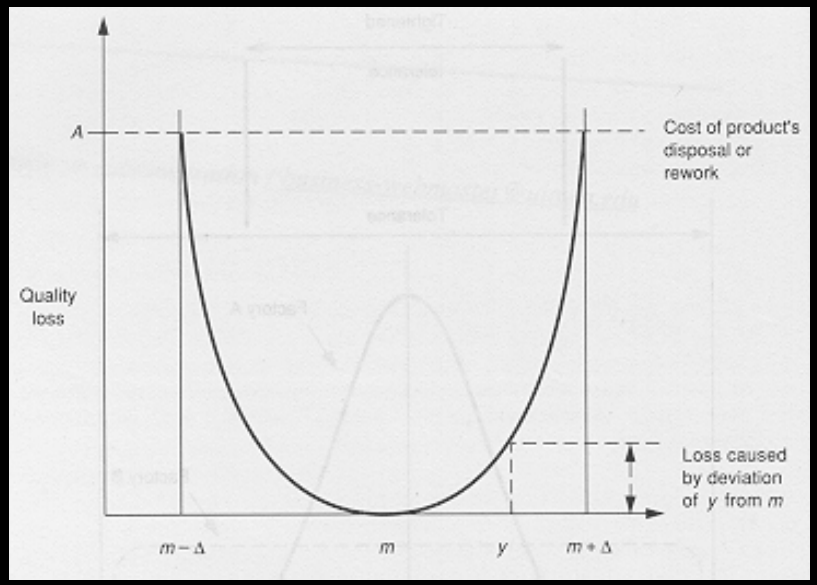
	US-made product	Japanese-made product
Purchase Price	P	0.5P
Losses due to product use	P	9(0.5)P
Total cost to customer	2P	5P



TAGUCHI LOSS FUNCTION

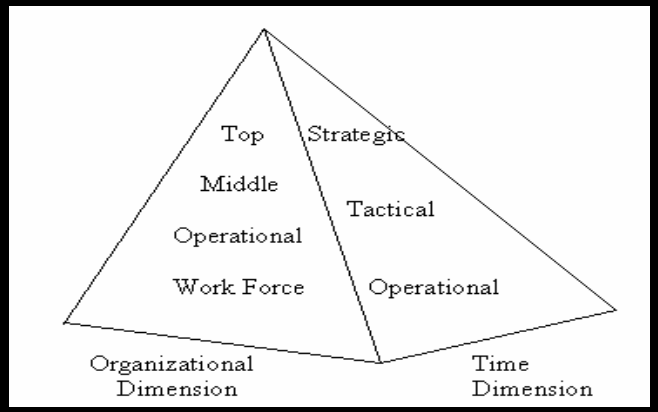
- General qualitative approach
- UCL and LCL
- Taguchi Loss Function

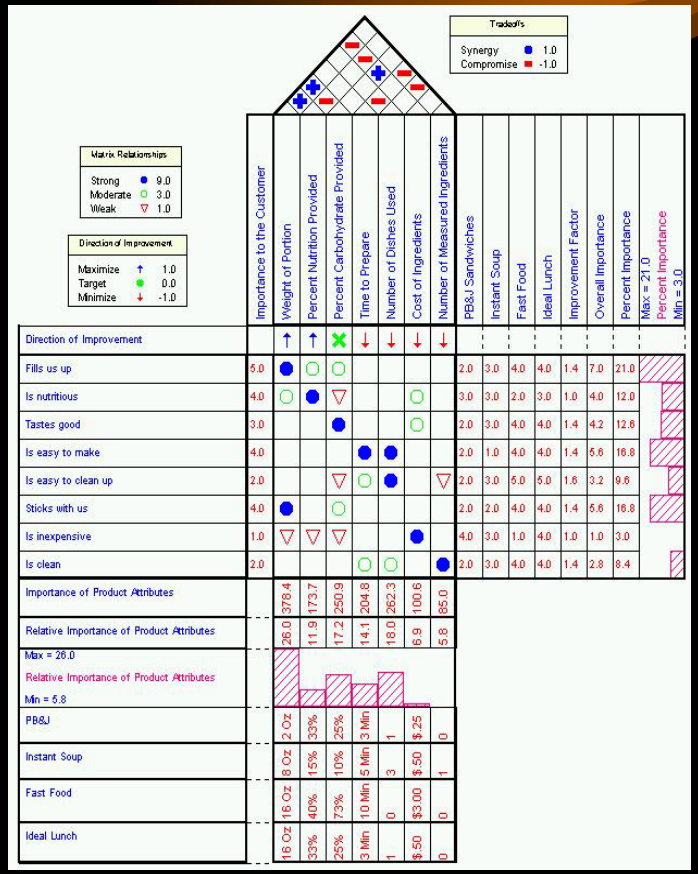
$$L(y) = ky^2$$



QUALITY PLANNING

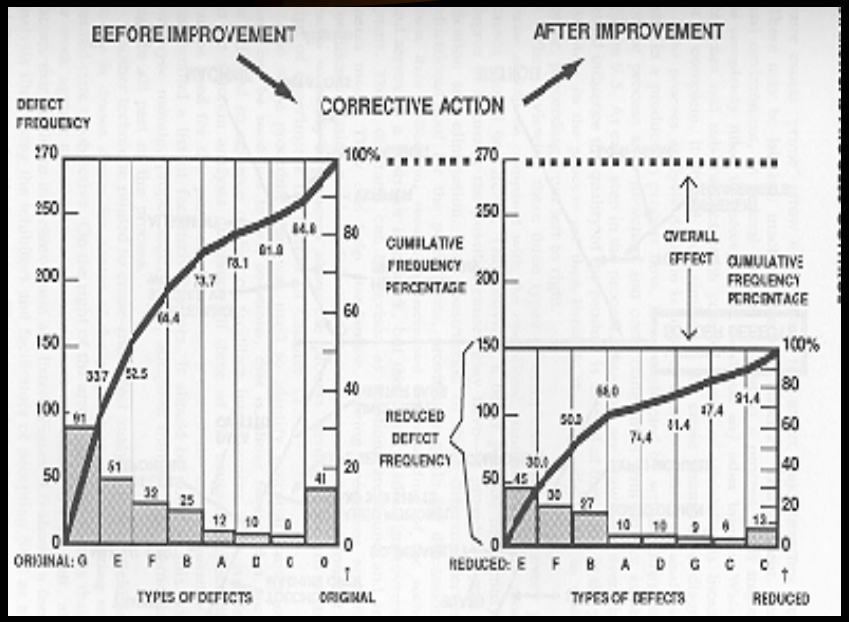
- Time dimension of quality planning
- Strategic, tactical and operational QP





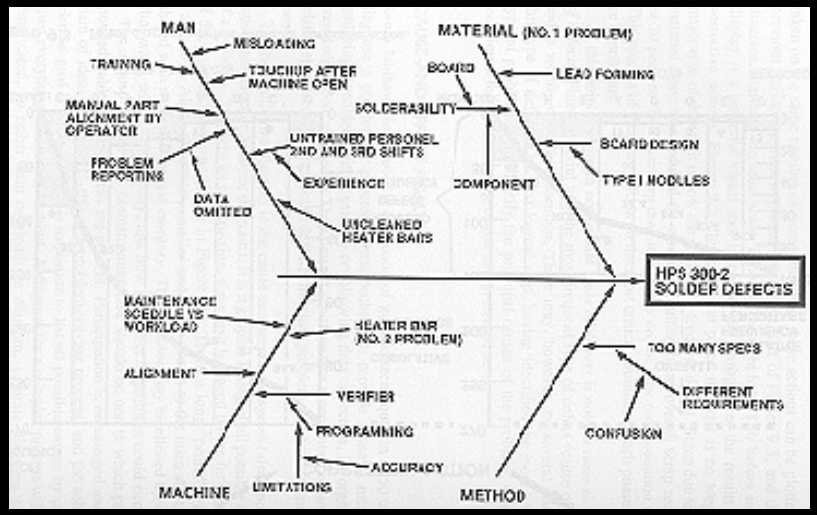
STATISTICAL PROCESS CONTROL

- Pareto Analysis
- The vital few and trivial many (J. M. Muran)
- 80-20 rule



STATISTICAL PROCESS CONTROL

- Cause and effect analysis
- Analyzing the problem (Kaoru Ishikawa)
- Cause enumeration diagram



DESIGN OF EXPERIMENTS

- Single factor
- Multiple factors
- Full factorial designs (2^k)

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Square	F_0
1. Between subjects	$\sum_{j=1}^{n} \frac{\overline{y}_{.j}^2}{a} - \frac{y_{..}^2}{an}$	$n - 1$		
2. Within subjects	$\sum_{i=1}^{a} \sum_{j=1}^{n} y_{ij}^2 - \sum_{j=1}^{n} \frac{y_{.j}^2}{a}$	$n(a - 1)$		
3. (Treatments)	$\sum_{i=1}^{a} \frac{y_{i.}^2}{n} - \frac{y_{..}^2}{an}$	$a - 1$	$MS_{\text{Treatment}} = \frac{SS_{\text{Treatment}}}{a - 1}$	$\frac{MS_{\text{Treatment}}}{MS_E}$
4. (Error)	Subtraction: line (2) − line (3)	$(a - 1)(n - 1)$	$MS_E = \frac{SS_E}{(a - 1)(n - 1)}$	
5. Total	$\sum_{i=1}^{a} \sum_{j=1}^{n} y_{ij}^2 - \frac{y_{..}^2}{an}$	$an - 1$		

CONCLUSIONS

- Modern QC started at early 20th century
- QE is a continuously evolving issue
- Taguchi "robust" design has a large spectrum in the QE literature
- Numerous tools exist